Eastern Band of Cherokee Indians

Strategic Energy Plan

January 2009

Final Report

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Table of Contents

List of Figures

List of Tables

Executive Summary

Project Overview

The Eastern Band of Cherokee Indians was awarded a grant under the U.S. Department of Energy Tribal Energy Program (TEP) to develop a Tribal Strategic Energy Plan (SEP). The grant, awarded under the "First Steps" phase of the TEP, supported the development of a SEP that integrates with the Tribe's plans for economic development, preservation of natural resources and the environment, and perpetuation of Tribal heritage and culture.

Project Goals

Resolution 636 (2007) passed by the Tribal Council, established the following energy goals for the Tribe:

- To protect, preserve and ensure the wise utilization of the limited natural resources located on Tribal Lands for the Cherokee people in the most efficient manner and in an effective way that the natural beauty of Tribal lands and natural resources, which are the basis of its cultural and economic well-being, are preserved and protected;
- To identify opportunities for economic and community development for the Tribe that promote sustainable development; and
- To identify energy cost savings opportunities for the Tribe.

Activities Performed

The Tribe formed an Energy Committee consisting of members from various departments within the Tribal government. This committee, together with its consultant, the South Carolina Institute for Energy Studies, performed the following activities:

- Develop the Tribe's energy goals and objectives
- Establish the Tribe's current energy usage
- Identify available renewable energy and energy efficiency options
- Assess the available options versus the goals and objectives
- Create an action plan for the selected options

Conclusions and Recommendations

Tribal energy projects can play a significant role in helping the EBCI meet its objectives to create new job opportunities for its members; attract new, high-tech businesses; preserve and enhance the natural environment; support the existing tourist and gaming industries; and protect the Tribe from the threat of energy price increases and supply shortages.

Eleven renewable energy opportunities, as well as numerous energy efficiency alternatives, were developed and assessed. From those candidates, the following renewable energy and energy efficiency options are recommended for action by the Tribe:

- Renewable Energy Recommendations
    - Wind Power
    - Municipal Wastewater-to-Electricity
    - Biodiesel Production from Waste Oil and Grease

- Energy Efficiency Recommendations
    - Increase use of energy efficient lighting for buildings and street lights
    - Implement a weatherization program for low income tribal members
    - Perform energy audits of EBCI government buildings
    - Implement an energy efficiency building code for residential, commercial, and government buildings
    - Implement a fuel efficiency requirement for all future government vehicle purchases
    - Provide “green driver education” to all EBCI staff that use government vehicles

Specific action plans for each recommendation are included in the body of this document.

Introduction

In October 2007, the Eastern Band of Cherokee Indians (EBCI) was awarded a grant under the U.S. Department of Energy's (DOE) Tribal Energy Program (TEP) to develop a comprehensive Tribal Strategic Energy Plan (SEP) for renewable energy and energy efficiency options on Tribal lands. The grant, awarded under the "First Steps" phase of the program, supported the development of a SEP that integrates with the Tribe's plans for economic development, preservation of natural resources and the environment, and perpetuation of Tribal heritage and culture.

The Tribe established an Energy Committee, comprised of representatives from various departments within the Tribal Government to develop the SEP. This committee, together with its consultant, the South Carolina Institute for Energy Studies (SCIES), undertook a five step process to:

1. Develop the Tribe's energy goals and objectives
2. Establish the tribe's current energy usage
3. Identify available renewable energy and energy efficiency options
4. Assess the available options versus the goals and objectives
5. Develop an action plan for the selected options

The results of each step are described in the following sections.

EBCI Energy Goals and Objectives

Energy Goals

Resolution 636 (2007) passed by the Tribal Council, established the following energy goals for the Tribe:

- To protect, preserve and ensure the wise utilization of the limited natural resources located on Tribal Lands for the Cherokee people in the most efficient manner and in an effective way that the natural beauty of Tribal lands and natural resources, which are the basis of its cultural and economic well-being, are preserved and protected;
- To identify opportunities for economic and community development for the Tribe that promote sustainable development; and
- To identify energy cost savings opportunities for the Tribe.

Energy Objectives

The objectives of this first steps effort were to:

- Establish the Tribe's current energy usage
- Identify renewable energy and energy efficiency alternatives available on Tribal lands;
- Assess the benefits and costs of each alternative; and
- Create a strategic plan for the development and implementation of the selected alternatives.

Current Energy Usage

The first step in the creation of the SEP was to determine where and how the Tribe currently uses energy. Overall Tribal energy use can be divided into three categories:

- Residential use of individual members
- Commercial business use (both Tribal member and Tribal government owned)
- Tribal government buildings and operations use

Current energy usage in each of these categories is presented below.

Residential Energy Use

No data sources currently exist for individual Tribal member energy use. Therefore, data from the Energy Information Administration (EIA) for residential energy end use in the East South Central region for 2005 was used as the basis for estimating average Tribal household energy consumption, shown in Figure 1. The dollar values shown are for an average 2000 square foot home and an energy cost of $0.10 per kilowatt hour. The total cost is approximately $2,600 per year. That represents a substantial portion of the household income of Tribal members. Data from the EBCI's Comprehensive Economic Development Strategy in Figure 2 shows that the median household income of Tribal members in 2000 was approximately $30,000 with almost 20% of all tribal households earning less than $10,000 per year. Therefore, energy costs represent a significant portion of many Tribal members' net income.

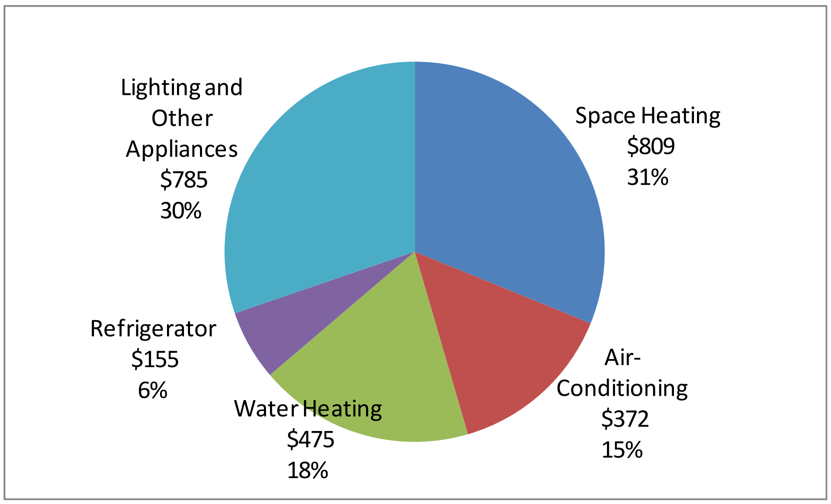


Figure 1 – Residential Energy End Use and Annual Cost in the US East South Central Region for 2005

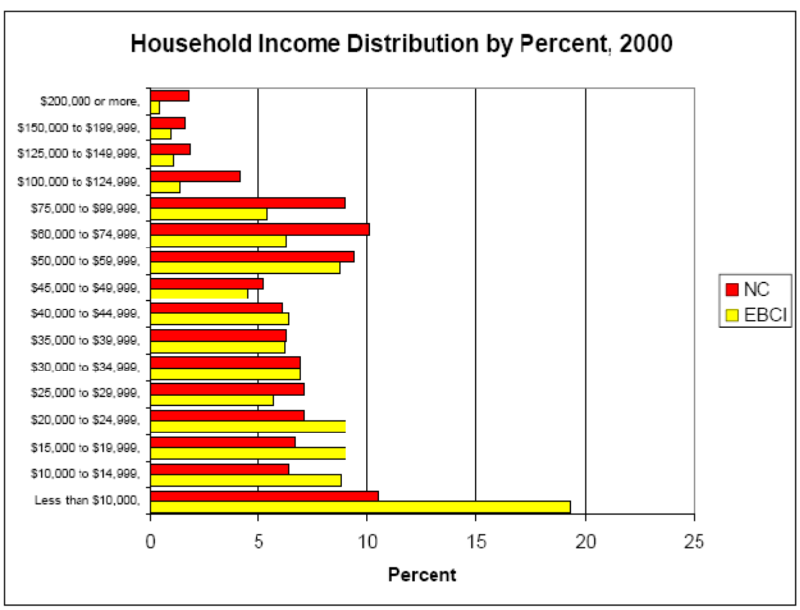


Figure 2 – Household Income Data for the EBCI and North Carolina

Commercial Business Energy Use

The commercial sector of the EBCI consists primarily of businesses that support the tourist industry. This includes small shops, eating establishments, motels, gas stations, and related service and retail businesses. In addition, the EBCI owns Harrah's Cherokee Casino, which includes a 550 room luxury hotel and conference center. The casino, which is the largest employer on Tribal lands, is operated under a management agreement with Harrah's Entertainment. Therefore, the casino was not included as part of the energy analysis, although other studies have shown that casinos tend to be large consumers of electricity.

