The Future of Energy in Sitka

Sitka Conservation Society

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The Future of Energy in Sitka

I. Background

Sitka, like most of Southeast Alaska, is facing a convergence of factors that threaten the long term viability of the community. One of these, the subject of this report, is increasing energy costs, particularly oil-based liquid fuel costs, which are the predominant energy source for heating and transport in the region.

Communities throughout the region and the state, and agencies at the national, state, and local levels, are exploring and pursuing energy strategies that decrease communities' reliance on oil-based liquid fuels, and increase reliance on renewable sources such as hydro and biomass. These strategies have potential to save individual consumers money and to free up available energy for economic development. They might also keep funds circulating within communities that are now exported to purchase fuel.

Public policy has been established at the local and state levels: The state has set an official policy of achieving a 15% increase in energy efficiency per capita by 2020. The city has passed Resolutions 2008-07 Supporting the Development of a Wood Based Fuel for Space Heating in Sitka, and Resolutions 2008-04 and 2009-37 related to greenhouse gas reductions[1].

II. Purpose and Scope

The Sitka Conservation Society (SCS), as part of its Community Sustainability program, has undertaken to review existing information on energy use, availability, and strategies for the future. **The intent is to look at energy issues on a community-wide scale and identify those strategies and approaches which appear most likely to produce dollar or energy savings, reduce energy demand, and/or decrease greenhouse gas emissions for Sitka, and which appear to create the best balance to provide for the long-term sustainability of the community.**

Overall, the intent is to take a pragmatic approach based on current technology to guide energy policy now, in ways that seem particularly suited to the Sitka's makeup geographically and demographically. The review included a survey of the many energy technologies now being used and tested. It focused on existing projects and information, and also included a survey of new and unconventional technologies. Some of those technologies might require large capital investment to test whether they would work in Sitka. The review did not attempt to identify new relatively untried technologies that might or might not work in Sitka.

[1] Resolutions can be found on the city's website: http://www.cityofsitka.com/government/clerk/index.html

III. Executive Summary

The greatest issue facing Sitka, and most Southeast Alaska communities, isn't energy efficiency, it is sustainability. A recent report by ISER[2] on fuel costs and migration from bush communities found that high fuel costs are not a standalone reason persons migrate from those communities. People migrate away for lack of opportunity.

Strategic use of Sitka's energy resources will provide greater opportunities for the community and its citizens by keeping money in the region and keeping energy available for economic development. (See charts next section.) This report identifies key strategies that we believe the community should be adopting now toward that goal.

Any discussion of energy in Sitka necessarily revolves around hydroelectric energy: cheap, clean, and versatile. It is an underlying assumption of this study that under conditions where electrical generating capacity is limited, electricity should be preserved for those activities and processes that electricity does particularly well, or for which other good alternatives do not exist. For example, this generally means that electric energy for manufacturing, such as fish processing, is a priority over electrical energy for space heating, for which alternative energy sources are available.

Historical and current electric rates have encouraged conversion to electric resistance space heating. Those conversions now threaten to overwhelm the utility's generating capacity, a region wide problem. That demand is a key factor requiring the running of supplemental diesel generators at significant cost. At current electrical pricing the trend toward space heating with electricity will likely continue. New economic development that would include any type of manufacturing is hindered by lack of available hydro power.[3]

Recommendations include:

1. Sitka should undertake development of an Integrated Energy Resource Plan[4]. The issues and variables surrounding energy are dynamic, involve significant tradeoffs and costs to the community and its citizens, and technology is changing continuously. A more robust planning process than is provided by this document or other current efforts is needed.
2. Demand side management (DSM) for electricity is an essential part of an overall energy strategy. Among the proven tools for DSM are inclining block rates and dynamic pricing. In an inclining rate structure, heavy users pay more. Dynamic pricing generally means a variable rate structure to increase (or decrease) rates during periods when hydro capacity is projected to be less (or more) than needed.
3. Conservation is an important first step in educating and empowering Sitkans with methods of reducing energy, and using conservation measures in concert with energy

[2] UAA Institute for Social and Economic Research (ISER); Fuel costs, Migration, and Community Viability, May 2008.
[3] Garry White, Director, Sitka Economic Development Association, personal communication: "Economic development is dead unless we get more power."
[4] An Integrated Resource Plan is a planning process and framework within which costs and benefits of both demand- and supply-side energy resources are evaluated to develop an optimum mix of resource options.

efficiency retrofits and weatherization should continue to be an overall part of the community's energy strategy.

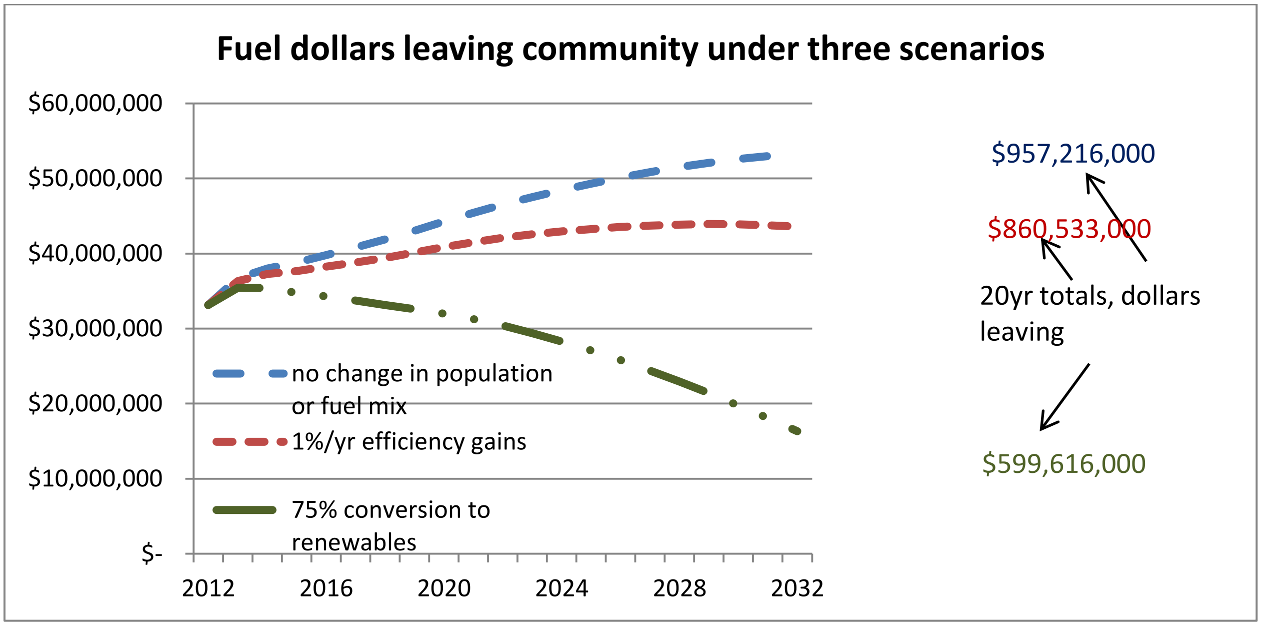
4. Energy efficiency measures should be more actively encouraged and promoted. Analysis shows, for example, that the unit cost would probably be cheaper per-megawatt for the utility to "create" or "free-up" electrical capacity by buying and installing heat pumps for residences which are currently resistance heating, than it is by adding capacity with the Blue Lake expansion. (This example used for comparative purposes only; we support the Blue Lake expansion.) Other efficiency measures may show similar economic dynamics.
5. Building owners should be installing multiple heating systems.
6. Sitka should promote air source heat pumps as the preferred space heating alternative to electrical resistance heating.
7. To facilitate discussion of space heating options and alternatives community wide, the report presents an estimate of minimum space heating requirements for Sitka.
8. The performance of electric cars is not yet at a level to justify replacement of gasoline vehicles in Sitka. However, if and when electric car performance, as measured by miles per kilowatt/hour, approximately doubles from current performance, it may be cost effective to promote community adoption of electric cars on a broad scale for light load transport. None of these recommendations is a new idea. They have been identified, studied, and discussed in various forums. Some strategies have greater public gain than individual benefit, and/or minimum economies of scale required to realize the benefits. In those situations, government is best suited with its role and resources to promote the change. Certain potential strategies, such as widespread conversion to pellet heating as recommended in the recently released draft Southeast Alaska Integrated Resource Plan, may provide greatest benefits if done in coordination among communities across the region.

