PENOBSCOT INDIAN NATION

LONG -TERM STRATEGIC ENERGY PLAN

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Department of Energy Award # DE-FG36-05GO15175

Prepared for the
Penobscot Indian Nation

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August 2006

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EXECUTIVE SUMMARY

The Nation's Strategic Energy Plan is divided into three parts:

I Tribal Energy Vision, Mission and Goals
II Current Energy Status, both current use and potential resource development
III Action Plan to achieve the energy goals

The Tribal Energy Vision provides a description of the Nation's long term energy goals (where it wants to go); the Current Energy Status evaluates existing tribal energy use (where it is now); and the Action Plan identifies options for moving toward achieving the Nation's energy goals (how it will get there).

I TRIBAL ENERGY VISION

The first step in developing an effective strategic energy plan is envisioning your destination. The Penobscot Indian Nation believes that its Energy Vision should go hand-in-hand with other Tribal objectives, like economic development, job creation, and cultural values.

In support of its long-term strategic energy planning effort, as well as its overall mission, the Nation has adopted the following Energy Vision:

> *The Energy Vision of the Penobscot Nation is to maximize the efficiency of energy usage and develop energy resources in ways that will sustain current and future generations by addressing the economic, environmental, and social issues of energy within the context of Penobscot Indian Nation culture, traditions and established tribal policies for the wise use of our forest, water, and wind resources.*

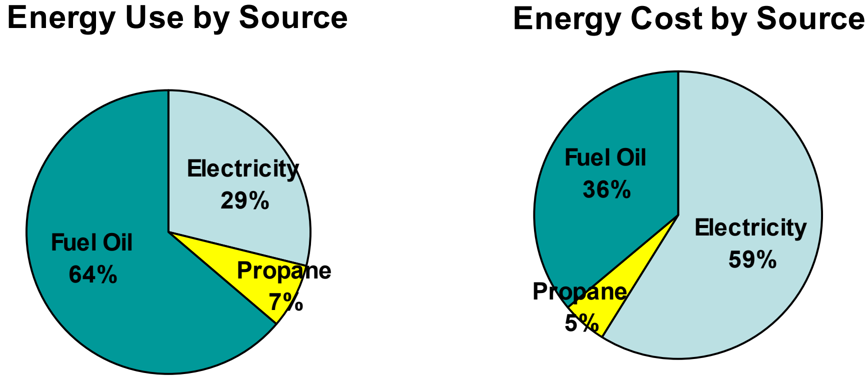
II CURRENT ENERGY STATUS

After identifying the Tribe's Energy Vision and Goals, the next step was to understand where the Nation is now. This requires a good understanding of the Nation's current energy status – its energy baseline.

The Nation currently relies on an energy mix of electricity, fuel oil and propane for its facilities and operations. For the year 2005, the Nation's annual energy cost was just over $482,000.

Electricity, supplied to the Nation by Bangor Hydro-Electric Company, accounted for 29% of the Tribe's overall energy use but 59% percent of the total energy costs. Fuel oil, on the other hand, accounted for 64% of energy use but 36% of total energy costs. These comparisons are shown in Table ES-1.

Figure ES-1. Comparison of Energy Use and Energy Cost, by Source



Energy costs could be reduced by 13% by investing in energy efficiency measures in tribal facilities. An investment of $128,000 (after rebates) would save over $64,000 in annual operating costs—a two year payback.

The Nation's current energy demands are expected to continue at a similar level into the near future unless energy efficiency measures are incorporated. Energy costs, however, may well increase with increasing electricity and fuel oil prices.

III ACTION PLAN

Once the Nation developed its energy goals and evaluated its existing energy use, the final step was to identify actions the Nation can implement to move toward achieving its goals. The three primary types of options for moving forward include:

- Energy Efficiency Options
- Energy Generation Options
- Institutional and Administrative Options

Since the Nation began this strategic energy planning effort, some actions discussed below have already begun, and in some cases have already been completed. However, there are a number of additional actions that can keep the Nation moving in the right direction, and that can set certain standards for how strategic energy planning can be incorporated into future development.

A Recommended Energy Efficiency Actions include:

1. Complete a thorough energy audit of all energy use at all tribal facilities and develop a prioritized list of energy efficiency measures.[1]
2. Develop a prioritized plan, including funding, to act on the recommendations contained within the audit.
3. Consider setting aside fuel oil cost savings (or the economic development rebate fund) to pay for energy efficiency capital improvements for tribal facilities or residences.
4. Pursue grants and rebates from USDA and Efficiency Maine to fund most of the costs of these improvements.
5. Incorporate energy efficiency requirements into the design requirements for any new or renovated tribal facilities.
6. Incorporate energy efficiency requirements into procurement policies for any energy consuming devices purchased by the Nation, including office equipment, vehicles, etc.

B Recommended Energy Generation Actions include:

1. Continue to focus on the wind project development at Alder Stream Township to ensure that appropriate environmental and technical studies are completed in preparation for a permitting process, and to identify and pursue capital financing opportunities.
2. Seek grant funding to hire a hydropower consultant to analyze potential small hydroelectric sites in more detail.
3. Evaluate geothermal heat pumps for three facilities after first installing recommended energy efficiency measures.
4. Monitor the market for biomass fuels and consider selling wood waste from Tribal logging operations should market opportunities arise.
5. Consider solar energy when designing and constructing any new facilities.

C Recommended Institutional and Administrative Actions include:

1. Continue to support, and gradually expand, the Nation's energy planning and coordinating staff capabilities and functions.
2. Continue to support the policy-level Energy Committee as the responsible body for energy program oversight and implementation, under the overall direction of the Tribal Council.
3. Seek funding to develop internal tribal regulatory capacity to review the siting and operation of energy generation facilities on tribal lands.
4. Investigate the economic and legal issues involved in establishing a tribal electric distribution utility.
5. Explore opportunities to participate in programs that lower costs by bulk fuel purchasing, such as arrangements with the Venezuelan government and Maine Power Options.
6. Consider adding a green power purchasing component to the Nation's current electric power purchases.