As with the residential sector, no data exists for the energy consumption of Tribal businesses. Therefore, EIA data for commercial building energy end use for 2003 was used to estimate energy usage and cost. The EIA data shows a wide variation in energy use by business type. The data in Figure 3 is for a nominal 2000 square foot retail establishment and an energy cost of $0.10 per kilowatt hour. The total cost is approximately $4,300 per year.

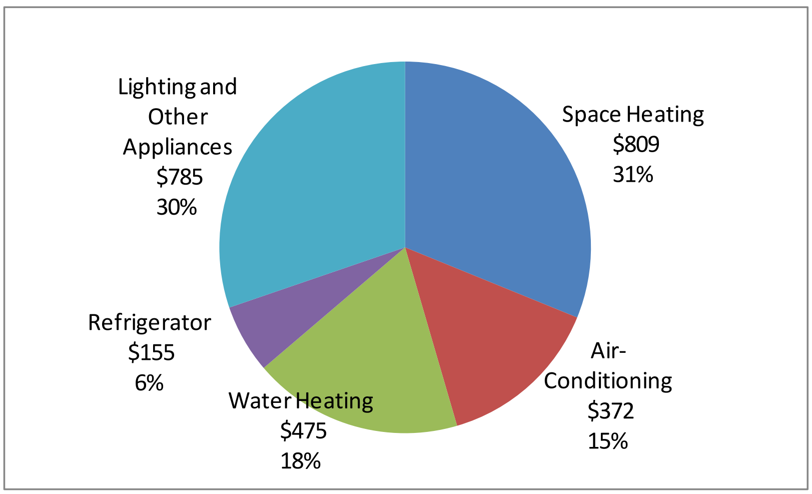


Figure 3 – Retail Space Energy End Use and Annual Cost for 2003

Tribal Government Buildings and Operations

Substantial data was available for electricity and fuel usage by the Tribal government. Electricity consumption data for 2007 was available by Tribal division and program. The total cost of electricity consumed by the Tribal government in 2007 was slightly more than $1,000,000. The top 10 electricity consuming Tribal government programs, listed in Table 1, accounted for approximately 75% of that total, as shown in Figure 4.

Area Code	Fund	Division	Program
TUWAT	Water & Sewer	Tribal Utilities	Water Treatment
SENCT	Senior Citizen	Social Services	Public Assistance
TUWAS	Water & Sewer	Tribal Utilities	Sewer
CLRW	Qualla Recreation	Economic Development	Civic Center
ROSID	Roads	Roads	Street Lights
TCPOP	Tsali Care	Health & Medicine	Tsali Care
SPECP	Special Projects	Economic Development	Building Construction
DRC	Wraparound	Social Services	Tribal
HOUSE	Housing	Housing	Housing
TRAVL	Travel & Promotions	Economic Development	Fairgrounds

Table 1 – Top 10 Electricity Consuming Tribal Government Programs

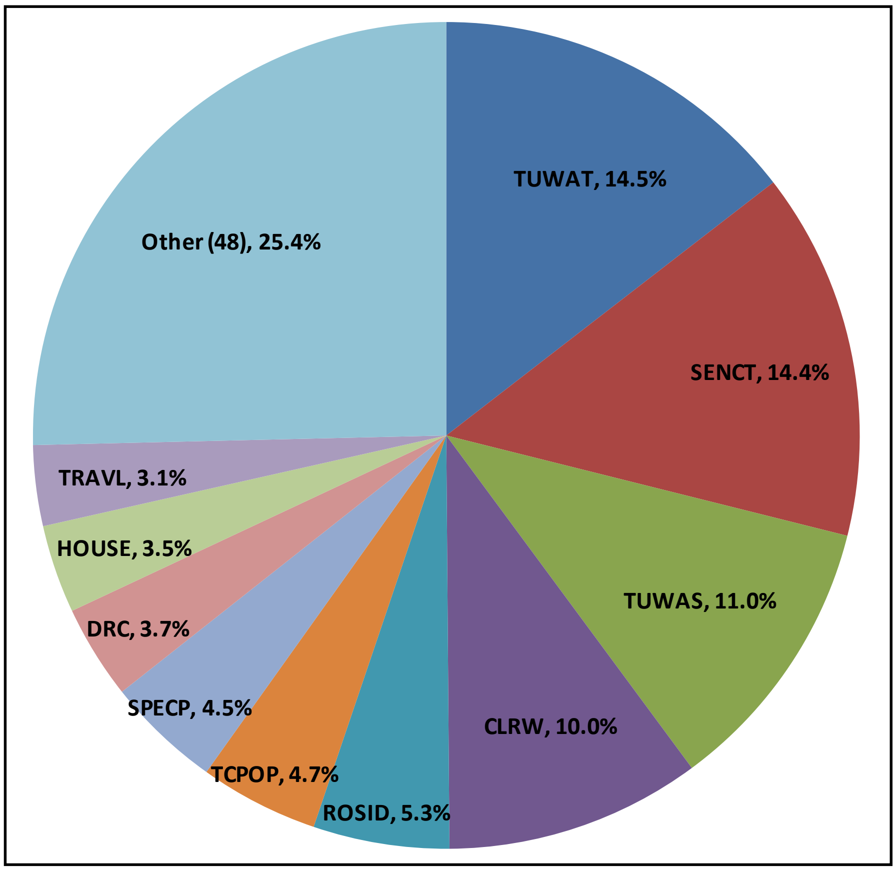


Figure 4 – Electricity Consumption by Tribal Government Program

Fuel consumption data for Tribal government owned vehicles also was available. The Tribe owns 423 vehicles, listed in Table 2. The Tribe operates a single fueling station, and data from that station showed that these vehicles consumed almost 500,000 gallons of fuel in 2007, at an average fuel cost of $2.53 per gallon, resulting in a total expenditure in excess of $1,000,000. Fuel consumption totals are listed in Table 3. This table does not include fuel that may have been purchased at any other fueling stations.

Fleet Inventory (as of June 2008)	
Light Duty Vehicles	
Autos	53
Pickup Trucks	101
SUV's	57
Vans	48
Hybrid Vehicles	1
Heavy Duty Vehicles	
All	55
Off-road	
Construction	69
Other	39
Total	423

Table 2 – Tribal Government Vehicles

Fuel	Gallons	% of Total Fuel
Unleaded	218,036	44.7%
Diesel	213,267	43.7%
Biodiesel	56,348	11.6%
Total	487,651	100%

Table 3 – Tribal Government Vehicle 2007 Fuel Consumption

Renewable Energy Options Selection and Planning

The overall process used to select renewable energy alternatives and develop action plans is shown in Figure 5. Efforts performed during each step of the process are described in the following sections.

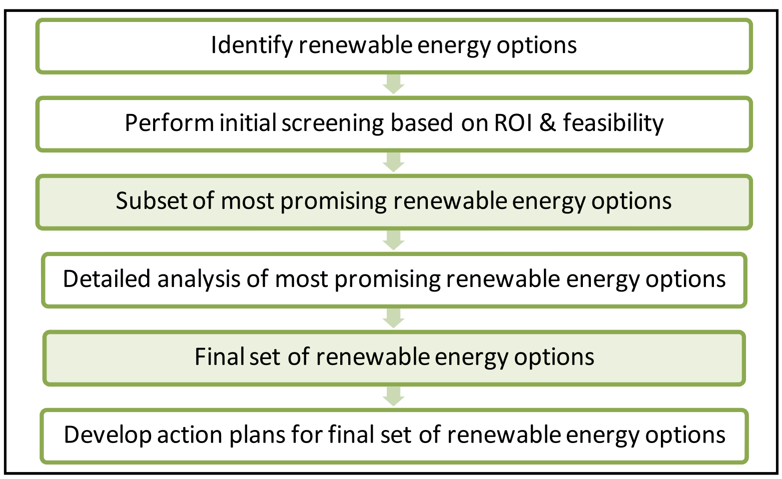


Figure 5 – Renewable Energy Options Selection and Planning Process

Identify Renewable Energy Options

Renewable energy is energy produced from natural resources such as sunlight, wind, water currents, geothermal heat, and biomass which can be naturally replenished. Eleven renewable energy options were initially identified and are listed in Table 4. These options include three different solar energy technologies and five different biomass technologies, as well as hydropower, geothermal power and wind power.

	Option	Potential Applications
1	Solar - Photovoltaics	Generation of electricity, either for individuals homes and commercial buildings, or large scale solar "farms"
2	Solar - Low Temperature Thermal	Used to produce hot water or heat for residences or commercial and government buildings, or to heat swimming pools
3	Solar - High Temperature Thermal	Large scale electricity generation
4	Biomass – Agricultural crops and waste	Used to produce electricity or for conversion to liquid transportation fuels
5	Biomass – Forestry trees and thinnings	Used to produce electricity or for conversion to liquid transportation fuels
6	Biomass – Municipal solid waste	Large scale electricity generation
7	Biomass – Municipal waste water	Large scale electricity generation
8	Biomass – Waste oil and grease	Biodiesel production
9	Hydro	Large scale electricity generation
10	Geothermal	Large scale electricity generation
11	Wind	Large scale electricity generation

Table 4 – Renewable Energy Options Considered

Perform Initial Screening Based on Return on Investment and Feasibility

Five of the eleven options were eliminated based on a cursory return on investment/feasibility screening. These five options, and the rationale for their elimination, are listed in Table 5. While these options were eliminated from further study at this point in time, they should be revisited periodically to determine if the conditions that warranted their elimination have changed, since renewable energy technologies are progressing rapidly.