IV. Current and future scenarios of fuel mix shown graphically

On the next pages are 5 graphs, representing different scenarios or combinations of scenarios. The graphs represent a uniform progression over 20 years starting with current conditions.

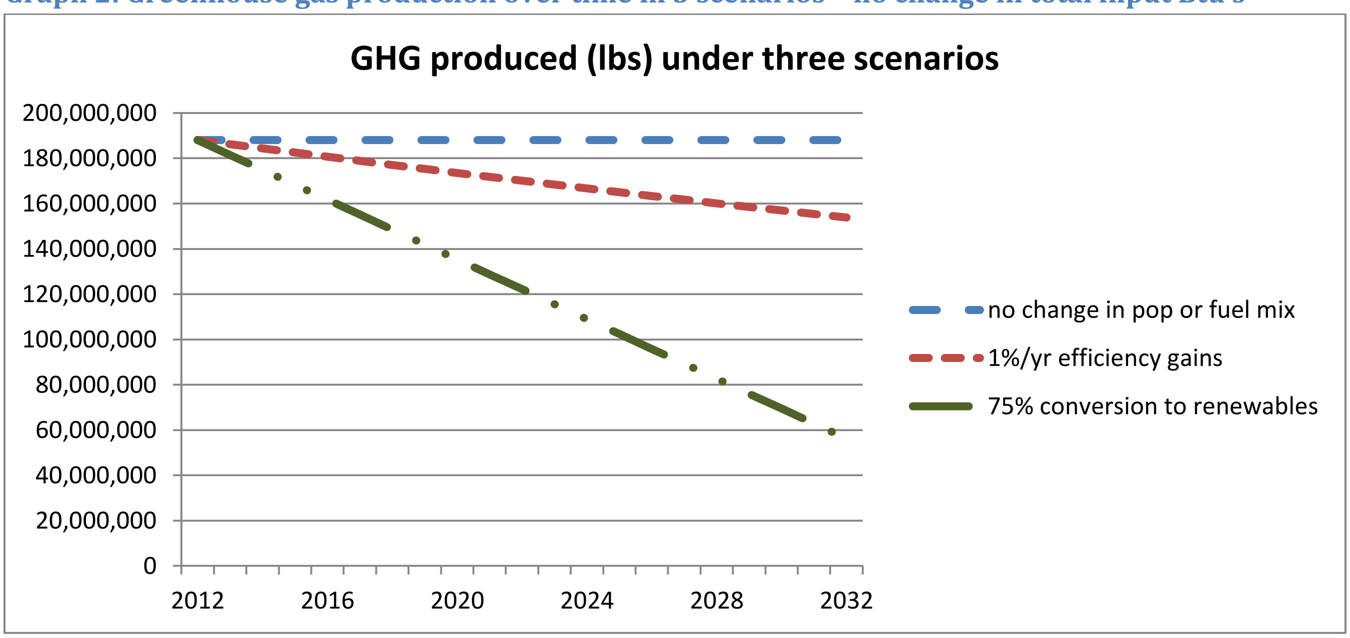
Graph 1:	Dollars leaving community for fuel under each of three scenarios.
Graph 2:	Greenhouse gas production under each of three scenarios.
Graph 3:	Scenario: Idealized scenario with Takatz showing the community relying 75% on renewables, compared to the current approximate 25% renewables mix.
Graph 4:	Scenario: A 1% per year reduction in energy use across the board, whether from efficiency gains or a population decline.
Graph 5:	Scenario: Idealized scenario without Takatz showing community increasing efficiency 1%/yr and conservation 1%/yr for 20 years, and assuming biomass provides 20% of community Btu's (about 10 times what biomass provides now).

Graph 1: Dollars leaving community over time in 3 scenarios

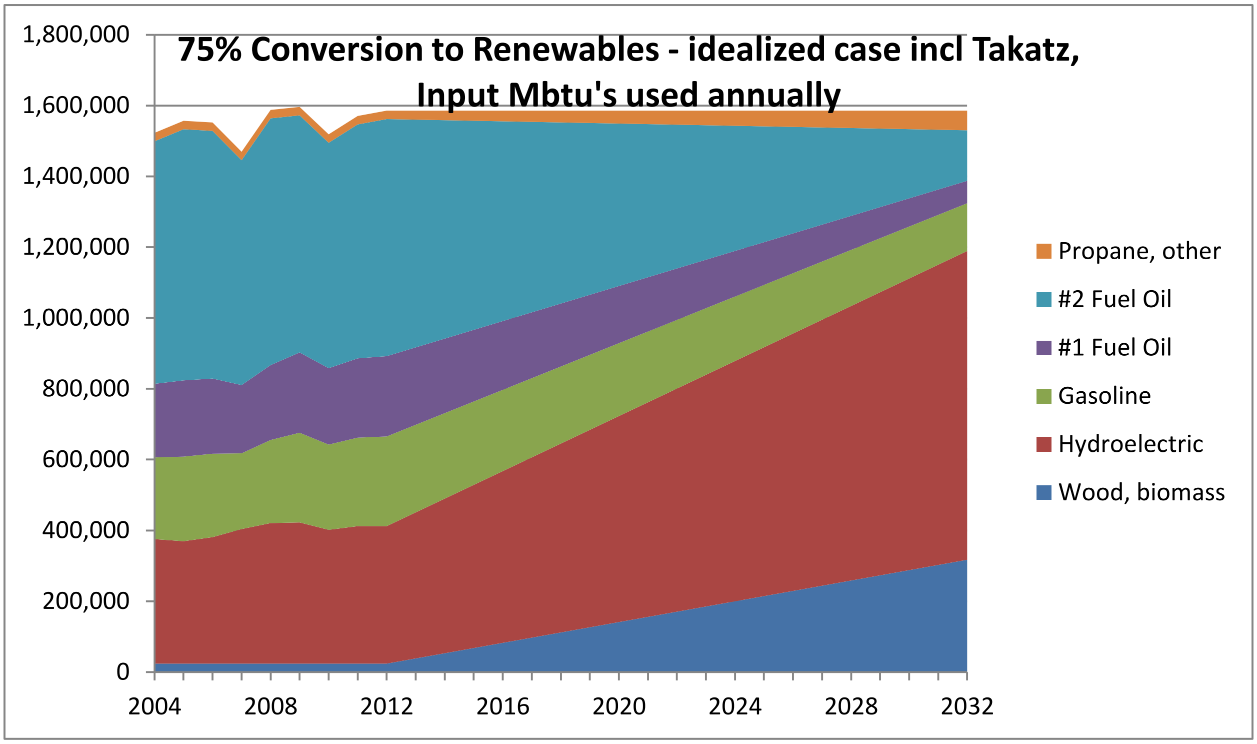


Fuel prices based on ISER Fuel Price Projections 2011-2035 updated June 2011; Medium Case for Haines Community Diesel, (draft SEIRP compares Haines to Sitka for fuel prices). Same price used for diesel #1, #2, and gasoline. Starting fuel price in series, year 2012 - $3.82/gallon, ending price in series year 2032 - $6.13/gallon. (1.6x increase in 20 years.) 2010 dollars, no inflation adjustment. Carbon pricing not added. See Graph 3 next page for assumptions for 75% conversion to renewables scenario. See Q&A section at end of report for results with other price projections.