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[1] This action item was completed in April and May, 2006. See Alan R. Mulak, Commercial Facility Energy Audits, Penobscot Indian Nation, Indian Island, Maine, June 8, 2006.

INTRODUCTION

The Penobscot Indian Nation comprises 2,261 members and land holdings of 118,885 acres in various parcels located in northern, eastern and western Maine, as well as access and rights to the waters of the Penobscot Rivers. Tribal lands include other significant waterways, including Sunkize Stream, Pushaw Stream, Birch Stream and the Passadumkeag River.

The Nation is located in a region of North America that has both a cold, harsh climate and high energy costs. Every year the Nation spends thousands of dollars on fuel oil, propane gas and electricity to heat, light and power its public facilities, and individual tribal families expend untold dollars to heat and light their residences. The Nation is also blessed with many natural energy resources. Penobscot lands contain mountains and high ridge lines, large forestry tracts, and access to moving river and stream water, all of which contain latent potential for renewable energy power generation. Jurisdictions to the south are increasingly demanding that clean energy resources be a part of their state energy supplies.

With this as background, the Nation believes that any energy strategy it adopts must achieve two principle goals:

First, it must reduce the cost burden of energy use to the Tribe and its members. To do this the Nation must both explore ways in which to make its existing public facilities and private residences more energy efficient, and examine alternative ways to purchase fuel supplies.

Second, it must address opportunities for sustainable energy production. In doing so the Nation must carefully consider the environmental and cultural impacts of potential sources of renewable energy production, the economic development potential of such activity, and the long-term cost and reliability of each option.

The Strategic Energy Plan is intended to serve as a guide in creating and conducting an effective energy management program for the Penobscot Indian Nation. The plan's primary objective is to create a long-term sustainable plan for energy self-sufficiency and energy development on tribal lands.

The Strategic Energy Plan is to be used to:

- Identify the current situation relating to energy supply, usage, and cost;
- Provide a structure for updating energy related requirements for the tribal administration and organization;
- Identify opportunities for development of long-term, cost-effective sources of energy; and

- Provide opportunities for tribal members to train and be employed in energy management and energy resource development, operations, maintenance and administration.

With these considerations as preface, the Penobscot Indian Nation Strategic Energy Vision, Mission and Goals follow.

ENERGY VISION, MISSION, & GOALS

A. Energy Vision

The Energy Vision of the Penobscot Indian Nation is to maximize the efficiency of energy usage and develop energy resources in ways that will sustain current and future generations by addressing the economic, environmental, and social issues of energy within the context of Penobscot Indian Nation culture, traditions and established tribal policies for the wise use of our forest, water, and wind resources.

B. Energy Mission

The energy mission of the Penobscot Nation is to aid in the social and economic well-being and development of the Tribe and its members through education about energy matters, conservation of energy resources, and development of environmentally acceptable, culturally appropriate, and economically cost-effective sources of renewable energy.

C. Energy Goals

The two primary energy goals of the Penobscot Nation are to:

1. Reduce energy usage and costs in tribally-owned facilities and in the homes of tribal members;

2. Develop energy resources on tribal lands that create revenues and job opportunities to the Nation, economic development to the region and achieves greater tribal energy self-sufficiency.

These goals will be achieved by pursuing over time the set of objectives and action items that are discussed further into this Plan. First, however, we summarize the current energy status of the Nation, both in terms of energy use and energy resource development potential.

CURRENT ENERGY STATUS

In order to identify the best way to achieve our goals, it is necessary to understand where we are now. This requires that we have a good understanding of the Tribe's current energy status – its energy baseline. In the following sections we first discuss the Tribe's current energy use, energy costs, and environmental impacts. Then we assess the energy resources available for development.

A. Penobscot Nation Energy Use

1. Energy Providers

The Nation currently relies on three different sources of energy to operate its facilities and operations: electricity, fuel oil, and propane. The Nation's electricity is provided by the Bangor Hydro-Electric Company; its fuel oil is purchased from R. H. Foster; and its propane is provided by Amerigas.

2. Tribal Facilities

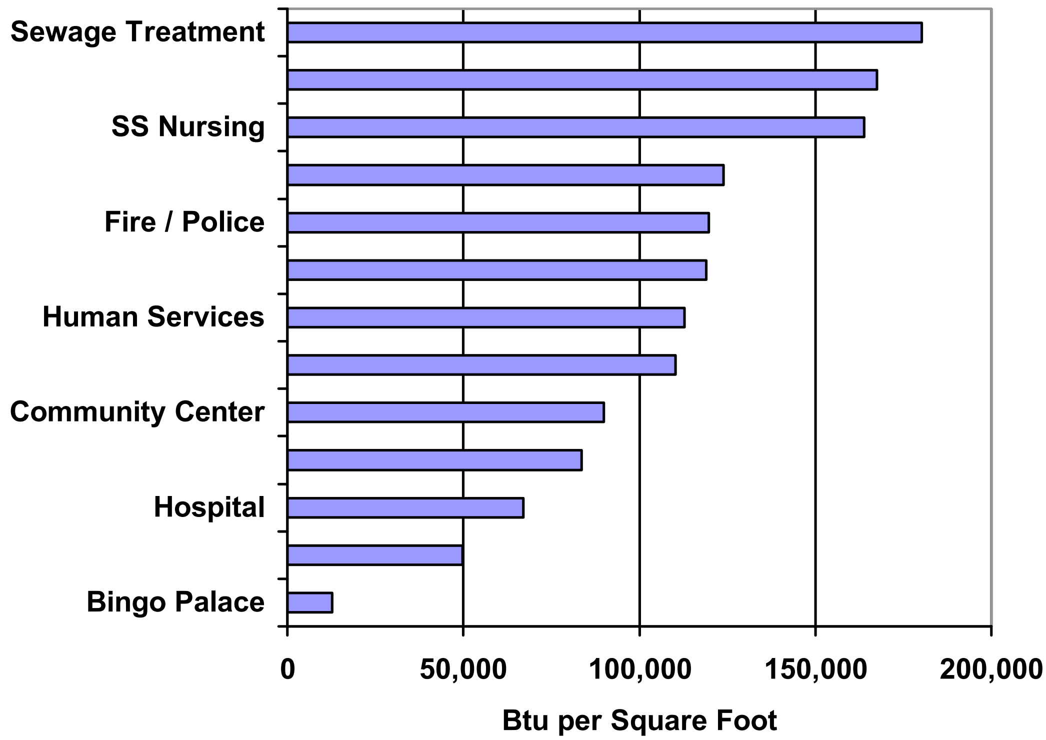
The Nation currently owns and operates a variety of facilities on Indian Island in Old Town, Maine. As shown in Table 1, the largest facility, by square footage, is the Sockalexis Bingo Parlor, followed by the Community Building, Olamon Industries/PIN Rx, and the Indian Island School.