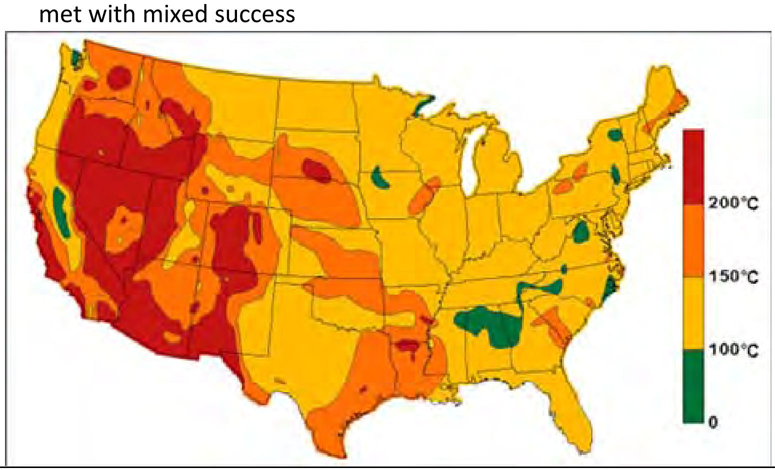
	Option	Rationale for Elimination
1	Solar - Photovoltaics	• The reduced level of solar radiation in this part of the US, combined with the current high cost of photovoltaic equipment prevents positive financial return on investment • The limited availability of open, flat Tribally owned land plus the potential adverse impact on tourism makes large utility scale solar installations impractical or undesirable
2	Solar - High Temperature Thermal	• The reduced level of solar radiation in this part of the US, combined with the current high cost of small scale (<30 MW) facilities prevents positive financial return on investment • Risk due to relative immaturity of this technology • The limited availability of open, flat Tribally owned land plus the potential adverse impact on tourism makes large utility scale solar installations impractical or undesirable
3	Biomass – Agricultural crops and waste	• The rocky, generally mountainous terrain of the Tribal owned land is not conducive to the growth and harvesting of large quantities of energy crops. • No agricultural waste streams of any significant amount exist on Tribally owned lands.
4	Biomass – Forestry trees and thinnings	• Estimates indicate that almost 35,000 acres of thinnings would be required to fuel a 1 MW power plant. The diffuse nature of this resource, together with the mountainous terrain from which it would be harvested, makes a positive economic return unlikely • Estimates indicate that approximately 3,100 acres of trees would be required to operate a 1 MW power plant. Continual annual cuttings of this amount of acreage would significantly impact the natural environment and tourist trade within the 56,000 acre Qualla Boundary
5	Geothermal	• No high temperature geothermal resource is predicted to exist at a reasonable depth in this area (see figure below) • Well drilling, even in more resource rich western areas, has been met with mixed success 

Table 5 – Renewable Energy Options Eliminated During Initial Screening

Detailed Analysis of Most Promising Renewable Energy Options

The remaining six renewable energy options were assessed in greater detail to determine if they met the goals established in the Tribal Council Resolution. Results for each option are presented below.

Wind Power

Wind energy is one of the fastest growing sources of electricity production in the world today. In 2007, 19,696 MW of new wind generation capacity were installed worldwide, bringing the total installed capacity to 93,849 MW, an annual increase of 27%. Based on current trends, the World Wind Energy Association estimates that total global installed capacity will reach 170,000 MW by 2010. The annual growth in installed capacity has exceeded 20% for each of the past 10 years.

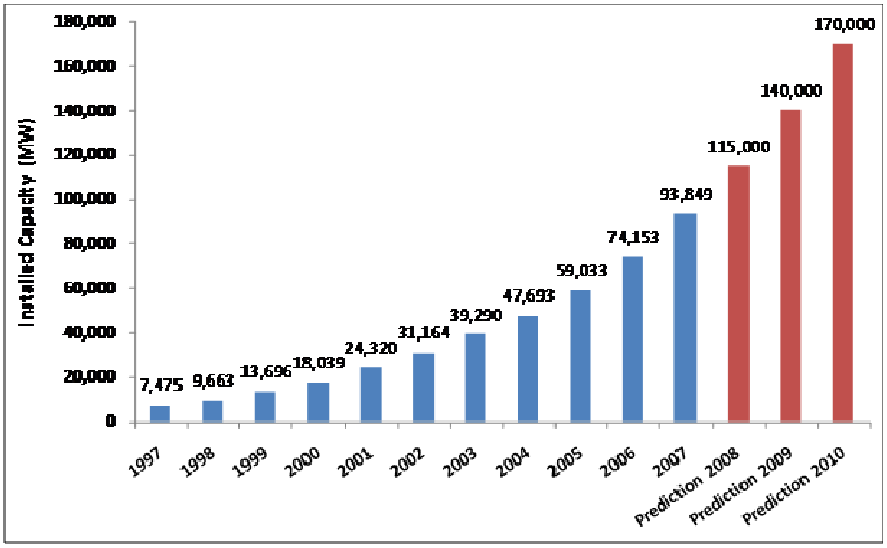


Figure 6 – Growth in Installed Wind Power Worldwide

Interest in wind power in North Carolina has increased recently with the enactment of a state Renewable Portfolio Standard (RPS) that requires North Carolina electric utilities to produce at least 3% of the electricity consumed in North Carolina from renewable energy sources by 2012, increasing to 10% by 2018 for rural electric cooperatives, and to 12.5% by 2021 for investor owned utilities. Land based wind power is a likely candidate for meeting the RPS requirement, because it is one of the most mature renewable technologies in widespread use today and it is one of the few that is cost competitive with conventional forms of electricity generation. However, only the mountain ridges in western North Carolina and ocean areas off the coast have winds speeds high enough to generate electricity at a competitive cost. The mountain ridges are subject to the North Carolina Mountain Ridge Law, which prevents construction of structures more than 40 feet high without state approval. The ridge law has created even greater interest in the ridge lines within the Cherokee reservation, which would not be subject to this law. However the EBCI share the same concerns of protecting the mountain environment that resulted in the ridge law, so a similar approval process by the Tribe for any wind farm should be expected.

A consistent, high wind speed is critical to the viability of a wind farm. Wind resources are typically defined in classes, ranging from 1 to 7. The classes are listed in Table 6, and are based on the amount of energy in the wind. A general rule of thumb, based on the cost and efficiency of modern wind turbines, is that at least Class 4 winds (i.e. an average wind speed of at least 7 m/s) are required for a land based wind farm to be cost competitive with other power sources.

Class	Wind Speed (meters/second)	Wind Power (watts/meter^2)
1	0 – 5.6	0 – 200
2	5.6 – 6.4	200 – 300
3	6.4 – 7.0	300 – 400
4	7.0 – 7.5	400 – 500
5	7.5 – 8.0	500 – 600
6	8.0 – 8.8	600 – 800
7	8.8 – 11.9	800 – 2000

Desired wind speeds

Table 6 – Standard Wind Classes

Based on estimates generated by the National Renewable Energy Laboratory, shown in Figure 7, there are two locations on EBCI lands that are predicted to have Class 4 or higher wind resources. These locations are labeled "Site 1" and "Site 2".

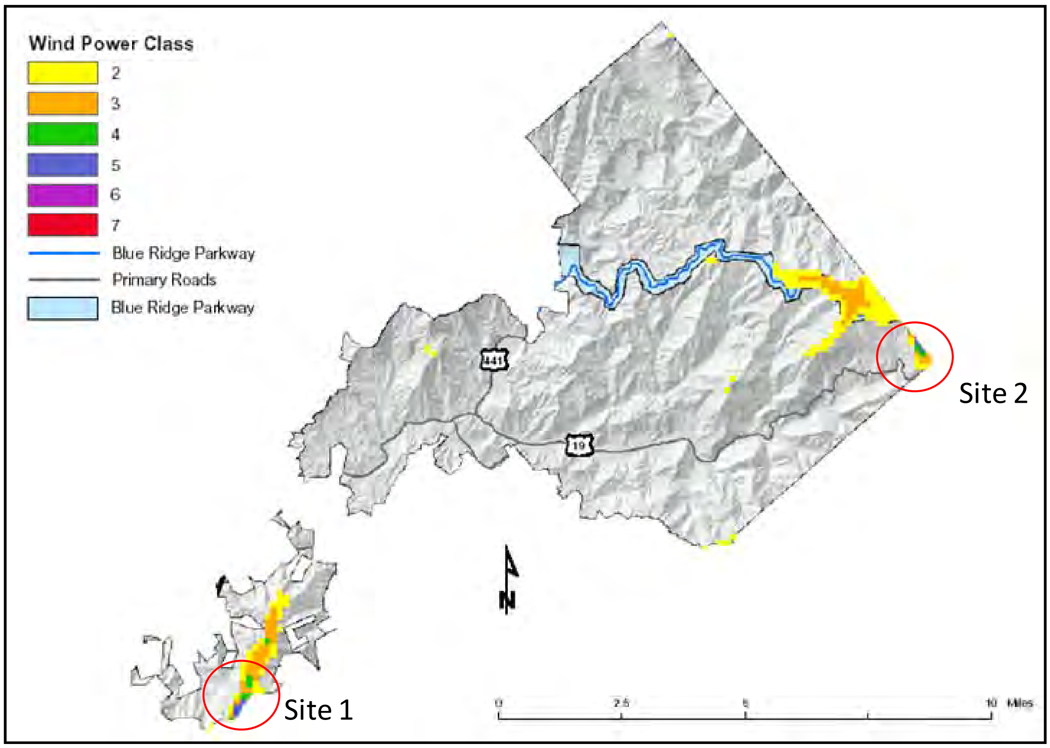


Figure 7 – Wind Speed Estimates for the EBCI Reservation

Both sites are on Tribal Government owned lands, as shown in Figure 8.