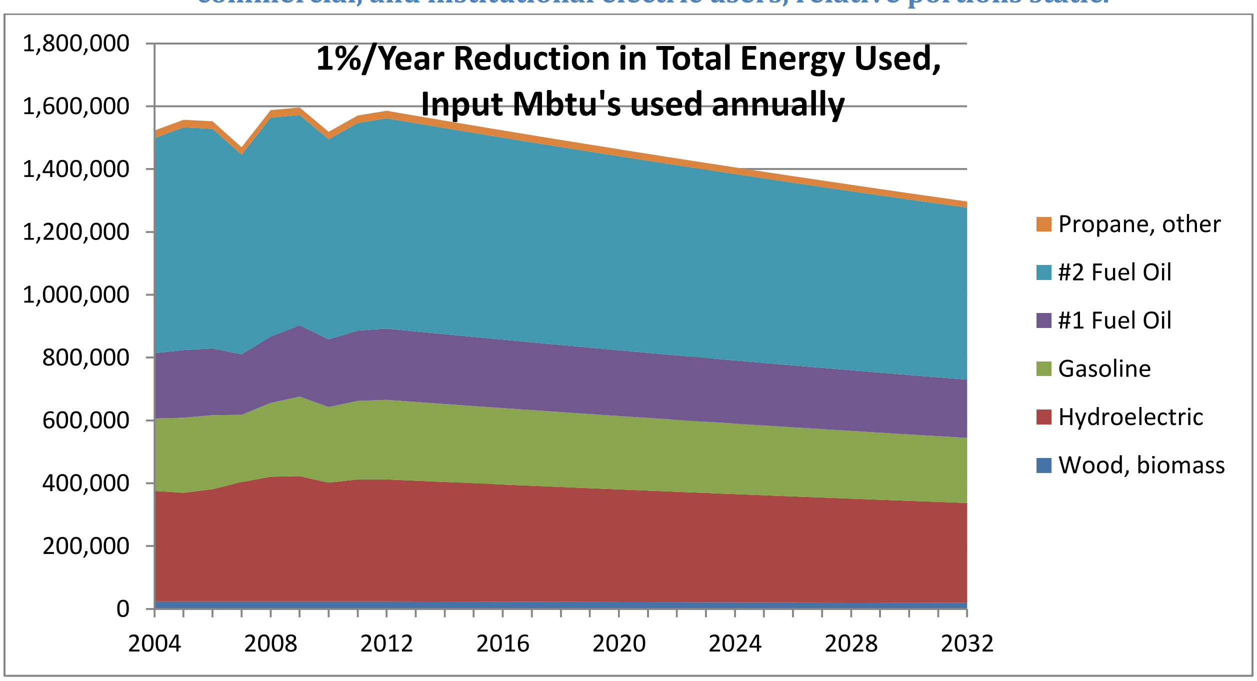
Graph 2: Greenhouse gas production over time in 3 scenarios – no change in total input Btu's



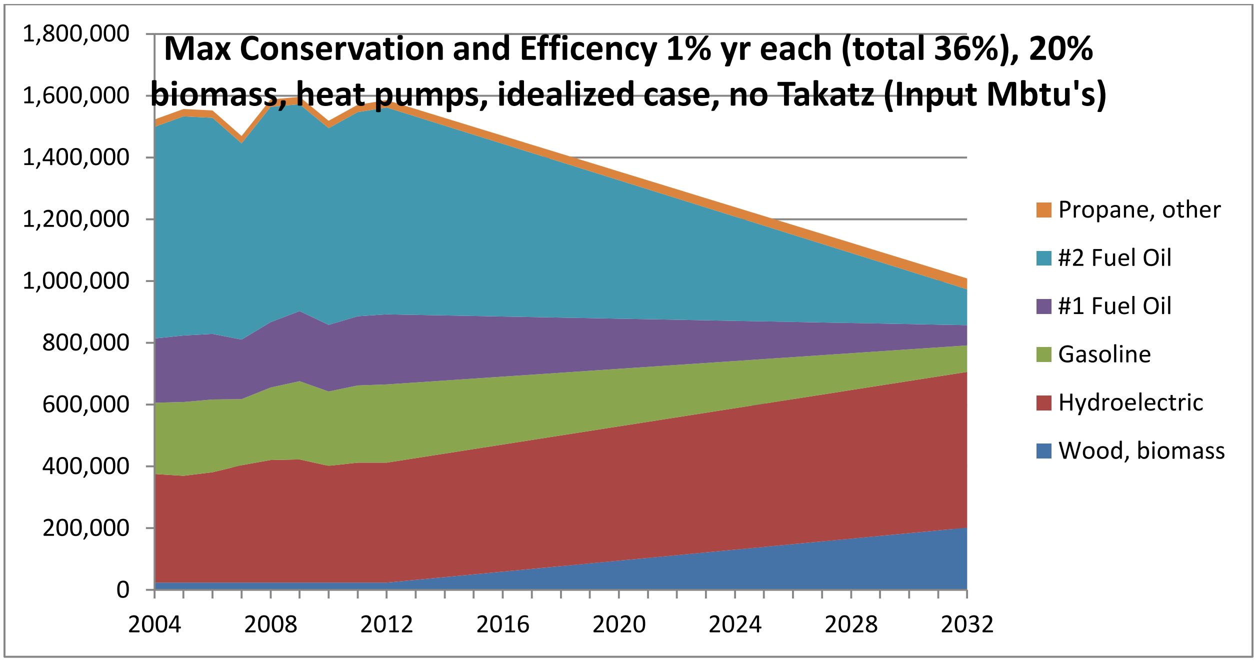
Graph 3: Projecting 75% conversion to renewables, progressive change over 20 years. Based on actuals through 2011. Assumptions for 2032: unchanged total energy consumed, 55% coming from hydro incl. Takatz, 20% from biomass, remaining 25% from oil-based liquid fuels and propane. Three-quarters of passenger miles driven are by electric vehicle (gasoline consumption reduced by half, add 13 Mwh/yr load to grid). No assumption for heat pumps.



Graph 4: Projection with 20% (1% a Year) efficiency gains among all residential, commercial, and institutional electric users, relative portions static.



Graph 5: Projecting idealized scenario showing 1%/year increase in conservation, 1%/year increase in efficiency, and 20% biomass



Graph 5 is intended to show that a major reduction in oil-based liquid fuel imports is possible without the addition of additional hydro capacity. This scenario represents the fuel mix and Btu's used in the community under the following assumptions: aggressively pursue conservation and efficiency, increase biomass to 20%, reduce gasoline consumption by one-half (by a combination of electric vehicles and behavior changes), and use heat pumps in place of most resistance heating and to displace over half of oil-based fuels now used for space heating. The fuel dollars leaving Sitka cumulatively over 20 years in this scenario are approximately equal to that depicted in the idealized scenario of a 75% conversion to renewables in Graph 1.