Table 1. Penobscot Facilities Ranked by Area, with Energy Use

Facility	Area sq. ft.	Electricity kWh	Propane gallons	Oil gallons
Sockalexis Bingo	125,000	118,800	-	8,630
Gov / Community	37,109	175,060	-	19,856
Olamon Industries	37,000	166,800	3,067	16,237
Indian Island School	35,800	334,725	-	20,345
Hospital	18,700	164,200	-	5,011
Nick Sapiel Jr.	11,019	262,520	10,373	-
Fire / Police	5,460	42,063	-	3,698
Sewage Treatment	5,000	130,520	-	3,298
Sarah Spring Nursing	3,700	71,000	-	2,637
Human Services	2,200	18,076	-	1,351
Assisted Living	2,100	3,746	-	665
Maintenance Garage	1,800	12,796	-	1,236
Housing Dept	1,700	11,755	-	1,236
Totals	**286,588**	**1,512,061**	**13,440**	**84,200**

Although they are the largest, they are not, however, the most energy intensive. Based on a 2006 energy audit of 13 tribal facilities, the buildings are rank-ordered for energy intensity in Figure 1.

Figure 1. Energy Intensity of Audited Facilities



The most energy intensive facility (measured in British thermal units per square foot[2]) is the sewage treatment facility, primarily because it has a small area and operates around the clock. This is also true with the Sarah Springs Nursing Facility. This is not true, however, for the Nick Sapiel Jr. building. Its relatively high energy intensity for an office building suggests the need for controls and better energy management.

3. Energy Use

The Nation's Facilities Manager maintains data based on monthly utility bills for calendar year 2005. This data is the basis for the evaluation of energy use in this section, as well as the evaluation of energy costs, discussed in the next section.

Electricity

Bangor Hydro-Electric (BHE) provides electrical power to all tribal buildings on Indian Island. In 2005, the Nation used over 1.5 million kilowatt-hours (kWh) of

[2] Converting kilowatt-hours of electricity, gallons of propane and gallons of heating oil to British thermal units or Btu allows for easy comparison using a common unit of energy.

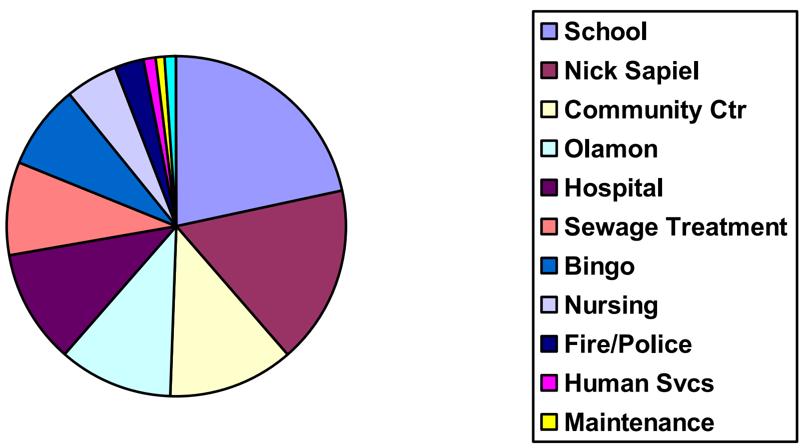
electricity at the 13 audited facilities. About 22% of this total (334,725 kWh) was used at the Indian Island School. Table 2 below displays the annual electricity use of individual tribal facilities for the year 2005.

Table 2. Annual Electrical Use for Tribal Facilities

Facility	Annual Electric Use kWh/year	Percent of Commercial Use
Indian Island School	334,725	22%
Nick Sapiel Jr. Building	262,520	17%
Gov't / Community Center	175,060	12%
Olamon Industries / PIN Rx	166,800	11%
Hospital	164,200	11%
Sewage Treatment Plant	130,520	9%
Sockalexis Bingo Palace	118,800	8%
Sarah Spring Nursing Facility	71,000	5%
Fire / Police	42,063	3%
Human Services	18,076	1%
Maintenance Garage	12,796	1%
Housing Department	11,755	1%
Assisted Living Facility	3,746	0%

Over half of the electricity use is consumed in three buildings, as shown in Figure 1 for the year 2005.

Figure 1. Annual Electrical Use



Fuel Oil
In 2005, R. H. Foster provided fuel oil for heating tribal buildings. The 13 audited facilities used about 84,200 gallons fuel oil. Table 3 below displays annual fuel oil use by each facility.

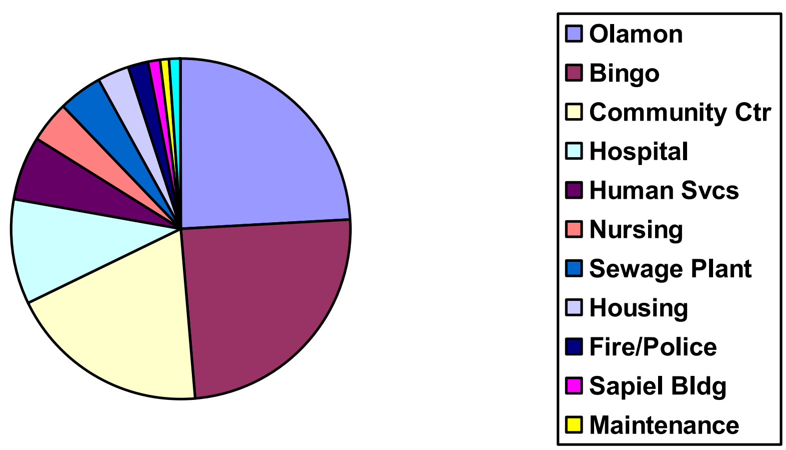
Table 3. Annual Fuel Oil Use for Tribal Facilities