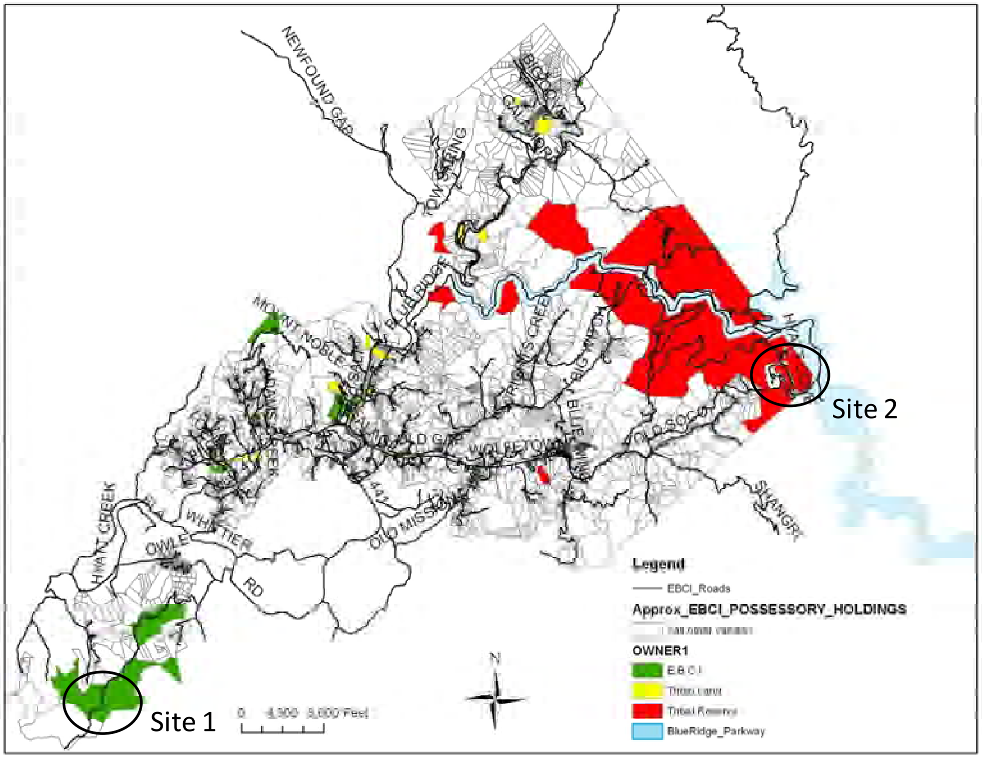


Figure 8 – EBCI Land Holdings

Site 1 is located on the southeast boundary of the 3200 acre track, along the Rattlesnake Mountain ridge line. Site 2 is located in the northeast corner of the Qualla Boundary. Figure 9 shows a topographical map of each site, with a wind energy rose for each location overlaid. In both cases, the wind roses indicate that the prevailing winds approach the ridge line from the reservation side of the ridge, with the winds being channeled by a valley, making the Tribal lands potentially good locations for wind turbines.

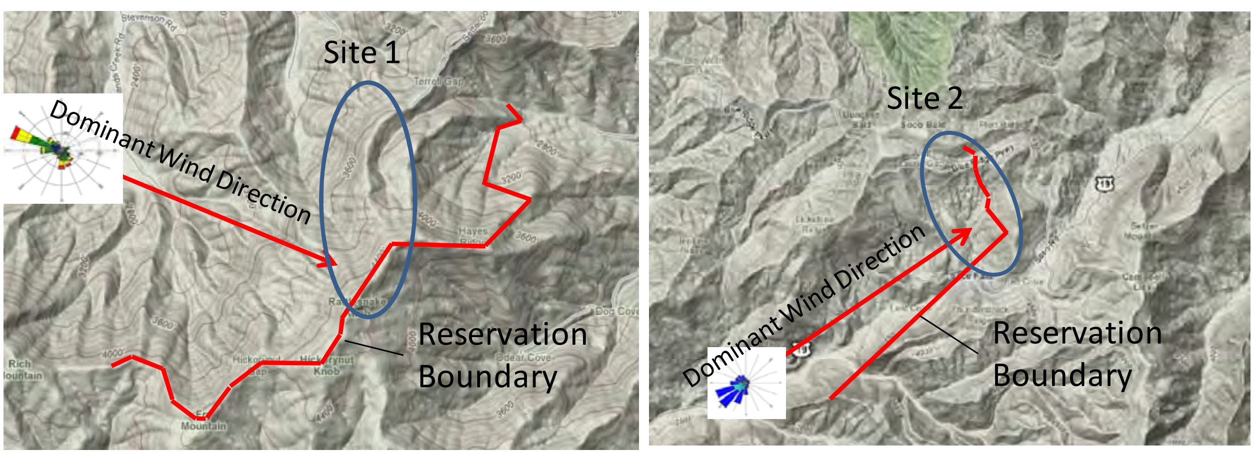


Figure 9 – Topographical Maps and Wind Energy Roses for Wind Sites

Since no wind measurements were available for either site, estimates were generated using WindPro software. This tool is the industry recognized standard for analyzing sites like these, which have complex topography and vegetation. The results for Sites 1 and 2 are shown in Figure 10. The results for Site 1 are promising. Not only are the predicted wind speeds adequate (ranging from 7.5 to 8.5 m/s along the ridge), but the portion of the ridge line owned by the Tribal government is long enough to place several turbines. In addition, this land is away from tourist and populated areas, making viewshed issues less of a concern. Site 2 results were not as promising. Wind speeds from 6.5 to 7.2 m/s were predicted, less than the minimum 7 m/s desired. In addition, turbines at this site would be visible from the Blue Ridge Parkway and nearby homes, and the ridgeline is shorter, meaning fewer turbines could be installed. Together, these facts resulted in Site 2 not being recommended for development. However, the analysis for Site 2 does show a promising alternative site on Lickstone Ridge that should be assessed.