V. Recommendations and Findings

Recommendation 1

Sitka should undertake development of an Integrated Energy Resource Plan.

The issues and variables surrounding energy are dynamic, involve significant tradeoffs and costs to the community and its citizens, and technology is changing continuously. A more robust planning process than is provided by this document or other current efforts is needed.

The recently released draft Southeast Alaska Integrated Resource Plan, a major region-wide effort, notably refrains from making community specific recommendations. In part, because good fuel and energy use information is difficult to access and compile, and also because of the multitude of variables in a larger community such as Sitka. We view the contents of our report as a significant but incomplete step toward the goal of a community plan, and offer it as a starting point for developing a more in-depth community wide energy strategy.

We propose that the Sitka Economic Development Association and the Sitka Conservation Society, in coordination with the Electric and Public Works Departments, undertake this effort. The deliverable should be identification of the specific mix of energy resources and demand side management/ conservation/efficiency strategies that best provide for the long term sustainability of the community.

Recommendation 2

The Electric Department should be given the authority by the Assembly to adopt additional demand side management measures, including but not necessarily limited to:

- charging higher rates during periods of limited electrical power availability and/or high loads ("dynamic pricing"), and lower rates during periods of excess power availability.
- adopting an inclining rate structure. (Users pay an increasing rate the more electricity they use.)

Hydroelectric power is the cleanest and cheapest energy for communities such as Sitka. It is the energy of "first resort," so to speak. It makes good sense environmentally and from an energy management standpoint to use all the hydroelectric power available, rather than exporting money for oil-based liquid fuels. However, when hydro capacity is insufficient for projected annual demand, the equation reverses and expensive supplemental diesel generation is required. The fuel Btu's burned to run generators are far less efficient than burning that same fuel for heat.

It is the job of the electric utility to balance the demand curve by predicting the annual demand and when necessary to try and influence that demand through measures such as appeals to the public to conserve.

As the community and the electric utility adjust to a shifting energy landscape, additional tools and strategies for influencing demand should be available. Pricing is one of those tools. National experience, as reported in *Customer Incentives for Energy Efficiency Through Electric and Natural Gas Rate Design*, demonstrates savings of 3.3% to 7.6% under five well documented dynamic pricing experiments in the US and Canada. This is not a new idea; as of 2008 twenty-four states had time sensitive rates in place. [5]

Historically, consumption of power was encouraged through rates that declined as users consumed more power (declining block rate). That pricing structure sends a signal which encourages higher use and discourages conservation. An inclining rate structure, where customers pay a higher rate the more electricity they use, encourages conservation.

Rate design is a complex issue requiring the balancing of opposing interests. For instance, increasing rates to encourage conservation may work in opposition to encouraging economic development with the availability of cheap hydroelectric power.

Providing the electrical utility a variety of tools to manage demand is part of a sound community-wide energy management strategy.

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[5] EPA National Action Plan for Energy Efficiency: Customer Incentives for Energy Efficiency Through Electric and Natural Gas Rate Design

Recommendation 3

Conservation is an important first step in educating and empowering Sitkans with methods of reducing energy, and using conservation measures in concert with energy efficiency retrofits and weatherization should continue to be an overall part of the community's energy strategy.

Conservation, unlike energy efficiency, focuses on the behavior of residential and commercial energy users. Changes in behavior are generally induced by education as well as better information, and can have significant impacts on energy usage when those practices become the standard within a community. For example, if a Sitka resident chooses to do their laundry in cold water versus hot water, or to keep their home thermostat turned down when they are at work, energy reductions can be made without significant sacrifice. Unfortunately, those changes in behavior are difficult to measure or predict.

Many studies indicate the most predictable and significant change is based on change in rates.

A relevant example of conservation within SE Alaska is the 25% precipitous drop of energy use in Juneau that followed an avalanche. Conservation and behavioral changes accounted for a significant portion of that energy reduction. Surely that reduction in energy was not sustainable, nor did it offer a comfortable way for residents to reduce energy. That said, there are several ways to reduce energy usage that do not require sacrifice.

Two ways that businesses and residents can change behavior is through smart metering and price changes. Smart metering is not quite ready for Sitka in its cost effectiveness and functionality. However, the promise of having a meter that shares information in real time with energy customers would allow for making different decisions and thus reduce energy loads. One study found that "real time" displays to homeowners of power being used correlated with an average 4% drop in energy consumption. Changing to an inclining block rate structure, that charges more per kilowatt-hour the more energy is used, will incentivize customers to make different decisions.

Due to the fact that there has been such a significant increase in residential electricity use over the past decade it is important to continue to educate residents about ways that they can cut down on their electricity bill and contribute to alleviating pressure on the community. Chris Wilbur, Facilities Manager for the Public Works Department for the City of Sitka advocates strongly for conservation measures for residents as well as city and commercial buildings.

The best solution lies in coupling conservation measures with energy efficiency and hard infrastructure changes that offer deeper savings and aid in the development of a local economy that uses its resources more effectively, creating more jobs and allowing for upstart businesses to access the necessary energy to fuel their endeavors.

Recommendation 4

Energy efficiency should continue to be encouraged with all means available.

Energy efficiency saves individual consumers and businesses money. In the case of electricity, it keeps capacity available for other purposes; in the case of oil-based liquid fuel, it keeps money in the community.

Official State of Alaska policy[6] is to increase energy efficiency by 15% on a per-capita basis by 2020. The state backs up this policy with well-funded incentive programs through AHFC which we encourage all citizens to take advantage of.

Hard data on cost effectiveness of specific energy efficiency measures for Sitka is not readily available. In the case of buildings, this is in part because multiple variables are at play: age of building, configuration of building, energy use habits of occupants, etc. A measure that produces a big payback in one building might have little effect in another.

According to Chris Duguay, local home energy rater with the AHFC Home Energy Rebate Program, Sitka homes which have undergone energy efficiency improvements under that program experience about a one-third reduction in energy costs. Jimmy Ord, AHFC Energy Programs Information Manager, reports that number is consistent with the statewide average of 33%, or an average of $1,297 saved annually in energy costs[7].

The same national study cited in the previous finding found that energy conservation consistently demonstrated a high payback on investment for consumers and utilities. A comprehensive study of energy efficiency best practices found that cost of efficiency improvements ranged from 20-90% (average 45%) of energy saved[8].

Recommendation 5

Building owners should be installing multiple heating systems.

The experience of the last few years has demonstrated that predicting energy trends is notoriously difficult and unreliable. A few years ago fuel prices were below $3/gallon, people were removing old wood stoves and pellet stoves, and the Electric Department was encouraging people to heat with electric.

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[6] HB 306 SLA 2010.

[7] Most recent Alaska Housing Corporation Weatherization and Home Energy Rebate Program Updates, undated, issued January 2012.

[8] Energy Efficiency Best Practices, National Action Plan for Energy Efficiency, EPA. Seven utilities, electric rates from $.07-.13 kw/h, 12 year life cycle of improvements assumed. Study based on data from 2004-6.

Now fuel oil is $4+/gallon, electric utilities with cheap hydro region wide are seeing system capacity maxed out, and wood pellets show a favorable Btu's-per-dollar ratio compared to other fuels (See Table 1, page 13). Fuel prices are variable and difficult to predict accurately. Multiple heating systems allow residents to shift to the cheapest fuel at a given time.