Facility	Annual Oil Use Gallons/year	Percent of Commercial Use
Olamon Industries / PIN Rx	20,345	24%
Sockalexis Bingo Palace	19,856	24%
Gov't / Community Center	16,237	19%
Hospital	8,630	10%
Human Services	5,011	6%
Sarah Spring Nursing Facility	3,698	4%
Sewage Treatment Plant	3,298	4%
Housing Department	2,637	3%
Fire / Police	1,351	2%
Nick Sapiel Jr. Building	1,236	1%
Maintenance Garage	1,236	1%
Assisted Living Facility	665	1%

The Olamon Industries facility used the most, even though it is only half occupied at this time. The Sockalexis Bingo Palace used nearly as much, even though it is used only for events. Clearly there is opportunity to reduce fuel oil use in these facilities.

As shown in Figure 2, over three-quarters of the fuel oil is used in just three facilities—Olamon Industries, the Bingo Palace, and the Community Center, which also houses the Nation's government offices.

Figure 2. Annual Fuel Oil Use



For the 2005-2006 heating season, the Nation was able to obtain a supply of fuel oil at a reduced cost through an agreement with the Venezuelan government and its US marketer Citgo. For the 2006-2007 heating season, the Venezuelan government has agreed to provide fuel oil at a price considerably below current market prices, and in addition has offered to rebate a percentage of the oil payments by the Nation for economic development purposes.

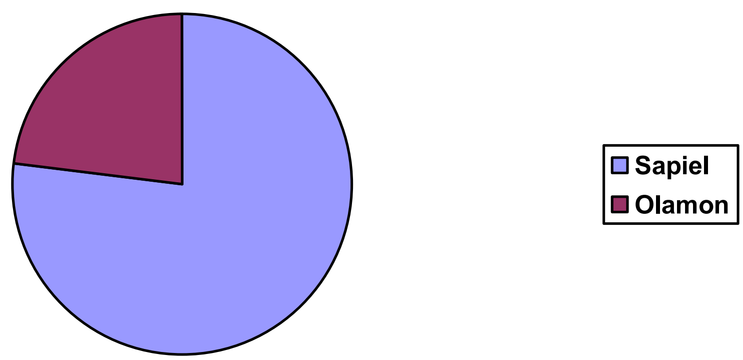
Propane
Amerigas supplies propane for heating (including hot water) at two facilities, the Nick Sapiel Jr. office building and the Olamon Industries building now used in part by PIN Rx. As shown in Table 4, the Nation used 13,440 gallons of propane in 2005.

Table 4. Annual Propane Use for Tribal Facilities

Facility	Annual Propane Use gallons/year	Percent of Commercial Use
Nick Sapiel Jr. Bldg.	10,373	77%
Olamon Industries / PIN Rx	3,067	23%

Figure 3 shows that most of the propane is used by the Sapiel Building.

Figure 3. Annual Propane Use



Total Energy Use
To compare the relative contribution of each of the energy sources to the Nation's overall energy use, it is possible to convert each source into an equivalent energy measurement in British thermal units (Btu)

Table 5 displays the Tribe's total energy use by source for the year 2004.

Table 5. 2004 Total Energy Use by Source

Source	Annual Use	Conversion Factor	Equivalent Btu/hr	Percent of Total
Electricity	1,512,061 kWh	3,413 Btu/kWh	5,160,664,193	29%
Fuel Oil	84,200 gal.	138,000 Btu/gal.	11,619,600,000	65%
Propane	13,440 gal.	91,600 Btu/gal.	1,231,135,144	7%
Total			18,011,399,337	100%

Based on the equivalent amount of energy consumed from each energy source, 29% of the Tribe's energy is supplied by electricity, 65% percent is supplied by fuel oil, and 7% percent is supplied by propane.

4. Energy Costs

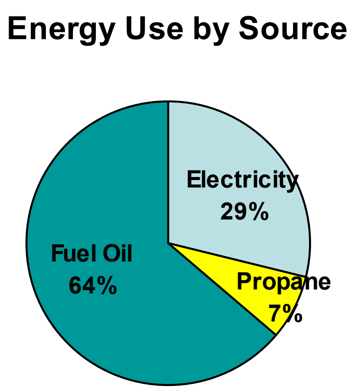
Based on information compiled for the energy audit conducted in 2006, the Nation spent just over $482,000 on energy for the year 2005. A breakdown of energy cost by source is provided in Table 6 below.

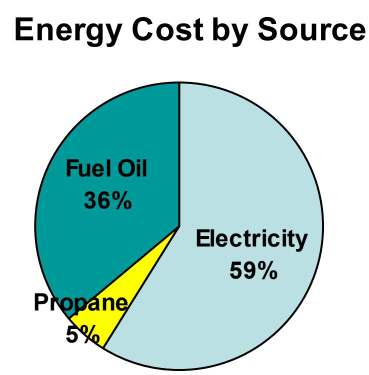
Table 6. Annual Energy Costs

Source	2005 Annual Cost	Percent of Total Energy Cost
Electricity	$287,291	59%
Fuel Oil	$172,610	36%
Propane	$22,580	5%
Total	**$482,481**	**100%**

Although fuel oil is by far the largest energy source on a Btu basis, accounting for 64% of total energy used by the Nation, it drops to 36% as a percent of total energy cost. Electricity, which is only 29% of total use, jumps to 59% of the total cost, as shown in Figure 4.

Figure 4. Comparison of Energy Use and Energy Cost, by Source





Total energy costs (electricity, fuel oil and propane) for individual tribal facilities are displayed in Table 7.