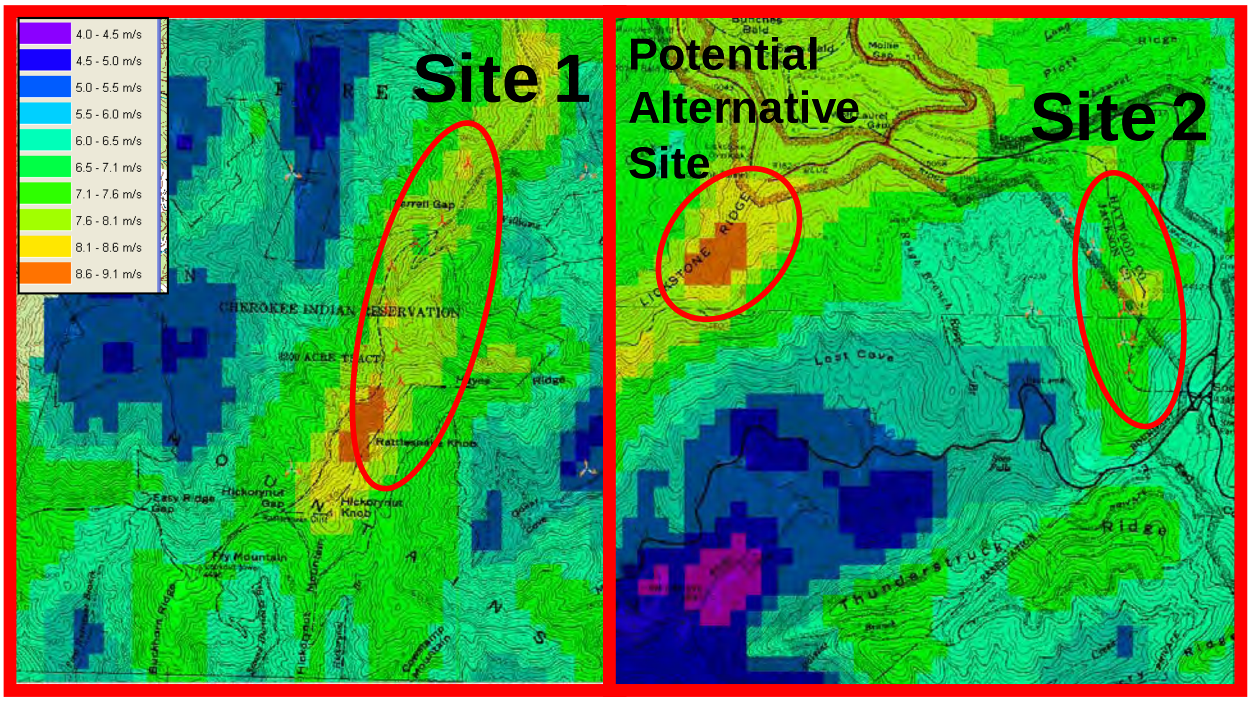


Figure 10 – Wind Resource Maps for Sites 1 and 2

An analysis of eight 1.5 MW turbines placed along the Site 1 ridgeline predicts almost 41,000 MWh of energy production each year. This equates to about $4,100,000 per year in income at a retail rate of $0.10 per KWh or $2,050,000 per year at a $0.05 wholesale rate. Based on a capital cost of $24,000,000 and an assumed operation and maintenance cost of $0.015 per KWh, the simple payback for Site 1 would be about 13.6 years at the wholesale rate and 6.8 years at the retail rate. However, there are several other financial factors that should be considered. A production tax credit of $0.021 per KWh is currently available from the Federal government for the first ten years of operation. This would equate to $861,000 per year. Renewable Energy Credits (RECs) for the carbon offset also can be sold. In addition, “green” power is typically sold at a $0.02-$0.03 per KWh premium, resulting in an additional $820,000 to $1,230,000 in income per year. These factors would substantially reduce the payback period and increase the return on investment.

Given the potential for a reasonable return on investment, plus the opportunities for creating new construction, operation, and maintenance jobs, this option is recommended for further consideration, and an action plan has been prepared.

Hydropower

Hydropower is the largest source of renewable energy in the United States today, as shown in Figure 11. It is also one of the lowest cost energy alternatives, typically competitive with fossil fuels. With the many streams and rivers that flow through the EBCI lands, hydropower would appear to offer significant potential as a renewable energy source.

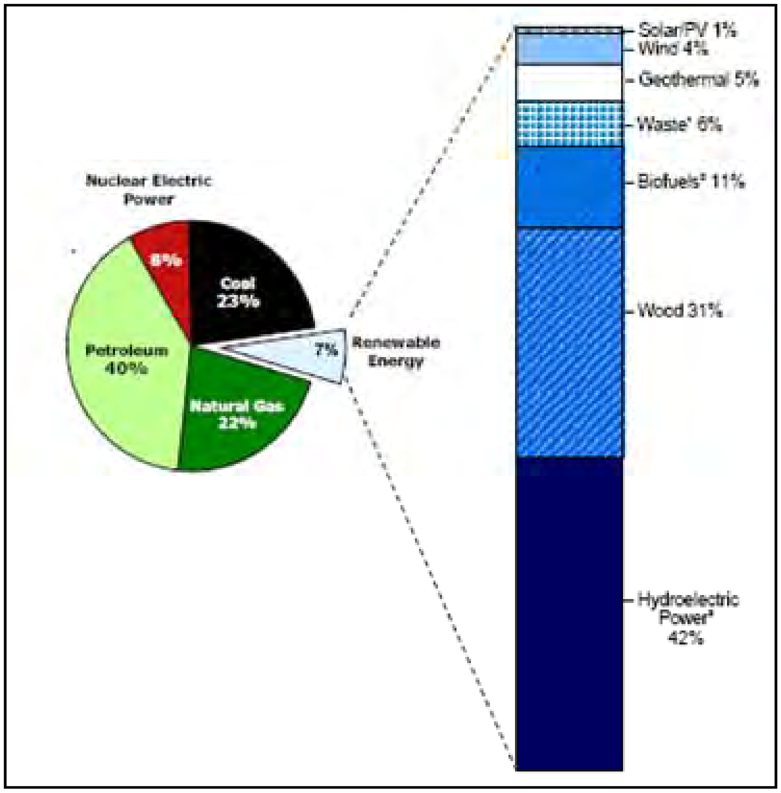


Figure 11 – Sources of Energy Used in the United States

The DOE has conducted extensive studies to identify potential hydropower locations throughout the US, including EBCI lands. This data is available through the Idaho National Laboratory Virtual Hydropower Prospector (VHP) website. Using this GIS database, four potential hydropower sites were identified on Reservation lands. These 4 sites are shown in Figure 12. The estimated power output for these sites ranges from 105 to 609 KW. Characteristics of the sites are listed in Table 7.

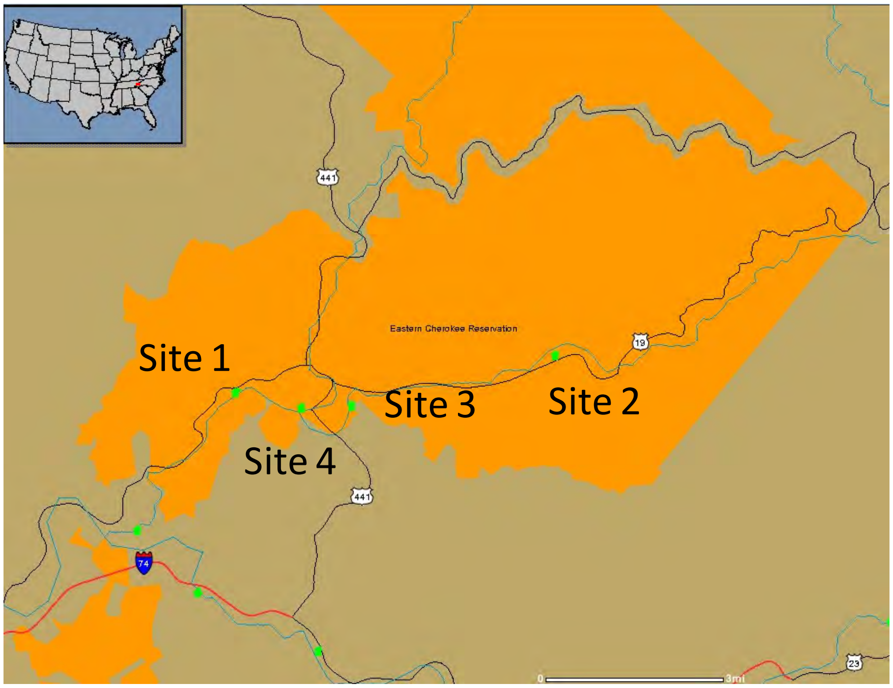


Figure 12 – Potential Hydropower Sites

Site	Power (kW)	Working Flow Rate (cfs)	Working Head (ft)	Reach Grade (%)	Penstock Length (ft)
1	609	236	30.4	0.505	575
2	132	41	38.0	1.386	420
3	126	55	27.1	0.955	378
4	105	60	20.6	0.667	418

Table 7 – Hydropower Site Data

Satellite photos of the sites are shown in Figures 13 and 14.

Figure 13 – Satellite Photos of Potential Hydropower Sites 1 & 2
(Courtesy of Google Maps)

Figure 14 – Satellite Photos of Potential Hydropower Sites 3 & 4
(Courtesy of Google Maps)

The GIS data obtained from the VHP website, listed in Table 7, indicates that these sites have very low slopes, ranging from 0.5 to 1.3%. Therefore, either a very long penstock or some type of impoundment would be required to generate the 20-38 feet of head needed to produce the power levels projected by the DOE. This type of design tends to be very expensive. In addition, a dam or diversion of the stream would adversely impact its recreational uses for swimming and fishing, as well as detract from the natural view. A visit to all four sites confirmed that they are visible from major roads, existing homes, motels, and campgrounds and are routinely used for both swimming and fishing,

An analysis of the largest of the four sites, Site 1, using the RETSCREEN hydropower software, predicts about 2,530 MWh of energy production each year. This equates to about $250,000 per year in income at a retail rate of $0.10 per KWh or $130,000 per year at a $0.05 per KWh wholesale rate. Based on a capital cost of $3,600,000 and an assumed operation and maintenance cost of $38,000 per year, the simple payback for Site 1 would be about 41 years at the wholesale rate and 17 years at the retail rate.

Even with green power premiums and the sale of RECs the return times are long and together with the potential adverse impact on tourism and current uses, plus the limited potential for job creation, resulted in no hydropower sites being recommended for development.

Municipal Solid Waste

Modern methods of converting Municipal Solid Waste (MSW) into energy are both clean and an effective way of minimizing landfill deposits. Currently 89 plants, with a total capacity of 2,700 MW, exist in the US. The overall MSW-to-energy process is shown in Figure 15, along with a photograph of an MSW plant located in Washington state.

