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Sustainability Education and Awareness for Santa Fe and Native American Communities

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Sustainability Education and Awareness for Santa Fe and Native American Communities

An Interactive Qualifying Project submitted to the faculty of
Worcester Polytechnic Institute

in partial fulfillment of the requirements for the Degree of Bachelor of Science

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The Santa Fe Indian School

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Abstract

This project compiled sustainability education and awareness resources for the Santa Fe and Native American communities. The team examined the resources currently available online and met with various organizations in the area that are knowledgeable about sustainable best practices in education and implementation of agriculture, renewable energy, and water conservation. The team then created a pair of websites with relevant information in order to allow the community to easily find ways to participate in and learn about sustainability.

Executive Summary

Efforts towards sustainability can be observed throughout the world and the United States. With a predicted worldwide population of 9 billion people by the mid-2000s, a way of reducing overall consumption is necessary to avoid drastic environmental changes. This is especially important in the United States where consumption per person is the highest worldwide (Indiana State University 2012). “If everyone on Earth (just the current population) expended as many resources as the average American, we would need four more Earths just to harvest for resources! (Indiana State University 2012)”

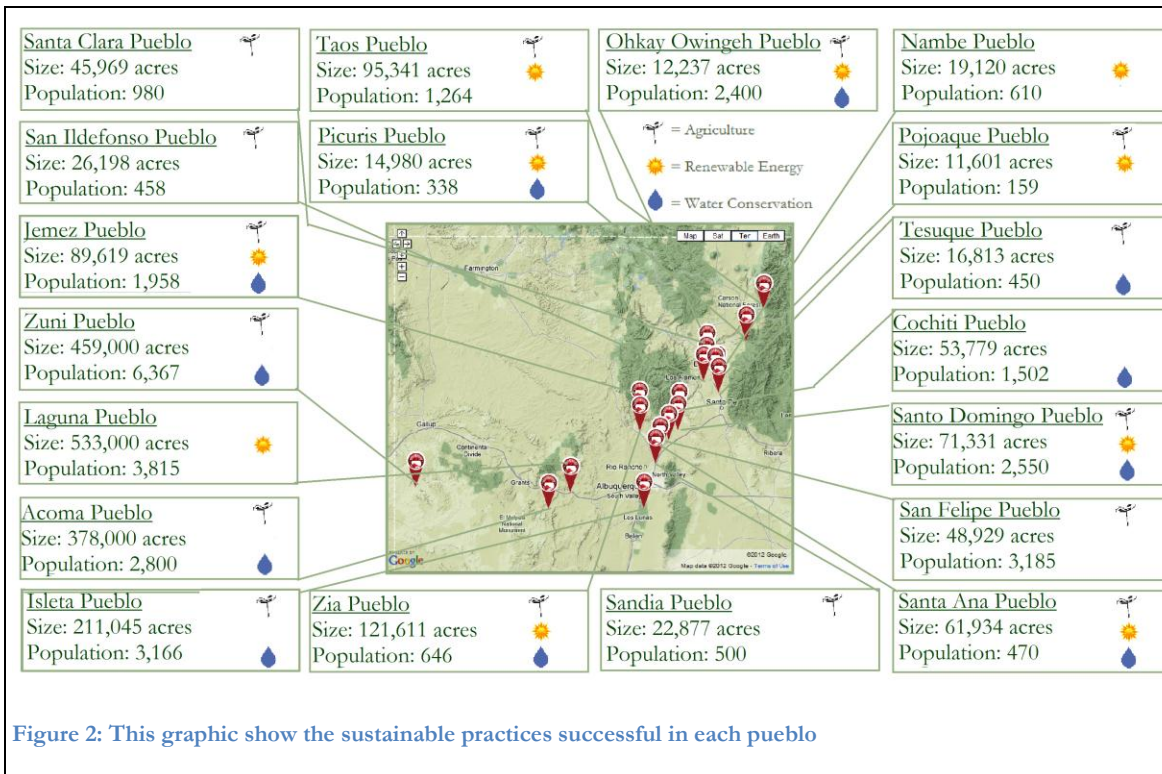
In Santa Fe, NM many efforts are being made towards improving sustainability through the projects, programs and volunteer opportunities of local organization and schools. Few people know about these efforts. The community could be more engaged and involved if it had the resources to access information about current projects.



Figure 1: The location of the pueblos in New Mexico.

The Native American communities, or pueblos, in New Mexico have recently implemented many projects for sustainability. Within New Mexico and especially in the Santa Fe area, as seen in Figure 1 to the left, there are 19 pueblos, which are historically known for their respect of the earth and everyday sustainable practices, which stems from how in touch with their land and values they are. Tesuque, the pueblo we used to demonstrate various components of our project, is located just nine miles north of Santa Fe. Despite being in touch with the land, a structured, reliable system or program that facilitates sustainability education and initiative amongst the pueblo communities does not exist. The

environmental departments could benefit from an educational system related to sustainability that will provide a mode of communication and education that will eventually translate into action projects. Pueblos have limited access to resources and could profit from a more effective way of utilizing the natural resources that are available to them such as energy from the sun or fertile soil. The graphic in Figure 2 shows which sustainability practices each pueblo has been successful with, as well as size and population.



The Santa Fe Indian School, owned and operated by the 19 pueblos, is the sponsor for this project. It is making great strides towards a more sustainable future. Community Based Education is one part of its efforts. Students work with the tribes and are able to do projects within the environment through this program. The school also offers an Agriscience class through which students learn about their culture and science while also practicing the “design and management of sustainable agriculture systems.”

The ultimate goals of this project were to aid the Santa Fe educational community in advancing sustainability education and to provide resources on sustainable practices applicable to Native American communities.

To complete this mission the team carried out various tasks to create the following deliverables.

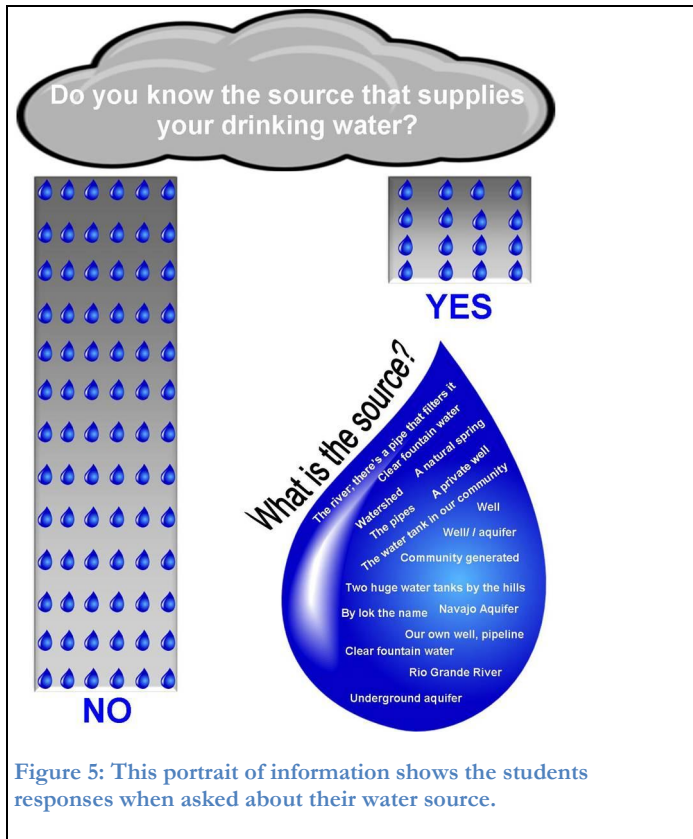
1. Student Survey Results
2. A Sustainability Curriculum Framework
3. A Sustainability Curriculum Outline
4. A website focused on Sustainability Education, titled “Positive Sustainable Change: Education”
5. A Sustainability Action Plan Framework
6. A website focused on Sustainability Practices for Native communities, titled “Positive Sustainable Change for Native American Communities”

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Figure 3: This screen shot show part of the tables of contents located in the Sustainability Action Plan Framework

To accomplish these goals and create the above products, the team contacted and met with various companies, organizations, and schools to gather information on current sustainability practices in Santa Fe. A screenshot of the Table of Contents can be seen in Figure 3 above. Through these meetings and further research, the team compiled success stories related to agriculture, renewable energy, and water conservation. The information collected allowed the team to design a Sustainability Action Plan Framework. An image of this Sustainability Action Plan Framework can be seen in Figure 3 above. The full document can be found in Appendix I. In this document a reader can learn about six important concepts a community should

consider when working towards sustainability. It also contains a section on implementing a plan which includes working towards energy efficiency, utilizing Geographical Information System (GIS), and modifying current success stories to suit their community. We suggest that another team next year be directly sponsored by a member of a pueblo to continue the sustainability aspect of our project and create a full sustainability plan for a specific community.



Since water conservation efforts are crucial in states such as New Mexico where water is very limited, the team felt it was pertinent that the students are aware of the source of drinking water in their own home. It was brought to our attention that only 16 of the 94 surveyed students felt that they knew the source that supplies their drinking water. However, several of the 16 students who did supply this information were not precise and supplied answers such as “the pipes.” The survey responses supported the team’s belief that the students could benefit from a sustainability curriculum and aided the team in the design of this framework and outline. The responses also geared the development of a curriculum framework in a direction that would be most beneficial by

focusing the content on information that appeared to be underprovided in the existing educational system.

We designed a curriculum framework for educators to utilize when teaching students about sustainability. This document contains principles important to sustainability education and outlines subtopics that teachers can focus their lessons around. The end of the document highlights a table with 4 columns to assist teachers in creating these plans. It includes the leading concept, desired outcomes, grade levels, activity ideas, along with a box that can be used for evaluation. We also created a sustainability curriculum outline. This outline provides a description of the class layout that we believe is most beneficial to students in high school. The team outlined a class for juniors and seniors in high school. It is specific for the Santa Fe Indian School, incorporating culture into sustainability. The outline provides resources for teachers to find lesson plans available online, it lays out projects and activities available, and provides ideas for guest lecturers and educational field trips. Through these two documents the team hopes that the Santa Fe Indian School will start a class that focuses on incorporating sustainability with culture. We hope that in the future there will be 2 groups that continue our project. We would like to see a group work with the SFIS or another school in Santa Fe to continue the curriculum work for sustainability education.

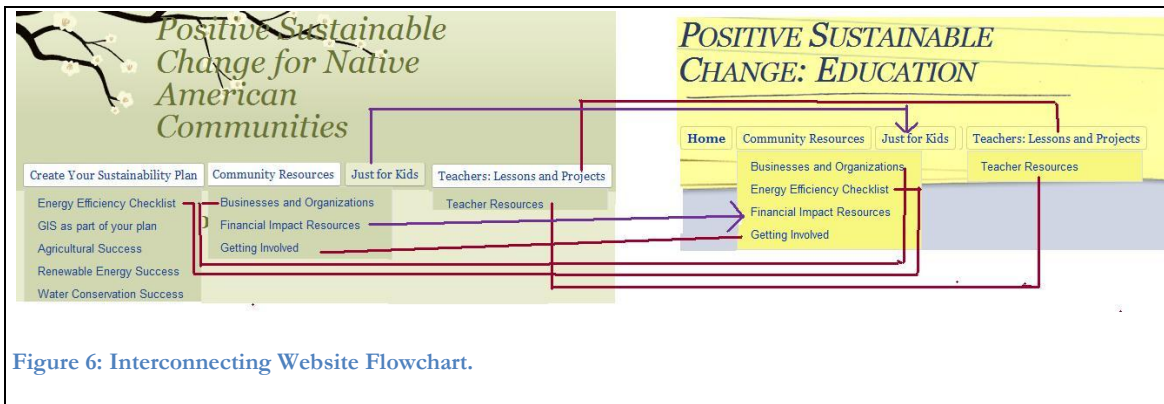


Figure 6: Interconnecting Website Flowchart.

To accomplish the project goals, the team designed and created two interconnected websites with various features. How these two websites interconnect can be viewed using the menus from these websites in Figure 6 above. The red lines show which pages are exactly the same while the purple arrows allow the user to connect to the other site for more information. The first website is called Positive Sustainable Change for Native American Communities. This website houses the Sustainability Action Plan, GIS maps, and Success Stories specific to Native American Communities. It also contains an Energy Efficiency Checklist to help users decrease their energy consumption, a Getting Involved page that provides readers with workshops, classes and volunteer opportunities that will teach them how to become more sustainable, a Businesses and Organizations piece summarizing those in the area excited to work with various communities, and finally a Financial Impact Resources page with summaries and links to websites that specifically aid Native American Communities with sustainability funding. The Financial Impact Resources page along with the Just for Kids page links to an educational website that the team also created. Finally there is a page that allows educators to upload and share lesson plans. This feature is also on the educational page. The second website designed was Positive Sustainable Change: Education, directed towards the general public in Santa Fe. It does not contain the information on the Sustainable Action Plan Framework, GIS maps, or success stories; however this site does contain the same information regarding businesses and organizations and how to get involved. On the educational website the Financial Impact Resources page contains energy efficiency calculators, renewable energy financing calculators, and resources about funding for renewable energy. This section of the website is not specific to any community. The educational website contains the Just for Kids page full of games and resources for children to learn more about sustainability. It also houses the same page for teacher to upload and share lesson plans. This page has a tutorial for users to understand how to upload a lesson plan. It also contains summaries and houses the curriculum framework and outline.

The team would like to see a new website created with its own server and domain. This would allow the two Google sites to be combined into one, the ability to password protect the Native American portion of the website, and the ability to create user profiles. In the meantime, the team has turned over ownership of the two Google websites to our liaison, Mark Ericson, to continue and manage. To further the sustainability of these websites a link to them can be found on the official Santa Fe Indian School website for easy access of the community. The links can also be found on relevant SantaFedia pages.

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1 Introduction

Today, efforts towards sustainability can be observed throughout the world and the United States. This has occurred because people recognize that society is making a negative impact on the earth and the natural resources are diminishing. Sustainability is the concept of preserving the earth and its resources for future generations. There are three main aspects of sustainability: environment, economics, and society. These principles are not independent principles; they are interconnected and make up a person's view of sustainability (Campbell). With a predicted world-wide population of 9 billion people by the mid-2000s, a way of reducing overall consumption is necessary to avoid drastic environmental changes. As the resources become more limited their prices increase, eventually reaching a point where economically renewable resources are the only option. This economic factor is just one reason that people should choose to follow sustainable practices. This is especially important in the United States where consumption per person is the highest worldwide (Indiana State University 2012). "If everyone on Earth (just the current population) consumed as much as the average American, we would need four more Earths just to harvest for resources!(Indiana State University 2012)"

Currently, the Southwest of the United States uses 76 percent of its surface water, which could rise to 86 percent when the region's population doubles within 50 to 100 years. It is necessary for water to be available for people and agriculture, but also for the environment. Rivers need enough water for the ecosystem to stay balanced ([Morello](#)). New Mexico contributes greatly to greenhouse gas emissions because of abandoned mines, on top of using more water than the environment can comfortably supply (Matlock, 2012). Efforts are being made in Santa Fe, NM towards improving sustainability through the projects, programs and volunteer opportunities of local organization and schools. Although these efforts exist there is little awareness of them, and the community could be more involved if it had a resource to access information about current projects. Within New Mexico there are 19 pueblos, which historically are known for their respect of the earth and everyday sustainable practices.

Pueblos were first discovered in the sixteenth century in southwestern America by Spanish explorers. The pueblos of New Mexico are home to communities of indigenous Native Americans who are self-governing and practice their traditions and customs to this day. In the past decade, the pueblos of New Mexico have made strides towards improving their environmental awareness. Nineteen pueblos are located in New Mexico and one of these pueblos is the Tesuque Pueblo, located just nine miles north of Santa Fe. The Tesuque Pueblo was used as an example throughout our project.

Pueblos are traditionally in touch with their land and values. Despite being in touch with the land, the lack of technology results in a lack of a structured, reliable system or program that facilitates sustainability education and initiative amongst the pueblo community. The environmental departments along with the pueblo communities could benefit from an educational system related to sustainability that will provide a mode of communication and education that will eventually translate into action projects. Pueblos have limited access to

resources and could profit from a more effective way of utilizing the natural resources that are available to them such as energy from the sun or fertile soil.

The goal of this project was to raise sustainability awareness in the Santa Fe area through education. This goal was achieved by creating two websites, one about sustainability in Native American communities, and another about sustainability education, for educators, students, and their families to learn from. We collected various forms of information and compiled them on the two websites, to make the sustainability process easier for families and communities.

This paper is organized to reflect the progress of our project. We started out by researching sustainability, sustainability projects in Santa Fe, renewable resources, pueblos, and our sponsor, the Santa Fe Indian School. All of the topics listed above are found in chapter 2, which is about the background of the project. Chapter 3 is a transition section that lists the actions we took after our initial research, before we started creating the products of our research. It tells about the businesses and organizations that we met with, what we expected, and what we got out of communicating with each one, as well as the other research we did. The chapters after chapter 3 include methodology, results, and analysis specific to the major aspects of our project. Chapter 4 discusses the need and results for a student survey that was conducted and chapter 5 is about the online resources we created, with information about the criteria, differences, and methods of promotion of the two websites. Chapter 6 details the steps we took to create a sustainability curriculum framework, outline, and the educational website; chapter 7 goes into detail about the framework of a sustainability model that we created as well as the Native American website creation. To conclude, chapter 8 lists our recommendations. The bibliography and appendices can be found after chapter 9, which contains our conclusions.

2 Background

This section explains in depth the main topics related to the project. The information provided will aid in understanding the purpose and expected results as they relate to sustainability, renewable resources, pueblos and the Santa Fe Indian School.

Sustainability is an overlying solution to this problem. The global sustainability efforts often influence countries, states and even cities or towns to try something new to help the environment and society. New Mexico and Santa Fe are working to improve their sustainability statuses and plans. Programs for the communities to participate in have been put into effect.

Renewable resources, a subset of the sustainability concept, can serve as a medium to physically impact the surrounding ecosystems. This will improve the impact that humans have on them.

There are also sections that discuss pueblos and the Santa Fe Indian School. This provides understanding of the communities the project is intended to assist. They go into depth on the efforts and needs of these communities.

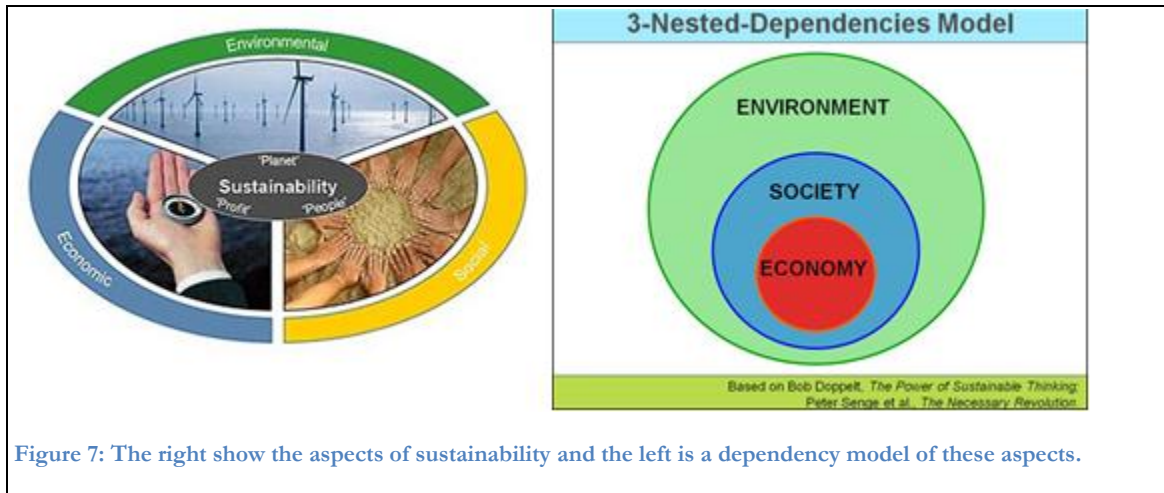
The following will serve to explain the current initiatives and efforts in use to develop a solution for the problems stated above. The sections below will discuss material leading to the formulation of the objectives for this study.

2.1 Sustainability on a Global and National Level

Sustainability is a concept gaining momentum in the United States but there is a lack of consistency within the definition of it (Johnston). These views of sustainability are a broad and disjointed group of explanations. Often it is expressed that the definition encompasses too many topics. Another problem is that people believe sustainability is based solely on green issues and is always prefaced by a form of the word environment (Agyeman). For this project, the term sustainability means using the natural and native resources to provide for the community while conserving resources for future generations. In more simple terms and better said by Chief Seattle, “We do not inherit the earth from our ancestors; we borrow it from our children (Chief Seattle).”

Sustainability is based on three main aspects; economics, environment, and society. Through these values communities can become sustainable as long as the balance is found. Another part of sustainability within a community is public policy. Whether or not laws and regulations are necessary to make the move towards sustainability within each individual community has yet to be determined nationally (Agyeman). Sustainable development can only occur once economic feasibility, environmental viability, and social desirability occur simultaneously (Campbell).

2.1.1 Aspects of Sustainability



(Siemens) (Willard)

The images in Figure 7, above, show the three main aspects incorporated into the concept and theory of sustainability. Without an even balance of these three individual concepts, sustainability cannot be achieved within a community. It is important to remember that these values themselves may often stand alone, but to define sustainability all three are necessary. The left portion of Figure 7 shows the dependency of the three sustainability aspects upon each other. From this image, one can begin to understand how society relies on environment and economy relies on society. Society needs the environment to survive, because of water, soil, and food. Then society determines how goods will be priced and distributed which makes economics dependent upon society (Willard). Below are the three aspects: economics, environment, and society, in greater detail as they pertain to sustainability.

2.1.2 Economic Sustainability

The concept of economics is a large factor in sustainability (Agyeman). Many reforms of the whole economic system must take place to reduce natural inputs as well as waste and pollution outputs. The manufacturing sector must make changes in product design and processing efficiency. However, these changes do not apply to just the manufacturing sector. The agricultural and commercial sector must also make modifications (Muschett). The agricultural sector can reduce soil erosion by simply using “careful farming methods, land use planning and proper construction practices (Muschett).” To decrease their overall impacts, improved land use need to be executed. Finally, economic substitutes should eventually be made, switching from fossil fuels to the use of energy efficiency and renewable resources (Muschett).

The involvement of economics however, goes past reforming existing systems. When designing a plan for a community to become sustainable it is important that it is feasible for all citizens. The programs put in place, for example, cannot leave the low-income families without electricity because the bill is too high due to the new implementation of renewable energy (Sustainable Santa Fe Commission). When implementing a new type of program that affects all members of the community, economics plays a major role to ensure that all members of that community can participate and do their part. It is important that people

realize that as the demand for these resources increases and the availability decreases, prices will rise. Eventually this cost will be high enough that it is unaffordable for families. This is just one reason that the push towards sustainability is strong, to help beat an economic crisis before it occurs.

2.1.3 Environmental

Environmental sustainability is the aspect that individuals immediately associate with the concept of sustainability. To remove the dependence on non-renewable resources and decrease dependence on replenishable resources is the general understanding of sustainability. Despite this, the environmental aspects play off of economic and society as well. Environmental sustainability refers to understanding the impact of humans on the ecosystem and doing what is possible to decrease this effect (Dorf). To obtain environmental justice, people must understand that coexistence of beliefs and politics can provide potential solutions (Agyeman). Ecologists believe that to maintain overall stability of the global ecosystem the preservation of integrity of ecological systems is critical (Campbell).

2.1.4 Society

In order for the public to provide extensive support there needs to be a source for sustainability education at an elementary, secondary and university level (Agyeman). By replacing traditional environmental and developmental issues with a social agenda, community involvement in sustainability practices can increase. Sustainable development must occur throughout the United States in a uniform manner being sure to include all cities and suburbs (Edwards). "One of the major challenges facing the world as it seeks to replace unsustainable development patterns with environmentally sound and sustainable development is the need to activate a sense of common purpose on behalf of all sectors of society (Edwards)."

Another focus for society is education. Society needs to be educated on the current status of sustainable practices within its communities as well as the world. This awareness will increase community support and eventually translate into great global progress. Communities should begin to implement an elementary program on basic sustainability skills as well as community classes for adults. These classes will allow them to learn about how to improve their at home sustainable practices. Society will then gain a better understanding of the need for individual participation.

2.1.5 Sustainable Policies

One policy that could be taken advantage of is called Ecotaxes. This is a positive re-enforcement concept through which the burden of taxes is moved from positive things such as employment to negative things such as pollution or resource usage. It is believed that this would be effective immediately after implementation. Another policy idea is the Federal Sulfur Tax which is similar to Ecotaxes but relates to sulfur rather than pollution and resource usage (Agyeman).

Another policy is Community Supported Agriculture. Through this envisioned policy, farmers markets and community gardens have become exceedingly popular throughout the United States. Need-assessment surveys have shown that in many urban areas citizens report

community food security is an issue (Agyeman).

There are discrepancies in opinions on whether public policy should be allowed to enforce sustainability (Ikerd 2008, 95). Using market-based instruments requires that the government have a way to measure environmental change and tax levels as well as a way of assigning a monetary value for each resource. The government would need to conduct assessments on each household to be able to compile a record of each household's emission output and energy usage in order to track and implement taxes correctly. One way that this value is currently determined is by the fluctuation of prices for specific goods that resource impacts. Another approach that is not currently in place within the United States is to use surveys with individuals who are willing to pay for the changes to happen within their communities (Mulder and Van Den Bergh, Jeroen C.J.M 2001, 110-111-134).

These are only a few policies within the United States, such as tax incentives, for the implementation of renewable energy. Many others are under consideration, as obstacles such as those mentioned above must be taken into consideration when putting a public policy into effect. The current question exists as follows: Can society take these existing policies and concepts and alter them for each community or must the process start over from scratch? (Agyeman)

2.1.6 Nudge Based Alternatives for Energy Efficiency

It has been found that using nudge based technologies to inform users of their amount of usage, such as meters to inform consumers of how much energy they use by hour and day, is helping increase energy efficiency and decrease energy consumption. It is thought that by receiving instant feedback on their usage, people adjust accordingly. The concept of a nudge



Figure 8: Energy Consumption Meter (P3 International Corporation)

based technological aid is to have a visual indicator allowing consumers to adjust accordingly based on their individual impact, removing the need for public policy to be implemented (Reeson 2009). Below in Figure 8, a nudge based technology for measuring the energy consumption of an individual household appliance can be seen. It has a digital output so that users can see how much energy is being consumed. This version of an energy consumption meter plugs into a standard U.S. outlet and the appliance is plugged into the meter. This specific meter allows the consumer to view the price of the energy they are using over a month, the amount in Watts /VA, Volts/AMP, and KWH/hour (P3 International Corporation).

People can also have companies, such as Positive Energy in New Mexico, come in and conduct an Energy Efficiency Assessment. After an assessment, households can make small changes to start reducing their individual effect on the environment and save money through the process as well.

2.1.7 Natural Capital

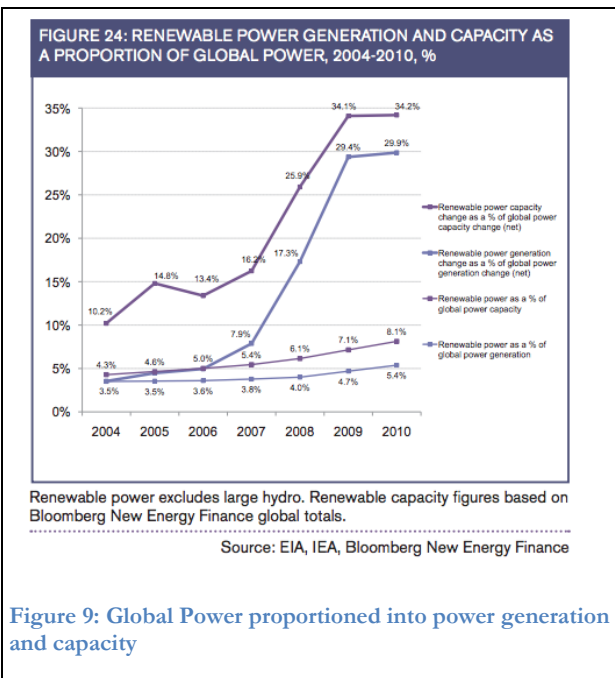
The definition of Natural Capital goes beyond inventorying resources and expands to the ecosystem, its structure and components. There are three types of natural capital; renewable, replenishable, and non-renewable. Renewable are living systems and ecosystems while non-renewable are fossil fuels and minerals. Replenishable are surface and ground. Renewable and replenishable capitals are critical for life. The underlying theme of sustainability is to conserve and increase natural capital stocks and survive off the monetary income produced by these resources. A common difficulty is that human monetary capital often depends on natural capital (Agyeman) (Dorf).

2.2 Renewable Resources

Renewable energy, the product of renewable resources, has seen an overwhelming increase in interest, functionality, and use in the past decade. Some of the main types of renewable energy include: wind energy, solar energy, geothermal energy, and biomass energy (also known as bioenergy). Renewable resources have seen an increasing level of interest and investment due to the recent success of the “green” (or eco-friendly) movement and increasing costs of fossil fuels (2011 global status report).