Table 7. 2005 Annual Energy Cost for Tribal Facilities

Facility	Annual Energy Cost	Percent of Total
Indian Island School	$ 105,305	22%
Gov't / Community Center	$ 73,966	15%
Olamon Industries / PIN Rx	$ 70,130	15%
Nick Sapiel Jr. Building	$ 67,306	14%
Hospital	$ 41,471	9%
Sockalexis Bingo Palace	$ 40,263	8%
Sewage Treatment Plant	$ 31,560	7%
Sarah Spring Nursing Facility	$ 18,896	4%
Fire / Police	$ 15,573	3%
Human Services	$ 6,204	1%
Maintenance Garage	$ 4,965	1%
Housing Department	$ 4,767	1%
Assisted Living Facility	$ 2,075	0%
Total	**$ 482,481**	**100%**

Four facilities—the school, the community center, the Olamon building and the Nick Sapiel Jr. building—are responsible for two-thirds of the Nation's energy costs.

The recent energy audits recommended a number of measures that could save the Nation over $64,000 per year (a 13% cost savings) and provide a two-year payback. These improvements require investment capital (after Efficiency Maine rebates) of $128,000, however, and we recommend that the Nation consider setting aside some or all of the cost savings (estimated at $54,000 for the coming year) from purchasing oil from Venezuela (or the rebate fund) and using it to fund the recommended energy efficiency projects. The fund could also be used to pay for efficiency upgrades to homes on Indian Island. There is also a possibility of funding (up to 60% of costs) from the USDA, which should be pursued.

5. Future Energy Use

The existing level and type of energy use by existing tribal facilities is expected to continue into the near future. However, there are plans for additional development on tribal lands that are likely to increase energy demand, including additional residential development of up to 26 homes. There has also been discussion of replacing or updating the Community Center.

B. Penobscot Nation Energy Resources

The analysis of Penobscot energy resources was in part conducted using several digital resource maps available through the federal national laboratory system. In each case, potential resource sites were located and marked on topographical maps of tribal land holdings – reservation, trust and fee lands. The intent was to draw attention to geographic areas of greatest technical potential, and, conversely, to eliminate those areas with no or marginal potential. Areas identified as high theoretical potential, based on the modeling, would require rigorous on-site measurement and analysis in order to verify and quantify the actual resource potential.

1. Hydroelectric Potential

The Nation's potential hydroelectric resources lie in two classes: low to medium-head hydro and high-head hydro.[3] Most existing hydro power installations in the regions where the Penobscot Nation owns land are low to medium head (10 to 100 feet), located either on rivers with large flows or on natural or man-made lakes with large impoundments.

High-head hydroelectric installations do not involve impoundments or dams and therefore involve considerably less capital investment than low-head dams. They also may have lesser environmental impacts than low-head impoundments.

A 1986 assessment of hydro potential indicated that virtually all sites with any reasonable potential for low-head hydro-electric development had been identified and reserved through preliminary licensing applications with the Federal Energy Regulatory Commission as of 1980.[4] Although a developer may pursue licensing of sites that they do not own, the assessment states that "The land holdings of the Penobscot Nation (except for islands in the Penobscot River) do not appear to have sufficient water resources for low-head hydro-electric power generation. Those lakes, ponds or rivers on or near the Nation's lands with any economic potential have already been developed."[5]

On the other hand, the 1986 assessment is more positive about the potential from high-head hydropower. Relying on an analysis of topographical maps, the assessment identified 18 potential sites on or near the Tribe's fee and trust lands, with a total capacity of 1.7 MW.

For this Energy Plan, we consulted new hydrographic models created by the Idaho National Energy Laboratory (INEL) using national level data and analysis.[6]

[3] "Head" is the height from water surface to the turbines in the power plant. The quantity of electricity generated is determined by the volume of water flow and the amount of head. The greater the flow and head, the more electricity produced.

[4] Penobscot Indian Nation Comprehensive Plan, Economic Development Component (authors unstated), 1986. Although the economics are out of date, this assessment should be consulted before pursuing additional hydro development.

[5] Ibid. p. 118.

[6] Douglas G Hall, Kelly S. Reeves, Julie Brizzee, Randy D. Lee, Gregory R. Carroll, Harold L. Sommers. "Feasibility Assessment of the Water Energy Resources of the United States for New Low Power and Small Hydro Classes of Hydroelectric Plants," Idaho National Laboratory, January 2006.

Criteria used by INEL to screen and assess potentially developable local sites included:

- Site accessibility, proximity to existing transmission infrastructure, and the absence of development;
- Implementation of only low power or small hydro projects that would not create a reservoir or impound the total stream; and
- Power production that would capture no more than half of the annual mean flow.

The INEL model was used in conjunction with the Webgis program found at http://hydro2.inel.gov/prospector to identify sites on Tribal lands. The resulting maps are shown in Appendix A.

Power for a specific site was estimated by looking at annual mean power, not the hydropower capacity. All the potential sites identified are indicated to be "low power sites," meaning they are capable of producing less than 1 average megawatt (MWa).[7] A visual inspection of the maps suggests a total of about 20 MWa on tribal lands. These are summarized by location in Table 8.

Table 8. Potential Sites for Hydro Development on Penobscot Lands

Location	No. of Sites x Est. Mean Power
Alder Stream	7 x 0.0 – 0.5 MWa 2 x 0.5 – 1.0 MWa 1 x 1.5 – 2.0 MWa
Alton	4 x 0.0 – 0.5 MWa
Argyle	6 x 0.0 – 0.5 MWa
Carrabassett Valley	6 x 0.0 – 0.5 MWa 3 x 0.5 – 1.0 MWa 1 x 1.5 – 2.0 MWa
Lakeville	5 x 0.0 – 0.5 MWa
Matagamon	none
Mattamiscontis	9 x 0.0 – 0.5 MWa
T1R6	5 x 0.0 – 0.5 MWa
T2R8	5 x 0.0 – 0.5 MWa 1 x 0.5 – 1.0 MWa
T3R1	1 x 0.0 – 0.5 MWa
Williamsburg	2 x 0.0 – 0.5 MWa

This modeling and mapping suggest more hydropower potential than was estimated for the comprehensive plan 20 years ago. In addition, there are relatively new technologies for application in small mountain streams, and energy prices and electric industry structure have changed significantly in the last 20 years. Before deciding whether to proceed with development at any of these

[7] An average MW is a megawatt of capacity that operates continuously, or has a capacity factor of 100%, although in reality each generating unit has different capacity factors.

sites, however, further engineering, economic and environmental analysis would be required.