Multiple heating systems also provide greater security in the event of a disruption in supply. For instance, Sitka's hydroelectric supply is carried in a single transmission corridor. A severe weather event, landslide, or infrastructure failure could interrupt power for days or weeks, creating a dangerous condition for homes reliant on electricity for their heating systems. Backup systems for electric heat should be standard, including for homes with oil burners that require electricity to operate the oil pumps and burner controls[9].

Additionally, multiple heating systems will complement a sound energy strategy of encouraging electrical use when dams are high or spilling, and conserving when the dams are low.

Recommendation 6

> Sitka should promote air source heat pumps as the preferred space heating alternative to electrical resistance heating. Heat pumps, however, should be paired with alternate heating systems for use in periods of extreme cold.

Prior to a few years ago, heat pumps were a promising technology but had yet to produce consistent results across a wide variety of buildings in Sitka's climate. Some installations had shown good results, but in others the performance was disappointing.

That has changed. The engineering of the pumps has progressively improved. Many dozens of heat pumps have been installed in residential situations in Sitka and cost savings to individual homeowners appear to be consistent and substantial. It was not possible to statistically measure energy savings from heat pumps alone because every homeowner identified during the research for this report changed more than one variable in their home when they installed heat pump(s), such as adding insulation, a new hot water system, or new windows.

Regardless, the savings demonstrated after heat pump installations are substantial, and are more than can likely be attributed solely to other factors. Typical savings have been over $100/month in reduced energy costs. Three homeowners who have kept careful records of their utility bills for a number of years each documented energy savings of over $2,000 a year after installing heat pumps and making other changes[10].

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[9] Current ordinance requires new homes with electric heat to have an alternate heating system, but older homes that have switched to electric heat and those with electrically controlled oil burners are still at risk.
[10] Tad Fujioka, Fabian/Eve Grutter, and Judi Lehman, personal communications.

Some basic calculations suggest significant energy savings to the community of 8 Mwh/yr[11] if replacement of existing electric resistance heating with heat pumps were to occur. That is about one-fourth of the total added capacity from the Blue Lake expansion. For example, the Blue Lake expansion is costing $94,500,000 for 35 Mwh/yr of added capacity, or about $2.7 million per megawatt/year. Cost to install 1,340 heat pumps, at $10,000 a pump, would be about $13.4 million, and save 8 Mwh/yr, or about $1.7 million per megawatt/year saved. We use this example for comparative purposes only, to demonstrate the value of increased efficiency; we support the Blue Lake Expansion project.

However, use of heat pumps comes with a significant caveat. Their efficiency drops dramatically at low temperatures. And the units may revert to a resistance heating/defrost mode at Sitka's seasonally coldest temperatures. This creates a significantly increased grid load at precisely the time of highest demand. Building owners must be able to switch to alternate heating systems at those times to avoid system overload.

An additional caveat applies to heat pump hot water heaters. A heat pump obtains heat from, and transfers cold to, the ambient environment. A hot water heat pump in an interior space will cool that space, which may in turn require additional space heating expense to compensate.

Sitka does not currently have sufficient hydro power available to support a community wide adoption of heat pumps as an alternative to fuel oil. But looking toward the future, if an abundance of hydro power is available (such as Takatz), heat pumps have potential to serve as a major, if not predominant, space heating option for the community.

This recommendation focused on air source heat pumps, because of their relatively wide adoption at this time. Ground source, and sea water source, heat pumps also show good results, and may be a preferred alternative to air source heat pumps depending on the building site.

Lastly, with the ongoing adoption of heat pumps in the community, equipment service and maintenance will become more important over time as the equipment ages. Local vendors and vocational educational programs might anticipate this development and be prepared to take advantage of this expanding niche for skilled trade work.

VI. Findings

Finding A

<u>To facilitate discussion of space heating options and alternatives community wide, included here is an estimate of minimum space heating requirements for Sitka,</u>

[11] The 2008 DHittle load forecast estimated 1,340 homes were heating with electrical resistance heating, at an electrical use averaging 12,000 Kwh/yr. Heat pumps use about half the electricity to produce the same heat in average winter temperatures. (1,340 X 12,000kwh/ year) divided by two = 8.04 Mwh/yr

Space heating is the biggest single energy use in Sitka and other Southeast Alaska communities. Much of that energy is now provided by oil. Space heating is unique in that not only is it a large energy end use, but several sources work well for space heating. These energy sources, over the long term, are somewhat interchangeable. The three most common are electricity, oil, and biomass. Oil is now the biggest source for heat – Sitka imports approximately 5 million gallons of oil per year for space heating. Finding ways to reduce the community's reliance on oil may be the single most important thing to foster the community's sustainability.

We estimate the communities minimum total space heating requirements at 526,300,000,000 Btu's per year. Note this number *excludes commercial/industrial/public authority electric space heating*, for which we did not find a basis on which to make a credible estimate. Nonetheless, we feel the overall load estimate here is a realistic *minimum* on which to begin discussion of possible community wide heating alternatives.

526,300,000,000 Btu's per year[12] is equivalent to:

- 154,260 megawatt/hours using electrical resistance heating[13]. Alternately, heat pumps could functionally halve the needed megawatt/hours, to about 77,000, to produce those Btu's under average winter temperature conditions.
- 4,750,000 gallons of fuel oil (#1 and #2) at 80% burning efficiency
- 33,000 cords of dry wood at 80% burning efficiency (modern catalytic EPA approved stove; older stoves typically burn at 50-60% efficiency)
- 41,100 tons of pellets at 80% burning efficiency

To use this information in a possible scenario, consider that if the community had Takatz on-line, total system generating capacity would be approximately 265,000 megawatt hours/year. Using extensive heat pumps at a COP[14] of 2.0 (see table next page), the heating load could be met by 77,000 megawatt/hours, which is arguably within total system capacity while meeting existing non-heating electrical loads and commercial/industrial/public heating loads now on the grid. To restate: if Takatz were online, Sitka might be able to meet the vast majority of its space heating load with electricity most of the year, and avoid the import of upwards of 5 million gallons of oil-based liquid fuels annually. See Section IV graph 1 of this report, representing fuel dollars leaving Sitka under different scenarios, to see a long-term financial representation of this scenario.

Another use of the information in a possible scenario would be to identify how much of a local forested land base would be required to support a cordwood and/or pellet manufacturing business to meet all or a portion of Sitka's space heating needs with biomass, and a valid and demonstrated sustained rotation and yield from that land base (i.e.: we can't mine old growth for heating and expect it to be sustainable).

For general reference, the following table summarizes heat values of various fuels.

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[12] This estimate is based on electrical use and fuel sales information from 2008.

[13] Assume 3.412 Btu's per watt

[14] Coefficient of Performance – meaning an input of one unit of electrical energy will produce two units of heat, compared to using that same electrical energy for resistance heating.