2.2.1 Global Renewable Resource Market

With prices on energies, such as petroleum and other fossil fuels, increasing due to scarcity and global conflict, the incentive to invest in alternative energy sources augments. It is no coincidence that the capacities and production of renewable energies have significantly increased in share of global energy since 2004. A sharp increase in share of renewable capacities and production was seen between the years 2007 and 2008 – where renewables saw an increase from about 7% to 17%. By the end of 2010, a third of the world’s power production consisted of renewable energies (McCrone, Angus (Lead Author, Chief Editor) 2011, 11).



(Global Trends in Renewable Energy Investment 2011, Bloomberg New Energy Finance, Frankfurt School, UNEP, SEFI, Figure 24)

Various indicators and statistics can demonstrate how the renewable energy market will continue to grow. This trend can be seen in Figure 9. Aside from the proportion of change in global energy production, annual investment and additions for renewable energy have seen all-time maximums in 2011 (Sawin 2011). The form of renewable energy that has seen the most significant growth in capacity is solar energy. Solar photovoltaic energy, observed in Figure 9, saw estimated increases of up to 17 gigawatts in capacity in the past year.

The overall behavior of this trend can almost be described as exponential. The current total capacity of photovoltaic is 50 gigawatts compared to the capacity of 0.7 gigawatts that accounted for the world's total solar photovoltaic capacity in 1997 (Sawin 2011). Most of this capacity is supported via grid connection. However, many countries and organizations seek to use non-grid connected solar resources. This type of energy is usually more useful for small establishments and facilities (Sawin 2011).

Figure 10 demonstrates increasing world capacity and cell production for solar photovoltaic energy (Swain 2011).

2.2.2 Renewable Resources in New Mexico

The state of the New Mexico utilizes and possesses numerous forms of renewable energy. The main types of renewable energy that the state's energy, minerals, and natural resources department focuses on include: solar energy, wind energy, and geothermal energy. Renewable energy in New Mexico is harnessed in two distinct forms: distributed-scale and utility scale (New Mexico Energy, Minerals, and Natural Resources Department 2011, 5).

Distributed-scale energy systems are usually based near the facility or area where the energy is being used. An excellent example of a distributed-scale energy system would be a farm that relies on wind turbine power. Utility-scale energy systems are usually much larger and sophisticated than distributed-scale ones. Utility-scale systems usually supply electrical power to urban areas from an isolated facility.

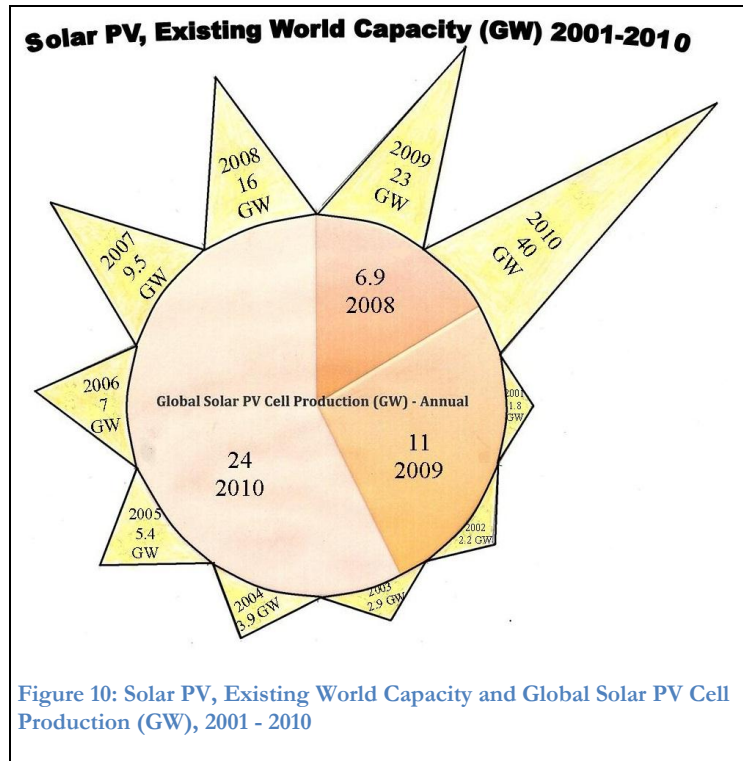


Figure 10: Solar PV, Existing World Capacity and Global Solar PV Cell Production (GW), 2001 - 2010

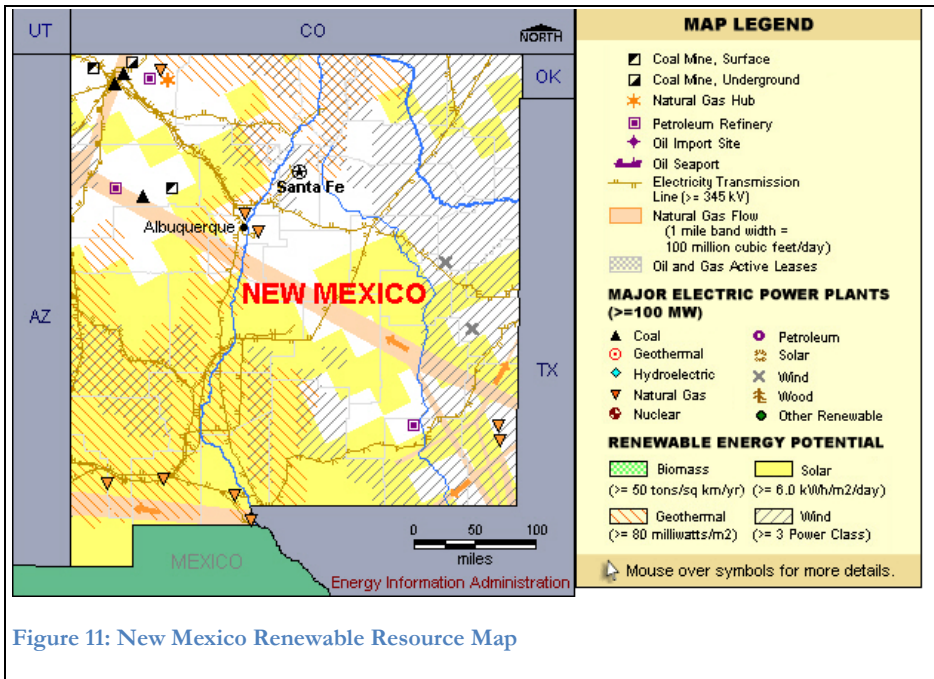


Figure 11: New Mexico Renewable Resource Map

New Mexico is one of the states in the U.S. with the highest solar energy potential. Based on a “sun index” that is measured by the average number of hours of peak direct sunlight hours per year, seen in Figure 11, New Mexico ranked 3rd behind Arizona and Nevada (Nebraska Energy Office 2010, 1). Despite the large potential for solar energy, there are no utility-scale facilities or systems for solar photovoltaic energy. However, the state of New Mexico has established extensive policy and financial incentives to encourage the homeowners and business of the state to operate using some form of solar power. Perhaps the most notable piece of legislature that has been passed on behalf of the state of New Mexico is the Solar Rights Act of 1978. This act acknowledges the benefits and efficiency that can be cultivated by using solar energy. The act has since been revised, the latest being in 2007. The amendment to this act disallowed the city from establishing any building code that would prohibit the installation of solar energy systems and devices with the exception of historical districts and properties (New Mexico Energy, Minerals, and Natural Resources Department 2011, 5). One of the more notable incentives created by the state to encourage the furthering of clean, renewable energy in the state is the Solar Market Development Tax Credit. This tax credit initiative was established in 2006 to provide up to \$5 million in state tax credit until the year 2016. There is, however, a utility-scale system for solar energy known as Concentrating Solar Power (CSP). This solar energy system has been supported by various projects to further its technology and success (New Mexico Energy, Minerals, and Natural Resources Department 2011, 5). The state has taken the stance that most efficient applications of solar electricity is for facilities and buildings that are located very far from utility plants. Heating water with solar power while powering the facility with electricity generated from solar energy should prove to be economical than installing utility line extensions that would be necessary to serve these isolated entities success (New Mexico Energy, Minerals, and Natural Resources Department).

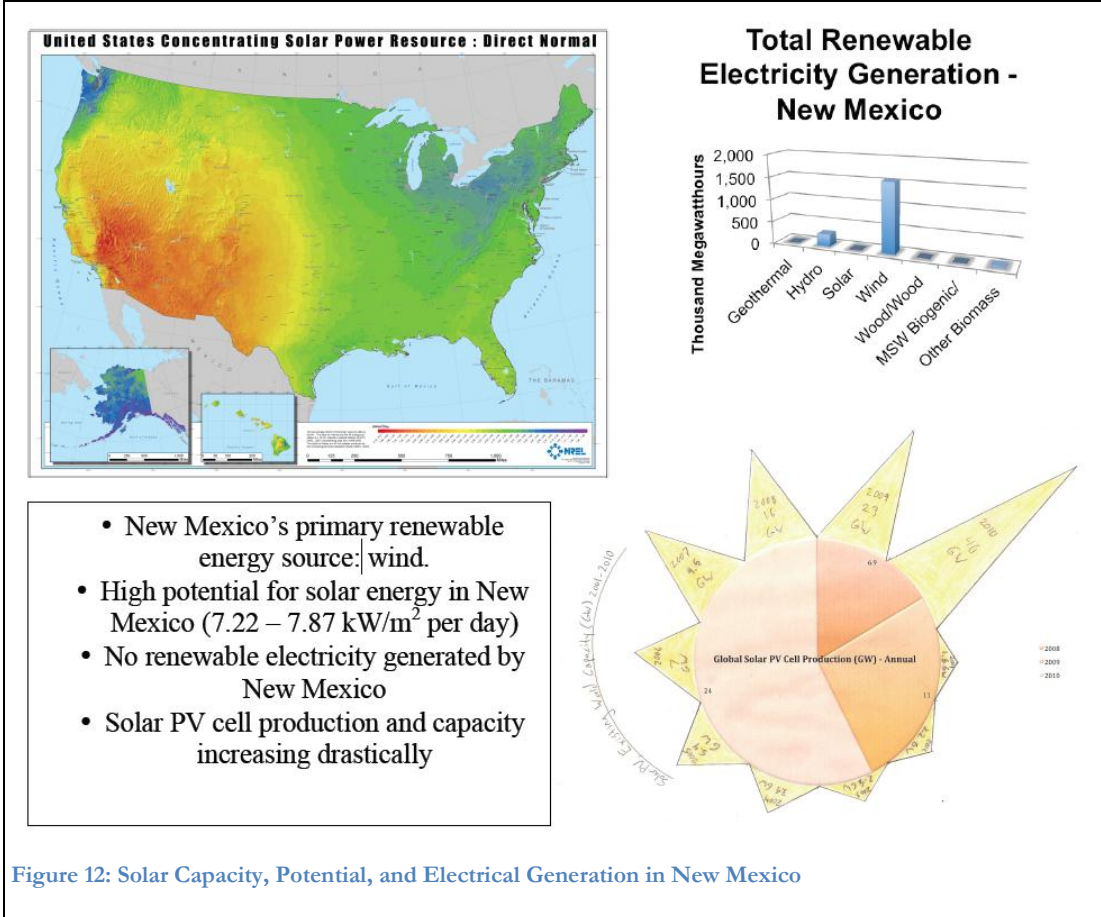


Figure 12: Solar Capacity, Potential, and Electrical Generation in New Mexico

New Mexico's primary renewable energy source is wind energy. Out of the total 1,851 thousand megawatt hours of electrical generation from renewable resources, wind composes 1,547 thousand megawatt hours of electricity (U.S. Energy Information Administration 2009, 2). The wind energy estimated electrical generation potential in New Mexico is 56 million MWh/year (energyatlas.org 2002, 51-52, 53, 54). New Mexico established a utility-scaled wind energy system in 2003 that has now grown into 698 megawatts of wind power capacity that is supported by seven wind power facilities (New Mexico Energy, Minerals, and Natural Resources Department 2011, 5). The energy that is created by these wind systems is purchased entirely by PNM, a power utility company in New Mexico. Just like solar energy, wind energy has high potential in the state of New Mexico; however this does not apply to Santa Fe due to its geographic location. New Mexico currently ranks 12th amongst states in the U.S. for highest wind electric potential with an estimated 435 billion kWh in potential. This is highly significant seeing that New Mexico can produce more electricity through wind energy than its own electrical consumption – therefore meaning that the state can afford to export this energy to benefit its welfare (New Mexico Energy, Minerals, and Natural Resources Department 2011, 5).

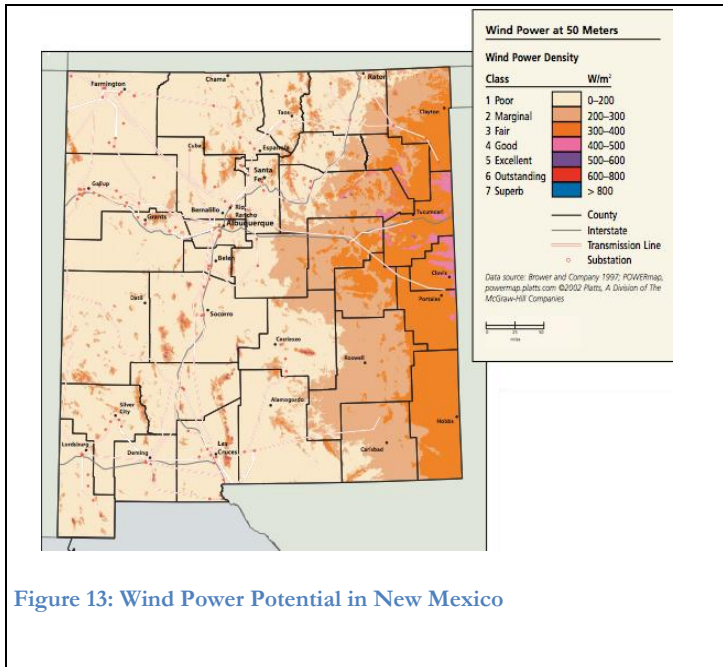


Figure 13: Wind Power Potential in New Mexico

Geothermal energy, Figure 13, is another form of renewable resources that has high potential within the state of New Mexico yet does not have any utility-scale facilities to further its development and cultivation (energyatlas.org 2002, 51-52, 53, 54). The state mostly uses geothermal energy in direct use while encouraging home and business owners to install systems such as geothermal ground-coupled heat pumps. The Geothermal Ground-Couple Heat Pump Tax Credit provides up to 30% (\$9,000 maximum) of the price of purchasing and installation for a pump system that harnesses geothermal energy (New Mexico Energy, Minerals, and Natural Resources Department 2011, 5). Geothermal energy is mostly used for green houses and similar facilities (energyatlas.org 2002, 51-52, 53, 54).

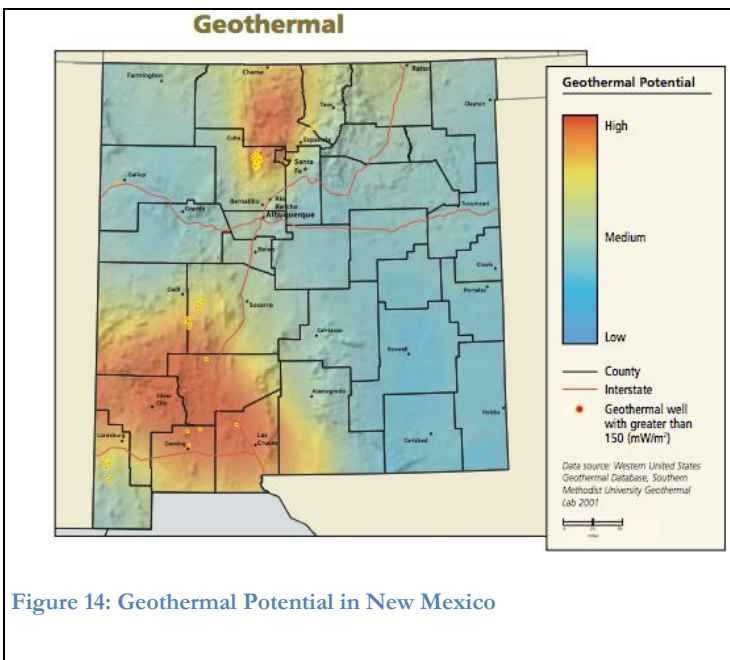


Figure 14: Geothermal Potential in New Mexico

Biomass energy, Figure 14, can also prove to be an efficient and useful renewable resource when considering the potential of energy that can be extracted from waste streams. Non-fossil bio-feedstock holds high value for other products such as firewood and particleboard. The total potential for this form of

energy is estimated to be near 35 trillion Btu per year. Bioenergy projects such as the construction of municipal solid waste reactor seem promising for the future of bioenergy in New Mexico. However, it is currently not an efficient or utility-scale renewable resource for the state (New Mexico Energy, Minerals, and Natural Resources Department 2011, 5).

2.3 Local Sustainability Efforts

New Mexico, where this project took place, has worked to put into effect specific programs to improve the state’s ecofriendly and sustainability movements. The New Mexico Energy, Minerals and Natural Resources Department has put into effect statewide land conservation tax credits and many other programs to help promote sustainability. Through these

programs the New Mexico Communities can get involved in the move towards sustainability (Anonymous). Throughout New Mexico, both abandoned and occupied mines are being monitored by the state. They enforce the rules and regulate inspections to be sure that all the safety hazards are removed and environmental damage is minimized. The state government also has a program in place to give money to communities to plant trees. These trees must match 20% or more of the native trees that currently grow in that area. New Mexico will also give tax credits to any citizens who donate land for conservation through which their wildlife can begin to thrive again. It is important to note that the New Mexico Energy, Minerals and Natural Resources Department does not have control over any of the Native American Pueblo Land or how the pueblo communities choose to use and govern this land. The government cannot enforce any of the statewide regulations onto any property of the Pueblos (Anonymous).

2.3.1 Santa Fe's Issues and Current Problems

The City of Santa Fe has made initiatives towards sustainability as a community as well. Its plans define three principles (social, environmental, and economics) that lead to the city's resistance to global warming, beyond just reducing greenhouse gas emissions. This plan uses history and culture to promote community sustainability (Santa Fe, NM and its representatives 2012). Santa Fe has a community resiliency plan in place which emphasizes that it is important to respect the history and cultural values of the city. The city officials have found that this promotes the community's involvement in their sustainability efforts. The city planned in 1990 to reduce its Greenhouse gas emissions to 7% by 2012. In 2008 a preliminary analysis was conducted and showed an increase by 8.5% in greenhouse gas emissions which would require a decrease of 18.9% to reach the goal set for 2012 (Santa Fe, NM and its representatives 2012). It is unsure if they met this goal however; in 2010 New Mexico produced 30 million metric tons of carbon dioxide, methane, and nitrous oxide (Matlock 2012).

Santa Fe has also made changes within the city government to improve energy and fuel efficiency. Every renovated building now has to be brought up to date, including green technology implementation. The city has started to remove methane from the water in the water treatment plant so that they may use it to power the rest of the treatment process. The city has implemented many water sustainability programs within the community for individual households and companies. The people of Santa Fe have decreased their water usage from 137 to 103 gallons a day per person throughout the city over the last seven years and they have begun to make efforts towards agricultural sustainability. They promote locally grown food to help decrease the greenhouse gas emissions that are incorporated into importing food. The community is strongly supporting the concept of a Santa Fe farmers market and community gardens (Santa Fe, NM and its representatives 2012).

2.3.2 Sustainable Santa Fe Plan

The Santa Fe Sustainability Plan outlines how the city plans to increase its sustainability and decrease its effect on the environment. The plan lays out the 12 step approach which ranges from reducing greenhouse gases to making the community resistant to weather changes, incorporating values important to the community such as history and culture. This plan was designed in 2007 by the Sustainable Santa Fe Commission after the adoption in 2006 of the

US Conference of Mayors Climate Protection Agreement. One goal within the plan is to help make the city resistant to peak oil prices and water supply reduction (Alliances and Sustainable Santa Fe Commission). The Santa Fe Alliance and the City of Santa Fe Economic Development Division are collaborating on the implementation of the Santa Fe Sustainability Plan in local economies through their current Programs. The Santa Fe Alliances uses programs to inform and teach the community about the Sustainability Plan. They also help businesses become more integrated within the community and identify green industries on the rise, as well as putting together regional food and fuel systems for the Northern portion of New Mexico (Alliances). The Sustainable Santa Fe Commission defined sustainability as they felt applied to their city and this proposal as “taking care of the needs of the present generation without compromising the ability to meet the needs of the future generations (Sustainable Santa Fe Commission).”

2.3.3 The 12 Step Approach

The 12 step approach of the Sustainable Santa Fe Plan stems from the concept of “walking softly”. Walking softly means to use local materials and food sources to decrease the impact of human existence on the ecosystem. It is important to note that not all land in New Mexico has been sustainable throughout history. Some land was once grazed over by local ranchers and never fully recovered to its original state. Ideally this plan takes into consideration convenience and comfort in its objectives laid out to obtain sustainability without harming the environment and future generations. To lay out these 12 objectives and the steps necessary to achieve each one, Baseline Emission Inventory measurements were obtained allowing progress to be measured. The local government plans to lead by example, putting each portion of the proposal into effect within the city government. It is through this that they can test each program’s efficiency before implementing it within the community and make any changes beforehand. The Sustainable Santa Fe Plan is a living document and will be updated to report progress (Sustainable Santa Fe Commission).

2.3.4 Sustainable Communities

Sustainable Development is a new term, however sustainable communities date back to ancient civilizations such as ancient Egypt and Carthage. The sustainable community movement requires a community acceptance of the principles; environment, society, and economy. To define what makes a community sustainable, the board of the Institute for Sustainable Communities is consulted and the elements necessary can be utilized. These goals are “scientifically, technologically, economically, and socially feasible.” A world database of sustainable communities, called Best Practices, is kept, in which examples of these goals being met can be located. As of 2003, no major US city had declared a plan to become sustainable with a set timeline, goals, or intermediate targets. It is evident that while small communities can make the push towards sustainability, the greatest challenge is getting large cities, worldwide, to do the same (Agyeman).

2.3.5 47 Ranch

People have begun to take initiative and do what they can to reduce their individual negative impacts on the planet and make changes to their daily lives. One instance of change is the 47 Ranch in Arizona. This ranch is free range, allowing its animals to graze as they wish naturally on the land. It uses solar power to run water pumps for its animals during the day

and wind energy to run them at night. These can be seen through an image of the ranch in Figure 15 below. Through the use of these renewable energy resources the ranch has not only been able to raise its cattle free range but has also seen an increase return in the area's native animals. The 47 Ranch grows its own fruits and vegetables and harvests them year round. Rain water in the southwestern region of the United States is scarce, requiring creative ways to harvest and reuse water. Captured rain water, drip irrigation systems, and mulches assist in using limited amounts of water.



Figure 15: The 47 Ranch, note the solar panels and windmill, two major sources of energy (Baja).

The 47 Ranch is run by Baja Arizona Sustainable Agriculture (BASA). BASA is a non-profit group in Arizona that works to increase the sustainable food production and marketing within a local region. Because of the environment and weather in Arizona, which is similar to that of New Mexico, crops can be grown through the winter. This is a possibility even at higher elevations through the use of greenhouses and cold frames. The key for these crops is the amount of sun that they receive through the typical off season (Anonymous2011).

2.3.6 New Energy Economy

New Energy Economy is a non-profit organization located in Santa Fe, NM. It is working to reduce carbon emission, while boosting job opportunities within the clean energy and energy efficiency field. This company works to help raise funds for community projects related to the implementation of renewable energy. New Energy Economy has assisted in the implementation of solar panels at the Navajo Nation Crownpoint Chapter House. The organization runs a program called HopeWell, in which it assists low income neighborhoods with weatherization, retrofits, and simple energy efficiency steps. New Energy Economy also works on creating and passing public policies in regards to pollution, public health, and safeguarding clean air, water and land.

Website: <http://newenergyeconomy.org/>

Contact page: <http://newenergyeconomy.org/contact-us/>

2.3.7 Local Energy

Local Energy is a nonprofit organization that develops renewable energy resources to lessen difficulties created by the use of fossil fuels. They facilitate community development of self-reliance in energy through their research, education, and projects. Local Energy supports the local control of renewable energy resources. They also sponsor programs to reduce energy costs leaving the community. Local Energy set various goals such as reducing negative environmental impacts, advancing renewable energy research, and setting up forums and other resources for the public to engage in discussion.

Website: <http://localenergy.org/index.html>
Contact Page: <http://localenergy.org/contactUs.htm>

2.3.8 Sacred Power

Sacred Power believes that the world can change its current direction. The world is dependent energy sources that produce pollution and Sacred Power hopes to convert communities to renewable technologies for clean long term solutions. Sacred Power Corporation has completed many projects in various renewable energy facets like power generation, livestock watering, and training education.

Website: <http://www.sacredpowercorp.com/index.htm>
Contact Page: http://www.sacredpowercorp.com/spc_news/site/contact.htm

2.3.9 City of Santa Fe

The City of Santa Fe has six projects in the Department of Housing and Community Development. One project of particular relevance is the Energy Efficiency and Renewable Energy project. The Sustainable Santa Fe Plan clearly highlights the initiatives that the city is committed to in order to become more ecofriendly. The city has put forth efforts to adopt policies that require the city to become energy efficient and use renewable energy resources. There are two staff members who oversee the implementation of these energy related projects. There are smaller projects incorporated in this larger one which include simple tasks such as getting rid of junk mail and piloting a green waste program.

Website: <http://www.santafenm.gov/index.aspx?NID=148>
Contact: (505)-955-6421 or (505)-955-6655

2.3.10 Santa Fe Community College

Santa Fe Community College has begun to focus on retrofitting its facilities to be more sustainable. The college itself has implemented a sustainability plan. This plan emphasizes sustainable practices that include reduction of pollution, healthy indoor environments, and teaching sustainable concepts. It also encompasses a LEED Checklist which mentions the requirements for certification. This institute serves as an example of sustainable practices for the community.

Website: <http://www.sfcc.edu/>
Contact Page: http://www.sfcc.edu/about_SFCC/about_sfcc

2.4 Pueblos

“Pueblo” is a term that means “village” or “town” in Spanish and was originally conceived to refer to Indian adobe house complexes of the Southwestern Indian Tribes. Many centuries ago, pueblos became rooted in the states of Colorado, Arizona, and New Mexico. Currently, 19 pueblos are located in New Mexico. They belong to a confederation called the “All Indian Council” where they make joint political decisions on behalf of all of the pueblos.

Each pueblo is operated by its own local government and led by an elected governor or tribal council. Pueblos also have some of their own laws, police forces, fire stations, services, languages and traditions, but the pueblo people are still U.S. citizens and are still expected to abide by American laws. As of 2002, 79% of the pueblo population belonged to the Catholic Church (Jones, Dale E., et al. 2002. *Congregations and Membership in the United States 2000*. Nashville, TN: Glenmary Research Center).

Each of the 19 pueblos has an Environmental Department within its community that has direct contact with the Environmental Protection Agency. This department focuses on education, restoration and protection. Its projects, which are funded by the EPA, have involved monitoring air and water quality, and reintroduction of native plants and animals. Previously, the tribal environmental departments have functioned through the creation and enforcement of environmental policies but do not have a clear emphasis on renewable energy related issues (Honabarger and Kaufman 2000, P-4). Resources providing applicable information on renewable energy sources are limited and are critical when pursuing a sustainable future. Many Native American practices are guided by their long standing respect for the Earth and its resources.

Most pueblo people still live in traditional multistory adobe house complexes. The adobe units are often connected side by side and ladders are used to access the upper levels of the complex (Redish 2011). Many people participate in farming and art based around traditional designs including pottery, jewelry, stone carving, and weaving. Pueblos are an important part of American history and their sustainability is crucial preserving their rich culture and traditions.

While many pueblos are successful in some aspects of sustainability they all could benefit in different areas of sustainability. The success in the three categories of agriculture, renewable energy, and water conservation throughout the 19 pueblos of New Mexico can be seen in Figure 16 below. It is important to note in this figure that many pueblos are successful with water; however some do not take any particular actions to conserve water. The uniqueness and privacy involved in these communities creates a culture that puts restrictions on the feasibility of certain changes. The Tesuque Pueblo was utilized in this project to demonstrate how a pueblo can employ a sustainability action plan. A background of Tesuque's current circumstance, in regards to the focuses of our project (renewable energy, agriculture, and water), is provided below to create an understanding of pueblo culture and how this impacts sustainability efforts. When viewing Figure 16, the plant indicates agricultural success, the water drop shows water conservation efforts, and the sun represents renewable energy.