We recommend that the Nation secure a grant to study these potential hydroelectric sites in more detail. With this grant, the Nation would hire a hydropower consultant to review the most recent data, review the most recent hydroelectric technology for in-stream power generation, conduct some preliminary economic and technical feasibility analysis, and recommend priority sites for development.

Penobscot River Restoration Project

Although it is not a new hydro development opportunity, we would be remiss if we did not mention the Penobscot River Restoration Project. The Project is a roadmap for the river basin that will:[8]

- Restore self sustaining populations of native sea-run fish, such as the endangered Atlantic salmon, through improved access to over 500 miles of historic habitat;
- Renew opportunities for the Penobscot Indian Nation to exercise sustenance fishing rights;
- Create new opportunities for tourism, business and communities;
- Resolve longstanding disputes and avoid future uncertainties over the regulation of the river.

Partners in the Penobscot River Restoration Project have negotiated an agreement that will redefine the Penobscot River over the coming years by allowing:

- The Penobscot River Restoration Trust, a non-profit entity formed in May, 2005, the option to purchase three dams from PPL Corporation, removing two of them (Veazie and Great Works) and decommissioning a third (Howland) while improving fish passage;
- PPL Corporation the opportunity to increase generation at six existing dams, which would result in more than 90% of the current energy generation being maintained;
- PPL Corporation to improve fish passage at four additional dams.

Partners in the agreement, which must be approved by the Federal Energy Regulatory Commission (FERC), include the dam owners, PPL Corporation, the Penobscot Indian Nation, American Rivers, Atlantic Salmon Federation, Maine Audubon, Natural Resources Council of Maine, Trout Unlimited, the U.S. Department of Interior's Bureau of Fish and Wildlife, Bureau of Indian Affairs, and the National Park Service, and four State of Maine natural resource agencies –

[8] Information on the Penobscot River Restoration Project is taken from http://www.penobscotriver.org.

the State Planning Office, the Department of Natural Resources, the Department of Inland Fisheries and Wildlife, and the Atlantic Salmon Commission.

Implementation of this unprecedented project – reconfiguration of the hydropower projects on the Penobscot River – will take time.

- One of the first things to occur is that PPL Corporation will apply to FERC and the Maine Department of Environmental Protection for energy increases at West Enfield, Orono and Stillwater.
- PPL Corporation will also begin to address impacts of energy operations on tribal lands.
- Following the signing of the final agreement on June 25th, 2005, the Penobscot River Restoration Trust -- a Maine 501(c)(3) not-for-profit corporation created by the conservation groups and the Penobscot Indian Nation -- has a 3-5 year option period during which time the dams must be purchased. The Trust will work with other interested parties to raise, from state, federal, and private funds, the $25 million needed to purchase the Veazie, Great Works and Howland Dams and also to raise the subsequent funding to implement the removals, alterations, mitigation and economic development elements of the project.
- With FERC's approval, the relicensing of the Howland and Great Works dams will be put on hold for five years to provide the opportunity for successful implementation of the project.
- Preliminary engineering work for removal of the Veazie and Great Works Dams and for the Howland bypass option is underway.
- The filing of the agreement with FERC also signifies the beginning of the federal and state regulatory process for the project, during which the public will have multiple opportunities to comment.

The three dams that will be purchased as part of the option agreement will not be altered or removed until sometime between 2006-2010.

2. Biomass Resource Potential

The Penobscot Nation has land resources of almost 120,000 acres, almost all heavily forested. The Nation manages this timberland under a long term sustainable management plan, developed through an extensive process that included broad tribal member input and support. The primary goals of this plan are sustainable timber harvesting and cultural and wildlife enhancement and preservation. Forest growth on the Nation's lands has a much higher value for pulp logs, and to a lesser extent for saw logs. Forest growth for biomass energy production is of much lower value. Thus, production for the primary purpose of biomass fuel is not, and will not be, a part of the Nation's forestry future. Management for the higher uses identified does produce some wood waste that could potentially serve as biomass fuel stock, but this byproduct by itself would not provide the foundation for an economically viable biomass electricity generation station.

Thus, any examination of biomass as an energy resource properly belongs in the realm of tribal economic and employment development strategies[9] that involve fuel stocks generated primarily from non-native land sources, a discussion that is beyond the scope of this Plan.

It is worthy of note, however, that new markets for renewable energy in southern New England, a federal production tax credit, and advances in conversion technologies have revived interest in this method of electricity production, and all of Maine's existing biomass plants are currently running at full capacity.

As part of its ongoing forestry management practice, the Nation should monitor the market for biomass fuels and consider selling wood waste from its logging operations should market opportunities arise.

3. Wind Energy Potential

Potential wind development sites are still being explored, although one site in particular is now the subject of development work. For the Strategic Energy Plan, wind development potential was assessed using data received from the National Renewable Energy Laboratory (NREL) in Golden, Colorado. This data was developed by TrueWind Solutions with their "Mesomap" system using historical weather data.[10]

The wind maps of tribal lands are included in Appendix B. These maps do not estimate power generation potential, but they do indicate, by color, the most promising wind sites for more detailed analysis. Clearly, and not surprisingly, the most promising wind energy potential areas are in the western Maine mountains – specifically in Alder Stream Township (trust land) and Carrabassett Valley (fee land).

The Alder Stream Township Wind Project

One potential wind power stands out from among the sites identified above by virtue of: (1) the scale of its potential; (2) the level of detailed analysis conducted at the site; and (3) the immediacy of a potential commercial development possibility.

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[9] A 2002 New Hampshire study found that a biomass station employs about 20 people at the plant and supports another 50 in the woods.