Table 1: Heat Values of Various Fuels

FUEL TYPE	Btu's/unit	Cost per unit	Efficiency factor in typical use	Cost per 1000 BTU's
Wood	20,000,000/cord (20% moisture)	$300 cord[15]	50%	$.0300
Wood	20,000,000/cord (20% moisture)	$300 cord	80% High efficiency-EPA approved stove	$.0188
Pellets	16,000,000/ton	$350 ton in Sitka	80%	$.0273
#2 diesel	138,500/gallon	$4.05 gallon	80%	$.0365
Electricity (resistance heating)	3.412/watt	$.0918 kw/h (rate for over 1,000kw/h)	100%	$.0269
Electricity (resistance heating)	3.412/watt	$.1053 kw/h (w-surcharge of .0135kw/h)	100%	$.0309
Electricity (heat pump COP 2.0)	6.824/watt	$.0918 kw/h	200%	$.0134
Electricity (heat pump COP 2.0)	6.824/watt	$.1053 kw/h	200%	$.0154

VII. Summary

To quote others who have worked on region-wide energy issues, there is no "silver bullet" to address Sitka's energy future. It will require a combination of additional hydro capacity, conservation, improved efficiency, and adoption of multiple heating systems, to name a few. At the core is finding ways to reduce oil-based liquid fuel imports without overdependence on limited hydroelectric capacity to meet space heating needs.

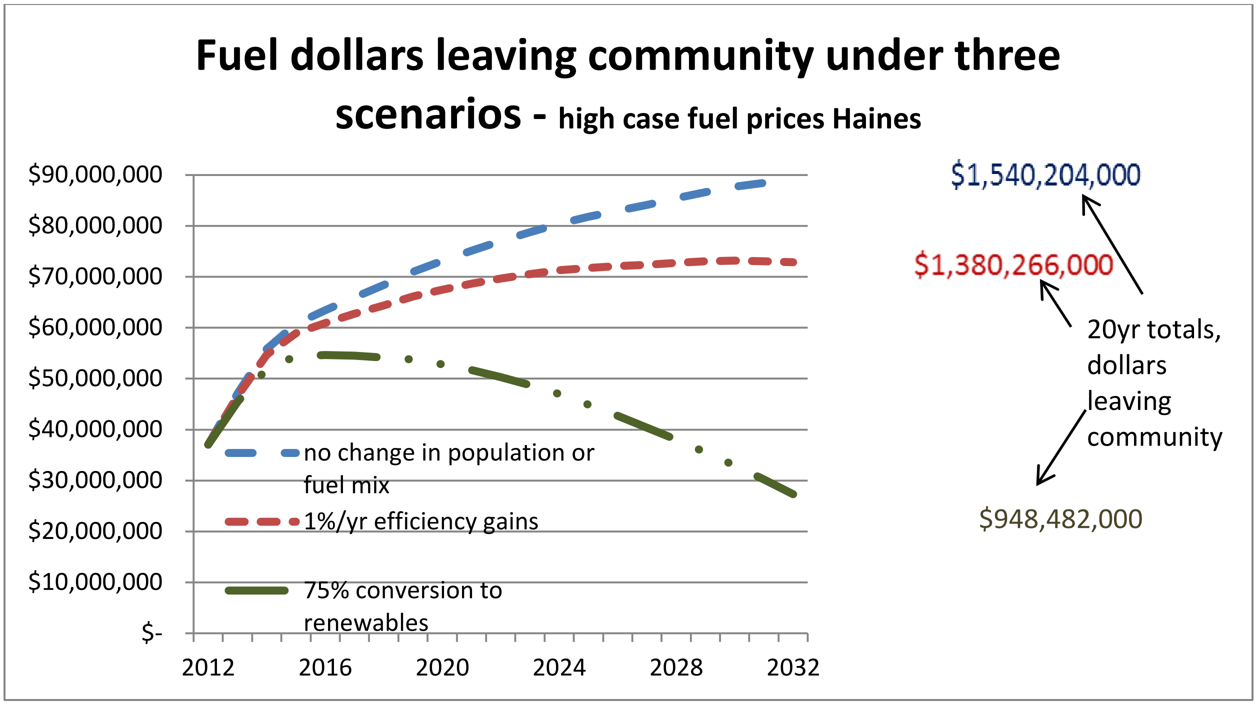
As with so many large scale endeavors, addressing the problem before it is too late is imperative. In this context that means taking proactive steps toward greater energy independence now, before Sitka might lose a significant portion of its population or economic base brought about by rising oil-based liquid fuel costs. We hope this report serves as a key step in that effort.

[15] A true "cost" of cordwood would include values to split, stack, and dry before use.

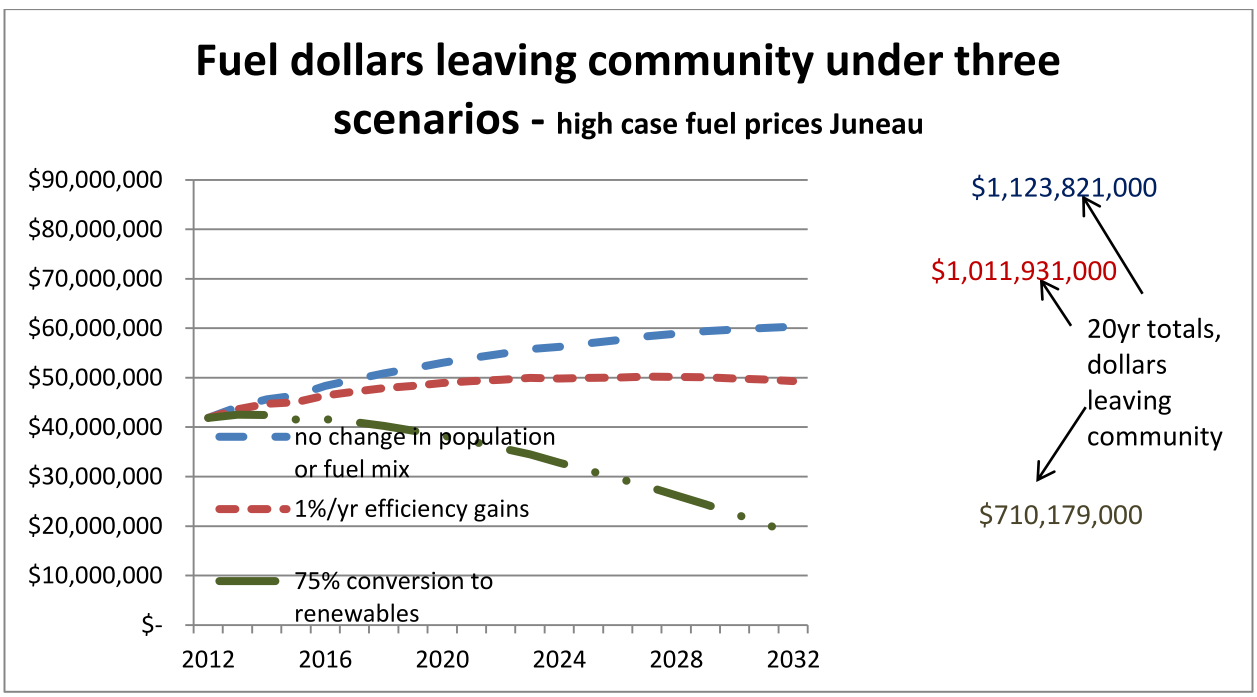
VIII. Questions and Answers

The draft of this report was distributed for comment to key municipal officials and other knowledgeable parties. That process generated several questions or observations. The most instructive of those we summarize here. Chris Brewton, Electric Department Director, provided written comments which are included in their entirety following the acknowledgements.