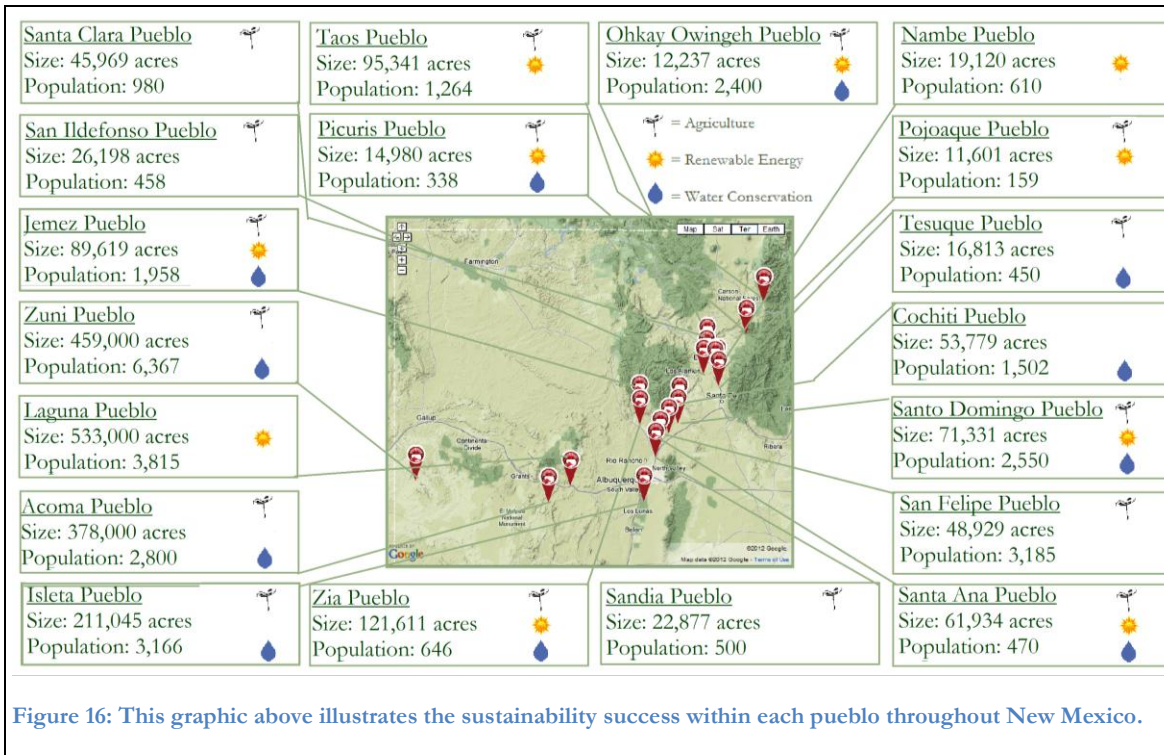


Figure 16: This graphic above illustrates the sustainability success within each pueblo throughout New Mexico.

2.4.1 Tesuque History and Culture

The Tesuque Pueblo is located in New Mexico, nine miles north of Santa Fe and can be seen in Figure 17. The name “Tesuque” is derived from a Spanish version of the original Tewa name “TeTesugehOweengeh” which is translated to the “Village of the Narrow Place of the Cottonwood Trees.” It is estimated to have stood in its current site since 1200 AD (Indian Pueblo Cultural Center). Tesuque is one of the smallest of the 19 pueblos in New Mexico as well as one of the most traditional. The people still speak their native Tewa language as well as English and some Spanish. The Tesuque Elementary School has a Tewa Language Program designed to preserve the native language. The school covers kindergarten through sixth grade, and 139 children attend. Preservation of culture is valued in the pueblo and encouraged by surrounding communities and the government. The people of the Tesuque Pueblo practice many of their customs, involving religious ceremonies, feast days, and sacred dances. They have one of the closest

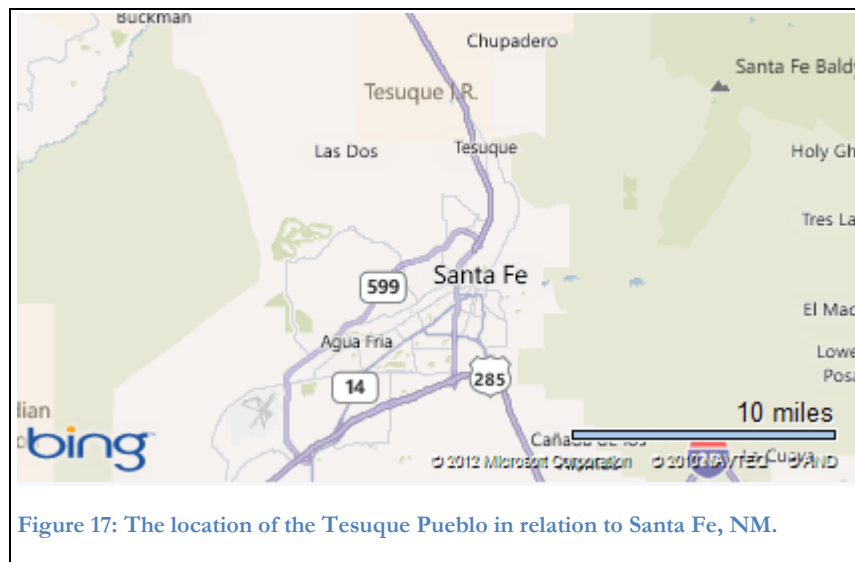
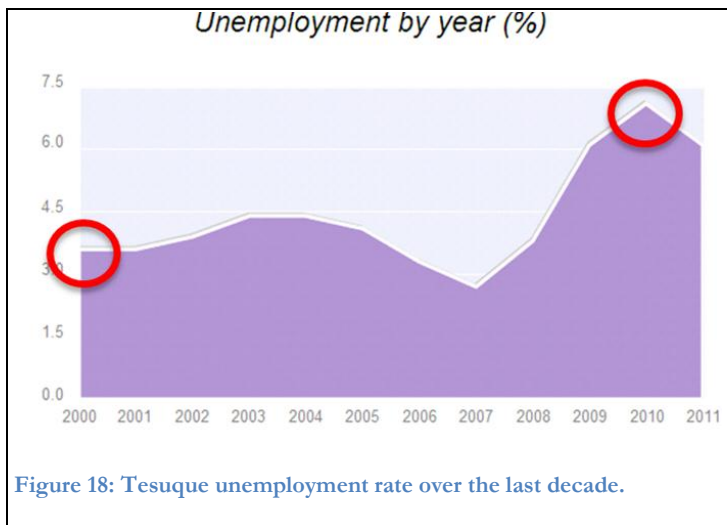


Figure 17: The location of the Tesuque Pueblo in relation to Santa Fe, NM.

relationships with the state capital and are therefore one of the most recognizable of the nine northern pueblos (The Santa Fe Unlimited 2012). The Tesuque reservation covers 17,000 acres of land which reaches into the Santa Fe National Forest. In the year 2000, according to the US Census Bureau, the Tesuque population was 909 people, 455 households, and 249 families. The 2000 CDP also revealed that the average age was 48 years, the female to male ratio was 10:9 and 12.6% of the Tesuque population was below the poverty line (U.S. Census Bureau 2010). As of 2012, there is an approximate population of 450 Native Americans still living in the Tesuque Pueblo, indicating that within the last decade the population has decreased by half. It is evident that the people of the tribe are leaving their community and not returning. It has also been found that career opportunities are currently limited in the pueblo to farming, art/craftsmanship, tribal council positions, teaching occupations, and jobs within their casino. In the last decade the unemployment rate of the Tesuque Pueblo community has doubled. The trend can be seen in Figure 18. The implementation of more



sustainable elements within the community would establish more career opportunities in agriculture, energy, and water, providing more incentive for the Native Americans to stay rooted in their pueblo. Note the vertical axis in Figure 18 is by percent and the horizontal axis is by year.

2.4.2 Tesuque Agricultural Sustainability

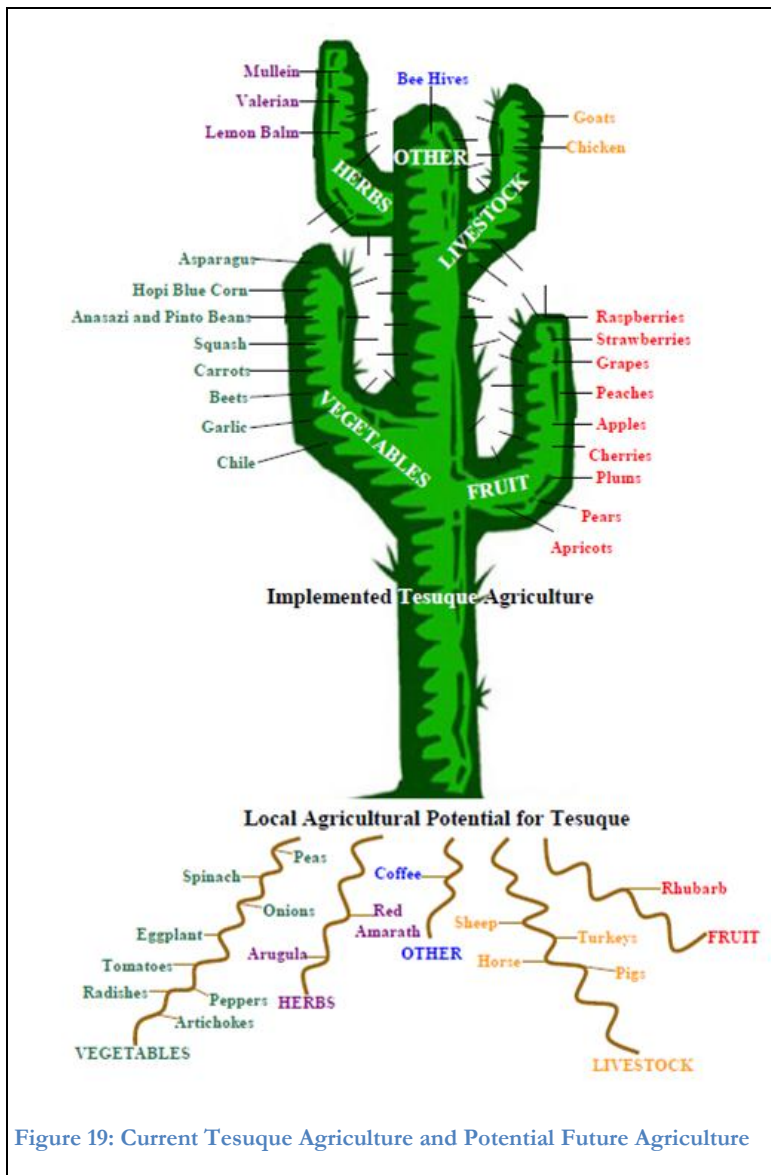


Figure 19: Current Tesuque Agriculture and Potential Future Agriculture

One of the most prominent efforts Tesuque has made towards sustainability is its 2006 implementation of the Tesuque Agricultural Initiative. The efforts can be seen to the left in Figure 19. The planners outlined plans to transform 40 acres of land into use for farming. By 2007, they had developed 15 acres with new plans to expand it to 80 acres. A seed bank to collect seeds had been established so that members of the community would not have to purchase them outside of the pueblo. In 2007, they began hosting an annual symposium at the Intergenerational Center of Tesuque Pueblo called “Sustainability and Food Security for the Twenty First Century and Beyond” which features speakers who are renowned experts from national and local organizations, in order to further agricultural education. The panel discusses dry farming and

water management techniques, heirloom seed saving and cleaning methods, traditional crops for nutrition and cultural health, medicinal herb cultivation, and spiritual agriculture (Grassroots and Netroots Alliance). Tesuque has begun workshops such as its “Farms Field Day,” when people from the outside community are given tours around the pueblo farms and are able to attend demonstrations such as seed cleaning and herb harvesting. Emigdio Ballon, a Quechua Indian, was brought to the pueblo to lead this initiative (DÁvila 2007, E-2). The environmental department recently installed four wildlife water guzzlers on the reservation, which are tanks of water that provide water to the two packs of elk which migrate to their land in the spring. The elk had been eating crops grown by members of the pueblo so the guzzlers, which are located towards the outskirts of the reservation, have diminished this problem because the elk no longer travel that close to the pueblo.

2.4.3 Tesuque Energy Sustainability

Tesuque was one of the first of the 19 pueblos to implement electricity on its land. Initially, 12,000 volt distribution lines were installed but they were unreliable with frequent outages. In 2001, the Public Service Company of New Mexico (PNM) began construction on a 115-kilovolt transmission power line that would traverse 9 miles of the Tesuque Pueblo reservation land. There were several Tesuque opponents to this project since the lines were to be built above ground, taking away from the traditional appearance of the pueblo. After several lawsuits, PNM halted construction. Along Highway 285, which runs parallel to the Tesuque reservation, pavement construction was being done by another company. An agreement was established allowing PNM to renovate their existing lines along the highway. Presently, Tesuque does have electricity on its reservation but it is not up to date and it relies on companies outside of the community, often resulting in controversy. Members of the Tesuque Tribal Council aim to implement solar panels but they are only in the preliminary stage of planning (PNM News Release). It is much more feasible for pueblo communities to install solar panels on their reservation if they are already connected to PNM's electrical grid because then they can connect their solar panels directly into the existing grid.

2.4.4 Tesuque Water Sustainability

The Pueblo of Tesuque is fully dependent on ground water and the Community Services Department currently maintains seven wells. In 2002, the New Mexico Rural Water Associations Tribal Source Water Protection specialist initiated the Wellhead Protection Program, which was approved by the EPA, created to manage water protection in the Tesuque Pueblo. The tribe's environmental department used this program to prioritize water protection efforts using Safe Drinking Water Act Set-Aside funds provided by the EPA. They then used these funds to create concrete pads around their well heads to divert run off away from the well, they installed and repaired security fencing around the public drinking wells along with plastic lining and gravel overlay to restrict rodents from contaminating the wells (Safe Drinking Water Act article).

One source of water present in the community is the Rio Tesuque Watershed, forty percent of which is owned by the Pojoaque and Tesuque Pueblos. Twenty nine percent is private land ownership and the rest is owned by USFS. The Water Master of the Aamodt water rights adjudication and the State Engineer handle negotiations between the various owners of the watershed as well as evaluate applications to alter place or purpose of an existing water right. Some of the expectations are that the proposed change abides by state water conservation efforts, that it will not impair other existing water rights, and that the intended use will not negatively impact the public welfare. The community also has an opportunity to oppose changes if they have a legitimate objection. Figure 20 below shows the waterways through Tesuque as well as the ownership.

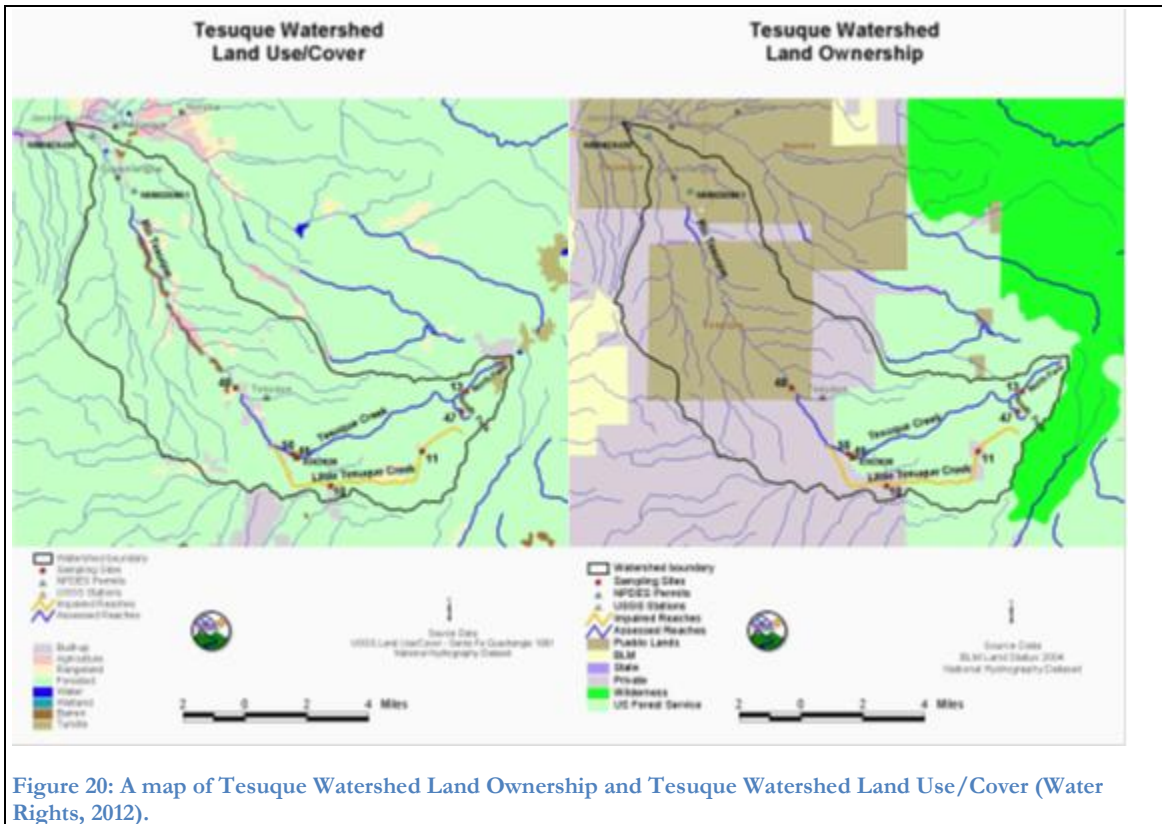


Figure 20: A map of Tesuque Watershed Land Ownership and Tesuque Watershed Land Use/Cover (Water Rights, 2012).

2.5 Santa Fe Indian School

The Santa Fe Indian School (SFIS) is the sponsor for this project. The school’s mission is:

“The purpose of the Santa Fe Indian School is to provide a challenging and stimulating academic program of excellence which shares the responsibility with students and their parents in developing the students’ potential to meet obligations to themselves and their communities.” (Anonymous)

The Santa Fe Indian School is a boarding and day school for Native American students from the 19 Pueblos of New Mexico. The school is owned and operated by the pueblos, which are spread throughout the state. SFIS is for grades 7 through 12 and the values of the school mirror those of the pueblo culture. The educators’ values in learning were converted into the Community Based Education (CBE) program, which involves students in real-life issues so that they learn while also applying their knowledge in a way that benefits their communities (Anonymous).

2.5.1 Santa Fe Indian School Sustainability Education

The Santa Fe Indian School is making great strides towards a more sustainable future. Community Based Education is one part of its efforts. Students work with the tribes and are able to do projects within the environment through this program. One important initiative is a branch of CBE called Agriscience, which “works closely with several Pueblo communities to engage students in all aspects of farming and agricultural practices through regular

community visits”. They learn about their culture and science while also practicing the “design and management of sustainable agriculture systems.” Another branch of CBE is the Senior Honors Project (SHP). The SHP is designed to teach seniors necessary project skills in a way that helps their community address current problems (Anonymous). Victoria Atencio’s SHP is a particularly relevant example. For her project, Honoring Mother Earth, she explored ways of “Reducing our impact on Earth by going back to traditional ways and focusing on renewable/alternative energy sources, enabling us to become a more sustainable community.” She worked with the school’s Green Team to teach her peers about more sustainable options (Santa Fe, NM and its representatives 2012).

2.5.2 The Issues SFIS is Facing in Regards to Sustainability

While the Santa Fe Indian School has made many attempts towards sustainability, there is still more it can do. There is no source available for students to learn solely about ways to help the environment and conserve resources. The project-based classes and SHP teach these concepts, however the main focus is not sustainability. The students of the SFIS would benefit from a website geared towards them to teach sustainability in an interesting and interactive way (Anonymous).

2.5.3 SFIS: A Key Factor in the Project’s Success

Student projects and coursework are an important part of this project. Students who are attending the school have the opportunity to learn how to use GIS, geographical information systems, to map their own pueblos. GIS can be used to map renewable resources or anything else of interest to the project, and the school’s pre-existing map saved time and effort. The most important reason the school enabled the project to succeed is that students are the future. Children and teenagers, especially those who are already encouraged to help their communities, can be the driving force towards awareness and change. The students were also an excellent sounding board in understanding potential outcomes of any plans for implementation within their pueblos. They will also help spread awareness of a sustainability education website after the conclusion of the project, and their teachers will be the pioneers in using the curriculum aspects of this project (Anonymous).

2.6 Summary of Chapter 2

In summary, sustainability is a solution to the problem the Tesuque Pueblo is facing. The three main aspects of sustainability are economics, environment and society, and there are various options for sustainable practices, as explained in section 2.1. One way of contributing to the overall health of the environment is using renewable resources to their fullest potential. Native American values correlate well with the use of renewable resources, but the Tesuque Pueblo would benefit from using them more. The pueblo and the Santa Fe Indian School would also benefit from a website for sustainability education where people can learn and share information and ideas. The following chapters combine methodology, results, and analysis for the major outcomes of this project.

3 Collecting and Organizing Information from Companies and Educators

This section details our steps as we gathered information for our project, before we created our websites, curriculum framework, curriculum outline, and sustainability action plan framework. It is short, but every step detailed below was important to our project, and led to the products listed above. This chapter contains every step of our information gathering process, so that others working on a similar project can copy our successes and avoid the steps that were unsuccessful. Figure 21 shows all of the businesses and organizations that we found helpful during the process.

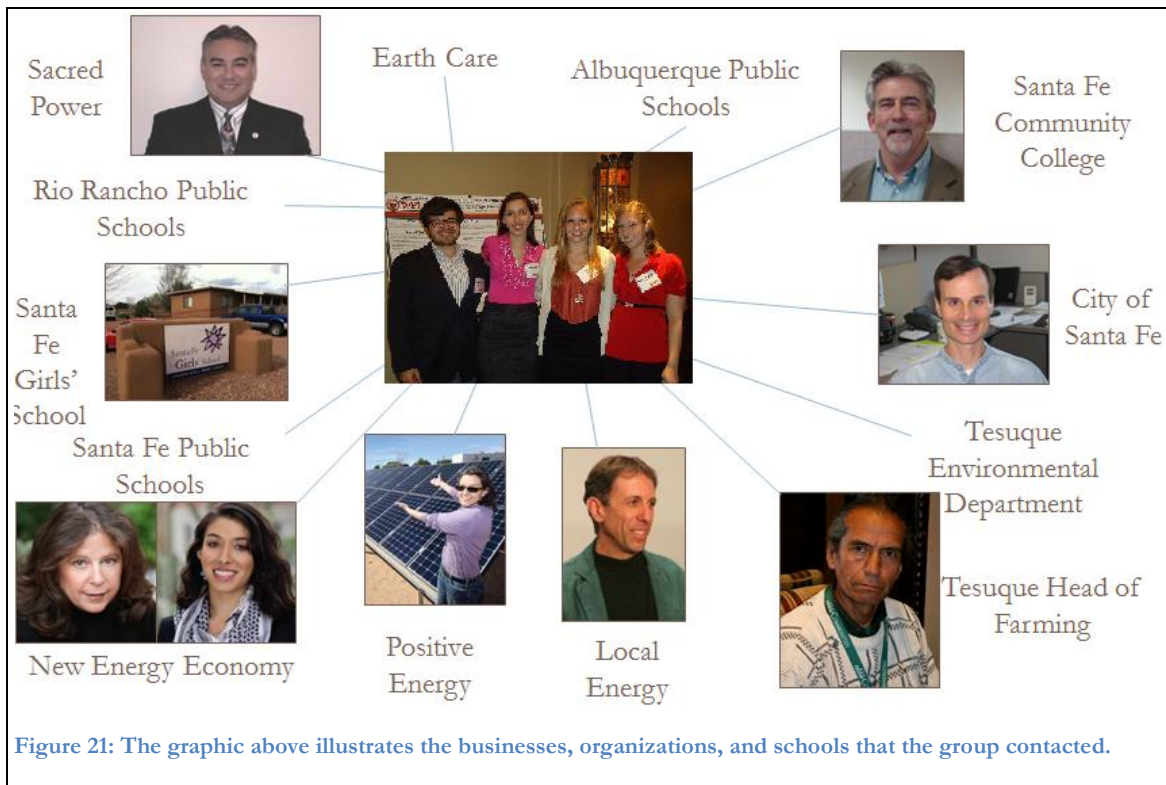


Figure 21: The graphic above illustrates the businesses, organizations, and schools that the group contacted.

We collected information on sustainability efforts currently in place in and around Santa Fe and categorized them into sections (agriculture, renewable resources, and water conservation). The information we collected was compiled and used on the website detailed in chapter 5. To find information, we contacted organizations our sponsor suggested, and then contacted many more organizations those led us to. Our steps for that process can be found in 3.1.2. We also looked at various websites. After finding examples of best practices, we summarized the ones that were most relevant to Native American communities in New Mexico.

3.1 Collecting Current Sustainability Successes within Pueblo Communities

We contacted the Eight Northern Pueblo Council to invite each tribe to share its greatest sustainability success. We didn't hear back from them via e-mail, so we decided to try calling instead, which was unsuccessful. Future project groups should attempt further contact with

the pueblos. We also researched success stories using the methods in sections 3.2 and 3.3. We contacted members of the Tesuque Pueblo to learn more about the pueblo's agricultural success.

1. We e-mailed Kai-t L.V. Blue-Sky, the wildlife biologist for the Pueblo of Tesuque Environment Department, and heard back almost immediately. We met him on a field trip with the Santa Fe Indian School Community Based Education class, and helped clean out guzzlers, which we learned a lot about.
2. We also e-mailed John Stokely, Director of the Environment Department for the Pueblo of Tesuque. When he responded towards the end of the project he was able to help us gain access to the Tesuque Farms.
3. We didn't have contact information for Emigdio Ballon, Tesuque Farms Director, but we got to meet him during our tour with John Stokely. Mr. Ballon gave us a tour of the farms, which we chose as an agricultural success story (see section 3.3).

A sample of the e-mail we sent the contacts listed above and those listed in 3.2 can be seen in Appendix A. The e-mail was changed slightly based on the recipient, and included how we heard of the person or organization. Our reply to their initial responses varied greatly because our project continued to change as replies came in. We provided each contact with updates and our new websites as they were created, in order to get the most accurate help from each person and organization.

3.2 Researching Communities through Company and Organization Interviews as well as Online

We contacted 6 local businesses and organizations, beyond our contacts at the Tesuque Pueblo. Our sponsor recommended each of them for different reasons. More information about our methods of contacting can be seen in 3.1 and a sample e-mail can be seen in Appendix A. We ended up setting up 3 interviews and 2 tours. We provided each contact with a PowerPoint explaining our project, and how it affects them, specific to each organization. Listed below are each of the businesses and organizations and a summary of what we expected from our meetings, and what we got out of them.

New Energy Economy – met with Mariel Nanasi and Lilia Diaz. We hoped they would let us use their Native Power Initiative as a success story, and asked them for any data they have regarding positive sustainable change, especially on the financial side. We invited them to submit a summary of their organization for our website, and they did. They were extremely informative, and went above and beyond what we expected. It turns out they have a grant for renewable energy on native land, but haven't decided where to use it yet, so if the Tesuque Pueblo has a good place to put solar panels, they can find funding.

Positive Energy – the woman Mark suggested we contact has an auto response set up on her e-mail for Positive Energy about not working there full time anymore. We e-mailed the addresses she recommended in the auto response, but did not hear anything from this organization.

Local Energy – We contacted Mark Sardella, and he asked for us to call him. We sent him a PowerPoint so he could know about us and our project before the call, and then we called him. We each took pages of notes during our conversation with

him, and he sent us an Energy Assessment Checklist and Energy Efficiency Recommendations for Commercial Buildings.

The City of Santa Fe – We contacted Nick Schiavo, the Energy Specialist for the City of Santa Fe. He responded almost immediately, and we were able to set up an interview with him that week. He told us that he always looks at energy efficiency options before renewable resources, which is a big part of why energy efficiency is such an important part of our website. Nick gave us a tour of the solar panels that the City of Santa Fe has put in and a work in progress.

Sacred Power Corporation – Dave Melton replied quickly, but was extremely busy, so we never talked to him on the phone or in person. He didn't even have time to provide a summary of his company, so we used the information from his website.

Santa Fe Community College – Mark suggested we get a tour of the new building on campus. We talked to Randy Grissom almost immediately and set up a time to tour the Trades and Advanced Technology Center. He explained the reasoning for almost every aspect of the building, which will hopefully be LEED Platinum Certified. He introduced us to various people in the building who explained their work to us. At the end of our tour, he gave us a flash drive with SFCC's sustainability plan and various other documents having to do with sustainability. We expected a tour of some interesting building, but got the tour with great explanations every step of the way, and some extremely useful documents.

Through these interviews and tours we learned more about efforts towards sustainability in local communities. Information on how these projects were started, funded, and any issues the organization or company faced aided us in the project. Understanding the current efforts in the area was also beneficial when creating the websites. We utilized these interviews to the best of our ability so that the most information could be passed along. We created the business interview seen below in Figure 22, before conducting any interviews, and didn't use it formally, but we did end up asking all of the questions on it anyway.

Business Interview

These questions will be asked during an interview either in person, over the phone, or via email.

What is your company's role in sustainability within the local community?

What difficulties have your company faces while supporting sustainability?

How has your company handled these difficulties?

What roadblocks have the local government or companies put in the way of sustainability for community members?

Has this affected your company?

What are the state incentives for people to move towards sustainability?

What are the federal incentives for members of the community to become sustainable?