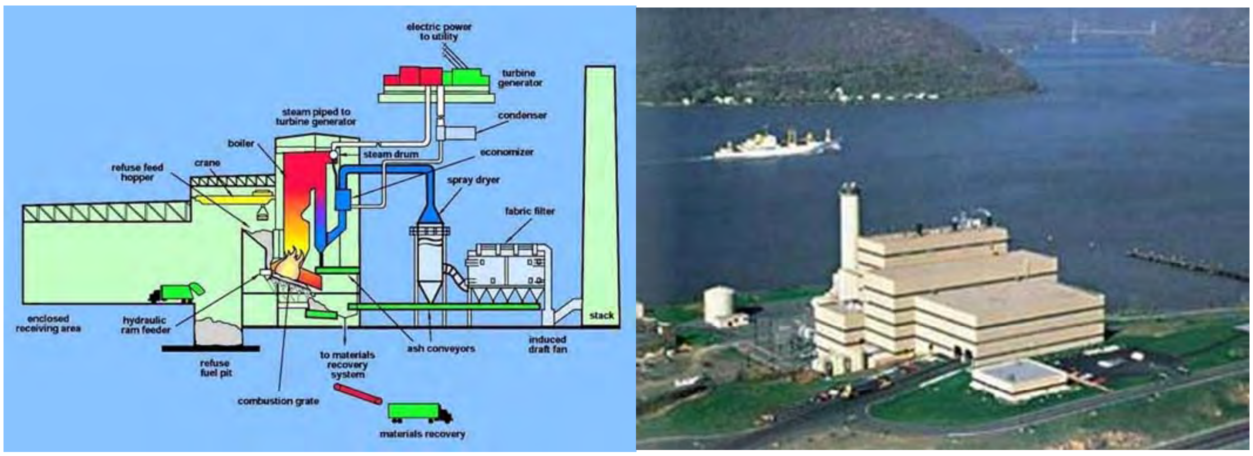


Figure 15 – MSW-to-Energy Process and Plant Photo

A MSW-to-electricity facility is a potentially attractive option for the EBCI, for the following reasons:

- The Tribe currently collects MSW, not only for the Reservation, but also for several surrounding counties, so there is a substantial quantity available and the cost of collection is already covered.
- The Tribe already separates metals and recyclables from the trash collected and has an enclosed receiving and sorting area, reducing the additional cost of a new MSW-to-electricity facility.
- The Tribe incurs substantial costs associated with trucking the MSW collected to a regional landfill in GA, because no local landfills exist. In addition, there are tipping fees at the landfill.

Based upon data provided by the EBCI's MSW department, the Tribe collects about 15,000 tons of MSW each year. This trash is transported in 20 ton loads to a landfill approximately 100 miles away, where a tipping fee of $20.29 per ton is paid. The total annual cost for labor, transportation, and tipping fees is about $775,000 per year. An MSW-to-electricity facility would reduce the amount of waste by approximately 85% to 2,250 tons, which would reduce the total annual cost for waste disposal to about $100,000 – a $675,000 annual savings. In addition, the facility would produce approximately 8100 MWh per year (equal to a plant of about 1 MW), which would provide income of about $405,000 at a $0.05 per KWh wholesale rate or $810,000 at a retail $0.10 per KWh rate. The combined savings plus revenue is equal to between $1,080,000 and $1,480,000 per year.

Based on an estimated facility capital cost of $6,300,000 and an annual operating cost of $840,000, the simple payback period would be about 10 years for the retail electric rate and 26 years at the wholesale rate. These facilities are currently eligible for a Federal production tax credit, which would reduce the payback period for business arrangements that can take advantage of the tax credit.

While these returns appear to be marginal, the costs used in this analysis are based on other facilities, and may not accurately reflect the infrastructure and personnel that the EBCI already have in place. Another factor that should be considered is the potential for job creation, both during construction and operation, as well as the potential benefits to the environment. Given all of these factors, an MSW-to-electricity facility was not selected as one of the highest payoff options, but is recommended for further consideration by the Tribe in the future.

Municipal Wastewater

The production of electricity from municipal wastewater is a proven process that is currently being used in 266 facilities throughout the US. These facilities are among the 3,452 facilities in the US that employ anaerobic digestion to process wastewater. A by-product of anaerobic digestion is methane, which can be used to power an electric generator. Details of the numbers and locations of these plants, as well as the process they employ, are provided in Figure 16.

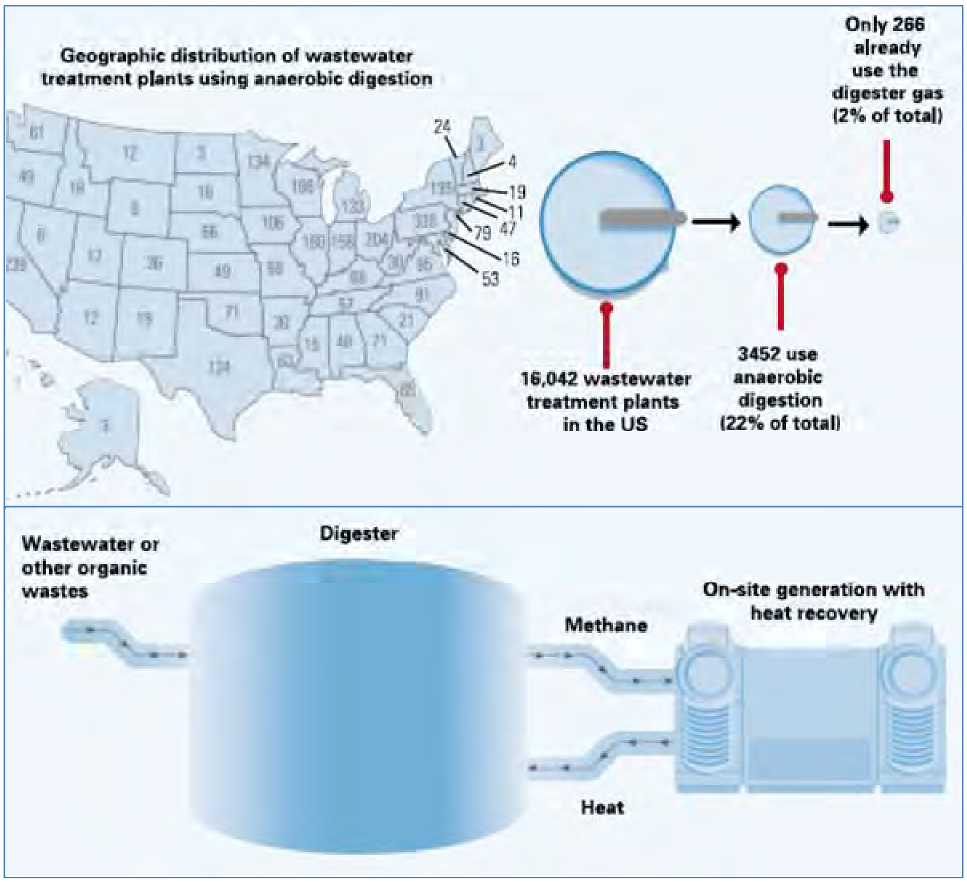


Figure 16 – Anaerobic Digestion Treatment Plant Locations and Process

The EBCI currently operate an aerobic wastewater treatment facility that processes approximately 1.8 million gallons per day (MGD). It is one of the Tribal Government's top three consumers of electricity. Because this is a smaller facility and does not use anaerobic digestion, it is not a good candidate for conversion to a wastewater-to-electricity facility. However, the Tribe is currently planning to construct a 5.5 MGD wastewater treatment facility in the near future. Facilities larger than 4.5 MGD are generally considered to be good candidates for electricity production. A 5.5 MGD facility can produce about 126

KW of electricity, plus 192 KW of heat that can be used for hot water or as process heat in a nearby manufacturing facility.

In calculating the cost of this option, only the additional cost of the generation equipment was included, because the new treatment facility must be built, whether it is used to generate electricity or not. In addition, it was assumed that the electricity would be used to power the facility, so it offsets electricity purchased at a retail rate (assumed to be $0.10 per KWh). The capital cost was estimated to be $500,000 with an additional $0.005 per KWh assumed to cover operation and maintenance. Using these assumptions, the simple payback would be 4.7 years. In addition, this facility should be able to sell RECs, which would provide an additional source of income, as would the sale of the process heat, if possible. In addition, the current Clean Water Act includes a set aside for Indian Tribes that could be used to cover some portion of the costs. Therefore, this option was recommended for further action by the Tribe.

Waste Oil and Grease

Waste oil and grease from restaurants have proven to be a good source for producing biodiesel, and with the large number of food service facilities in the area that support the tourist industry, there is a large, readily available supply. Tribal Government vehicles alone consume 270,000 gallons of diesel fuel per year, and with recent prices at or above $4 per gallon, there is a potential for substantial savings. In addition, the use or sale of biodiesel locally would have a significant positive impact on the generation of smog and sulfur emissions (which result in acid rain), both of which are significant problems in the region due, in part, to the high volume of tourist traffic.