1. The first graph in this report uses the medium case fuel price projection for Haines to show fuel dollars leaving Sitka under different scenarios. This pricing appears unrealistically low based on recent experience. What would be the projection using the high case? *Answer: Additional projections using Haines high case, and Juneau high case were developed. See next page for both graphs.*



Fuel prices based on ISER Fuel Price Projections 2011-2035 updated June 2011; **High Case** for Haines Community Diesel, (draft SEIRP compares Haines to Sitka for fuel prices). Same price used for diesel #1, #2, and gasoline. Starting fuel price in series, year 2012 - $4.26/gallon, ending price in series year 2032 - $10.26/gallon. (2.4x increase in 20 years.) 2010 dollars, no inflation adjustment. Carbon pricing not added.



Fuel prices based on ISER Fuel Price Projections 2011-2035 updated June 2011; **High Case for Juneau** Community Diesel. Same price used for diesel #1, #2, and gasoline. Starting fuel price in series, year 2012 - $4.82/gallon, (cont) ending price in series year 2032 - $6.94/gallon. (1.4x increase in 20 years.) 2010 dollars, no inflation adjustment. Carbon pricing not added

2. The draft Southeast Alaska Integrated Resource Plan advocates for a region-wide conversion to pellets, concluding that even with the cost of shipping pellets from down south they are a more economical fuel source for space heating than fuel oil. What did your study conclude regarding advisability of conversion to pellets?

   Answer: On a straight "cost per Btu" pellets compare favorably to fuel oil. Pellet stoves are not widely used in Sitka, but those that do use them report good results. Whether to convert to pellets requires a building-specific analysis, including factoring in how pellets will be delivered and handled. Pellets for the homeowner come in 40 pound bags and must be stored in a dry place. Handling those bags on a regular basis may be too much for older persons or those not able or willing to heft such loads on a regular basis. A pellet stove costs $5-6,000 to purchase and install. A pellet boiler, to replace the central oil burner common in older Sitka homes, costs at least twice that. Pellets from outside the region are subject to price instability and supply disruption, much like oil.

   Commercial buildings would face similar factors but might take advantage of automated pellet delivery and handling systems. In summary, a building by building analysis should drive this decision for now. If a local or regional pellet manufacturing business were to be developed it would very likely be to the greater community benefit to adopt pellet stoves and pellet boilers more widely.

3. It's easy enough to suggest the measures in the report, but how do we as a community take the important step toward implementation?

   Answer: Good question, one which is a little beyond the intended scope of the report. But more than a few suggested dedicating staff to these efforts would be worth the costs. One issue which came up is that even for an informed and motivated homeowner, it can be daunting to navigate through the many questions, such as identifying what efficiency and conservation efforts make the most sense for a given building, what appliances are worth the investment, and what assistance programs are available and how does one maximize the available assistance?

   An individual whose job it is to assist residents and businesses with these questions might be a good investment for the community. A model already exists for this type position through the several internships SCS has had with the Electric and Public Works Departments over the last several years.

   Another suggestion for this person would be to give educational programs in the elementary schools. Students might bring the energy conservation message to the home more effectively than educational efforts targeted at the general public.

4. What about wind energy for Sitka?

   Answer: Wind energy for Sitka has been studied by the Electric Department and the Alaska Energy Authority and the conclusion is that Sitka is simply not windy enough at sea level. Some of the mountain ridges have better average wind speeds but as of the 2008 studies it was concluded that investment in hydro such as expanding Blue Lake is more cost effective than wind turbines.

   The small wind turbine at the visible at the Coast Guard Maple building is successfully generating electricity, at an approximate cost of $2.00 per kilowatt/hour. For comparison, Sitka electric utility rates are now about $0.105 per kilowatt/hour.

5. Some recent work on Combined Heat and Power (CHP) is encouraging. A CHP plant produces electricity by burning biomass and then distributes the excess heat to nearby buildings. Should we try something like this in Sitka?

   Answer: Yes. CHP generates electricity at about 20% efficiency, with the remainder going to thermal output. Installing small CHP systems (1-3 MW) adjacent to heating loads might yield very high overall efficiencies. The thermal energy offsets heating oil usage, and the electrical energy powers heat pumps, doubling its effectiveness. The combined thermal efficiency, including the heat pumps, could exceed 100%. We believe a pilot project testing the viability of a CHP plant in Sitka would be worthwhile.

6. What about electric cars? It seems that Sitka, with its short driving distances, is ideally suited to using electric cars instead of importing gasoline for passenger autos.

   Answer: When we first began our research for this report, we expected to find that electric cars make economic good sense for Sitka for passenger driving, and that a careful analysis would show quantitatively the benefit to the individual car owner and to the overall community.

   But the result of our work was that, in economic terms, there isn't a compelling case for electric vehicles based on current performance of the vehicles. Because of the widespread interest in this topic, and the many factors involved, both objective and subjective, we include as an Appendix a more detailed discussion of this topic. We considered average miles driven, miles per kilowatt/hour, cost of electricity, cost of replacement batteries, additional load on the electric grid, and gallons of gasoline which would not be imported.

   An individual might review our analysis and reach a different conclusion, or still make the decision to acquire an electric vehicle because of a personal preference.

7. What about hybrid cars? Don't they combine the best of both worlds, with the economy of electric vehicles and the performance of a gasoline vehicle when needed?

   Answer: Hybrid vehicles have potential as a superior option for passenger vehicles. They were not analyzed for this review because the technologies used in hybrids, and their performance under different conditions, is too varied to analyze as a class. There are full hybrids, mild hybrids, extended range electric vehicles, parallel hybrids, series hybrids, powersplit, and plug-in types available. Many if not most of the units operate without plugging into the electric grid.

They obtain electric power for the batteries and electric motor from the onboard internal combustion engine. Performance characteristics vary widely. For the individual consumer, whether or not a hybrid makes sense would require an individual analysis based on the specifics of a particular vehicle (purchase cost, performance, mpg) and how many driving miles it would take to recover the higher purchase cost in gas mileage savings.

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Electric Department Comments

By Chris Brewton, Director

I agree with almost the entire document and commend the Sitka Conversation Society for addressing a crucial portion of the energy puzzle. However, from the Department perspective, *reliability* not *sustainability* is the greatest energy issue facing Sitka.

There are a multitude of situations that could result in partial or complete system failures. With the loss of a single element in either the generation, transmission, or distribution systems, blackouts would occur, and for potentially long periods of time. The consequences of an extended outage could be catastrophic. That is the immediate risk to the community. Therefore, all utility resources must be focused on resolution or mitigation of these system deficiencies.

1- Report recommendation: Sitka should undertake development of an Integrated Resource Plan.
   Electric Department Response: The department strategic plan is in essence, the long term capital budget. The capital plan addresses all system deficiencies in a logical order to improve system reliability. I'm not sure what particular goals or objectives a Sitka specific IRP would address but until the existing deficiencies are corrected, the limited Department resources must be focused on known problems. I do not object to the SCS independently working on an IRP but our limited staff and funding must be directed towards capital improvement of the system.

   SCS comment on Electric Department response: The Electrical Department and municipal capital budgets are a major element of the community's strategic energy plan. And we recognize that the Electric Department has provided and continues to provide outstanding service to the community. But, a long-term community wide strategy for energy sustainability includes elements both within and beyond the direct role of Electric Department. It is the factors outside the utility system, but that influence the system, that are important. These factors include, for example, developing goals and strategies for the use of biomass, for promoting efficiency (such as the well- funded AHFC rebate and weatherization programs) and conservation, possible development of a pilot project for a Combined Heat and Power unit, or devising other strategies to reduce the community's reliance on oil-based liquid fuels. Even though these factors are independent of system reliability, they can have a major influence on the overall system.