Are there any grants available through the EPA or the BIA (Bureau of Indian Affairs) for Native Communities?

Figure 22: These questions provided a guideline for the interviews.

3.3 Researching Best Practices in Sustainability

We researched best practices in sustainability, or as we call them for the project, “success stories,” covering the three aspects of our sustainability plan framework (agriculture, renewable resources, and water conservation). These tables can be seen in the Sustainability Action Plan Framework located in Appendix I. This was done via the internet as well as by contacting the leaders and officials mentioned above for further information that may not be accessible online. We created a synopsis of each success with an explanation of why it succeeded, which was linked to a detailed version of the success story that covers all aspects of the effort, including financial issues and any other roadblocks the organization ran into throughout its project.

4 Student Survey Results

Sustainability knowledge was recorded through the use of a general information survey, which can be used in future months to gauge the effectiveness of the education methods implemented. We also used the information we found to gauge student interest in sustainability use and education. The results gathered from this survey were able to help us identify any gaps in the current curriculum as well as any success stories that may have otherwise gone unnoticed. The survey can be seen in Appendix B and graphs of the results can also be found in Appendix B

When the surveys were printed, each team member was escorted by a SFIS student to classrooms whose teachers had given us permission to administer the survey. Upon arrival each team member gave a brief description of our project and the survey before it was distributed. 94 high school students, representing the Santa Fe Indian School high school student population, were surveyed; ages 14 to 19. The survey took approximately 5 to 15 minutes to complete. The team members collected and randomized the surveys. The survey responses were put into an excel spreadsheet and standardized (i.e. spelling and capitalizations) in order to create graphic representations of the survey results.

In the survey the students were first asked their age and gender. The average age of the students was 16 and the female to male ratio was 53:41. Then we asked what pueblos and tribes they belonged to and whether or not they lived with their tribe when they were not in school. We created the graphic illustration to show all of the pueblos the students belong to and their

distribution using pie chart slices. The greatest percentage of the surveyed students came from Santo Domingo Pueblo (15%), Ohkay Owingeh Pueblo (14%), and Navajo Nation (13%). The full distribution of students can be seen to the right in Figure 23.

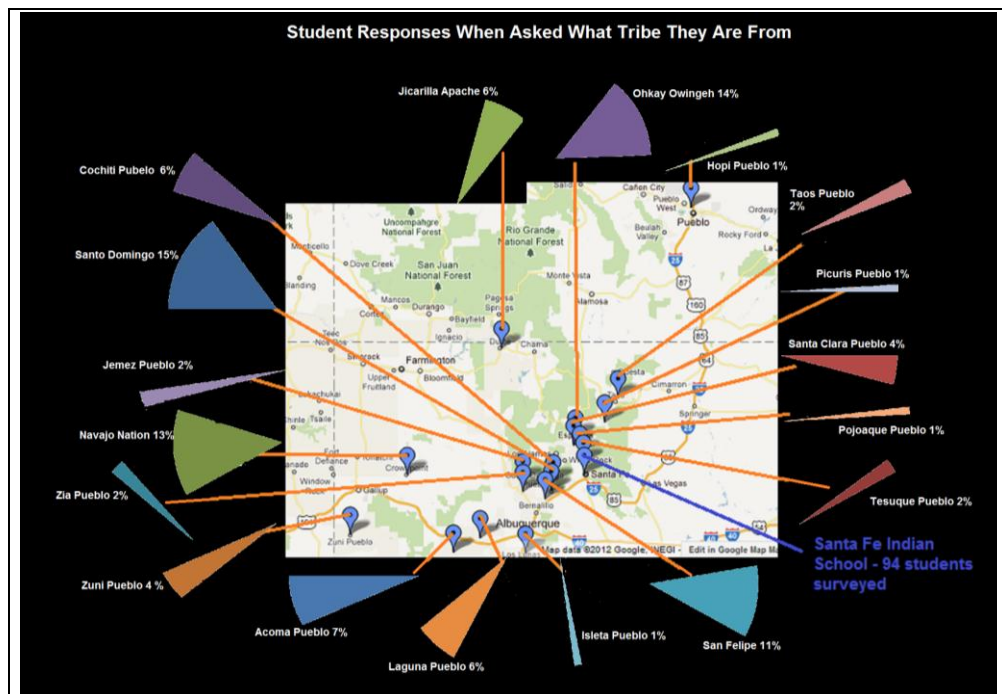


Figure 23: Distribution of students surveyed amongst the pueblos and other Native American communities.

The students were also asked about their family’s contribution/role in the community. The students could circle as many as applied to them and almost all circled more than one role. 76 of the 94 surveyed circled “Tradition” as one of the roles their family has in the community. It is clear that tradition is a fundamental component of Native American culture and is consistent across all pueblos. Other frequent responses included “Farming” and “Art.”

The next survey question read “Does your family grow any crops? If yes, what?” as well as “Does your family raise any livestock? If yes, what?” The responses to these questions are portrayed on the spikes of the cactus illustrations shown on the left of Figure 24. They are organized by the branches with the groups “vegetables,” “fruit,” “livestock,” and “other.” Students were also asked what they feel makes a Native American community successful in agriculture. These responses make up the roots of the cactus because they are the foundation of the successful growth of agriculture. Recurring responses included the concepts of teamwork, tradition, commitment, respect and relevant resources. The collective responses of the students illustrated a community that functions as a unit and utilizes its resources in collaboration with traditional practices to develop agriculture. Finally on the right of figure 24 one can find the results for when students were asked how often they eat food grown in their community, on average the students said “monthly.” The responses of the students provide insight to the potential reasons behind Native American communities’ successful agriculture.

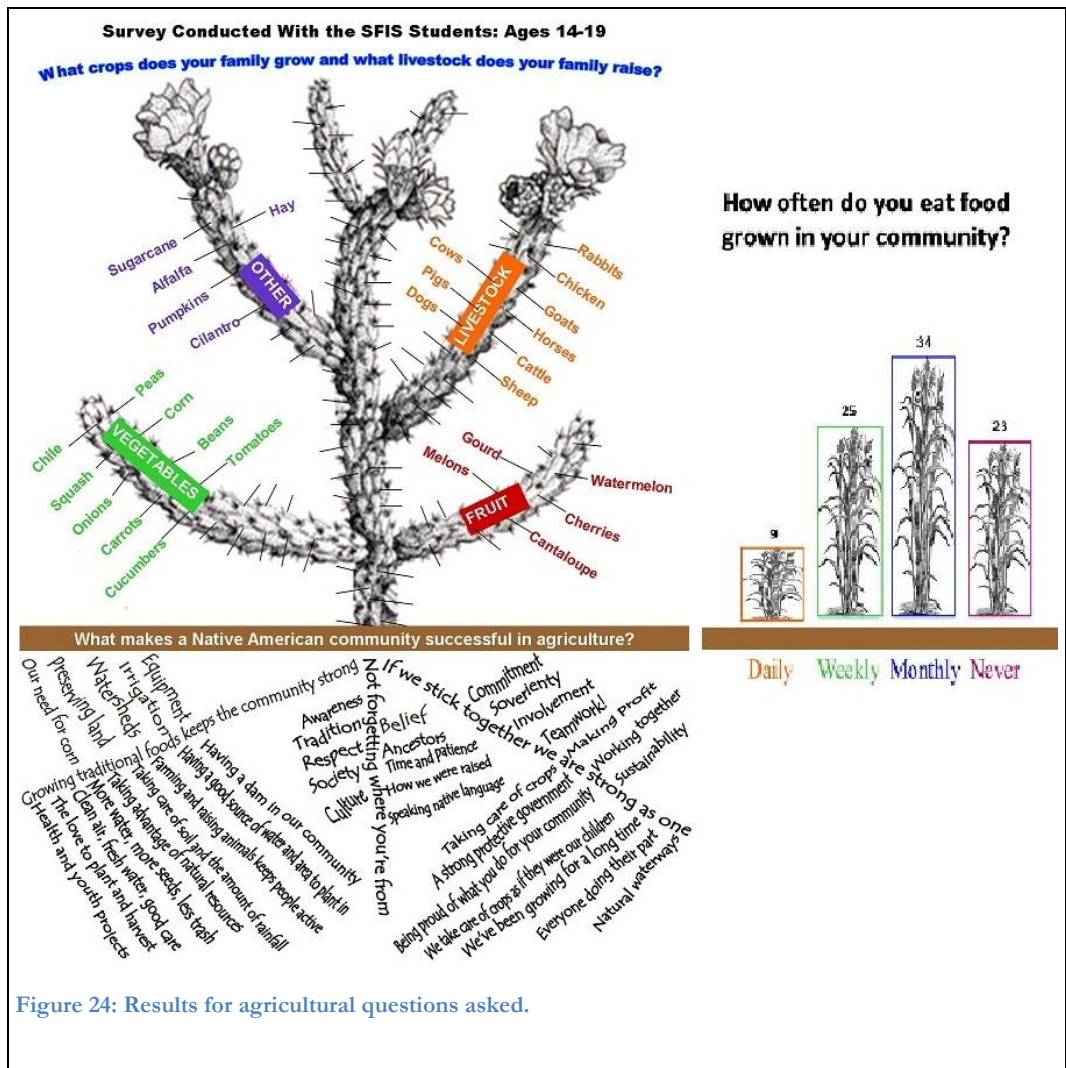


Figure 24: Results for agricultural questions asked.

We asked for their source of electricity and how often they have electricity in their home. 81% said that their electricity came from a company and it can be inferred that this company is PNM. 14% responded saying they have community generated electricity. A few of the

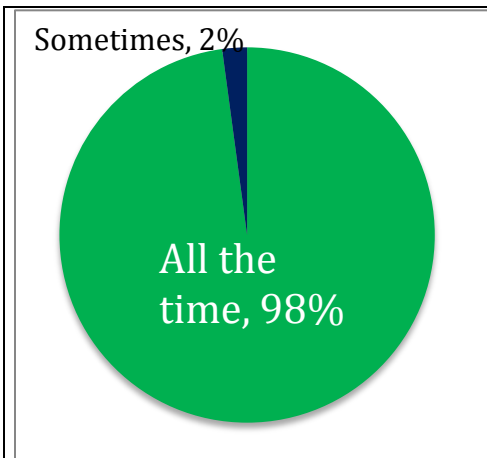


Figure 25: The pie chart above illustrates the survey responses to “Do you have electricity in your home?”

pueblos have solar panels but we could not confirm that any of these actually supply electricity to homes in the pueblo. The team speculates that a portion of the students do not understand the distinction between community and company generated electricity. The other 5% did not respond to the question. 92 of the 94 students said they have electricity in their homes all of the time, the other 2 said sometimes. This question is relevant because there are many changes a household can make to limit their electricity usage and bills. The responses can be seen below in Figure 25.

The students were also asked whether or not they have internet access in their home; 42%

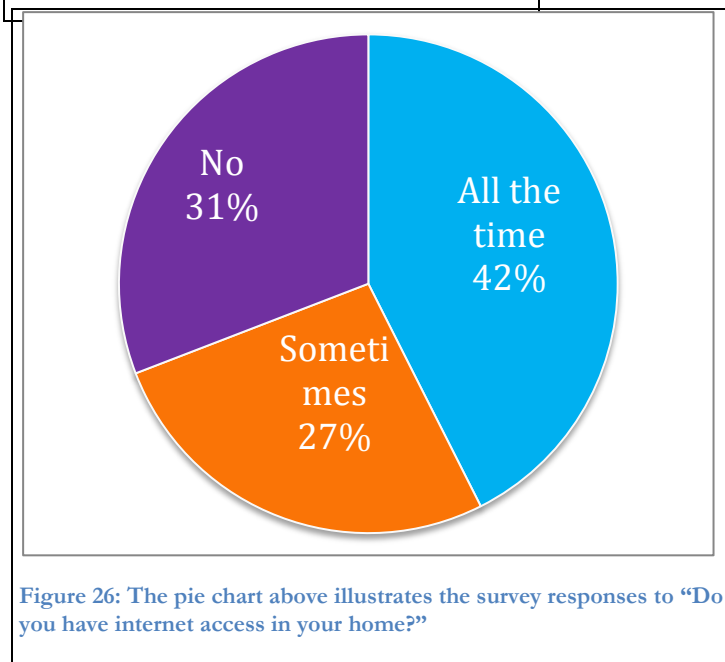
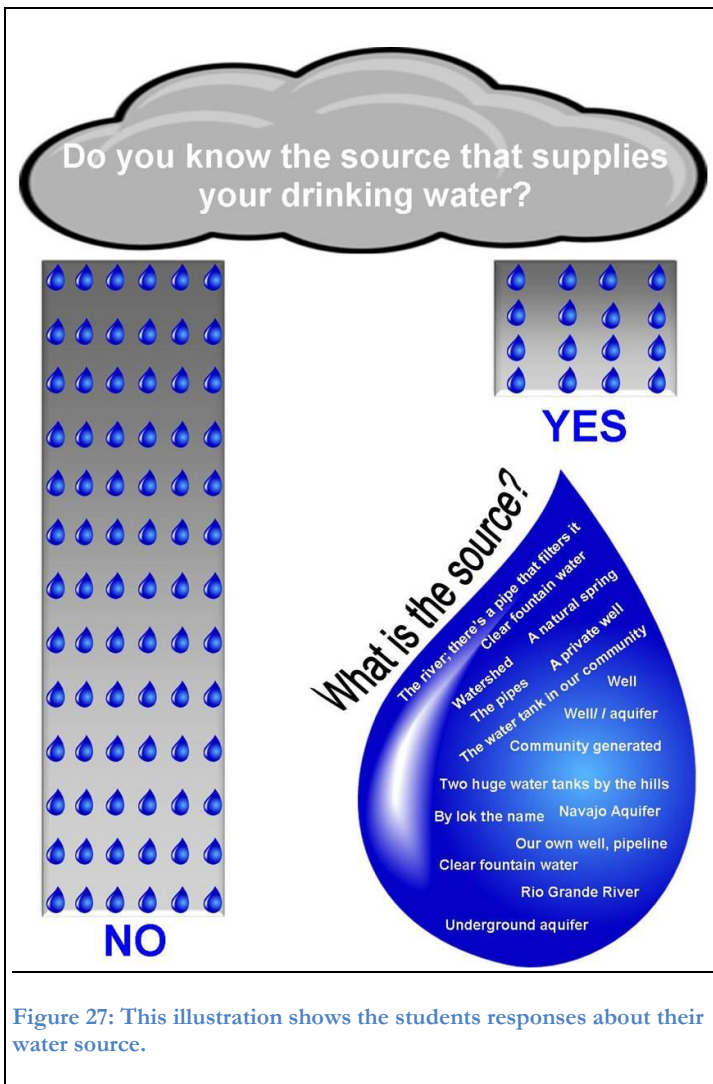


Figure 26: The pie chart above illustrates the survey responses to “Do you have internet access in your home?”

said all the time, 27% said sometimes, and 31% said no. This question, seen in Figure 26, was pertinent to our project because the “Positive Sustainable Change for Native Americans” website needs to be easily accessible for the pueblo communities since it is a resource designed for them. Just under half of the surveyed students said they have internet in their homes all of the time. The pueblos have internet access in their community buildings so the members still have internet access available to them. This essentially increases the effectiveness of our project

because it is crucial for the longevity of our website that people have access to and use the “Positive Sustainable Change for Native Americans” website.

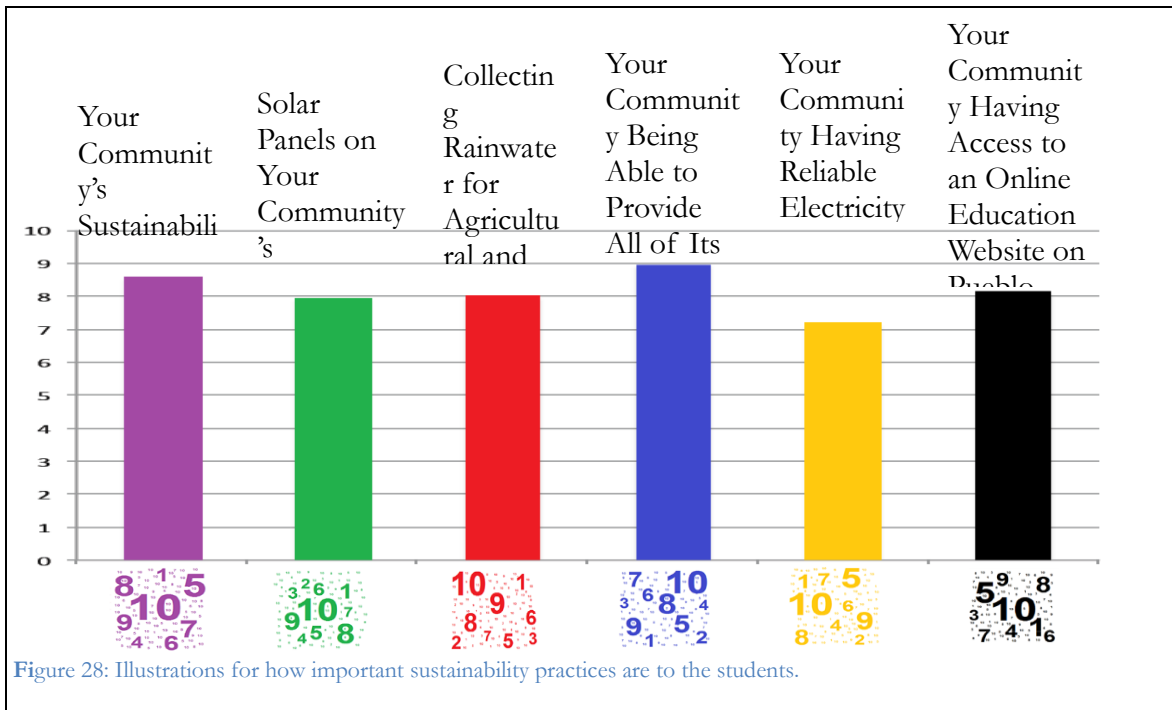
The next survey questions read “Does your family have running water in your home?” and “Do you know the source that supplies your drinking water? If yes, what?” Only 16 of the 94 students said that they knew the source that supplies their water. It was evident, that of those 16, many did not truly know where their drinking water comes from, as there were answers such as “the pipes” and “community generated.” Other students were more knowledgeable and listed the specific name of the well or river that supplies their water. All



these responses can be seen in Figure 27. In a location where water conservation is vital, being aware of the source of water that sustains you is important. Sustainability education courses would help students understand the importance of knowing all of the topics mentioned in the last few paragraphs.

The next section of the survey asked students to rate how important different concepts of sustainability were to them with “1” being “unimportant” and “10” being “very important.” On average, the students ranked all of the concepts with a value between “7” and “9” indicating that all of them were important. The most frequent response for all of the concepts was a “10” meaning that those who support sustainability consider it to be very important to them. On average, the surveyed students

considered “your community being able to provide all its food” to be the most important aspect of sustainability. In Figure 28 below the bars show the average responses from the students while the number clouds show the frequency of the responses. The larger the number, the more responses that number received.

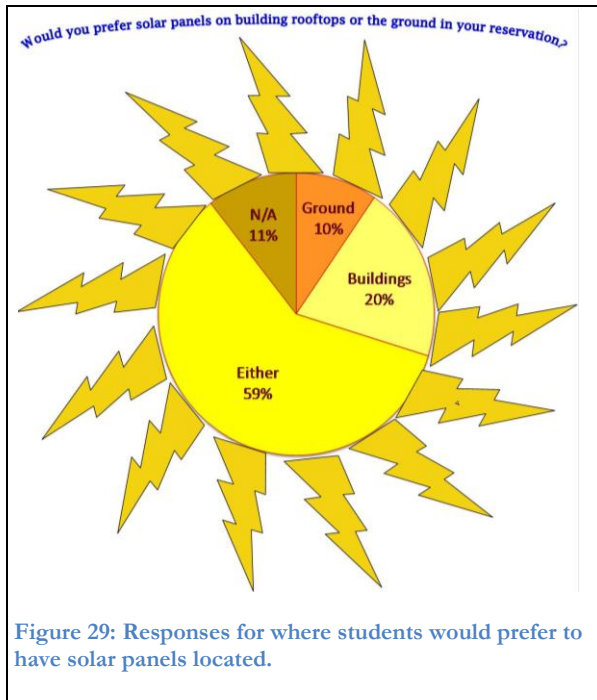


Then the students were asked “Do you feel that solar panels on your community's reservation would negatively impact the culture of your tribe? If yes, why?” and 78% of the student’s said no. Some of the reasons students had for believing solar panels would negatively impact the culture of their tribe are listed:

- Religion
- Visually taking away from traditional areas if not well hidden
- Getting in the way of their tradition
- Getting in the way in general
- Because it is the white man’s way
- Because it would be adapting to mainstream white society
- People wouldn’t be able to use them

Sustainability education would allow students to form a non-biased opinion on how solar panels can positively and negatively impact their community. Some students that responded with “yes” said that it would help them save power, lower electricity bills, stop global warming, benefit the tribe to not have to worry about power, and conserve energy.

These responses indicate that several students misunderstood the question and responded with how solar panels would positively impact the culture of their tribe. The final question we asked the students was “would you prefer solar panels be built on the on the ground or on top of the buildings on your reservation?” This was a multiple choice question with the option of “Ground,” “Building,” or “Either” and 59% said either.



The student survey responses provided us with a foundation for our sustainability curriculum framework because we needed to gage the level of knowledge on sustainability and their interest in engaging in particular sustainable efforts.

5 Creating an Online Resource for Local Sustainability Applications and Education

Using the information gathered throughout the project, we created a website covering a broad range of sustainability information, with the option to explore each topic in greater detail. The general topics are agriculture, renewable resources, and water conservation, but other information is also available. The sustainability education tool was designed for the Santa Fe Indian School and other interested people in the Santa Fe area, specifically residents of pueblos and similar communities. The data collected in the student surveys previously mentioned was used to indicate the extent of the sustainability knowledge of the students at the school, the sustainability education program currently implemented, and how it could be expanded and improved to better suit the needs of the people. The educational tool is an interactive website that is both entertaining and informative, allowing students and their communities to enjoy using it as they learn.

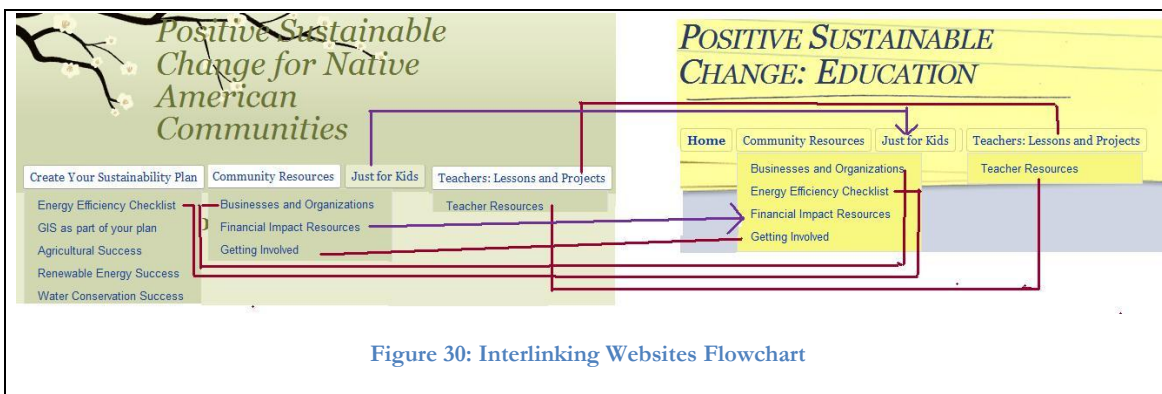


Figure 30 shows how the two websites interconnect. The red lines show which pages provide the exact same information. The purple arrows show the pages that provide links to another, with the arrow indicating which page the link brings you from and to. If there are no arrows that page stands alone and is only accessible on one page.

We created these two websites, one focused on education and one focused on resources for Native American communities. Both websites have a page called “Teachers: Lessons and Projects” which teachers can use to upload or download lesson plans. Both websites contain tabs called “Businesses and Organizations”, “Energy Efficiency Checklist”, and “Community Resources”. The two sites also have the pages “Just for Kids” and “Financial Impact Resources”, which are on the educational website, but links to them are on the Native American communities’ site, along with information specifically for Native Americans.

These two websites each required specific criteria.

The “Positive Sustainable Change for Native American Communities” website has to be geared towards sustainability within Native American Communities. It needs to have the ability to house the Sustainability Action Plan Framework, as well as allow for clean formatting of success stories. We originally desired a website that would allow users to create profiles where they could track their improvements and sustainable changes. We also wanted

to allow users to upload files that could be accessed by any other viewer. Due to time constraints and a lack of programming ability the team chose to use a Google website. Due to this decision, we were not able to put profiles or uploading abilities into effect.

The “Positive Sustainable Change: Education” website should have the same desired criteria as listed above for the Native American site. The main difference is that instead of being geared towards Native American communities it is geared towards educating general communities. It will not need to house the Sustainability Action Plan Framework or success stories. This webpage was also created through Google sites for the same reasons listed above.

Finally, the websites also need to be promoted amongst both the Native American and the educational communities. To do this the team created a handout for students to take home to their families. This handout, which can be viewed in Appendix H, explains our project and the aspects of one of our websites. It also contains the link for the website so that families can go online and use them. This is how we promoted our “Positive Sustainable Change for Native American Communities” website to the Native American community. The team is also tasked with promoting the educational website to the Santa Fe community. We contacted Will Barnes at the Santa Fe Girls’ School and Lisa Randall with the Santa Fe Public School to share our educational website. Lisa Randall passed the website along to the teachers in the public schools to use and upload lesson plans. Both websites were also placed on the Santa Fe Indian School website as resources for families to use.

6 Sustainability Education

The team worked to uncover many sustainability education practices throughout the Santa Fe area and the rest of the country. We compiled various information regarding curriculums, lesson plans, and potential projects that teachers can utilize within a classroom. We met with many educators to gauge their opinions and needs to best include everyone's desires within the tool that we turned into a website. The team then created an educational website based on sustainability that covers a wide range of users. The website includes individual learning online, information to further the individual learning process with classes, workshops and volunteer opportunities, as well as a location that teachers can use to share and gather ideas for sustainability education within the classroom. This section outlines the steps taken to gather the information and nicely organize it into a useful website.

6.1 Compiling Successful, Innovative Ideas from Teachers in the Area

In addition to researching online (as explained in section 3.2) and surveying students (as explained in 3.1), we contacted educators in the Santa Fe area, starting with Mark Ericson at the Santa Fe Indian School, and moving on to Will Barnes at the Santa Fe Girls' School at the suggestion of Professor Carrera. Our professor also suggested we speak with Eileen Everett, the Education Director for the Santa Fe Watershed Association and she gave us contact information for Lisa Randall, the Energy Conservation Program Coordinator of the Santa Fe Public Schools. Ms. Randall connected us to teachers in the school district and other districts in the area. We decided to plan the framework for a curriculum based on hands-on learning, with lectures and field trips included when possible, so ideas and advice from teachers regarding those ideals were considered.

6.2 Collecting Lesson Plans

Using the teachers we contacted for section 3, we created a form to collect sustainability lesson plans. The "Teachers: Lessons and Projects" tab on each website has a link to "Share a Lesson Plan or Project" and lesson plans shared on either website go to the same "Plan Summaries" document, so that teachers can read important information about each other's plans before choosing to download them from the links in the "Submitted Lesson Plans" Google spreadsheet.

Will Barnes was a big help when we were creating the form. We tested it by having him find and use it on his own, and then wrote down all of his concerns, and made changes accordingly.

When we met Eileen Everett and some other environmental educators at a meeting they were having, she suggested that we reach out to the public school system, because they are more constrained by lesson plans than the private school teachers we had been meeting with, who can take their students on educational field trips on a weekly basis.

Marcia Barton contacted us after receiving our information from Lisa Randall, and suggested we find websites with lesson plans on them, because teachers are very busy right now and the year is winding down.

We found a few sites with sustainability lesson plans, and shared them on the "Teachers

Resources” page, but we still like the idea of teachers in the Santa Fe area interacting with each other, so we continued to share the lesson plan sharing form with the teachers we are in contact with. One way of doing this was showing our website to the teachers at SFIS and inviting them to share lesson plans. We also asked Mark to add a lesson plan, as an example, but also as a beginning.

We encouraged Mark Ericson and other teachers we have been in contact with to upload lesson plans. We asked the educators for feedback on how easy the process was, and made changes accordingly. We also asked Mark to create a lesson plan based on our framework, which is described in the following sections.

6.3 Researching Sustainability Education and Hands-on Learning

We went beyond the information from teachers and researched sustainability education and classes such as the one we chose. Multiple options were considered, but they were narrowed down to a concise list for the school to look at when deciding whether or not to utilize this plan for a class. We designed a curriculum outline, seen in appendix C, which provides resources for lesson plans, ideas for speakers, and field trips.

6.4 Curriculum Framework Criteria

A curriculum framework should be broad and general. It should be able to be utilized by teachers anywhere for students of all ages. It should also be easy to understand. This framework needs to outline important concepts for students to learn. It should then provide subtopics so that teachers can choose a subtopic to focus lesson plans around. This document should not outline a curriculum to be used but instead identify the key concepts in sustainability education.