To determine the quantity of waste oil and grease that might be available, a survey of local food service facilities within a 50 mile driving distance of Cherokee was conducted. Research identified 1348 facilities, of which 1121 were of a type that might produce waste oil and grease. A phone survey of approximately 1/3 of these food service establishments in 3 neighboring counties (Swain, Haywood, and Cherokee) was conducted to provide an adequate sample from which the available supply of oil and grease could be estimated. The survey found that approximately 14,500 gallons of waste oil are produced by these facilities each month, of which about 9,700 gallons per month was potentially available for collection and processing into pure biodiesel, called B100. The B100 produced is typically blended with conventional diesel fuel in a ratio of 20% B100 to 80% petroleum diesel, producing B20. So 9,700 gallons of B100 would produce 48,500 gallons per month of B20. Tribal government vehicles currently consume about 22,500 gallons per month, so an adequate supply would exist not only for these vehicles, but also for other Tribal uses or for sale.

The capital cost for a facility that would produce 9,700 gallons per month of B100 would be about $300,000 and would employ 2 full time personnel. The estimated cost of B100 produced is $1.61 per gallon. Based on a retail price of $2.53 per gallon (the average price paid by the Tribe in 2007), this facility would generate an annual income of $110,000 during an assumed 10 year period of capital repayment, and $150,000 per year thereafter.

Because of the potential for income and job creation, as well as the environmental benefits, this option was recommended for action by the Tribe.

Energy Efficiency Options Selection and Planning

Energy Efficiency (EE) means accomplishing the same goals while consuming less energy. Implementing a Tribal energy efficiency program can have many positive impacts. These include the reduction of energy costs and the associated freeing of significant financial resources for other important uses, increased energy independence, improved air quality, reduction in environmental impacts, and others. By employing EE measures, it is possible to save 10 to 50 percent on energy costs. Energy efficiency options were developed in two categories – (1) homes, businesses and government buildings and (2) Tribal government operations.

Homes, Businesses and Government Buildings

A variety of options for reducing energy consumption in homes, businesses and government buildings were identified. These include:

- Replacing incandescent lighting with compact fluorescent bulbs (CFLs) or light emitting diodes (LEDs).
- Performing routine maintenance and repair of existing HVAC units.
- Selecting high SEER HVAC units for new construction or when replacing an existing unit
- Using Energy Star™ appliances in new construction or when replacing a worn out appliance.
- Weatherizing existing homes and buildings, and placing higher weatherization standards on new construction.
- Testing and, where required, sealing HVAC ducts in existing buildings.
- Using ground assist heat pumps
- Using passive solar heating

Each of these options was rated in terms of their cost, ease of implementation, and potential energy savings. The results are listed in Table 8. Those options rated low or moderate in terms of cost and ease of implementation, and moderate or high in energy savings potential (i.e. all greens or yellows in the table below) are recommended for implementation.

EE Measure	Cost	Ease of Implementation	Energy Saving Potential
Retrofit existing incandescent lighting with CFLs and LEDs	LOW	EASY	HIGH
Use Energy Star™ Appliances	LOW	EASY	MODERATE
Perform routine maintenance on existing HVAC units	LOW	MODERATE	MODERATE
Select high SEER HVAC units for new construction or replacement	MODERATE	EASY	MODERATE
Weatherize existing homes and buildings	MODERATE	MODERATE	HIGH
HVAC duct testing and sealing	MODERATE	DIFFICULT	HIGH
Use ground assist heat pumps	HIGH	DIFFICULT	HIGH
Use passive solar heating	HIGH	DIFFICULT	HIGH

Table 8 – Energy Efficiency Options for Homes, Businesses and Government Buildings

Government Operations

An analysis of existing Tribal government energy usage found that government agencies use about $1,000,000 of electricity annually and an additional $1,000,000 in fuel for government vehicles. An analysis of electricity use found that 10 government programs, listed in Table 1 and shown in Figure 4 above, are responsible for 75% of the electricity used. The 3rd highest consumer is the sewer system, and a method of offsetting this energy use is outlined in the renewable energy options section above. The 5th highest use is street lights, and their replacement with high efficiency lighting is recommended. It is recommended that the other eight programs be studied to determine how the electricity is being used (e.g. lighting, heating, hot water), so that energy saving alternatives can be identified.

Several options for reducing the Tribe's gasoline and diesel fuel costs also were developed. They are:

- Right sizing vehicles - Ensuring that each vehicle in the Tribe's fleet is no larger than required to perform the functions for which it was purchased can result in significant fuel savings.
- Purchasing Flex Fuel or Alternative Fuel Vehicles – Flex fuel vehicles are designed to operate on a wide range of gasoline/ethanol blends up to E85. Alternative Fuel Vehicles (AFVs) are designed to operate on non-petroleum-based fuels. These fuels include ethanol, biodiesel, natural gas, propane, and hydrogen. Such vehicles would provide the flexibility to purchase different fuels, based upon changing market conditions.
- Purchasing hybrid vehicles – Hybrid vehicles should be considered for any applications that involve a substantial amount of stop-and-go driving or long times sitting at idle. This includes vehicles operated largely in congested areas, used for delivery or pick-up (such as trash trucks), or that sit idling for long periods (such as police vehicles). The Tribe currently owns only 1 hybrid vehicle.
- Purchasing of high fuel economy vehicles – Tribal procurement policies should be modified, as necessary, to require that total ownership cost, which includes not only the purchase price, but also the cost of fuel, maintenance, and insurance over the life of the vehicle, be used as the basis for making vehicle selections.
- Implement "Green Fleet" driver training – This training includes simple things like the best way to accelerate and decelerate, the impact of high speed driving, the importance of maintaining proper tire pressure, and the cost of sitting with the engine idling. Studies have shown that drivers who receive this instruction typically improve their fuel economy by 15-25%.

An evaluation of these options found that adequate numbers of alternative fueling stations presently do not exist on or near Tribal lands, making flex and alternative fuel vehicles of limited value at this time. However, fleet right sizing, purchasing of high fuel economy and hybrid vehicles, and implementing green fleet training are low cost options that can be easily implemented. Therefore, these options are recommended for action by the Tribe.

Action Plans

The following renewable energy and energy efficiency options are recommended for action by the Tribe:

- Renewable Energy Options
  - Wind Power
  - Municipal Wastewater-to-Electricity
  - Biodiesel Production from Waste Oil and Grease
- Energy Efficiency Options
  - For residential, commercial and government buildings
    - Retrofit existing incandescent lighting with CFLs and LEDs
    - Use Energy Star™ Appliances
    - Perform routine maintenance on existing HVAC units
    - Select high SEER HVAC units for new construction or replacement

        - Weatherize existing homes and buildings
    - For Government Operations
        - Replace existing street lights with high efficiency lighting
        - Assess government programs with high electricity usage for possible savings
        - Assess the current government vehicle fleet for "right sizing"
        - Consider fuel economy in all future vehicle purchases
        - Implement "Green Fleet" driver training

Specific action plans for each recommend option are included in the following section.

Wind Energy

1 – Confirm the Tribe's commitment to a wind farm installation. The compatibility of a wind farm with the Tribe's commitment to protecting the natural environment and the potential impacts on the tourist industry must be addressed by Tribal leadership prior to initiating any efforts toward implementing wind energy. While a wind farm offers the Tribe a number of economic benefits, it also will be a major capital investment and will necessitate other expenses, such as road improvements to the site and installation of new transmission lines. And while the sites selected are remote from major tourist and residential areas, there will be a visual impact from some locations that should be assessed.

2 – Collect wind speed data. At least one year of anemometer data at hub height should be collected to confirm the viability of the site and provide a firm basis for making economic estimates.

3 – Determine the business arrangement to be used. Several business alternatives are possible. To minimize the Tribe's investment, the site could be leased to a third party, who would install and operate the turbines, in exchange for an annual payment. Alternatively, the Tribe could contract for the installation of turbines that the Tribe would then operate and maintain. This would require a substantial investment of funds, but also would provide greater return. Two important factors in structuring the business arrangement are ensuring the full utilization of the production tax credits and the sale of renewable energy credits. Operation and maintenance jobs for Tribal members could be created under either option.

4 – Implement the selected business plan. Assuming that the Tribe has confirmed its interest and commitment to a wind project and that the wind data confirms the financial viability of the site, the Tribe should implement the preferred business arrangement.

The recommended next step for wind energy is:

Next Step	Gather information needed by Council to make an informed decision concerning wind energy. The key pieces of information required are: • Data on visual impact to homes, business, and the tourist industry • Wind speed data to determine the income potential • Infrastructure (roads, transmission lines) impacts and costs
Timeframe	Immediate
Resources	Cost – $40K (funds may be available to cover a portion of this cost) Personnel – Grant, EBCI staff, consultants
Status	TBD
Other	TBD

Table 9 – Wind Energy Next Step

Municipal Wastewater-to-Electricity

1 – Confirm the Tribe's commitment to including this capability in the new wastewater facility design. Generation of electricity from wastewater will have some impacts on the design of the new wastewater facility; therefore, the Tribe should confirm its interest in a wastewater-to-electricity project prior to the initiation of planning for the new wastewater facility.

2 – Include the requirement for electricity generation in the Request for Proposals for the new wastewater facility. The Tribe can either purchase this capability as part of the initial installation, or include those requirements necessary to allow for a future, separate installation.