[10] Based on modeling assumptions, the TrueWind analysis produces estimated annual average wind resource potential for the State of Maine at a 50 meter height. The national level analysis was commissioned by the Massachusetts Technology Collaborative, in conjunction with the Connecticut Clean Energy Fund and Northeast Utilities, and the were validated by NREL. However, the data is not suitable for micro-siting potential development projects. The maps of Penobscot lands shapefile was generated from a raster dataset with a 200 m resolution, in a UTM zone 19 datum WGS 84 projection system.

The Alder Stream wind site is located in northern Franklin County, Maine, about fifteen miles from the Canadian border within a 35 square mile township held in Trust for the Nation by the federal government. The township is currently managed by the Nation for commercial forestry and recreation.

From September, 2003 to August, 2005 the Nation had an agreement with a wind developer to develop a wind project on the site. During that two-year period, the developer maintained a 40-meter meteorological tower installed at an elevation of 2879 feet. The data collected and recorded from that tower shows average sustained wind speed in excess of 18 mph.

In August 2005, this original developer made a corporate decision to consolidate its resources and focus it efforts on developing other projects, and allowed its agreement with the Nation to lapse. The Nation then issued an RFP for a wind development partner and, as this is written, is finalizing an agreement with the selected developer.

The original capacity estimate was that 100-200 MW of wind power generation could be installed on this site. A more recent estimate from the second developer is that perhaps 30 MW can be economically installed. Sites for Individual turbines, though very windy, might be too costly to develop in the rugged terrain, leading to a lower estimate of potential. Additional data collection and environmental studies are now being undertaken.

Our recommendation is that the Tribe continue its focus on the development at Alder Stream Township, ensuring that appropriate environmental and technical studies are completed in preparation for a permitting process.

4. Geothermal Energy Potential

Electricity from geothermal resources deep below the earth's surface requires very hot water or steam, but these resources exist primarily in the western United States. Maine has low to moderate temperature resources that are less suited to electricity generation but that can be tapped for direct heat or for geothermal heat pumps.[11]

[11] According to the Geothermal Energy Association, recent advances in geothermal technology have made possible the economic production of electricity from lower temperature geothermal resources, at 100o C (212o F) to 150o C (302 o F). In what are known as "binary plants," the geothermal water heats another liquid, such as isobutane, that boils at a lower temperature than water. The two liquids are kept completely separate through the use of a heat exchanger used to transfer the heat energy from the geothermal water to the "working-fluid." The secondary fluid vaporizes into gaseous vapor and (like steam) the force of the expanding vapor turns the turbines that power the generators. While Maine has temperatures estimated at 150-200 degrees C, accessing these temperatures would require drilling to a depth of 6 kilometers

The most likely geothermal application for the Tribe is the geothermal heat pump, also known as the ground source heat pump. It can be a very efficient means to provide heating and cooling to some facilities. Geothermal heat pumps are similar to ordinary heat pumps, but use the ground instead of outside air to provide heating, air conditioning and, in most cases, hot water. Their renewable advantage is that they work by concentrating naturally existing heat, rather than by producing heat through combustion of fossil fuels.

The technology relies on the fact that the earth (beneath the surface) remains at a relatively constant temperature throughout the year, warmer than the air above it during the winter and cooler in the summer, very much like a cave. The geothermal heat pump takes advantage of this by transferring heat stored in the earth or in ground water into a building during the winter, and transferring it out of the building and back into the ground during the summer. The ground, in other words, acts as a heat source in winter and a heat sink in summer.

In fact, a recent audit of tribal facilities on Indian Island recommended that the Tribe look into geothermal heat pumps for potentially three facilities—the Nick Sapiel Jr. Building, the Olamon Industries building, and the sewage treatment plant.[12] The audit report noted, however, that all three facilities should first take an aggressive approach to energy efficiency and reduce energy consumption as much as practical.

5. Solar Energy Potential

Solar energy is generally expensive compared to power purchased from the utility grid, but it may be very cost-effective for off-grid applications as an alternative to the expense of bringing a distribution line to a site. With on-grid applications, solar projects can serve an educational function if undertaken at a highly visible site such as a school or other community building. A number of communities across the United States that have installed solar photovoltaic systems on their schools have incorporated solar energy into the school curriculum.

Commonly known as *solar cells*, individual photovoltaic (PV) cells are electricity-producing devices made of semiconductor materials. PV cells come in many sizes and shapes — from smaller than a postage stamp to several inches across. For building applications, they are connected together to form larger PV *modules* that may be up to several feet long and a few feet wide. Modules, in turn, can be combined and connected to form PV *arrays* of different sizes and power output.

The size of an array depends on several factors, such as the amount of sunlight available in a particular location and the power needs of the user. The modules of the array make up the major part of a PV *system*, which can also include

[12] Alan R. Mulak, Commercial Facility Energy Audits, Penobscot Indian Nation, Indian Island, Maine, June 8, 2006.

electrical connections, mounting hardware, power-conditioning equipment, and batteries that store solar energy for use when the sun is not shining.

PV systems can go on a rooftop or be mounted on a column, and sometimes (especially with new buildings) may be integrated into building materials such as glass, roofing shingles or flat-roof insulation.

Maine has a moderate solar potential as shown by the two maps in Appendix C.

We recommend that the Nation consider solar energy whenever it undertakes construction of a new facility, whether on-grid or off-grid. If the Nation is planning to erect a permanent structure that is remote from existing power lines, it should consider solar for an energy source.

INSTITUTIONAL CAPACITY

Energy Project Manager

The Nation currently employees a part-time (18-34 hours per week) Energy Project Manager, funded out of federal grant funds from the US Department of Energy. Given the opportunities and challenges facing the Tribe, as outlined in this Plan, this position should be continued at least at the current level in the near term.

Energy Committee

To ensure that this Plan has the broadest possible support within the Penobscot Nation, and that the Action Plan is implemented with appropriate direction and policy oversight, the Energy Committee should be continued with its current mission and structure. The Committee has been charged by the Chief and Council with the responsibility of developing all internal tribal energy policy and management capabilities, as well as with the selection and oversight of any contractors or experts engaged to assist in the development of tribal energy policy and regulations. The Energy Committee consists of the Nation's Directors of Economic Development, the Department of Natural Resources, and the Department of Trust Resources, as well as the Nation's Administrative Officer and one member of the Tribal Council. The Nation's Energy Project Director chairs the committee.