6.5 Curriculum Framework Creation

The curriculum framework, found in Appendix D, is based off of other frameworks that we researched. The principles and goals that the framework sought to achieve are to recognize the duty of educators to assist learners in applying sustainable practices through inquiry and critical thinking. The elements that compose the introduction and definition of the framework were based off issues that were outlined by UNCED in their Agenda 21- Rio Declaration. This declaration acknowledged the interdependence and functionality of ecosystems in the Earth. Other topics that Agenda 21 acknowledged were the need to preserve and restore the ecosystems of the Earth, the cooperation of all people to address unsustainable behavior and consumption, and the need for the youth to be creative and educated in the field of ecosystem preservation and sustainable practices. Particular chapters of this declaration highlight education specifically therefore, one can see that there has been authoritative documentation of the need for sustainable education in society. Reference to this declaration and other definitions of key aspects in a curriculum framework were provided by The International School Association as well as Second Nature: Education for Sustainability. Both of these organizations work to promote sustainability efforts and practices and provide examples of curriculum frameworks on their websites (Anonymous 2007).

6.6 Curriculum Outline Criteria

The curriculum outline is specific to the design of a class for the Santa Fe Indian School. A curriculum outline should contain ideas and notes for teachers looking to pursue a full class sustainability curriculum. This is not a document looking to teach sustainability as a mini lesson over a few days. This outline should contain information for teachers to use to develop their own lesson plans. It should be more detailed than the curriculum framework mentioned above in 6.4 and 6.5.

6.7 Curriculum Outline Creation

The team conducted research to find sources of well thought out lesson plans. These sources were compiled into a document along with other aspects of the outline that follow the class design we focused on. We searched for sustainability examples within New Mexico that teachers could use as field trips to teach their students about successful practices. We also compiled a list of businesses and organizations that a teacher could use a representative from as a guest lecturer. Furthermore, the team compiled resources for project ideas and activities that can be utilized in a classroom setting.

6.8 The Sustainability Curriculum Framework

This framework serves as an outline for educators to effectively model a curriculum based on sustainability. The framework includes major concepts and topics that are relevant within sustainable practices.

We define “sustainability education” as the learning process that applies problem-solving and critical thinking skills, scientific and social literacy, and a commitment to engage in responsible individual and cooperative actions. These practices can help maintain a self-sufficient community that is economically stable and prosperous. This definition recognizes the duty of educators around the world to assist learners in applying sustainable practices through inquiry and critical thinking.

In the full sustainability curriculum framework, in Appendix D, topics and corresponding subtopics are followed by an explanation of their relevance and importance in sustainability curriculums. Each topic can be drawn individually from the curriculum using the subtopics to incorporate it into the classroom. The topics can also be used collectively to create an entire sustainability curriculum.

The final component of the sustainability curriculum framework is the “leading concept chart/themes.” This chart includes; the leading concept, desired outcome, learning themes/interactions, activities/plans, and evaluation. The purpose of this chart is to provide the user with key sustainability concepts, the appropriate age groups they should be taught to, and suggestions for how to teach the lesson to receive the desired outcomes. (See Appendix D for the full Sustainability Curriculum Framework)

The team has made this document accessible from both the Educational and the Native American websites explained in chapter 5. It is intended to be downloaded and a starting location for teachers looking to implement sustainability education. It serves as a resource for educators to utilize in designing individual lesson plans and full sustainability curriculums. It is the team’s desire that schools in and around Santa Fe will begin using this framework when implementing sustainability education. This document is intended to reduce the effort of educators in designing a sustainability curriculum or class from scratch. With its help one

can reduce the necessary research to find and locate information about sustainability education and evaluation.

6.9 The Sustainability Curriculum Outline

The curriculum outline contains resources that can be utilized and adapted for all class styles and age groups, providing potential lesson plans related to sustainability. It is a supplementary source for the “Sustainability Curriculum Framework” that we have created. The “project resources” section contains a list of resources with links that provide hands-on learning opportunities that can be incorporated into the classroom. The “lectures” section describes ways to effectively create an interactive learning environment such as having students share sustainability efforts that their own community has implemented. Lastly, there is a “field trips” section that offer links and descriptions to local informative field trips that students can benefit greatly from. This outline is intended to be a tool for teachers looking for existing sustainability lessons and programs.

This outline was designed for a course specific to the Santa Fe Indian School which encompasses sustainability and cultural practices. The team would like to see this class or one similar implemented at the school. The outline clearly lays out the resources for each portion of the class style chosen; lectures, field trips, projects. It is hoped that these resources, which can be accessed on both “Positive Sustainable Change” websites under the “Teacher Resources” tab in the drop down menu of “Teachers: Lessons and Projects”, will decrease the necessary research that the teachers at the school will need to complete to implement a class such as this. It is provided on the Educational website as an example for sustainability education class outline as well as for people to utilize the most useful resources the team located. The team would like to see other schools in the Santa Fe area utilize an outline such as this one to create course designs for this own school.

6.10 Creating an Educational Website to Meet Various User Needs

The “Positive Sustainable Change: Education” website provides a resource for the Santa Fe community to learn more about sustainability. Through the utilization of this website children can learn through games, teachers can gain valuable resources for teaching about sustainability practices, and community members can learn about how they can improve their personal practices. The section below outlines the purpose and intended use of the pages available on this website. The homepage can be viewed in Figure 31 below. This page does not contain pertinent information to the user but gives an introduction of who the group is as well as what can be found throughout the website.

6.10.1 Testing the Teachers Page Usability with Will Barnes

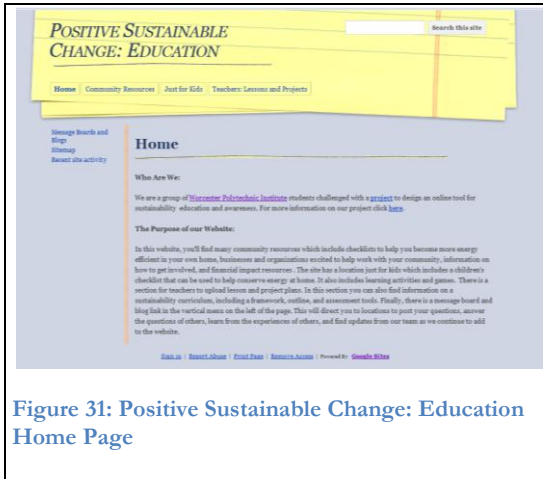


Figure 31: Positive Sustainable Change: Education Home Page

We met with Will Barnes, a teacher at the Santa Fe Girls' School, to discuss our plan for a curriculum. We asked Mr. Barnes to sit down and take a trial run through the website without assistance from us. He gave us a lot of useful feedback, both by using it, and by voicing his opinions. We watched as he tried to navigate his way through the site and as he filled out the form to upload a lesson plan. Before, we did not have a spot to upload a file itself. Because of this meeting, we decided that we needed to have a process of uploading the lesson plans. This led to the development idea of utilizing Google documents and their privacy setting

to our advantage. The first question on the form now requests a link to the Google doc with the user's lesson plan. We request that they use the setting "view by anyone with a link". This allows other viewers to access that lesson plan but removes the option for them to edit the original version online.

From observing Will Barnes use the website, we were able to gain advice for the final design of our "Teachers: Lessons and Projects" page. Some features that showed up because of errors in embedding (like extra scroll bars) were difficult for Mr. Barnes to navigate and he told us he would not have found them if we had not pointed it out. For this reason, we removed the embedded form and left it as a link. From this, we learned that it was necessary for us to keep in mind usability. After educators fill out the form, including the link to the lesson plan, the information will show up in a spreadsheet summary that is accessible for all website users to view. This is how they can gain access to the other lesson plans and modify them for their own use.

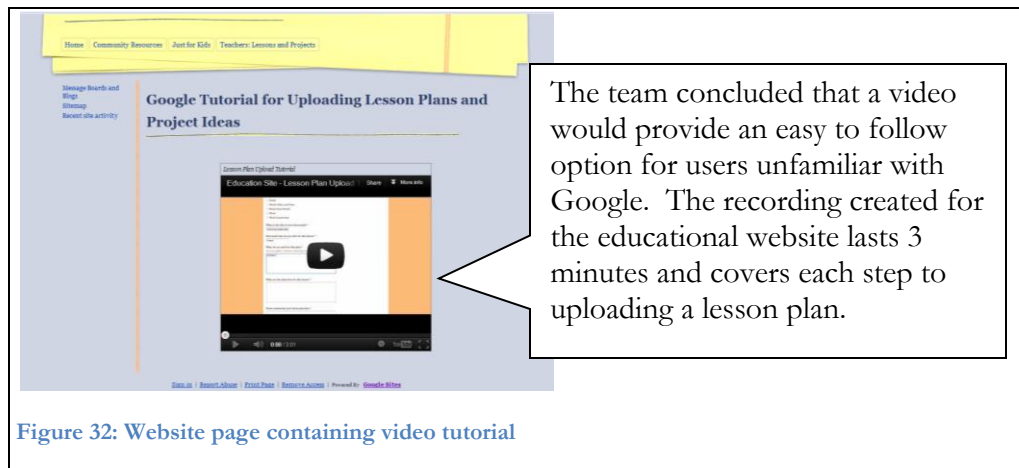


Figure 32: Website page containing video tutorial

From here, the team determined that creating a tutorial video to place on the website would help any users who may still have difficulty navigating their way through the uploading process. The page containing the tutorial can be seen in figure 32. The team used QuickTime, a screen recording program, to create a walkthrough of uploading a test lesson plan. This allows the page to remain independent after the conclusion of the project.

6.10.2 Teacher Resources Found in Our Websites

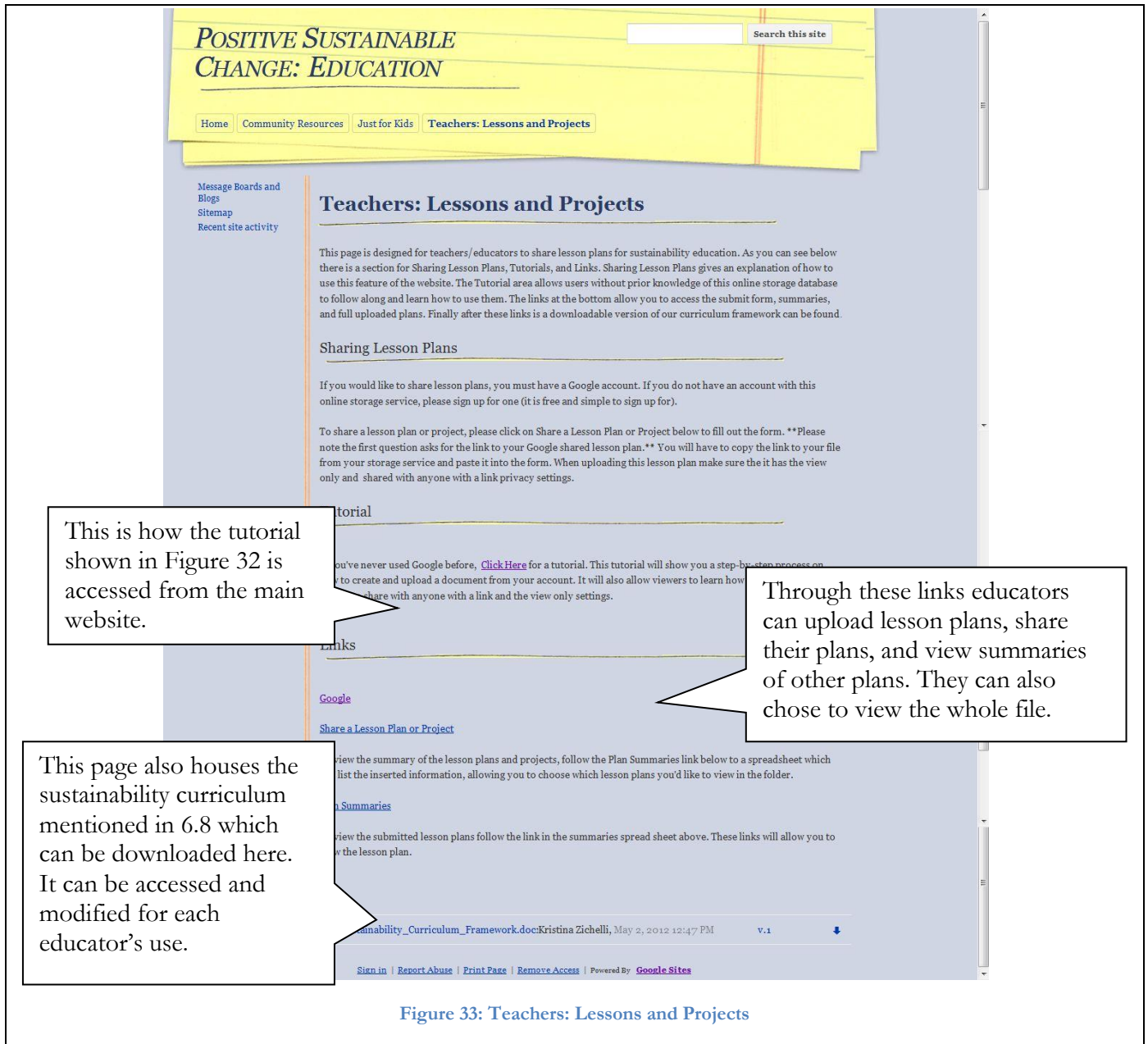


Figure 33: Teachers: Lessons and Projects

The purpose of the Teachers: Lessons and Projects page viewed above in Figure 33 is for educators to utilize the resource provided to create their own sustainability curriculum or lesson plan. This website has been sent out to many schools and Lisa Randall of the Santa Fe Public Schools, who has forwarded it along to all the teachers in the district. Through this connection the team has heard from many teachers interested in using our website. As this continued we have watched and seen lesson plans begin to get submitted onto this page. The curriculum framework and the curriculum outline that the team has designed are intended for educators to utilize when determining how to incorporate sustainability into their current curriculum.

The screenshot shows a website navigation menu with tabs for Home, Community Resources, Just for Kids, and Teachers: Lessons and Projects. The Teachers: Lessons and Projects tab is selected, and a sub-menu item 'Teacher Resources' is visible. The main content area is titled 'Teacher Resources' and contains a paragraph about a curriculum outline for 'Sustainability through Culture Preservation' at Santa Fe Indian School. Below this is a list of resources available for lesson plans, including the Green Schools Program, EPA Resources, Green Teacher, and others. Three callout boxes provide additional context: one on the left explains that the page provides a curriculum outline for Santa Fe Indian School; one on the right explains that teacher resources can be found under the Teachers: Lessons and Projects tab; and one at the bottom right explains that users will find resources for lesson plans, projects, and fieldtrips.

Home | Community Resources | Just for Kids | **Teachers: Lessons and Projects**
Teacher Resources

Message Boards and Blogs
Sitemap
Recent site activity

Teacher Resources

Below is a curriculum outline that our team created. It outlines a class which we designed for the Santa Fe Indian School called Sustainability through Culture Preservation. It is intended to be a semester long class for juniors and seniors in high school involving guest lectures, field trips, and projects. Below are all the resources we have put together. The resources can be utilized and adapted for all class styles and age groups. A pdf version of this outline can be found at the bottom of the page.

Sustainability through Culture Preservation

Resources available that could be utilized for potential lesson plans regarding sustainability

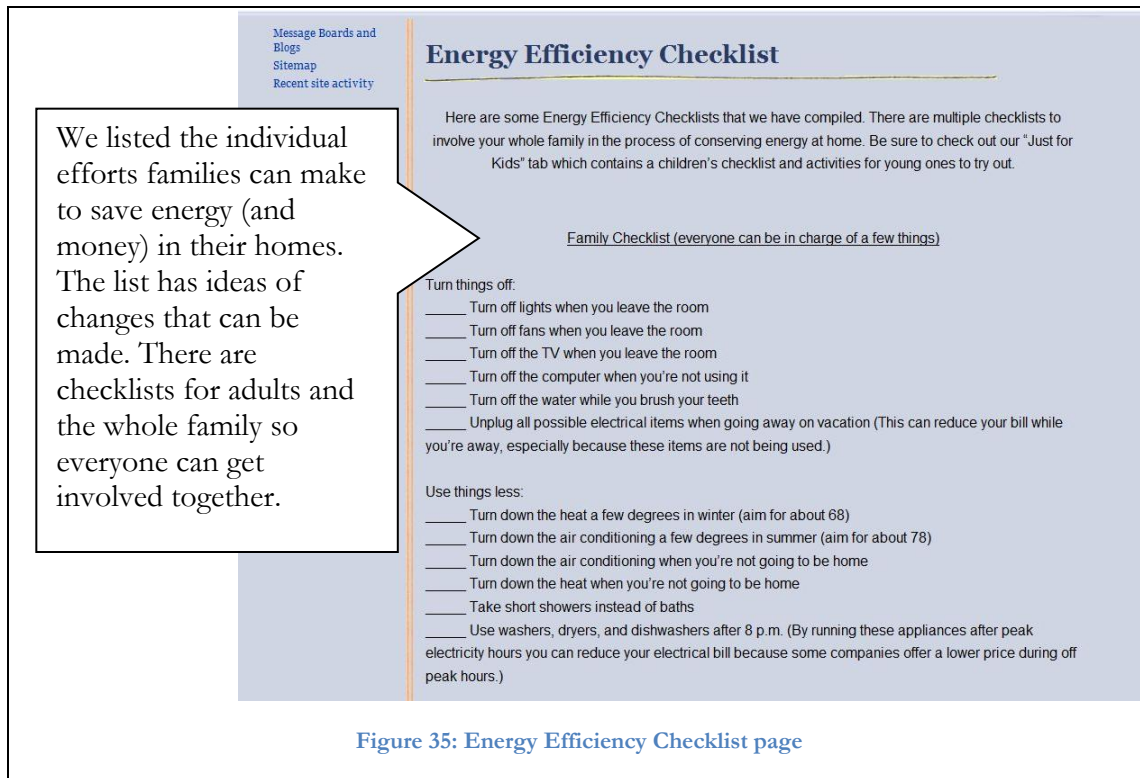
1. [Green Schools Program](#) - This site empowers students to make a difference in the way their school uses energy. Students learn about energy and the importance of energy efficiency and are trained to use a diagnostic toolkit to assess energy usage. Funding often comes from utility companies, and the program is available at school systems.
2. [The EPA Resources](#)
 - a. Games for K-12 students
 - b. Students - Homework resources, student blog posts, community service projects, science fair projects, internships and summer program opportunities.
 - c. [Teachers/Parents](#) - lesson plans, teacher guides, online resources, publications, school environmental education and environmental education
 - i. EPA Resources:
 1. Air - offers many lesson plans for 9-12 as well as other age groups covering, air quality, Ozone, indoor air, radiation and offers activities
 2. Climate change - basics and details - uses student guide to global climate change
 3. Ecosystems - information and lesson plans regarding wetlands, coral reef protection, estuaries, effects of pollution, exploring estuaries, water shed location, stream conservation.
 4. Energy - Fuel Economy and Environmental labels and lesson plans
 5. Health - asthma, secondhand smoke, lead in paint, dust and soil, mercury, ultraviolet radiation, tap water
 6. Reduce, Reuse, Recycle - basics, hazardous waste, superfund (what is it, activities, and other), reduce school waste, publications (resources), websites and organizations that provide more info
 7. Water - acid rain, clean water act, ground water connection, tracking pollution, water source books
 - ii. External Resources - lists other resources and age groups for each above
 - d. News and deadlines
3. [Green Teacher](#) - magazine that provides articles and activities for ages 6-18 offered in an online database
4. [Center for Integrated Agricultural Systems](#) - Sustainable Agriculture Curriculum for High School Educators Announced provides 6 modules to be integrated into an existing class
5. [Education for Sustainability](#) - provides sustainability education core content standards and sample lesson plans
6. [There's No New Water](#) - curriculum geared towards water conservation and quality
7. [Solar Energy Internationals](#) - resources on renewable energy, climate change, conservation, solar cooking, solar energy kits for classrooms, and teacher grants
8. [New Mexico Solar Energy Association](#) - from oil wells to solar cells, energy concepts primer provides many projects for students to participate in such as passive solar design

Figure 34: Teachers Resources Page

The “Teachers Resources” section within the “Teachers: Lesson Plans and Projects” tab, seen above in Figure 34, provides the Santa Fe community with a class outline full of various resources to find lesson plans and other curriculums. This outline is specific to the

Santa Fe Indian School but provides an example to the community of a class that would address sustainability education. The team would like to see schools throughout Santa Fe utilize these resources and with a few modifications to this outline, implement an appropriate class for that school on sustainability education.

6.10.3 Utilizing an Energy Efficiency Checklist



The screenshot shows a webpage titled "Energy Efficiency Checklist". In the top left corner, there are links for "Message Boards and Blogs", "Sitemap", and "Recent site activity". The main content area has a heading "Energy Efficiency Checklist" followed by an introductory paragraph: "Here are some Energy Efficiency Checklists that we have compiled. There are multiple checklists to involve your whole family in the process of conserving energy at home. Be sure to check out our 'Just for Kids' tab which contains a children's checklist and activities for young ones to try out." Below this is a section titled "Family Checklist (everyone can be in charge of a few things)". Under "Turn things off:", there is a list of items with checkboxes: "Turn off lights when you leave the room", "Turn off fans when you leave the room", "Turn off the TV when you leave the room", "Turn off the computer when you're not using it", "Turn off the water while you brush your teeth", and "Unplug all possible electrical items when going away on vacation (This can reduce your bill while you're away, especially because these items are not being used.)". Under "Use things less:", there is another list: "Turn down the heat a few degrees in winter (aim for about 68)", "Turn down the air conditioning a few degrees in summer (aim for about 78)", "Turn down the air conditioning when you're not going to be home", "Turn down the heat when you're not going to be home", "Take short showers instead of baths", and "Use washers, dryers, and dishwashers after 8 p.m. (By running these appliances after peak electricity hours you can reduce your electrical bill because some companies offer a lower price during off peak hours.)". A callout box on the left side of the page contains the text: "We listed the individual efforts families can make to save energy (and money) in their homes. The list has ideas of changes that can be made. There are checklists for adults and the whole family so everyone can get involved together."

Figure 35: Energy Efficiency Checklist page

There is also a more simple kid's version under the "Just for Kids" tab. Ideas for the checklists were found using the various websites listed underneath the checklist, as well as during interviews. Nick Schiavo was the only one to tell us things that we hadn't already found, but even he mostly only had explanations for the things we already had. The full checklists can also be seen in Appendix E.

This energy checklist, observed in Figure 35, is meant to be used by individuals throughout the community to determine where there is room for improvement. Individuals can use the checklists to start new habits in conserving energy; they may even see differences in their energy bills because of it. This page provides community members with a cost effective way to start working towards more sustainable practices, like utilizing nudge based alternatives to increase their awareness.

6.10.4 Including Financial Impact Resources for Saving by Specific Actions

The Financial Impact Resources section, viewed in Figure 36 below, is supposed to show the community the long term benefits of making sustainable changes versus the initial cost while providing various resources on funding. Through this page a user can access calculators that will determine the amount of money saved through following specific sustainable practices. This page should be used by the community to foresee these changes before determining

their best course of action while providing them with the ability to observe the monetary differences between multiple options being considered. For example through the use of this calculator the team learned that by changing 6 light bulbs in a house the electricity bill will decrease by approximately \$42. The resources can also be utilized by any community that wishes to pursue various funding options for renewable energy applications.

[The remainder of this page has been left blank, continue to the next page for Figure 36]

Located on the “Positive Sustainable Change: Education” website under “Financial Impact Resources” any user can find general information about financial resources. Throughout the page are hyperlinks to the original source for the user to pursue more information.

Financial Impact Resources

Below is a series of calculators and resources that currently exist online. There are summaries with each link informing you of what you will find at each site. Use the sites below to determine how you can make sustainable change without hurting yourself financially and what options are available for funding.

Calculators

1. **You Sustain** offers many sustainable actions calculators. It covers conservation and efficiency, transportation, recycling, renewable energy, and consumer products. It's very easy to use. For example, under conservation and efficiency, if you choose replacing lights with CFL light bulbs, you can choose details or calculate. The details button returns various information including costs and benefits. Then if you press calculate and enter the number of light bulbs you plan to change, it returns a monetary value of savings for the year and the amount of CO₂ emissions that are cut. A view of the light replacement example can be seen below.

2. **Household Emissions Calculator** put out by the U.S. Environmental Protection Agency, allows you to estimate your current household emissions, and then explore options to reduce them. You can also see how much you can save from these actions.

3. **Clean Energy USA** allows you to put in information about where you live, current energy usage, and the PV system. It then returns an estimate for initial costs, any state and federal rebates available, the net cost, and the years it will take to return the investment.

4. **Wind Project Calculator** is a website that allows a community to input specific information about the turbines in consideration. It also requires that you input the estimated average annual wind speed, electricity usage, and rates. If you input information about financing and income taxes, it will return estimates on cash flow for investment and your return on that investment.

5. **My Solar and Wind Estimator** will estimate the cost and size for installing an energy system for any home or building. It takes into consideration the options for both solar and wind energy systems based on the zip code provided. After filling out the information requested, a financial estimate will be returned showing expected savings in bills and net cost after taxes and other incentives.

Resources

1. **Environmental Protection Agency Funding Opportunities** is a resource that directly connects to the EPA webpage about funding opportunities. It lists all the grant categories as well as which grants are still open and accepting applications as well as applicable deadlines.

The calculators chosen for this page allow the users to look into renewable resource as well as energy efficiency options and see the predicted outcomes in their energy bills. The first and second calculator relate specifically to energy efficiency allowing the user to see differences in their electricity bills.

For the third, fourth and fifth calculators a user inputs information about where they live and the calculator returns an estimate for initial costs, any state and federal rebates available, the net cost, and the years it will take to return the investment for the implementation of a solar system, wind systems, or hybrid respectively.

There are also six resources available to all communities regarding funding options. The first four provided on the website are federal grants and loan options, while the last two are New Mexico State grants and loans. These are each linked to their respective websites allowing users to learn more information and pursue their best option for funding.

Figure 36: Financial Impact Resources page

6.10.5 Combining Local Businesses Summaries

The “Business and Organizations” page can be found under the “Community Resources” Tab. The businesses listed are those that the group set up meetings with.

Links to the websites and contact information for local businesses that have made current sustainable efforts or support the move towards sustainability can be found here.

These organizations have provided brief summaries or permission for us to use information from their sites, of who they are, what they do, and contact information. This allows community members to know what they are involved in, saving research time when seeking further information or assistance. For those that did not provide us with information we wrote the summaries ourselves.

Home Community Resources Just for Kids Teachers: Lessons and Projects

Businesses and Organizations

Here is a list of companies and organizations that our group has met with. Below are the companies, a summary of who they are and what they do, as well as a link to their website and contact information. These are groups that we found very helpful while doing our research and who were eager to get involved in helping Native American Communities implement a plan.

Local Energy

Local Energy is a 501(c)(3) nonprofit organization that helps develop their local, renewable energy resources in ways that mitigate the hardships being created by the degradation of fossil energy resources. Through their research, education, and projects, they facilitate the process of developing community self-reliance in energy by supporting local control of renewable energy resources and programs that reduce the flow of energy dollars leaving the community

Specific goals of Local Energy include:

- Promote and advance projects that relieve the hardship of high energy costs on local municipalities, their citizens, and on businesses that are vital to their communities
- Reduce the negative environmental impacts of energy use
- Conduct nonpartisan research to advance the science of renewable energy and energy self-reliance for the benefit of local communities and the environment
- Set up discussion groups, forums, panels, lectures, and similar programs that engage the public with the principles and practices of local self-reliance in energy.

Information provided by LocalEnergy.org

Website: <http://localenergy.org/index.html>
Contact page: <http://localenergy.org/contactUs.htm>

Figure 37: Business and Organizations Page

Figure 37 above shows a glimpse of the “Business and Organizations” page available to the community. It displays Local Energy as an example of how the page is organized. There are various companies and organizations included on this page. These groups are all local and support the sustainability efforts within the Santa Fe Area. Specifically, Local Energy has assisted in energy efficiency and installing solar panels within the Santa Fe community.

This page allows community members to research multiple companies that are involved in sustainability practices all in one place. They can read a summary and follow the link at the bottom of the page to their website for more information or contact the person listed on the site as well. This page can be used by the community as a single location for information on all their local companies allowing them to pursue relationships with the company that best suits their needs.

6.10.6 Compiling a Database for Further Individual Learning

The “Community Resources” tabs on the “Positive Sustainable Change” websites contain one more page for individual learning. This is the “Getting Involved” page. This page shows community members various workshops and classes that they can attend in the Santa Fe area. Community members can attend these workshops and classes to learn how to make their lives and households more sustainable. In Figure 38 below the “Getting Involved” page can be seen. There are many options listed in this table however in Figure 37 only three can be observed. The team spoke with many of these organizations or visited them ourselves to

understand what the community can gain from the experience. The team took a trip to the first opportunity, Gaia Gardens. This garden is growing solely on volunteer work and donations. It is still in the formation phase, however it is intended to be a place for the whole community to utilize as well as assist in providing organic and locally grown crops. Many of these opportunities, like Gaia Gardens, are a way for people to learn in a hands-on environment and help improve their community at the same time.