The recommended next step for municipal wastewater-to-electricity is:

Next Step	Following Council approval, include electricity generation in bid process for the new wastewater facility
Timeframe	Immediate
Resources	Cost – None Personnel – EBCI staff
Status	TBD
Other	TBD

Table 10 – Wastewater-to-Electricity Next Step

Biodiesel Production from Waste Oil and Grease

1 – Confirm the Tribe's commitment to the installation and operation of a biodiesel production facility. The installation and operation of a biodiesel facility should have minimal impacts on existing Tribal businesses and operations, however, Tribal leaders may wish to tour one of the local biodiesel production plants prior to making a final recommendation concerning this project.

2 – Establish agreements with local restaurants for waste oil and grease. Preliminary contacts made during the course of this study confirmed the willingness of local restaurants to provide waste oil and grease, however, prior to committing to plant construction, formal agreements should be established with local suppliers to ensure that adequate feedstock will be available. These agreements should specify methods of storage prior to pickup, pickup schedule, and purchase price or tipping fees (if any).

3 – Develop the business case and determine the business structure. This business could be operated by the Tribe, or by a third party on Tribal lands in exchange for lease payments or other compensation. Factors to be addressed in determining the best business structure for the Tribe include capital investment costs, return on any investment, job creation, and guaranteed availability and pricing of the biodiesel produced.

The recommended next step for biodiesel production is:

Next Step	Gather information needed by Council to make an informed decision concerning biodiesel production. The key pieces of information required are site location, capital cost, and business structure.
Timeframe	Based upon availability of funds.
Resources	Cost – $30K Personnel – Grant, EBCI staff, consultants
Status	TBD
Other	TBD

Table 11 – Biodiesel Next Step

Energy Efficiency

1 – Develop an Energy Efficiency Vision for the Tribe. The EBCI road to energy efficiency must begin with a clear vision communicated by tribal leadership. The Tribe should adopt an energy efficiency goal, expressed in clearly measurable terms, such as:

> *The Eastern Band of Cherokee Indians shall implement energy conservation measures wherever they are cost-effective – in government facilities and operations, to reduce energy consumption by 15% by 2020.*

This level of reduction is consistent with those that have been established by other states, some examples of which are shown in Table 12.

Table 12 – Energy Efficiency Goals of Various States

State	Goal	Year
Hawaii	20%	2020
New Jersey	20%	2020
New York	15%	2015
Washington	10%	2025
Conneticutt	14%	2020
North Carolina	12.50%	2021

The reason for recommending a 15% energy efficiency goal is twofold. First, a 15% reduction in energy consumption is obtainable with minimal cost, when planned over a period of 10 or more years. Second, whenever starting on a new path, initial goals should be relatively easy to achieve. Most of the changes and/or improvements needed to reach a 15% goal are not difficult to implement.

2 – Establish a standing committee to coordinate all energy efficiency programs. Although energy efficiency programs usually bring significant cost savings, without a dedicated agency or committee to focus on reduced energy consumption, little improvement occurs. The Tribe should establish a standing committee for tribal energy efficiency programs in order to achieve the recommended goals. The committee would act in a coordinating role, and not necessarily as the implementer of Tribal energy efficiency programs.

3 – Develop a comprehensive energy efficiency public awareness program. The purpose of an energy awareness program is to eliminate energy waste by making energy users more energy conscious. That is, an awareness program attempts to alter the attitudes of energy users and, through those changed attitudes, to change their behavior as well. An effective program targets specific audiences, involves as many energy users as possible, is widely publicized, and makes energy saving actions and goals as concrete as possible. Successful public outreach programs continually present the "need for energy conservation" and "how to save energy" themes. Publicizing conservation information on a regular basis tends to increase the program's effectiveness by increasing and maintaining participation.

4 – Collect baseline data. There has never been a comprehensive survey of energy end-use in the Qualla Boundary. Understanding how people use energy will help the Tribe better target their efforts at reducing energy consumption. More importantly, energy conservation programs and policy effectiveness cannot be measured without establishing a current baseline. Collecting baseline energy consumption data is the first step in launching a meaningful energy efficiency program. Energy users and policy makers will be encouraged if they have evidence that energy efficiency measures are working and will have the opportunity to change course if they are not.

5 – Provide funding for a Tribal-wide low income weatherization program. Through weatherization, low-income families permanently reduce their energy bills by increasing the energy efficiency of their homes. Typical weatherization measures include installing insulation; performing basic heating tune-ups and repairs; and mitigating air infiltration through doors and windows. According to a 2006 study conducted by the Oak Ridge National Laboratory (ORNL) the average natural gas heated house that participates in the low income weatherization program sees a 32% decrease in energy consumption for space heating.

6 – Develop and implement a new Tribal residential and commercial energy efficiency building code. Building energy codes establish minimum energy performance features in new residential and commercial buildings. Because most new homes are built to a building code, consumers assume their new building will be energy efficient. However, most new buildings do not meet minimum requirements of modern energy codes. Many builders are not aware of the levels of performance required to meet those standards.

Buildings, both homes and commercial structures, will endure for several generations. The single best opportunity to assure these buildings meet minimum levels of energy efficiency occurs during initial design and construction. Many energy performance features cannot cost-effectively be retrofitted at a later date. Failure to install certain features during construction dooms these structures to poor performance for life. Building energy codes help assure new buildings will be constructed to a minimum level of energy efficiency.

Minimum performance levels specified in energy codes are based on today's energy prices and construction costs. The impact of energy use from these buildings will increase as energy prices escalate and will be felt for years to come. In order to reduce future energy consumption, the EBCI should incorporate the 2008 International Energy Conservation Code into its current building codes.

7 – Conduct energy audits of government and commercial buildings. A proven way of reducing energy costs is to perform energy audits of existing structures. The Cherokee Preservation Fund has already coordinated the auditing of 10 buildings, and this process should be continued and encouraged, both for government and commercial buildings.

8 - Conduct a fleet vehicle analysis. One of the first steps toward an energy efficient fleet plan must be to conduct a fleet review that provides a comprehensive analysis of the types of vehicles, their primary use and the amount of fuel they consume. This analysis will establish a baseline against which future changes can be measured. It also will determine both areas for efficiency improvements and the cost of those improvements.

9 - Set a goal to reduce Tribal government fuel use from 2007 levels by:

- 5% by 2010
- 10% by 2015
- 15% by 2020

10 – Establish a requirement that all future vehicle purchases consider fuel economy as part of the decision process. The total cost of ownership, not just purchase price, should be the basis on which all future vehicle purchases are made.

11 - Establish a goal that all Tribe diesel fuel should have a biodiesel blend of at least B5 or B20, depending on season, by the end of 2010. This will have a positive impact on the environment and help to reduce the cost of fuel and the volatility of fuel prices.

12 – Establish a goal that all Tribe employees who drive Tribal government owned vehicles should complete a green driver education course. The following interim goals are recommended:

- 50% by 2010
- 100% by 2012

The recommended next steps for energy efficiency are:

Next Step	Obtain council approval for the establishment of an energy efficiency fund.
Timeframe	Immediate (this project should be a top priority)
Resources	Internal
Status	FY09 funds have been identified
Other	Energy Committee would vote on projects to implement energy efficiency improvements to the EBCI's existing building stock. Funds would be allocated annually in a pre-determined amount (seeking $50,000). All expenditures would have to show documented simple payback of 10 years or less.

Next Step	Formulate a CMAQ grant application for an electric, hybrid or biodiesel transit service
Timeframe	FY09
Resources	Grant, EBCI staff, Transit staff
Status	Grant identified, need to identify match. Need to determine extent and which technology to use.
Other	EBCI qualifies for Congestion Mitigation and Air Quality funding due to the GSMNP being a non-attainment area. Project must use alternative and zero-emission technologies.

Next Step	Formulate the policy for implementing improvements to the intermodal (bike and pedestrian) transportation system.
Timeframe	TBD
Resources	TBD
Status	Initial phases.
Other	Benefits not directly financially quantifiable to EBCI, however recommendation was a direct result of findings of other endeavors. Idea is to implement a half cent sales tax to install bicycle and pedestrian facilities or formulate another funding method that is non-EBCI funded on an ongoing basis.

Next Step	Executive office and corresponding Deputies need to confirm the staffing required to carry out these action plans.
Timeframe	Immediate
Resources	EBCI internal plus possible new staffing
Status	Underway
Other	The Strategic Energy Plan formulation has been directly carried out by the EBCI CDOT transportation planner. The process has been very time consuming. EBCI staff needs to be identified to carry out the action steps of this plan. Likely departments include Planning and Development or Environment and Natural Resources. In addition, the creation of a new department or staff position within an existing department should be considered. If the Tribe takes ownership of projects (wind turbines for example) this will become a requirement as staff will need to be retained and trained to manage and maintain equipment. Many tribes have Energy Agencies that can provide examples to EBCI. Legal and Finance offices will be key to project implementation due to the complex legal agreements (power purchase agreement for example) and numerous tax issues involved with the action plans. Also the Renewable Energy Committee should be expanded and approved as the executive office sees fit to make decisions (which may have significant financial, staffing, legal, and other implications) on behalf of the Tribe.

Table 13 – Energy Efficiency Next Steps