Regulatory Capacity

The Nation should also develop a regulatory and technical capability, through creation of an oversight entity, to monitor the development of energy projects and to oversee ongoing power generation at developed sites. This includes developing the internal capability – both administrative and technical – to conduct environmental assessments and set forth developmental conditions based on their results. It also includes organizational development, staff selection, and staff development and staff training components. Implicit in this task is a determination of the legal relationship between the authority of the State of Maine and the authority of the Penobscot Indian Nation with regard to regulation of energy and environmental projects on Penobscot Tribal, Trust and Fee lands. The pendancy of the Alder Stream Project, discussed above, gives a particular urgency and priority to completion of these tasks.

Tribal Electric Distribution Utility

Currently, dollars spent to heat and light tribal facilities, and the homes of tribal members, are expenditures that create no economic value for the Nation. Utility bill payments flow out of the community. These are diverted funds that would otherwise be retained within the Tribe where they would be applied to activities that create either internal economic activity or goods and services for export to off-reservation buyers. Indigenously produced energy should also be used, either directly or indirectly, to help offset current high energy costs and support tribal economic development, and the Nation's regulatory framework should facilitate this. For these reasons, the Nation should research the legal, institutional, and economic viability of establishing a tribally-owned electric distribution utility.

ENERGY ACTION PLAN

As a result of its analysis of the above data and plan recommendations, the Penobscot Energy Committee recommends the following actions for immediate attention.

Recommended energy efficiency actions include:

1. Complete a thorough energy audit of all energy use at all tribal facilities and developing a prioritized list of energy efficiency measures.[13]
2. Develop a prioritized plan to act on the recommendations contained within the audit. Recommended energy efficiency measures could save the Tribe over $64,000 per year and provide a two-year payback.
3. Consider setting aside cost savings (estimated at $54,000 in the coming year) on fuel oil from Venezuela (or the economic development rebate fund) to pay for energy efficiency capital improvements.
4. Apply for grants and rebates from the USDA (60%) and Efficiency Maine (35%) to pay for a majority of capital costs.
5. Incorporate energy efficiency requirements into the design requirements for any new or renovated tribal facilities.
6. Incorporate energy efficiency requirements into procurement policies for any energy consuming devices purchased by the Nation, including office equipment, vehicles, etc.

Recommended energy generation actions include:

1. Continue to focus on the wind project development at Alder Stream Township to ensure that appropriate environmental and technical studies are completed in preparation for a permitting process, and to identify and pursue capital financing opportunities.
2. Seek grant funding to study potential small hydroelectric sites in more detail. With this grant, the Nation should hire a hydropower consultant to review the most recent data, review the most recent hydroelectric technology for in-stream power generation, conduct preliminary economic and technical feasibility analyses, and recommend priority sites for development.
3. Evaluate geothermal heat pumps for three facilities—the Nick Sapiel Jr. Building, Olamon Industries, and the sewage treatment plant. First, however, energy efficiency should be pursued aggressively in all three facilities to reduce energy use as much as practical.

[13] This action item was completed in March and April, 2006. See Alan R. Mulak, Commercial Facility Energy Audits, Penobscot Indian Nation, Indian Island, Maine, June 8, 2006.

4. Monitor the market for biomass fuels and consider selling wood waste from its logging operations should market opportunities arise.
5. Consider solar energy whenever construction of a new facility is undertaken. If the Nation is planning to erect a permanent structure that is remote from existing power lines, it should consider solar for an energy source.

Recommended institutional and administrative actions include:

1. Assign staff who will be responsible for coordinating and implementing energy planning efforts.
2. Continue to support the policy-level Energy Committee as the responsible body for energy program oversight and implementation, under the overall direction of the Tribal Council.
3. Develop a regulatory framework, and the administrative capacity to implement it, that will allow for orderly, balanced, environmentally sound, and economically sustainable development of renewable energy resources on tribal lands.
4. Produce a coherent and organized set of regulations, which, properly administered, will balance the above objectives.
5. Secure and develop staff for the new regulatory entity.
6. Establish a funding mechanism to sustain the entity independent of federal funding.
7. Investigate the economic and legal issues involved in establishing a tribal electric distribution utility.
8. Explore opportunities to participate in programs that lower costs by aggregating many customers into bulk fuel purchasing cooperatives, such as Maine Power Options.
9. Consider adding a green power purchasing component to the Tribe’s current electric power purchases.

APPENDIX A: HYDROELECTRIC POTENTIAL MAPS

Alder Stream hydro

Alder Stream hydro contours

Alton hydro

Argyle hydro contours

Carrabassett Valley hydro

Carrabassett Valley hydro contours

Lakeville hydro

Lakeville hydro contours

Matagamon hydro

Matagamon hydro contours

Mattamiscontis hydro

Mattamiscontis hydro contours

T1R6 hydro

T1R6 hydro contours

T2R8 hydro

T2R8 hydro contours

T3R1 hydro

T3R1 hydro contours

Williamsburg hydro

Williamsburg hydro contours

APPENDIX B: WIND POWER POTENTIAL MAPS

Wind Potential GIS maps were created using ESRI Arcmap version 8.1. Tribal lands data layers were obtained from Binke Wang. These layers include: streams, rivers, ponds, roads, contours, and Tribal land boundaries. Wind Potential data layer was obtained from US Department of Energy, National Renewable Energy Laboratory (http://www.nrel.gov/gis/).

Alder Stream

Alder Stream, Round Mountain (this is a close-up of the joint PIN/TC site)

Alton

Argyle

Carrabassett Valley

Carrabassett Valley - Poplar Mtn (close-up)

Carrabassett Valley - Sugarloaf Mt. (another close-up)

Lakeville

Matagamon

Mattamiscontis

T1R6

T2R8

T3R1

Williamsburg

APPENDIX C: SOLAR ENERGY POTENTIAL MAPS

Maine direct normal solar potential

Maine PV solar potential