The screenshot shows a website titled "POSITIVE SUSTAINABLE CHANGE: EDUCATION". The navigation menu includes "Home", "Community Resources", "Just for Kids", "Teachers: Lessons and Projects", and "Teacher Resources". The "Getting Involved" section features a table with the following data:

Name	Location	Opportunity	Contact Information
Gaia Gardens	2255 Paseo de los Chamisos Santa Fe, NM	<ul style="list-style-type: none"> - Community Farming Volunteer Hours: Thursdays and Sundays from 2-6pm - Outreach Coordinator: Someone willing to talk to schools and neighbors to make them aware of the farm in needed. - Compost Pick-up Coordinator: The farm is beginning to collect food waste from various restaurants. Someone to schedule and manage that aspect of the farm is needed. - Facebook Group Administrator: Looking for a Facebook aficionado interested in running our Facebook group. - Grant Writers: Working under the fiscal sponsorship of the New Mexico Community Foundation, a 501(c)3, people experienced with writing grants are needed. 	Project Coordinator: Poki Email: poki@nodilus.org Phone: (505) 796-6000
Southwest Marketing Network	New Mexico	<ul style="list-style-type: none"> - Community food projects: Apply to receive funding from the USDA Community Food Competitive Grants Program - SWMN Conferences 	Project Director: Jim Dyer Phone: 978-588-2292 Email: jaydyer@frontier.net
New Mexico Food and Seed Sovereignty Alliance	805 Early St. Suite 203B Santa Fe, NM	<ul style="list-style-type: none"> - A food and agriculture program that promotes the cultivation of native seeds and protection from genetic contamination - The Outreach and Assistance for Socially Disadvantaged Farmers and Ranchers Program - The Sembrando Semillas Acequia Program- inspire the next generation in agriculture through mentoring and organizing activities for the youth - Community Organizing and Leadership Development Program- governing body of NMAA 	Office Phone: (505) 995-9644 Office Fax: (505) 995-0097 (Send emails via the contact tab at the bottom of the webpage)

Callouts in the image provide the following information:

- "Getting Involved" is located under the "Community Resources" tab.
- Each title is a link on the page to the original source of information.
- The location of the opportunity can be found.
- Each has a description so that people can find what they want instead of trying links at random.
- Contact information is also provided.

Figure 38: Getting Involved Page

"Getting Involved" provides the community with new resources for learning about local sustainable efforts and ways that they can become more involved. By using this page community members can pursue workshops, classes, and volunteering opportunities in which they can learn more about improving their own sustainability practices.

Under the "Just for Kids" tab, there are links to other websites that can further the learning of children through interactive games and activities. This can be viewed in Figure 38 below. There are a total of 6 games, 1 quiz, the kids' energy efficiency checklist, and two links to help kids find their own games and energy efficiency information. This page is intended to be the main hub of individual learning for children. The quiz is difficult and could even be used in classrooms by teachers to learn how much their students already know about sustainability when designing a curriculum around it.

The "Just for Kids" page is designed so that kids can play fun games and learn about sustainability at the same time. We hope that teachers will encourage students to use this site on their own time at home. It is also meant for parents to use with their children so that the sustainability practices transfer from games to life.

The “Just for Kids” tab provides games and a quiz on sustainability as well as the energy efficiency checklist for kids.

Pros and Cons for each game can be found along with a description.

If more games are available on the website those are also listed along with a version for adults or older children.

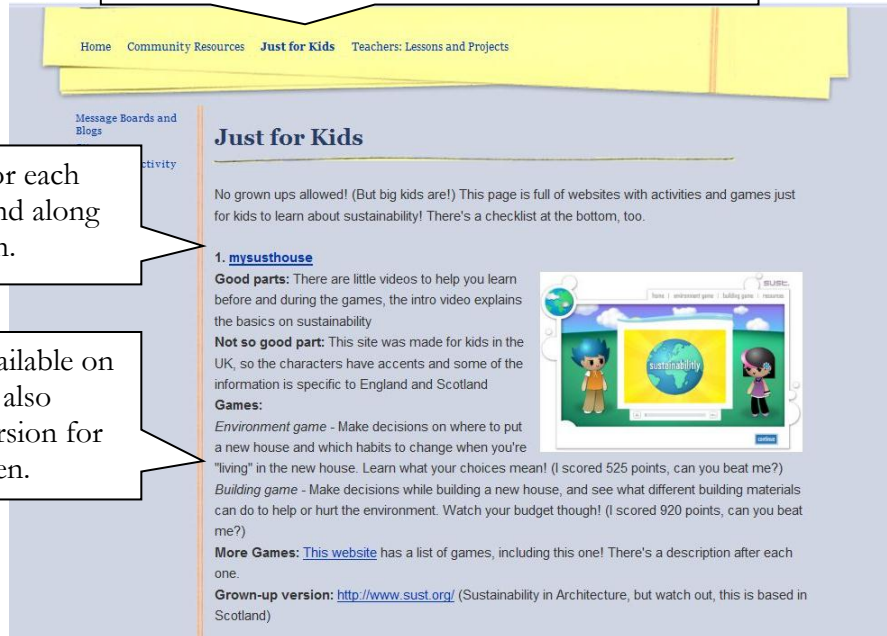


Figure 39: Just for Kids page

7 Sustainability Action Plan

We put together the framework of a sustainability model so that members of each pueblo can take the pieces of the plan that most apply to them. For example, there are multiple options for agricultural help, water conservation assistance, and the implementation of renewable energy. The individual communities can review the success stories that they believe will work best in their community, and pursue the best option. This allows each community to take the best agricultural and water conservation options as well as proceed with the implementation of renewable energy, where in a rigid sustainability model, one of these factors may not apply to them for many reasons.

7.1 Providing Success Stories

The success stories mentioned in part 3.3 were used as options for different parts of the sustainability model framework.

7.2 Sustainability Framework Criteria

A sustainability framework should provide information regarding the current situation with sustainability. It should cover at least the three main topics our project focuses on; renewable energy, water conservation, and agriculture. This document should provide a plan for implementation. It should walk a reader through the general process of implementation including the use of GIS and success stories a community can model projects after. This document should provide the reader with contact information and summaries for the successful sustainable practices. It is important that this framework has a clear mission towards sustainable practices.

7.3 Creating the framework

We analyzed two sustainability plans, The Santa Fe Community College Sustainability Plan and the University of California Santa Barbara Sustainability Plan. Through these, we developed the framework for a sustainability plan. It contains all information that will be needed by every community and leaves space for communities to make choices and input the success stories they wish to use in order to further the sustainable practices within their communities. This allows all communities to use the plan and alter it to their liking. The Sustainability Action Plan Framework can be viewed in Appendix I.

7.4 The Sustainability Action Plan Framework

The sustainability action plan framework includes a set of major concepts and practices within sustainability that provide a basis for more sustainable, eco-friendly community.

The overview, mission, and vision of the framework are followed by a section on agricultural practices that supplement sustainable practices. This section mentions key components for a successful practice such as reducing CO₂ emissions, creating quality food that is also healthy and unaltered, and satisfying the needs of the community that the agricultural field revolves around. The section is then complemented with a set of charts that include success stories related to agriculture as well as local agricultural efforts in Santa Fe. The chart includes information such as the name of the program or practice, the date it was established, where it is located, the reason that is considered to be a successful practice, and contact information.

The next major section of the action plan framework focuses on energy as a component of sustainability. The section opens with information on renewable resources and the recent surge in capacity and interest by organizations and economies. The section includes an energy efficiency checklist for families and adults specifically. This allows heads of households as well as children who are part of these households to participate in conserving energy. Some major sections of the energy efficiency checklist include ways to turn off appliances and utilities, how to use the weather to reduce energy use in a household, and many other tasks people can participate in. Similar to the agricultural practices section of the action plan, the energy section includes a chart with successful renewable energy initiatives in the Santa Fe community and other information. Information included on the chart includes the name of the program or practice, the date it was established, where it is located, the reason that is considered to be a successful practice, and contact information.

This section also includes a chart with water conservation initiatives in the Santa Fe community. It includes information such as name of the program or practice, the date it was established, where it is located, the reason that is considered to be a successful practice, and contact information.

The implementation section ties in the information of the previous major topics and gives an overview of how these concepts can be put into practice through the use of various tools and resources. The GIS, section 7.5.3 and Appendix F, sub-section explains the functions and benefits of GIS mapping with examples of GIS maps of the Tesuque Pueblo. These examples outline the agricultural fields, rooftops, and waterways of the pueblo - therefore allowing users to have attributes and information necessary to make adjustments to the community for the installation of renewable resource systems such as solar panels or beaver dam devices. To effectively further assess the attributes of these communities a field form and survey are included in the section so one can record the coordination of a location, who owns various properties in a territory/area, and information on the overall attitude towards renewable resource system use with questions such as "Would you be ok with solar panels on land within the Pueblo?" These questions can obviously be tailored to the community they would be administered in.

There is a small section that provides a diagram on environmental assessment planning and the steps associated with it. It includes the four major processes of this sort of planning: planning, reviewing, assessing, and implementing. The diagram outlines the components of each process and how each process can behave and move onto the next step. The major section also includes an outline of how to develop a sustainability plan. The major components being:

The final component of the implementation section of the action plan framework is a resources section that provides financial calculators and information sites and sources that assist users in assessing their energy expenses based on their utilities, appliance use, and facilities that they utilize. The action plane framework is concluded with references section that outlines the publications and sources the group used to develop the action plan framework.

7.5 Creating a Website to Highlight Practices and Assist the Native American Communities

The purpose of this website is to provide resources specific to Native American communities. Each page provides specific information for Native American communities when looking into pursuing sustainability. Many of these communities currently follow some sustainability practices however there is room for improvement and options for funding. This page is available for all Native American communities to utilize and learn about their options when furthering their sustainability practices. The following sections explain each page on the website, its purpose and how the team hopes the page will be used.

7.5.1 Housing the Sustainability Action Plan Framework

The first major aspect of the Native American communities' website is the creatable sustainability plan. Users can design a plan to fit their lives. This page can be seen in Figure 40 below. This page is what houses the Sustainability Action Plan Framework the team created. The other aspects of this Action Plan Framework are found in the drop down menu under the "Create Your Sustainability Plan" Tab.

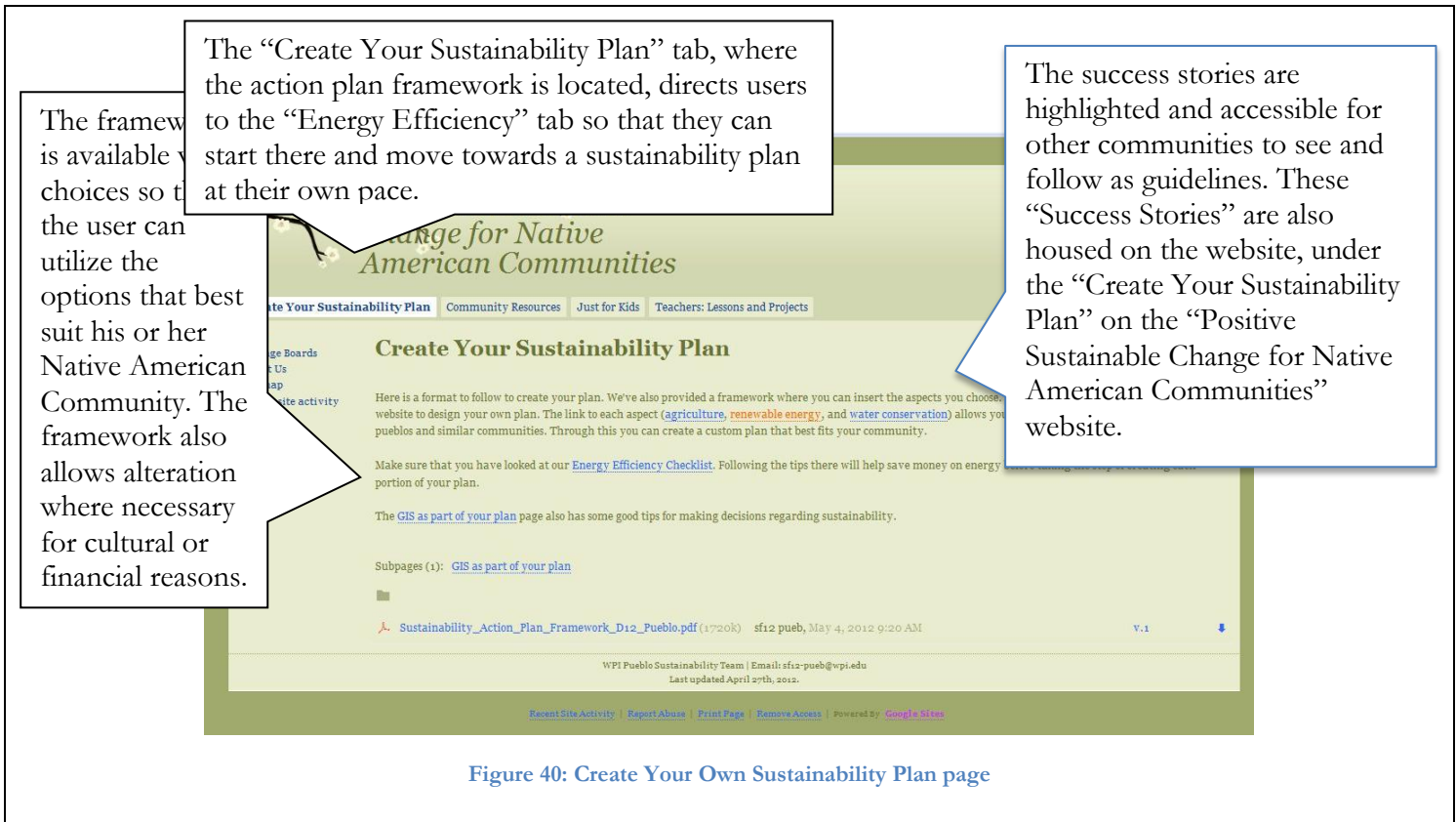


Figure 40: Create Your Own Sustainability Plan page

The Sustainability Action Plan Framework document is provided as a downloadable pdf file that a user can download, save, modify, and utilize. The document provides all of the summaries available on the document for the success stories, GIS information, and financial resources. This allows users to utilize the website to go to the original sources while having a hardcopy with the overall information as well. The team foresees communities utilizing this framework as a guideline to assist them in the creation and implementation process of a sustainability plan.

7.5.2 Housing Success Stories

The “Positive Sustainable Change for Native American Communities” website contains success stories for Agriculture, Renewable Resources, and Water Conservation. These pages can be found under the “Create Your Sustainability Plan” tab in the horizontal drop down menu. Each page has the same formatting which allows users to have an easy time locating the information about each success story. In each page they will find a chart. The columns go from right to left as follows: name, date, location, description, reason for success, and contact information. These fields were filled out for each success story under the correct page with the name being the links to the original source for readers for find more information. Figure 40 shows the “Agricultural Success” page, Figure 41 displays the “Renewable Energy Success” page, and Figure 42 presents the “Water Conservation” page. All three of these figures below use the bubbles to reveal an interesting success story in each category.

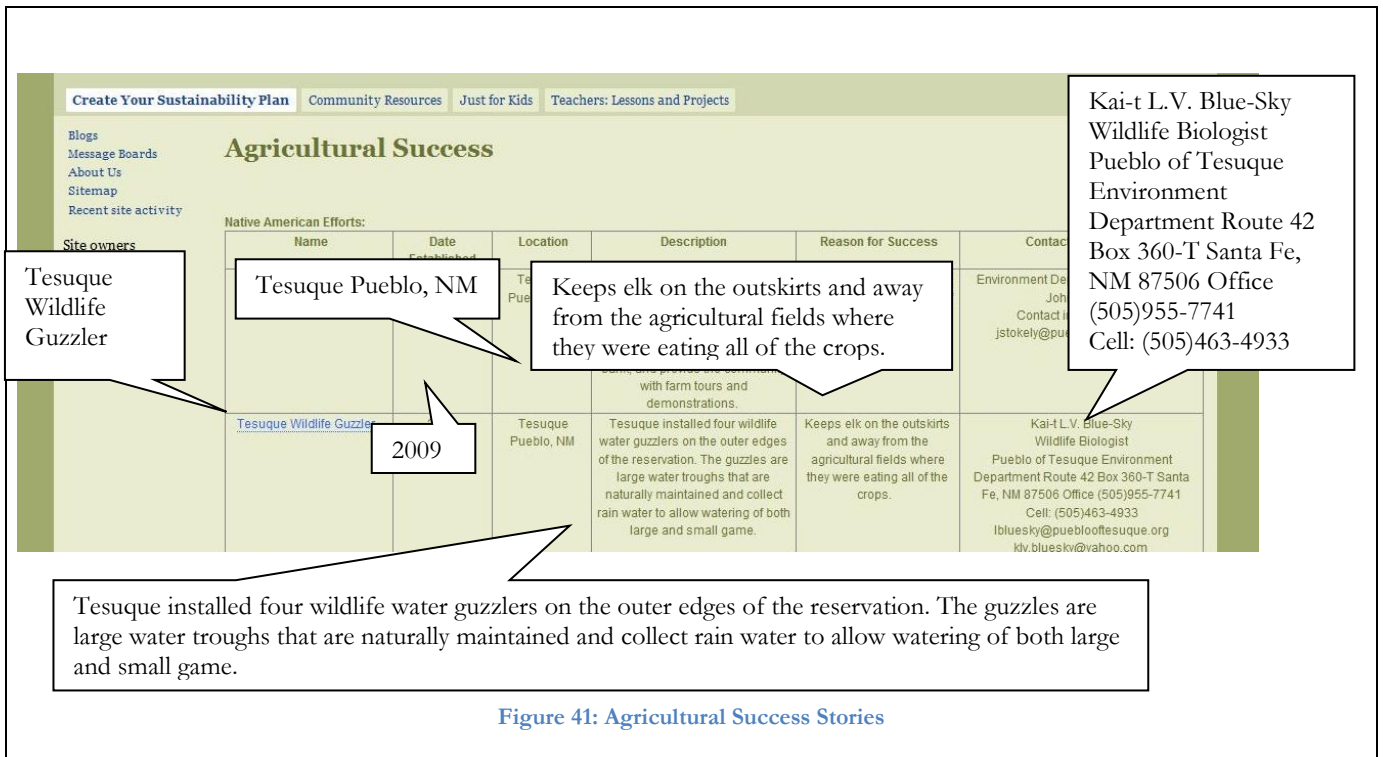


Figure 41: Agricultural Success Stories

Renewable Energy Success

Name	Date Established	Location	Description	Reason for Success	Contact Information
City of Santa Fe		Santa Fe, NM	The City of Santa Fe has made many efforts towards sustainability.	Energy efficiency options analyzed before more costly efforts are made.	Nicholas Schiavo naschiavo@ci.santa-fe.nm.us
Gallup High School Solar Project	February 2011	Gallup High School, Gallup, NM	Gallup High School installed solar panels to save on fuel costs and teach students about alternate energy systems.	Sacred Power Corp. constructed the system using new technology developed by Emcore Corp. The system saves money and is an educational tool.	Gallup High School 505-721-2500 Sacred Power Corporation Emcore Corporation
Native Power	May 2011	Navajo Nation	New Energy Economy raised the cost of solar panels.	An outside organization helped find the money, so the money	New Energy Economy Contact information

Callouts:

- February 2011
- Gallup High School Solar Project
- Gallup High School, Gallup, NM
- Gallup High School installed solar panels to save on fuel costs and teach students about alternate energy systems.
- Sacred Power Corp. constructed the system using new technology developed by Emcore Corp. The system saves money and is an educational tool.
- Gallup High School 505-721-2500 Sacred Power Corporation Emcore Corporation

Figure 42: Renewable Energy Success Storie

Water Conservation Success

Name	Date Established	Location	Description	Reason for Success	Contact Information
Clemson Beaver Pond Leveler	March 1994	Clemson, South Carolina	The Clemson Beaver Pond Leveler is a device that was placed in the center of a pond create naturally by beaver dams. They inserted a device through the beaver dam that would slowly drain water out of the pond at the same rate that water enters. The water is then released further downstream which allows the stream or river to continue running even with the beaver dam.	Utilized natural made ponds to their advantage	Dr. Gee E. Wood, Mr. Larry A. Wood and Dr Greg Yarrow Department of Agriculture, Fisheries and Wildlife, Clemson University, Clemson, South Carolina, 29634 Tel: (803) 656-3117
City of Santa Fe Sustainable Plan	October 2008	Santa Fe, New Mexico	The City of Santa Fe Plan, created in 2008, focuses on water conservation for the city. It is a public document and intended to be updated. The plan includes various steps and tasks to be completed to save water.	Santa Fe has done a great job at making this public knowledge and promoting the concept of saving water. The city is leading by example.	City of Santa Fe, Sustainable S Commission

Callouts:

- Clemson, SC
- Utilized natural made ponds to their advantage
- Clemson Beaver Pond Leveler
- March 1994
- The Clemson Beaver Pond Leveler is a device that was placed in the center of a pond created naturally by beaver dams. They inserted a device through the beaver dam that would slowly drain water out of the pond at the same rate that water enters. The water is then released further downstream which allows the stream or river to continue running even with the beaver dam.

Figure 43: Water Conservation Success Stories

The three pages, seen above in Figures 40, 41, and 42, on the “Positive Sustainable Change for Native American Communities” website make up the main sources of information for communities looking for examples to improve their sustainability practices. It is intended for users will have these as examples and chose the success story that they would like to modify and pursue within their community. The pages provide both Native and Non-Native success stories which allow the users to share within the culture as well as adapt practices from

outside the culture. When taking a successful practice from each category a user can start building the framework of their own by using the sustainability action plan our team has provided.

7.5.3 Implementing GIS as an example tool that communities can use

The team used a GIS map of Tesuque provided by the Santa Fe Indian School to map out the options for renewable resources. This map is on the website in order to show other communities the ease and benefits of using GIS to complete such a task. We mapped out agricultural land, water sources, roads, and buildings through the use of shape files that were then layered on top of each other, revealing the unused land. The website explains how to see which land can be used for renewable resources or agriculture.

GIS is Geographic Information System. It is a computer tool, used both on and offline, that allows the user to map out his or her desired features. This tool is easy to learn and use. There is also a help feature which makes it great for users of all abilities. Through the use of GIS, a community can map out its resources and occupied land to determine the best location for renewable energy implementation. We suggest using a free online version called ArcGIS explorer. This version allows you to share the maps with other members of your community. Through the use of explorer, a user can create a map and share it with a private group of other users. This allows many people to work on the same map while also keeping it private from those outside the group. ArcGIS explorer provides various privacy settings that the creator of the group can choose. It is important to note that ArcGIS will not allow you to export any maps or create attributes, which are two functions that we wanted but may not be necessary for a different project. Our team used the full desktop version which does cost money and was available to us through the Santa Fe Indian School. On this version we were able to create our shape files and attributes and upload them into ArcGIS to share with our private group. These files were eventually also uploaded into a private group in GIScloud through which they can be layered and exported. GIScloud also provided the same privacy settings, but does not allow the creation of shape files with the draw and polygon functions.

To start, the user must create an initial map with the boundaries of their land. For example, we started with a map of the Tesuque Pueblo that included the boundaries of the reservation. This map can be seen in Figure 31 Appendix F.

From there, users can start to use shape files to map out different details of the land. We chose to map out rooftops, waterways and water sources, as well as agricultural fields. These should be done using the editor. It is best to use the polygon or free hand feature to create these maps. It is also possible to use a GPS to locate specific features which can be uploaded into GIS and show the specific points.

By mapping rooftops, the user gains two valuable types of information. He or she learns where buildings are located, as well as the potential for placing solar panels on these roofs for renewable energy. Some communities may be against placing panels on their rooftops for various reasons so this shape file will at least indicate occupied land. It is important that attributes are created for this shape file so that when users click on a building, they can see important information. We chose to have roof type (slanted, flat, directs north, south, east,

or west), area, occupancy, any roof top obstructions (trees, etc.), and building type (community or individually owned) as the attributes associated with each rooftop. The information gained from these attributes allows the user to know more details about each building mapped and who owns the land, as well as a person to contact about further use of that building. The map below shows the buildings covered in blue with an attribute box, which users can edit to insert the correct information. This shape file was initially created on the desktop version of GIS and then uploaded into explorer and can be seen in figure 32 in Appendix F.

Water sources in New Mexico are very valuable and can often be difficult to come by. Therefore, it is important to map out all useable water sources so as to avoid harming them in any process of implementation with renewable resources. The team created a second shape file that contains all the waterways, ponds, and lakes within the Tesuque Reservation. It was important to map out all possible water sources that exist, including those that are seasonal or no longer providing water, but at one point did, and could possibly again. In the map below, the blue lines map out the rivers and waterways while the orange covers the lakes and ponds. This shape file was initially created on the desktop version of GIS and then uploaded into explorer and can be seen in Figure 33 in Appendix F

Finally, we determined that agricultural land should also be mapped out. Agricultural land is extremely important to small communities with the goal of being self-sustaining. For communities that provide a significant amount of their own food, it is important to include this in occupied land. This shape file was initially created on the desktop version of GIS and then uploaded into explorer and can be viewed in Figure in 34 Appendix F.

It is also suggested that the community map out the ownership of the land. This will allow the community to see who the land belongs to, whether it's an individual or the community as a whole, when trying to determine their options for renewable energy sources. We did not map out the land parcels because of the difficulty accessing these files and putting them into a digital form. It is also unique to each community which would make the process unique to each community as well.

Once the shape files of information deemed important by the users are finalized, they can be layered together in one map. This map can show each layer desired individually or as many as desired by using the tool bar feature on the side and checking those that want to be viewed. Through this function the designer can observe any unused land and consider it as a possibility for renewable energy. The map below shows all the shape files layered together. The waterways can be seen in blue, bodies of water in purple, roof tops in red, and fields in green. Each shape file contains its own attributes that will pop up when clicked on the information, circle i, tool. This map was created in GIScloud through uploading the shape files created on the desktop version. This layered map can be viewed in Figure 35 in Appendix F.

It is important that before following through with placing anything on an unused location that it is observed physically instead of just through GIS. When it is surveyed, the land should be ruled out as a possibility for future agricultural fields or an area that may provide water. An ideal location for renewable energy is one that cannot provide any other resource and is otherwise unusable. The GIS map provides a great starting point when considering

renewable energy as an option within a community because the community can see where it is located in relation to all other resources and homes.

If GIS is not an option for the community, the field form found in appendix G can be utilized to help map out open land. It can also be used when completing the physical observation of the land.

The purpose of having an entire page on GIS is so community members can observe the steps the team took to produce their final maps. It is hoped that this page will be used in multiple ways. The team wants users to learn from this how to use GIS when creating a sustainability model. We also want readers to understand the steps taken so they can replicate the process with their own community. Finally we would like the users of the websites to understand any difficulties with the programs used so that they may avoid these roadblocks themselves.

7.5.4 Teachers: Lesson Plans and Projects

The purpose of this page is for educators to utilize the resource provided to create their own sustainability curriculum or lesson plan. This website is being publicized to the teachers at the Santa Fe Indian School as well as students and families of the Santa Fe Indian School. Mark Ericson, the team's liaison, is a teacher at the Santa Fe Indian School and tested this feature for us. He started uploading some of his lesson plans for others to see and utilize. Through this the team got confirmation that the design works and is not difficult to use. Mark also sat down with the curriculum framework we designed and created a lesson plan through the use of that. From this the team gained confidence that these resources can be applied to educators and utilized to design their own sustainability curriculum and lesson plans. This page also provides a link to a tutorial page for help with Google. This is designed to aid those that may not have previous experience still be able to use the lesson plan feature. This tutorial is discussed in section 6.10.1 and contains the same video walkthrough.

The "Teachers Resources" tab within the "Teachers: Lesson Plans and Projects" tab provides an example of a course outline that the team created. This page also provides a pdf downloadable version at the bottom for educators to keep and utilize. The team foresees the administrators and educators at the Santa Fe Indian School taking this outline, making any final adjustments, and implementing this course into the school's curriculum. The team would also like to see other schools similar to the Santa Fe Indian School take this outline and start to implement related classes within their curriculums.

7.5.5 Energy Efficiency Checklist

This checklist is not specific to Native American communities because they are able to take the same steps as other communities to be more energy efficient. However, the checklist is available and applicable to pueblo communities and is relevant to their lifestyle and culture. These can be accessed under the "Energy Efficiency Checklist" tab on the "Positive Sustainable Change for Pueblo Communities" website and displays the same information as that on the educational webpage. The team's desired purpose and use for this page can be seen in section 6.10.7.

benefits of making sustainable changes versus the initial cost while providing various resources on funding.

7.5.7 Businesses and Organizations

The Business and Organizations tab available on the “Positive Sustainable Change for Native American Communities” website contains the same information as “Positive Sustainable Change: Education”. All of these companies support Native American sustainability efforts and are available under the “Businesses and Organizations” tab on both websites. The purpose and use of this website are described above in 6.10. 5.