2- Report recommendation: The Electric Department should be given authority by the Assembly to adopt additional demand side management measures, etc.
   Electric Department Response: This is a funding not authority issue. The Assembly as the rate-making authority can adopt any particular rate structure they like. We have a DSM capital account and have established a limited DSM program. The SEIRP suggests DSM is a viable strategy for the region and should the Legislature adopt and fund these measures, Sitka will aggressively pursue funding for additional DSM. A Cost of Service Study has been completed and a Rate Design Study is in progress. I fully expect a substantial change in our present rate structure that will address our limited hydroelectric generation. The challenge the Department faces is lack of adequate funds to complete necessary capital projects.

3- Report recommendation: Conservation…should be a part of the community's energy strategy.
Electric Department Response: Agreed. I would be very interested in "whole house" energy displays that could be utilized to manage energy usage. Smart metering as a technology is too expensive for a small utility and would not return anywhere near the required energy savings for the requisite investment.

4- Report recommendation: Energy efficiency should continue to be encouraged with all means available.
Electric Department Response: Absolutely, and this particular area would be well suited for SCS and SEDA. The Department has utilized a multitude of resources with limited success. I suspect rates will be the ultimate method to encourage conservation.

5- Report recommendation: Building owners should be installing multiple heating systems.
Electric Department Response: Having options for life support functions during emergencies is always a good idea. Not sure how that can be mandated; I would suspect this is a building code issue.

6- Report recommendation: Sitka should promote heat pumps.
Electric Department Response: I support all the heat pumps we can possibly get, but the ratepayers cannot afford to subsidize a project of this scope until the critical system deficiencies are corrected.

Appendix: Discussion on electric cars (from question 6, p17.)

<u>The performance of electric cars is not yet at a level to justify replacement of gasoline vehicles in Sitka. However, if and when electric car performance, as measured by miles per kilowatt/hour, approximately doubles from current performance, it may be cost effective to promote community adoption of electric cars on a broad scale for light load transport.</u>

This is essentially a recommendation to "wait and see" when it comes to electric cars. It naturally depends on relative costs of gasoline and electricity over time, and improved performance (or not) of electric and gasoline powered vehicles.

We set out to answer two main questions: "Is it to the economic benefit of an individual to have an electric vehicle over a gasoline vehicle?", and "Is it to the economic benefit of the greater community if electric vehicles were widely adopted in Sitka?"

To answer the first question we used the Nissan Leaf, a new electric vehicle, at a cost after federal rebate of $28,550. (Before rebate $36,000.) We compared that car to a typical gasoline compact car at $20,000, getting 25 mpg in Sitka. The Nissan Leaf costs approximately $.90 to drive 25 miles at Sitka's electric rates, or $.036/mile. At $4.10/gallon, the gasoline powered vehicle costs $.164 to drive a mile, or a savings of $.128/mile to drive the electric vehicle. To recover the $8,550 higher purchase price in saved fuel expense would take 66,800 miles. At the average annual Sitka driving distance of 4,380 miles/year, it would take 15 years to recover the higher initial cost, which is close to the life of a typical vehicle.

There are more factors than simple mileage to consider when it comes to comparisons, some which are hard to quantify, such as cold weather performance, resale value, range limitations, load hauling capability, and so forth. However, several independent analyses of electric car cost /benefit come to the same conclusion: "The bottom line is that electric vehicles currently do not provide private attributes and benefits that exceed, or even equal those of most conventional gasoline-powered cars"[16]. High initial cost is one reason, battery fatigue and replacement cost is another.

To use an anecdote to illustrate the difficulty of which assumptions to use, a particular commercial electric vehicle now in Sitka cost approximately $20,000 new, $7,000 less than the Nissan Leaf. The battery pack lasted three years and cost $1,500 to replace. Amortizing the battery pack cost over miles driven, and adding in the electrical cost for battery charging, the cost per mile over those three years was .$23/mile. Compare this to $.21/mile for a gasoline powered vehicle at $4.25/gallon and 20 mpg, and the gasoline powered vehicle is cheaper to operate. Nissan claims the Leaf battery pack will last 5-10 years and 100,000 miles, but the vehicle has not been on the road long enough to validate that longevity claim.

On the other hand, electric car and battery technology, service, and reliability are improving at a rapid pace, and petroleum prices are going up. In the next five years, analysts expect there to be 159 hybrid and electric vehicle models available for purchase in the U.S. market – a substantial increase from the 31 hybrid and electric models in 2009. The US government is actively promoting electric cars with incentives. It is likely that electric car industry and infrastructure will continue to improve and could become mainstream in the next several years.

We next looked more closely at the second question, "Is it to the economic benefit of the greater community if electric vehicles were widely adopted in Sitka?" We assumed that the maximum adoption of electric cars would be 75% of passenger miles driven.

Widespread adoption of electric cars (75%, or 3,500 cars) in the community would avoid the import of approximately 700,000 gallons of gasoline[17]. This equates to $2,800,000 annually that would stay in the community at today's gasoline prices. Using the DHittle and Associates, 2008 Load Forecast, adjusted to Nissan Leaf 2.9 miles/kwh for, rather than 7 miles/kwh assumed by the load forecast, to power 75% of miles driven with electricity instead of gasoline would put an additional demand on the grid of about 14,796 Mwh/year of electricity[18], or about one-half of the extra capacity gained by the Blue Lake dam expansion.

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[16] Lee, Henry and Lovellette, Grant, "Will Electric Cars Transform the U.S. Vehicle Market? An Analysis of the Key Determinants," Discussion Paper 2011-08, July 2011, Belfer Center for Science and International Affairs. Harvard Kennedy School, Harvard University.
[17] Assume 4,380 miles annually per vehicle, 25 mpg.
[18] Source: DHIttle and Associates, 2008 Load Forecast, Table 13.

Working with those numbers we calculated that 75% of total miles driven by electric vehicle would put an additional demand on the electric grid of about 10%, while decreasing gasoline imports by 30%, and total oil-based liquid fuel imports by about 9%. At current electric rates[19] and gasoline pricing, 14,796 Mw/h would cost consumers $1,558,018, while avoiding fuel expense of $2,800,000 annually. The numbers in this paragraph are included primarily as reference points for ongoing assessment of electric car viability.

It is our conclusion that the gasoline savings and avoided fuel imports are not now significant enough to justify a recommendation to move to electric cars as a matter of overall community benefit. The numbers suggest a greater certainty than we have. Several key factors aren't quantifiable, such as:

- Effect on consumer behavior of increasing gasoline prices. People may simply drive less, walking, bicycling, or using public transport.
- Increasing mileage performance of gasoline vehicles. Mileage of gasoline vehicles is improving. A savvy consumer might find that a high mpg lightweight vehicle provides a better overall performance value than an electric vehicle.
- Improved performance of electric vehicles. This is probably the biggest unknown. The history of electric vehicles going back many years is an assumption that in "the next few years" performance would greatly improve. So far the big advances haven't occurred, but maybe this time is different.

In conclusion, it is our opinion that with other factors holding steady, if electric vehicle mileage approximately doubles from current levels, to 7 mi/kwh from the current 3 mi/kwh, it will probably be to individual and overall community advantage to consider a community-wide strategy of adopting electric vehicles. The individual benefit would be, simply, because it would save consumers money. The community benefit would be from the multiplier effect of keeping dollars in the community that would otherwise leave the region to purchase gasoline.

[19] .1053 kw/h