7.5.8 Getting Involved/ Just for Kids

These two pages contain information for all communities. The Getting Involved page contains the same information as that on the educational website and the Just for Kids page links to the one on the educational site. On the “Positive Sustainable Change for Native American Communities” website the “Just for Kids” tab links to the one on the “Positive Sustainable Change: Education” site where all of the games and activities can be found. This is reiterated in Figure 30 previously seen by showing the red line between the Getting Involved pages and a purple arrow going from the Native American website to the Educational website. The purpose and use of these pages can be found in section 6.10.8.

8 Recommendations

The following are our recommendations for future, similar projects and conclusions from this project. These suggestions and conclusions range from potential sponsors to extensions of this project as future projects. This section includes improvements to this project and how it will be kept alive once our 7 weeks finished.

8.1 Continuation of Project

We have two suggestions of potential future sponsors, to continue the two main aspects of our project, sustainable action and sustainability education.

8.1.1 Continuation of the Sustainability Plan Aspect of the Project

We had difficulty accessing the Tesuque Pueblo to follow through with the creation of a sustainability plan that could be modified and utilized by all Native American communities. We discovered that Tribal Council within the pueblo was too busy to assist us to the necessary extent. The connections within the pueblo that we could form did not follow through enough for us to complete the sustainability plan. Our team recommends that the pueblo sponsor a team, creating a direct connection, so that the necessary follow through is enabled. This group will then be able to use our Sustainability Action Plan Framework (see appendix I) and follow through with creating a sustainability model, as was originally planned.

8.1.2 Continuation of the Curriculum Aspect of the Project

Our team created a curriculum framework and outline. We found that due to the seven week time constraint it was not possible to complete a full curriculum along with the other aspects of the project. We propose that another team makes the sustainability curriculum their focus. We suggest that this future team works with the Santa Fe Indian School or another school in Santa Fe to complete and test this curriculum. The team also hopes that the curriculum for sustainability education will then be shared with all of the schools in Santa Fe.

8.2 Improvement of the Websites

We had a limited amount of time to create our websites, and although they contain a lot of useful information, there is room for improvement. People who are more familiar with creating websites will hopefully improve our websites in the future.

Due to a lack of time and programming ability the team created two Google sites. We recommend that a future team has a member with the ability to create a website from scratch. Ideally, this new website will have its own server and domain. Through this programming ability the website will be able contain profiles so that users can track their sustainable changes. With this independent website, the two Google websites could be combined onto one site. This would allow all of the information to be in one location, with password protection for the information specific to Native Americans.

The team has given Mark Ericson ownership of the two Google websites we created. He will be able to maintain, update, and improve these two websites until an independent website is created.

8.3 Presenting our Findings to the Santa Fe Indian School

We compiled all of our ideas into one frame of a curriculum, including educator feedback from Mark, and possible changes based on feedback. The frame was made accessible to the administrators at the Santa Fe Indian School to be considered as a half-year class for the 2012-2013 school year. The final presentation of this project was also made accessible to the school, as an example for the Senior Honors Project students.

9 Conclusion

Throughout 7 weeks the team watched this project change and grow into what it has become. During this time period the team adapted and changed the project to fit the needs of the Santa Fe and pueblo communities. We met with various business, organizations, and educators. Through these meetings we gathered information to assist in the creation of two Frameworks, a Sustainability Action Plan Framework and a Curriculum Framework. We surveyed 94 students of the Santa Fe Indian School to gather more information to support a curriculum as well as the websites. Through these surveys the team was able to conclude that the curriculum framework and outline would be useful to the Santa Fe Indian School and potentially other schools in the Santa Fe area. They team was also able to conclude that even though not all students have internet directly in their homes in the pueblos that there was enough support and access for us to create two websites.

The team created two Google websites that house all of the work that has been put together over the course of 7 weeks. There is the “Positive Sustainable Change for Native American Communities” Website that allows users in the Native American community to access various resources for creating their own sustainability plan, financial resources, teacher resources, and to further their individual learning. While creating this site the team realized this issue went beyond Native American communities and created a website “Positive Sustainable Change: Education” for the Santa Fe community. This website has similar information but for the general Santa Fe community and excludes the pages related to creating your own sustainability plan. The team wanted a website that could allow more user interaction and would combine the two websites into one. We desired the ability for users to create profiles and track their progress towards sustainability as well as the ability to password protect just the Native American resources while keeping everything on one website. Due to time constraints and a lack of programming ability the team was not able to complete this aspect of the project. Lastly, the team has given Mark Ericson ownership of the two Google websites we created. He will be able to maintain, update, and improve these two websites until an independent website is created.

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Appendices

Appendix A: Email to Contacts

Dear _____,

We are students from Worcester Polytechnic Institute in Massachusetts and we're in Santa Fe to work on the junior year project for our school, which involves working on a project that allows us to learn and create beyond what we focus on for our majors while still using the skills we have gained so far.

Our majors are: Biochemistry (Nikole), Industrial Engineering (Lazaro), Biomedical Engineering (Bethany) and Mechanical Engineering (Kristina).

We are the team that was selected to work with Mark Ericson of the Santa Fe Indian School on the Pueblo Sustainability Model project and we are very excited.

A mission statement we have developed based on our understanding of the project is: The ultimate goal of this project is to collaborate with the Tesuque Pueblo to create a sustainability model that can be applied to other pueblos.

Based on our mission statement, we created four objectives:

1. To observe and examine the sustainability efforts currently in place at the Tesuque Pueblo.
2. To map the renewable resources available to the Tesuque Pueblo.
3. To develop a sustainability plan for the Tesuque Pueblo that can be implemented in other similar communities.
4. To design an online tool to be used for sustainability education at the Santa Fe Indian School.

The above and other information can be seen at our website
<https://sites.google.com/site/sf12pueblo/>

Recently, we shifted the focus of our project to solar energy, because from what we've heard, the pueblo may be interested in utilizing it if it's worth it, and it is already sustainable in other aspects like agriculture and water use.

We are contacting you to ask for your help with objectives ____ & ____

Thank you, we look forward to hearing from you! Please reply all to this e-mail or e-mail sf12-pueb@wpi.edu at your convenience, if you would like to contribute.

Sincerely,

Nikole Jordan
Biochemistry

Lazaro Rodriguez
Industrial Engineering

Bethany Storie
Biomedical Engineering

Kristina Zichelli
Mechanical Engineering

Appendix B: Student Survey

We are a group of college students working with the SFIS and the New Mexico Pueblos to create a sustainability plan. This survey is completely anonymous and will be used solely in our efforts to help your communities. Please respond to any of the questions you feel comfortable answering to the best of your knowledge.

What is your age? _____

What is your gender? Male Female

What pueblo(s) and/or tribe(s) do you belong to?

Where do you live during the school year? School City Town Pueblo Other:

If you answered school, where do you live when not at school? City Town Pueblo Other:____

Which city, town, pueblo or other?

All of the following questions relate to when you are living at your home with your family.

What is your family's contribution/role in your community? (Circle all that apply)

Art Farming Government Health Teaching Tourism/business Tradition

Other _____

Does your family grow any crops? Yes No

If yes, what?

Does your family raise any livestock? Yes No

If yes, what?

How often do you eat food grown and raised in your community?

Daily Weekly Monthly Never

If yes, what?

What do you think makes a Native American successful in agriculture?

Where does your electricity come from?

Company Community Generated Don't have electricity

Do you have electricity in your home? All the time Sometimes No

Do you have internet access in your home? All the time Sometimes No

Do you have running water in your home? All the time Sometimes No

Do you know the source that supplies your drinking water? Yes No

If yes, what is the source? _____

If we tell you that sustainability is the concept of preserving the earth and its resources for future generations; on a scale from 1-10 please rate how important the following ideas are to you:

1=not important, 10=very important

Your community's sustainability _____

Solar panels on your community's reservation to generate electricity _____

Collecting rainfall for agricultural and wildlife purposes _____

Your community being able to provide all of its food _____

Your community having reliable electricity _____

Your community having access to an online educational website on pueblo sustainability

Do you feel that solar panels on your community's reservation would negatively impact the culture of your tribe? Yes No

If yes, why?

Would you prefer solar panels be built on the ground or on top of the buildings on your reservation?

Buildings Ground Either

Appendix C: Curriculum Outline

Sustainability through Culture Preservation

Resources available that could be utilized for potential lesson plans regarding sustainability

Green Schools Program – Empowers students to make a difference in the way their school uses energy. Students learn about energy and the importance of energy efficiency – trained to use a diagnostic toolkit to assess energy usage – buildings become labs for students to learn and apply math science, and language arts to problem solving. Funding often comes from utility companies, municipalities and school systems. <http://ase.org/index.php?q=programs/green-schools-program>

EPA Resources <http://www.epa.gov/greenkit/student.htm#teacher>, below are from <http://www.epa.gov/students/index.html>

Games for K-12 students

Students - Homework resources, student blog posts, community service projects, science fair projects, internships and summer program opportunities.

Teachers/Parents – Lesson plans, teacher guides, and online resources. Publications, school environments and environmental education. Below is from

<http://www.epa.gov/students/teachers.html>

EPA Resources:

Air – Offers many lesson plans for 9-12 as well as other age groups covering, air quality, Ozone, indoor air, radiation and offers activities

Climate change – basics and details – uses student guide to global climate change

Ecosystems – Information and lesson plans regarding – wetlands coral reef protection, estuaries, effects of pollution, exploring estuaries, water shed location, stream corridor, ext.

Energy – Fuel Economy and Environmental labels – lesson plans

Health – asthma, secondhand smoke, lead in paint, dust and soil, mercury, ultraviolet index, water on tap

Reduce, Reuse, Recycle – basics, hazardous waste, superfund (what is it, activities, and other), reduce school waste, publications (resources), websites and organizations that provide more info

Water – Acid rain, clean water act, ground water connection, tracking pollution, water source books

External Resources – Lists other resources and age groups for each below

Green Teacher – Magazine that provides articles and activities for ages 6-18

<http://www.greenteacher.com/>, offers online database

Center for Integrated Agricultural Systems – Sustainable Agriculture Curriculum for High School Educators Announced <http://www.cias.wisc.edu/education-and-training/sustainable-agriculture-curriculum-for-high-school-educators-announced/> – 6

modules to be integrated into an existing class – can access at this website

<http://www.cias.wisc.edu/curriculum/index.htm> - can use bits and pieces

Education for Sustainability - http://www.pnwbores.org/efs/sample_lessons.html

Provides sustainability education core content standards and sample lesson plans

There's No New Water - <http://www.4-h.org/resource-library/curriculum/4-h-theres-no-new-water/> Curriculum towards water conservation and quality – 6 modules for high school students with activities

Solar Energy Internationals- <http://www.solarenergy.org/resources-educators> - Resources on renewable energy, climate change, conservation, solar cooking, solar energy kits for classrooms, teacher grants
New Mexico Solar Energy Association - <http://www.nmsea.org/Curriculum/Listing.htm> - From oil wells to solar cells, energy concepts primer provides many projects for students to participate in such as passive solar design.

Project Resources

Give Water a Hand - Students, educators, natural resource experts, and community study water issues and take action to solve them.
<http://www.uwex.edu/erc/gwah/> Give water a hand is a national watershed educational program. It provides an action guide the class plans and completes a project for the community. www.uwex.edu/erc/gwah/#What is Green House – There are many ways to get the students involved within the green house. Here is a link to site that talks about having a greenhouse at a school and getting students involved. It is very hands on and offers many project ideas
<http://www.freewebs.com/managingschoolgreenhouses/studentmanagement.htm>
Rebel Tomato - <http://www.communitygarden.org/rebeltomato/fruits/garden-classroom.php#curriculum> Provides garden and green house lesson plans/curriculum ideas as well as activities such as hydroponics and farming in space.
New Mexico Solar Energy Association - <http://www.nmsea.org/Curriculum/Listing.htm> many projects such as passive solar design or exploring fuel cells and photovoltaics.
Homemade solar panels – www.makehomemadediysolarpanels.com
Build your own wind turbine - <http://www.homemade-wind-turbines.org/information/build-your-own-wind-turbine/>
Santa Fe Institute Sustainability Summer School
http://tuvalu.santafe.edu/events/workshops/index.php/2010_Global_Sustainability_Summer_School-Debates

Lectures

Preserving Culture
Members from tribal councils
Tribal Elders
Native American teachers
Sustainability
Experts in sustainability
Students from this class and other classes who want to share knowledge (SHP prep)
How they can help with sustainability
Have people from organizations come and talk about how these students can help
Have teachers within the school talking about how the students can help at school and home
Also could just be your lectures and that can be your lesson plans
Or student projects can be presented
How sustainability can help preserve the culture

Bring in people from local companies come and talk about how they help communities through their products.

How students can get involved with the efforts these companies and organizations are pushing for.

Find the balance between lectures and hands-on <http://educationnext.org/sage-on-the-stage/>

Field Trips

Earth Ships

Red Willow Growers

Red Mesa Wind Farm

Cimarron NM Solar Farm

Appendix D: Curriculum Framework



Sustainability Curriculum Framework

Introduction

This framework serves as an outline for educators to effectively model a curriculum based on sustainability. The framework includes major concepts and topics that are relevant within sustainable practices.

Education for sustainability needs to be an integral part of all school programs. It is the responsibility of all teachers to increase the awareness, values, skills, and understanding needed to create a just and sustainable future.

The following terms are a set of essential concepts supported by significant subtopics that highlight potential sustainability curriculum material. Although there is no particular progression to these topics, there is a suggested progression included at the end of the framework.

Definition

Sustainability education is the learning process that applies problem-solving and critical thinking skills, scientific and social literacy, and a commitment to engage in responsible individual and cooperative actions. These practices can help maintain a self-sufficient community that is economically stable and prosperous.

This definition recognizes the duty of educators around the world to assist learners in applying sustainable practices through inquiry and critical thinking. Overall, if a community is seeking to be more sustainable, it holds a responsibility to produce and maintain a sustainability education program.

Themes & Benchmarks:

Parameters

Time Scale:

How time plays a factor in sustainable development and how various human actions and projects make a certain impact based on that amount of time.

This distinguishes how sustainability is overall a long-term approach for results within a community.

Some projects and initiatives may show immediate results however the goal is for long-term success.

The distinction between those practices that provide both short and long-term results is key.

Geographical Contributions:

How location and geographical aspects of a particular area or community contribute and affect sustainability.

This aspect of parameters correlates directly with the short and long-term products of a sustainable community.

Renewable resource abundance is strongly dependent on the environment of a particular plan or system that incorporates sustainable practices.

Morals, Ethics, and Values

Culture:

This theme focuses on how culture and society are affected by sustainable development

The acceptance of technology impacts whether modern or traditional practices will be implemented

This concept heavily relies on equity, policy, and cultural practices that are affected by sustainability

Social Welfare:

Distinguishing what practices benefit or inhibit the development and growth of a community

Development focuses more on the quality of these aspects as opposed to growth – which quantifies these aspects

Decision Making & Analysis:

Scientific reasoning and analysis is a key component of sustainable practices

This concept heavily relies on precautionary principles as well as the scientific method

Economic/Social Development –

This concept is concerned with holistic contributions by individuals who also participate in practices that improve their individual well-being.

Distinguishing positive and negative impacts for different social classes

Overall, it is essential to have a balance between individual and communal endeavors.

Nature and Humans

Nature/Human Relationship:

For one to understand sustainable practices and concepts, it is necessary to understand that humans are a part of nature and can live within it while benefiting from its resources

It is essential for humans to respect this relationship by preserving the various aspects of nature

This concept also dwells on the effect of systems and technology on the natural environment

Scarcity of resources, technology, resource use, and nature must all be maintained in balance in order create a sustainable environment

Natural Systems

Natural Laws:

Understanding the functions and behavior of nature can explain why certain natural systems produce the way they do

There is both cooperation and competition within ecosystems – however, they come together to make one, cohesive product that is nature

Technology and Economics

Strategies and Tools:

There are various methods that encourage sustainable development

Excellent examples of these tools include technology that harnesses renewable resources, water preservation practices, and agricultural planning

wind energy

solar energy

biomass energy

geothermal energy

irrigation systems

beaver dams

preserving native seeds

greenhouses

Renewable Resources v. Non-Renewable Resources:

Distinguishing the costs, benefits, and disadvantages for renewable and non-renewable resources is fundamental in deciding what should be implemented in a sustainable practice or plan

Ecological Planning and Control:

Resource use must be planned efficiently for pollution reduction

Preventing excessive waste can provide health, environmental, and other benefits for a community

If ecological modifications are made to an environment, one must make sure that biodiversity is maintained

If forest fires are to be limited, then there must be forest management and rearrangement so the forest can continue to grow naturally and healthily

Sustainable Behavior

Legal and Political Initiatives/Frameworks:

This concept explains the various guidelines and policies that a government and economy must establish to encourage sustainable development

Some of these policies include tax incentives and refunds for renewable resource utility installations and laws that encourage funding for public works that encourage sustainable practices

Economic Incentives:

Pricing on energy use, appliance installation, and tax policies are key factors in sustainable or non-sustainable behavior

Many institutions and organizations find the economic benefits of certain sustainable practices to be huge incentives

Interpreting the behavior of finances and the economy can indicate information about sustainable behavior

Spirituality and Culture:

Spiritual beliefs and cultural practices directly affect sustainable behavior

Communities may be hesitant or enthusiastic to participate in sustainable practices based on their cultural beliefs

Just as there are groups of individuals who believe that the implementation of certain technologies such as solar panels interferes with the natural state of ecosystem, there are others who believe it merely complements its success and health.

Pedagogical Practices/Exercises

Research:

Research and the utilization of scholarly resources is fundamental for economic and technological sustainable practices

These resources dwell on energy and resource efficiency while highlighting the various advantages and disadvantages of certain practices in sustainability

Experience and Service-Learning:

A hands-on approach to sustainable learning proves to be quite practical and beneficial

These exercises should be implemented on site and then hopefully on a greater scale such as the surrounding community or other locations

Practical Success Stories and Case Studies:

An excellent method for studying sustainable practices is looking at success stories of communities who have implemented sustainable systems and methods

Case studies of these stories can help a student learn about what systems and methods that are most effective for certain situations or problems

These also provide proof of project feasibility allowing room for modification and improvements

Leading Concept Chart/Themes

Leading Concept	Desired Outcome	Learning Themes / Interactions	Activities / Plans	Evaluation
Interdependence	Helping distinguish the outcomes of manipulating an ecosystem or environment. To demonstrate how various components of a given ecosystem are interrelated and dependent on each other	Grade Levels 7-12	Local land use analysis on how changes over time affect a particular area.	

Diversity	<p>Discusses the importance of maintain diversity in an ecosystem to keep it in balance. Helps students recognize how resources provided by a certain component prove to be essential at certain levels for other components. Relates to the interdependence leading concept. This topic also reflects on the benefits of utilizing various renewable resources.</p>	Grade Levels 7-12	<p>Compare and contrast different agricultural practices of various communities. Note what they do well, note what they can do better, distinguish which factors contribute to these outcomes.</p>	
Quality of Life	<p>Instructs students on how to analyze and make use of published indices as indicators of development and to then build models based on these indices that provide data on quality of life.</p>	Grade Levels 7-12	<p>Gather data on published indices on quality of life and compare and contrast results</p>	
Ecosystem Preservation	<p>This concept will teach students how to manage and keep up with a particular ecosystem. If humans are to make changes to a local ecosystem, it is necessary for them to maintain it as well.</p>	Grade Levels 7-12	<p>Create a small garden with a group of students and show how certain changes done within the garden affect the outcome of the growth of certain plants. Incorporate sophisticated agricultural practices for a much more vivid demonstration</p>	

Change	Understanding the importance of natural evolution and how it is manipulated by certain factors within an ecosystem such as human activities.	Grade Levels 7-12	Create a predator/prey model and show how this relationship can tell more about evolution	
Maintenance of the Environment for the Future	Identifying which resources can be reused and what materials are recyclable. This is a key component of sustainable practices.	Grade Levels 7-12	Science experiments that can demonstrate which materials are recyclable.	
Poverty	Distinguishing how poverty is related to sustainable practices and how it can be reduced with implementing a sustainable plan	Grade Levels 7-12	Have groups engage in a project in which they identify how low social welfare is impacted by non-sustainable practices and then have the group develop solutions or policies that can benefit this.	
Resources	This concept will assist students in understand more about the resources that the planet has to offer. It will assist them in understanding which ones are most appropriate for certain forms of energy production	Grade Levels 7-12	Have students pick one renewable resource and develop a chart in which they highlight its benefits and disadvantages. The chart can also highlight various regions of the world where these resources are abundant and useful.	

Citizenship	Students will identify the cause and effects of the changes in the environment through policy and other law. They can then learn how they can change this through participating in their community	Grade Levels 7-12	Writing and conducting surveys. Campaign building or letter writing to local offices.	
Equity & Justice	This concept describes and analyzes how decision making processes affect how the environment is utilized.	Grade Levels 7-12	Mock/role play of a case study	
Uncertainty, Precaution, Recovery	This concept reflects on how natural phenomenon impacts the economic environment. The students can then see how to prepare for this phenomenon and what is the best way to respond in certain cases.	Grade Levels 7-12	Study scenarios and terminology review	

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Appendix E: Energy Efficiency Checklist

Family Checklist (everyone can be in charge of a few things)

Turn things off:

- Turn off lights when you leave the room
- Turn off fans when you leave the room
- Turn off the TV when you leave the room
- Turn off the computer when you're not using it
- Turn off the water while you brush your teeth
- Unplug all possible electrical items when going away on vacation (This can reduce your bill while you're away, especially because these items are not being used.)

Use things less:

- Turn down the heat a few degrees in winter (aim for about 68)
- Turn down the air conditioning a few degrees in summer (aim for about 78)
- Turn down the air conditioning when you're not going to be home
- Turn down the heat when you're not going to be home
- Take short showers instead of baths
- Use washers, dryers, and dishwashers after 8 p.m. (By running these appliances after peak electricity hours you can reduce your electrical bill because some companies offer a lower price during off peak hours.)

Use the weather:

- Let the sun in on sunny winter days (It will help warm your home and reduce the amount of heat needed during the day.)
- Keep the sun out on hot days (Try blocking windows without shades with a blanket or sheet to help keep your home cool.)
- Check for leaky air by holding a ribbon near the edges of windows to see if it moves (Reinforcing or replacing leaky windows will save you on heating/cooling.)

Adult Check List (kids can assist with some of these)

Use things correctly:

- Keep refrigerator/freezer coils clean
- Only wash full loads in the dishwasher
- Use the "energy saver" drying option on your dishwasher, or open it before the drying cycle begins
- Use the microwave to reheat food
- Use the microwave to cook small amounts of food
- Set your water heater thermostat to 120 degrees or 140 degrees if you have a dishwasher

Invest in small things:

- Use dimmer switches or timers on lights
- Use energy-saving shower heads, faucets or flow restrictors

_____ Wrap your water heater with a water heater blanket, especially if it's in a cold part of your home

Invest in big things:

_____ Use energy-efficient appliances

_____ Use storm or thermal windows

Try this:

_____ Complete a home energy Audit to determine exactly what your home can change through this website <http://www.energyright.com>

Appendix F: GIS Maps

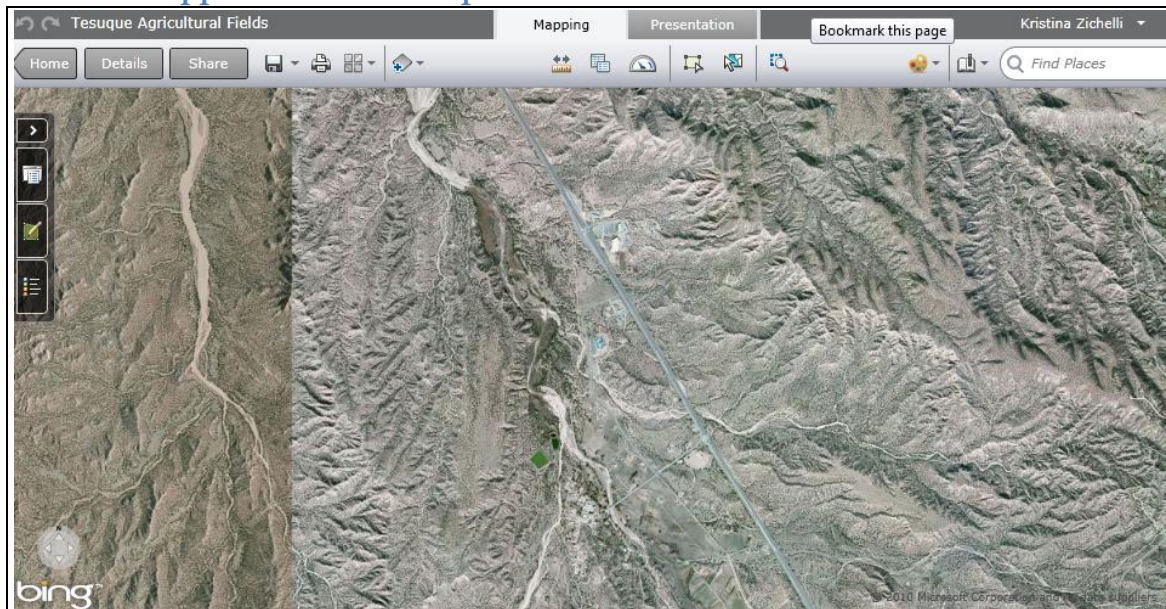


Figure 45: Base map for GIS of the Tesuque Pueblo.

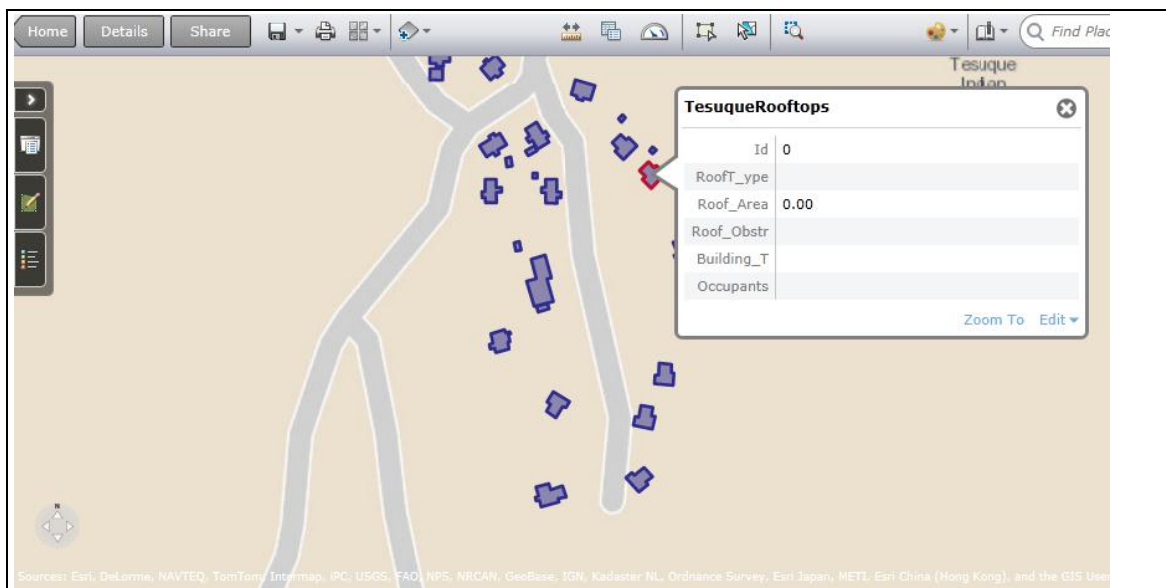


Figure 46: This GIS map highlight the Tesuque rooftops and shows their attributes

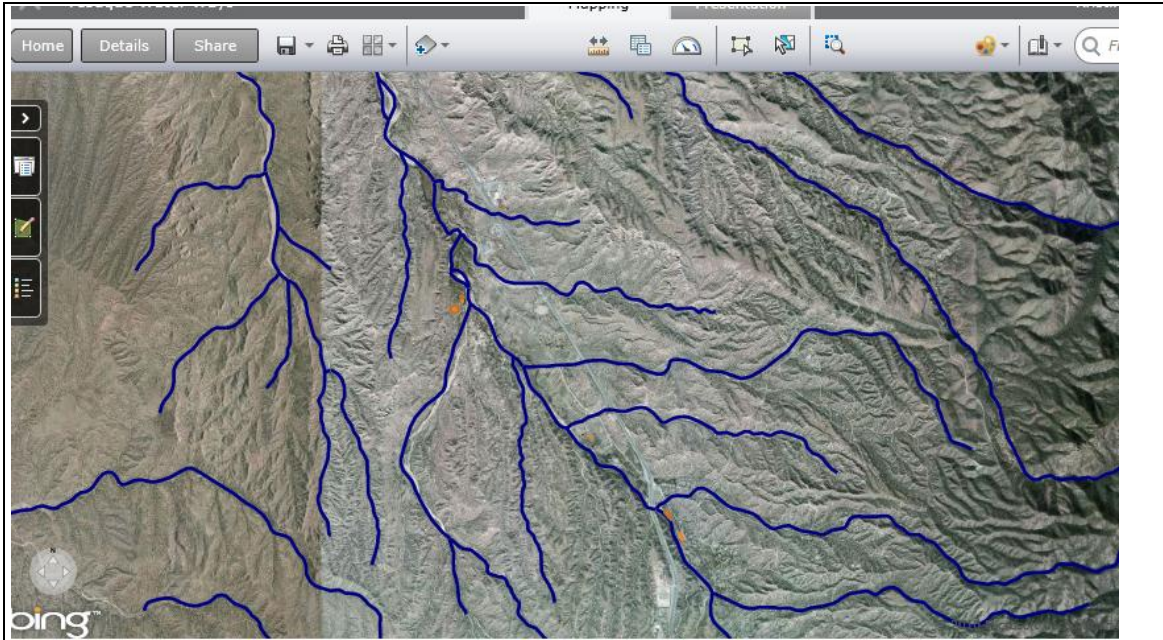


Figure 47: This GIS map shows the waterways and bodies of water within the Tesuque Pueblo

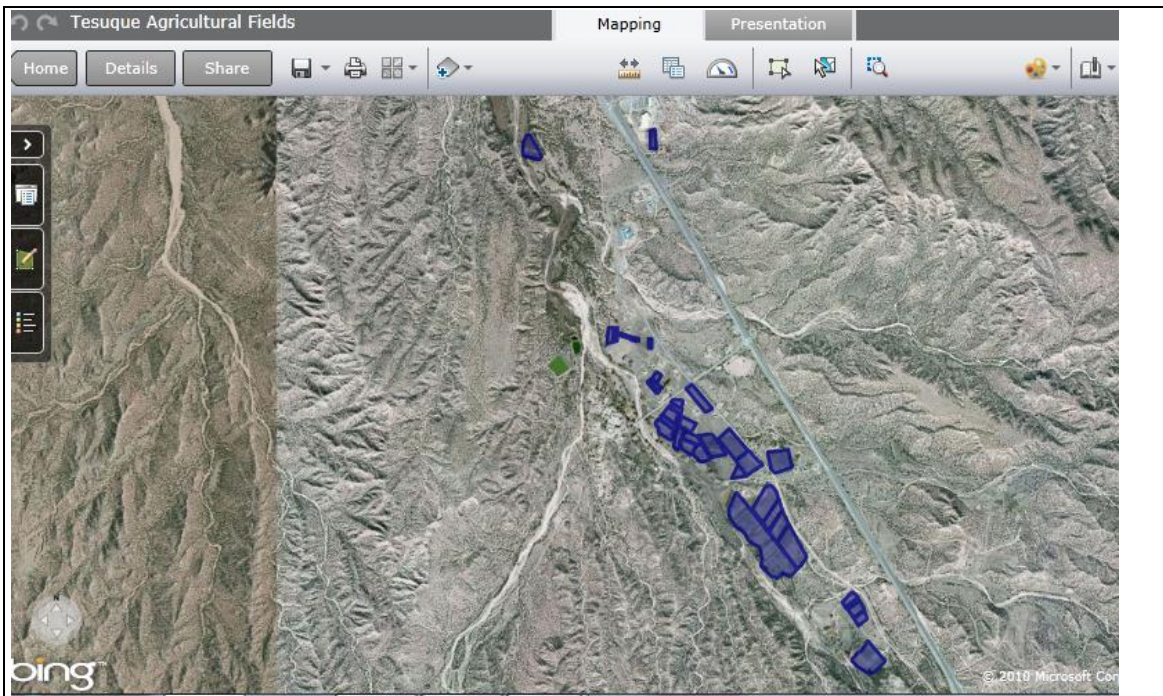


Figure 48: The GIS map above displays the agricultural fields in the Tesuque Pueblo

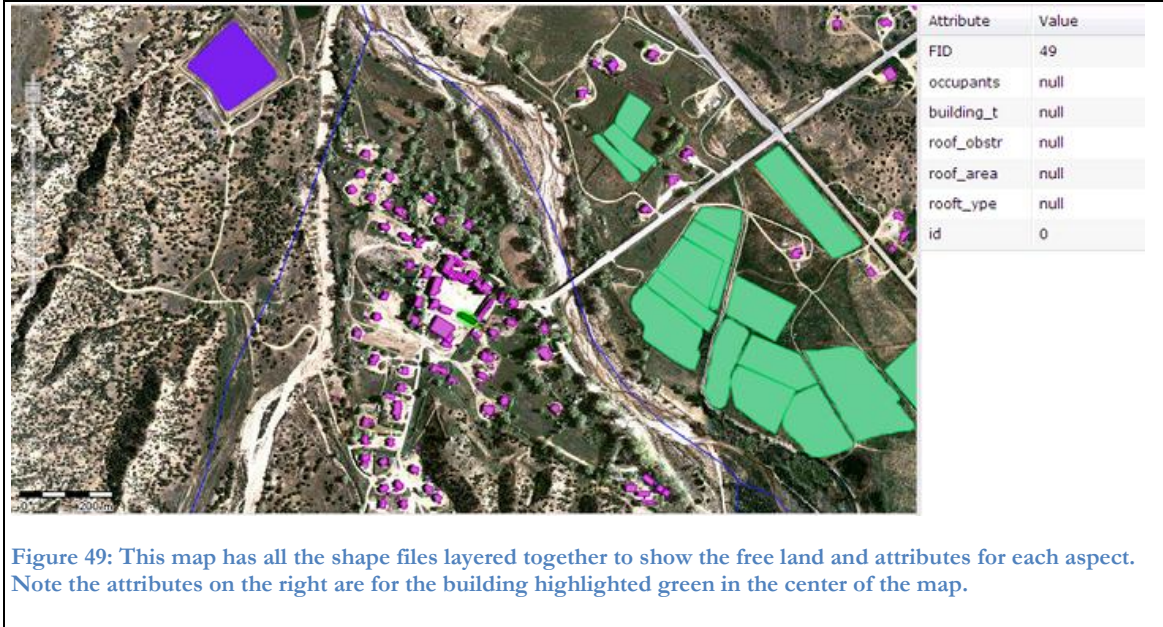


Figure 49: This map has all the shape files layered together to show the free land and attributes for each aspect. Note the attributes on the right are for the building highlighted green in the center of the map.

Appendix G: Field Form to Survey Land if GIS is not available

Field Form

What are the coordinates of this location? _____

Who owns the land? _____

Is anything being grown on this land? If so what?

Is the land near houses? _____

How far from the nearest house? _____

Are there houses on this land? _____

Is there a resource available on this land? If so which resources? (water, agriculture, etc.)

What are the land dimensions?

Are there any specific geographical details that would affect implementation of renewable resources? Ex: Hill, plateaus, valleys, rivers etc.

Field Survey

(On a scale from 1 to 10, with 1 being the least and 10 being the greatest)

Would you be ok with renewable energy resources on the Pueblo land? _____

Would you be ok with solar panels on land within the Pueblo? _____

Would you be ok with Windmills? _____

Would you be willing to implement a device on your house to capture and reuse rainwater?

Would you be willing to use solar panels on your home? _____

Would you be ok with solar panels on community buildings? _____

If a website were designed would you use it to learn more about sustainability within Pueblo Communities? _____

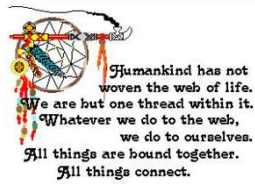
Appendix H: Handout for Santa Fe Indian School Students



Positive Sustainable Change in Native American Communities

We are a group of college students from Worcester Polytechnic Institute. For the past 14 weeks we have been working on a project to foster sustainable practices in Native American communities. The SFIS has been our project sponsor with teacher Mark Ericson as our liaison. The focus of our project has been renewable energy, agriculture, and water. We have created a website where the Native American communities can access a sustainability model framework as well as a sustainability educational curriculum resource for teachers. After surveying 94 high school students from the SFIS, it became evident that the students, like ourselves, cherish the earth and utilizing its natural resources to the fullest. Our mission is to help the Native American communities remain sovereign through utilizing available resources. Please take some time to check out our website:

<https://sites.google.com/site/sustainablechangeformative/>

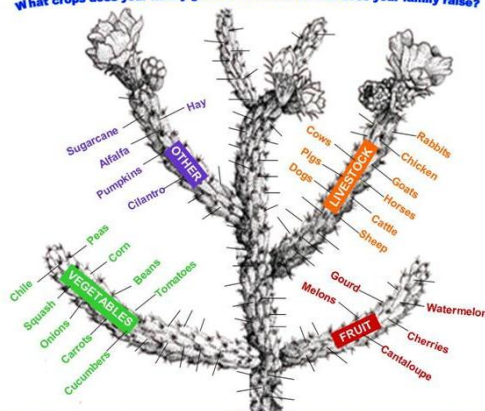


Humankind has not woven the web of life. We are but one thread within it. Whatever we do to the web, we do to ourselves. All things are bound together. All things connect.

-Chief Seattle-

Survey Conducted With the SFIS Students: Ages 14-19

What crops does your family grow and what livestock does your family raise?



What makes a Native American community successful in agriculture?



Components of Website

- **Energy Efficiency Checklist:** changes households can make to save electricity
- **GIS Maps:** explains how this tool allows mapping of resources
- **Agriculture, Renewable Energy and Water Conservation Success Stories:** how Native American communities have been successful in areas of sustainability
- **Local Businesses and Organizations**
- **Getting Involved:** links to local adult workshops, courses, & volunteer opportunities that provide sustainability knowledge and technical skills
- **Financial Impact Resources:** information on how to receive funding for sustainability projects
- **Just for Kids:** games to learn about sustainability
- **Teachers Lesson Plans:** view and upload sustainability curriculums and lesson plans
- **Sustainability Action Plan:** outlines the core concepts and actions taken to develop a sustainable community

Appendix I: Sustainability Action Plan Framework



Sustainability Action Plan Framework

Nikole Jordan, Lazaro Rodriguez, Bethany Storie, Kristina Zichelli

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Introduction

Partaking in sustainable practices can be overwhelming for many organizations and individuals. One may ask questions such as, “Where do I start?” or “How exactly do I partake in more sustainable living?” Most would agree that “sustainability” is a fairly broad topic that umbrellas many aspects of society. This action plan highlights those practices and actions that make one more sustainable.

Overview of the Sustainability Framework

A mission that outlines the sustainable practice agenda for any group or individual who wishes to engage in a more sustainable community

A set of broad, yet distinct goals that construct a vision and mission that describe the desired outcomes for sustainable practices

A set of themes that are areas of interest for sustainable actions

A set of resources, plans, and other goals that help achieve these sustainable practices

Mission

The mission of this plan is to provide a framework of major concepts and ideals of sustainability that provides a basis for sustainable practice. This is a general set of methods and concepts that are essential for a community practicing sustainability.

Vision

Organizations and communities will be able to engage in sustainable practices by making use of the implementation section of this action plan framework. Groups will be able implement policies and programs that will reflect the concepts in the framework and therefore promote energy efficiency, ecosystem preservation, and renewable resource use.

Agricultural Practices

Agricultural initiatives are based on the following major objectives:

To have a system that reduces CO₂ emissions and greenhouse gasses by limiting the use of fossil fuels

To create quality, healthy food that is sufficient in quantity for the market or community it is harvested for

To satisfy the needs of the people for the particular community and having them involved with the farming systems if necessary.

Ideas from the chart below can be emulated and altered for other communities:

Successful agricultural initiatives:

Name	Date Established	Location	Description	Reason for Success	Contact Information
Tesuque Agricultural Initiative http://www.santafedia.org/index.php?title=Tesuque_Pueblo_Agriculture	2006	Tesuque Pueblo, NM	Tesuque utilized acres of land for farming and is growing thousands of different types of crops. They hold an annual symposium on farming, are developing a seed bank, and provide the community with farm tours and demonstrations.	The Farming Department's passion for farming, love of the sacred earth, and the time and energy they put into their work.	Environment Department at Tesuque: John Stokely Contact info: 505 955-7746, jstokely@pueblooftesuque.org
Tesuque Wildlife Guzzler http://www.santafedia.org/index.php?title=Tesuque_Pueblo	2009	Tesuque Pueblo, NM	Tesuque installed four wildlife water guzzlers on the outer edges of the reservation. The guzzlers are large water troughs that are naturally maintained and collect rain water to allow watering of both large and small game.	Keeps elk on the outskirts and away from the agricultural fields where they were eating all of the crops.	Kai-t L.V. Blue-Sky Wildlife Biologist Pueblo of Tesuque Environment Department Route 42 Box 360-T Santa Fe, NM 87506 Office (505) 955-7741 Cell: (505) 463-4933 lbluesky@pueblooftesuque.org klv.bluesky@yahoo.com

<p>Navajo Nation Traditional Agriculture Outreach</p> <p>http://nntao.org/about-us.html</p>	<p>1997</p>	<p>Navajo Nation, AZ</p>	<p>A supportive network that works with disadvantaged Navajo farmers to provide resources and services to them.</p>	<p>Since 1997 they have conducted multifaceted operations, management training, and created the Western Navajo Nation Food Policy Council.</p>	<p>Developing Innovations in Navajo Education Inc. 9975 Chestnut Rd Flagstaff, Arizona 86004 telephone: (928) 606-4998 Fax: (928) 699-9142</p>
<p>Taos County Economic Development Corporation</p> <p>http://www.tcedc.org/communitygarden.html</p>	<p>1987</p>	<p>Taos, NM</p>	<p>Developed the Community Garden Project which involves the community in planning, planting, cultivation, harvesting, processing of sales of 1 acre of vegetables, and herbs and flowers at the project site. The project provides educational, life-skills and work-training opportunities.</p>	<p>Receives financial and technical assistance from the NMDA and USDA as well as the community and nonprofit organizations</p>	<p>1021 Salazar Rd. Taos, NM 87571 P.O. Box 1389 Phone: (575) 758-8731 Fax: (575) 758-3201</p>
<p>Traditional Native American Farmers' Association</p> <p>http://nativeharvest.com/tnafa</p>	<p>2006</p>	<p>Santa Fe, NM</p>	<p>A leading voice for food sovereignty; encouraging organic farming with traditional methods. TNFA has many programs including corn processing for home use, community seed "library" workshops, seed distribution, home gardening workshops, traditional agriculture/permaculture design course, youth in agriculture and other workshops.</p>	<p>They believe that family oriented farming is the best approach in developing a sound future in agriculture.</p>	<p>PO BOX 31267 Santa Fe, NM 87594 Phone: 505-983-4047 Email: cbrascoupe@yahoo.com</p>

Local Efforts:

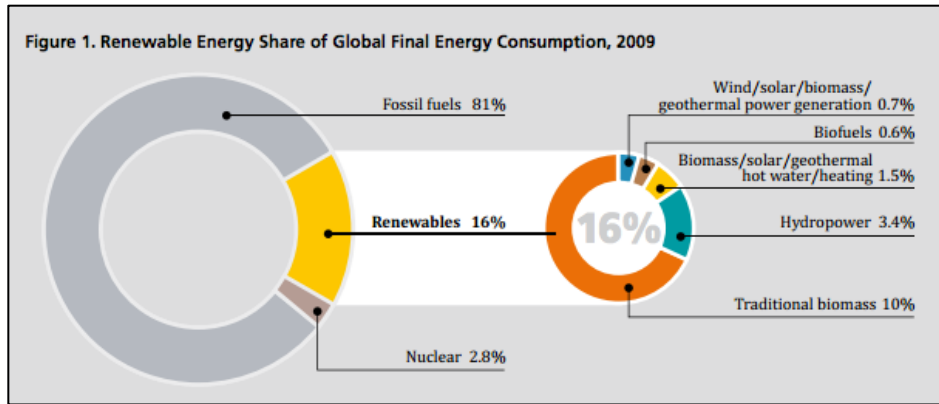
Name	Date Established	Location	Description	Reason for Success	Contact Information
Edible Santa Fe http://www.ediblecommunities.com/santafe/who-we-are/who-we-are.htm	2002	Santa Fe, NM	Promote sustainable methods of working with animals and the land. They value local, seasonal, authentic foods and culinary traditions.	They use a printed publication, website, and events to aim to connect consumers with local growers, retailers, chefs, and food artisans.	551 West Cordova Road #551 Santa Fe, NM 87505 Email: info@ediblesantafe.com Phone: 505-212-0791
Santa Fe Farmers Market http://www.santafefarmersmarket.com/about/links/	1960's	Santa Fe, NM	New Mexico's largest farmers' market and one of the most widely recognized markets in the United States. With over 150 active vendors, it features hundreds of different agricultural products. It began year round in 2002 to meet the demand of fresh, local produce. In 2001, they established the Santa Fe Farmers Institute which is a nonprofit that implements programs to promote agriculture in Northern New Mexico. The market became LEED certified in 2008.	Santa Fe Farmers Market assures that all products sold by its vendors are locally grown by the people selling them. The market moved several times to allow it to expand in size	1607 Paseo de Peralta, Ste A Santa Fe, NM 87501 Phone: 505-983-4098 Fax: 505-983-8015
Seeds of Change http://www.seedsofchange.com/enewsletter/issue_68/farmhistory.aspx	1989	Estaca, NM	They make organically grown seeds available to gardeners and farmers, while preserving heirloom seed varieties that are	They have a donation program and they create new varieties through	P.O. Box 4908 Rancho Dominguez, CA 90220 Phone: 888.762.7333

			in danger of being lost to the "advances" of modern industrial agriculture.	traditional plant breeding techniques that bring out unique or improved characteristics or combine desirable traits from existing varieties.	
Sustainable Agriculture Science Center at Alcalde http://alcaldesc.nmsu.edu/	2008	Alcalde, NM	This center is dedicated to research that will benefit small family farms of north-central New Mexico.	They typically have several projects underway at the same time.	317 County Road 40 P.O. Box 159 Alcalde, NM 87511 Phone: (505) 852-4241 Fax:(505) 852-2857 Email: alcalde@nmsu.edu
Gaia Gardens http://gaiagardens.blogspot.com/p/concept.html	2012	Santa Fe, NM	They are in the process of developing a 1.5 acre experimental farm in the city of Santa Fe. They educate participants on many aspects of agriculture and always ask the question; "What would nature do?" They also manage local compost pick-up from restaurants and engage the community through various events and volunteer opportunities.	They have sponsors, hold events for fundraising and advertising, they have a Facebook page for publicity, attend community meetings, hold farm days for volunteers and social-music gatherings around the fire. Since this is such a new successful project they are a good example of how to get a	Poki - Project Coordinator Phone: (505) 797-6006 Email: poki@nodilus.org

				new project started and the initial steps taken to do so.	
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Energy

There are various ways to participate in the energy efficiency aspect of sustainability practices. Figure 1 shows the different forms of energy used globally in 2009. Only 16% of energy consumed is renewable, and a large percent of that is biomass.



To address issues with energy consumption and use, one must implement energy efficiency actions. An excellent way of monitoring one's energy consumption is through an energy efficiency checklist. Below is an example of what an energy efficiency checklist may look like as well as other components and actions that promote energy efficiency:

Family Checklist (A checklist entire families can use):

Turn things off:

- _____ Turn off lights when you leave the room
- _____ Turn off fans when you leave the room
- _____ Turn off the TV when you leave the room
- _____ Turn off the computer when you're not using it
- _____ Turn off the water while you brush your teeth
- _____ Unplug all possible electrical items when going away on vacation (This can reduce your bill while you're away, especially because these items are not being used.)

Use things less:

- _____ Turn down the heat a few degrees in winter (aim for about 68)
- _____ Turn down the air conditioning a few degrees in summer (aim for about 78)
- _____ Turn down the air conditioning when you're not going to be home
- _____ Turn down the heat when you're not going to be home
- _____ Take short showers instead of baths

_____ Use washers, dryers, and dishwashers after 8 p.m. (By running these appliances after peak electricity hours you can reduce your electrical bill because some companies offer a lower price during off peak hours.)

Use the weather:

_____ Let the sun in on sunny winter days (It will help warm your home and reduce the amount of heat needed during the day.)

_____ Keep the sun out on hot days (Try blocking windows without shades with a blanket or sheet to help keep your home cool.)

_____ Check for leaky air by holding a ribbon near the edges of windows to see if it moves (Reinforcing or replacing leaky windows will save you on heating/cooling.)

Adult Check List (mostly for adults in households but children can assist):

Use things correctly:

_____ Keep refrigerator/freezer coils clean

_____ Only wash full loads in the dishwasher

_____ Use the “energy saver” drying option on your dishwasher, or open it before the drying cycle begins

_____ Use the microwave to reheat food

_____ Use the microwave to cook small amounts of food

_____ Set your water heater thermostat to 120 degrees or 140 degrees if you have a dishwasher

Invest in small things:

_____ Use dimmer switches or timers on lights

_____ Use energy-saving or water-saving shower heads, faucets or flow restrictors

_____ Wrap your water heater with a water heater blanket, especially if it’s in a cold part of your home

Invest in big things:

_____ Use energy-efficient appliances

_____ Use storm or thermal windows

Ideas from the chart below can be emulated and altered for other communities:

Successful Renewable Energy Initiatives:

Name	Date Established	Location	Description	Reason for Success	Contact Information
City of Santa Fe http://www.santafenm.gov/index.aspx?NID=148	1607	Santa Fe, NM	The City of Santa Fe has made many efforts towards sustainability.	Energy efficiency options are analyzed before more costly efforts are made	Nicholas Schiavo naschiavo@ci.santafe.nm.us
Gallup High School Solar Project http://www.navajotimes.com/education/2011/0311/030311solar.php	February 2011	Gallup High School Gallup, NM	Gallup High School installed solar panels to save on fuel costs and teach students about alternate energy systems.	Sacred Power Corp. constructed the system using new technology developed by Emcore Corp. The system saves money and is an educational tool	Gallup High School 505-721-2500 Sacred Power Corporation Emcore Corporation
Native Power http://newenergyeconomy.org/native-power/	May 2011	Navajo Nation Crownpoint Chapter, NM	New Energy Economy raised money to install solar panels on the roof of the Crownpoint Chapter house.	An outside organization helped find the money, so the money saved goes back to the community immediately	New Energy Economy Contact information
Pueblo of Jemez Sustainability Efforts http://www4.nau.edu/tribalclimatechange/tribes/southwest_jemez.asp	2008	Jemez Pueblo, NM	The Jemez Pueblo has made various efforts towards sustainability via renewable resources.	The community utilizes the solar energy. It also uses the other available resources to their fullest, and recognizes the need to educate and involve the youth of the tribe.	Greg Kaufman, Director, Natural Resources Department gkaufman@jemezpuablo-drp.org
Red Mesa Wind Farm http://renewableenergyde	2011	Cibola County,	The Red Mesa Wind Farm is a \$215 million	The farm is in an ideal place to collect wind	Next Era Energy Resources

v.com/wind-power-red-mesa-wind-farm-new-mexico/		NM	project, worked on by a variety of organizations.	power. It has created around 125 jobs while it was being constructed, as well as 10 full time jobs and has moved New Mexico one step closer to energy independence.	Contact Information
Santa Fe Community College's Sustainability Commitment http://www.sfcc.edu/sustainable_technologies_center/sfcc_commitment	2006	Santa Fe Community College, NM	SFCC developed a five-year plan for sustainability with multiple initiatives.	The plan involves everyone in the community, and set obtainable goals that would make a difference.	Randy Grissom, Director, Sustainable Technologies Center randy.grissom@sfcc.edu

More Information:

Name	Date Established	Location	Description	Reason for Success	Contact Information
America's Clean Water Foundation http://www.acwf.org/	1989	Washington, DC	America's Clean Water Foundation promotes education and involvement for clean water. This site has many options for renewable energy success.	The website shows information for whichever state you choose, and in some cases, has cities as an option as well, so anyone can use it.	webmasteracwf@acwf.org
Green Fire Times http://greenfiretimes.com/	2009	Northern New Mexico and online	This is a newspaper that is distributed in print form but can also be found online. It is basically a home for sustainability	There is an Indigenous Issue annually, and all of the issues contain projects that work in this area.	Green Fire Times Contact

			success stories.		
<p>Renewable Energy Projects in Indian Country Conference</p> <p>http://nativenationevents.org/EventsNativeAmericanConferences.asp?eventID=79</p>	2008	Talking Stick Resort 9800 East Indian Bend Road Scottsdale, AZ	Native Nation Events, based in New Jersey, plans conferences for Native Americans based on different issues (such as renewable energy projects) .	Representatives from Native American communities can meet and exchange their own success stories, which they can then bring home and implement.	Native Nation Events
Various Organizations' Projects	Varies	The New Mexico Area	Try looking at the websites of different businesses and organizations in the area and look at their "projects" tabs for ideas. Start with Trees, Water & People and First Solar, and the organizations highlighted on this site.	These organizations have done multiple projects professionally and are experts in the field.	Find contact information on each page

Water Conservation

The following highlight the goals of sustainable water conservation practices:

- To encourage the community to participate in water conservation
 - To ensure that a community has a reliable source of high-quality drinking water
 - To ensure that water resource facilities and other related infrastructures are prosperous and running at a high efficiency
 - To ensure that a community's sewage and flood management systems do not overflow or fail
 - To ensure that local water ways such as rivers are ecologically sound and provide the economic benefits they can to the community
- Ideas from the chart below can be emulated and altered for other communities

Water Conservation Initiatives:

Name	Date Established	Location	Description	Reason for Success	Contact Information
Clemson Beaver Pond Leveler http://www.clemson.edu/psapublishing/pages/afw/afw1.pdf	March 1994	Clemson, South Carolina	The Clemson Beaver Pond Leveler is a device that was placed in the center of a pond creates naturally by beaver dams. They inserted a device through the beaver dam that would slowly drain water out of the pond at the same rate that water enters. The water is then released further downstream which allows the stream or river to continue running even with the beaver dam.	Utilized natural made ponds to their advantage	Dr. Gee E. Wood, Mr. Larry A. Woodward, and Dr. Greg Yarrow Department of Agriculture, Fisheries and Wildlife, Clemson University, Clemson, South Carolina, 29634 Tel: (803) 656-3117
Sustainable Santa Fe Plan http://www.santafenm.gov/DocumentView.aspx?DID=702	October 2008	Santa Fe, New Mexico	The Sustainable Santa Fe Plan, created in 2008, outlined 12 steps towards water conservation for the city. This document is a public document and intended to be a living document in which it is annually updated. Section 8 on water conservation outlines various steps that Santa Fe has made so far and future tasks to be accomplished in the process of making a water conscious	Santa Fe has done a great job at making this public knowledge and promoting the concept of saving water. The city is leading by example.	City of Santa Fe, Sustainable Santa Fe Commission

			and conserving city.		
Arizona Water Meter http://www.westernresourceadvocates.org/azmeter/report.pdf	October 2010	Arizona	The Arizona Water Meter Report outlines the state criteria for each program offered throughout the state within various communities. It outlines each of these programs and how they incorporate education within each one. The report also outlines the Arizona State incentives of which may be similar or inspire new incentives within New Mexico.	They've done an excellent job recording and reporting their success for 15 water conservation programs. They've promoted educating consumers as well as making changes.	Western Resource Advocates, 2260 Baseline Road, Suite 200, Boulder, CO 80302 Tel: (303) 444-1188
The Sustainable Use of Water in the Lower Colorado River Basin http://www.pacinst.org/reports/sustainable_co_river/sustainable_co_river_es.pdf	November 1996	Lower Colorado River Basin	This 18 page case study covers concepts and criteria for sustainable water usage in the Colorado River basin. These are then used to determine water use patterns and water allocation and management making it sound and sustainable. The findings provide information on sustainable river basin management that can be applied in the southwest and other regions.	Highlights the unsustainable patterns of water use while providing demonstrations of improvement through technology public policy, and management strategies.	Pacific Institute for Studies in Development, Environment, and Security 1204 Preservation Park Way Oakland, California 94612 Tel: (510) 251-1600 Email: pistaff@pacinst.org

<p>Funding Mississippi River Swells</p> <p>http://www.waterconservationusa.org/articles/279-water-conservation-funding-swells-along-mississippi-river.html</p>	<p>2009</p>	<p>The Mississippi River from Minnesota to Gulf of Mexico</p>	<p>This project worked towards improving water quality in 40 watersheds from Minnesota to the Gulf of Mexico. Farmers and landowners were offered the chance to volunteer and participate in the programs designed by the government. The participants saw many benefits in these programs such as redevelopment of wet lands and a decrease in nutrient wastes.</p>	<p>Farmers volunteered to participate and they received government funding.</p>	<p>Natural Resources Conservation Service (NRCS)-USDA 1400 Independence Ave., SW, Room 5105-A Washington, District of Columbia 20250 USA</p>
<p>Using Shock Wells to Recharge the Water Table</p> <p>http://articles.timesofindia.indiatimes.com/2012-02-27/gurgaon/31103858_1_new-tubewells-water-table-cgwa</p>	<p>February 2012</p>	<p>Gurgaon, India</p>	<p>Gurgaon city is completely dependent on ground water after digging shock wells in parks and near local residences and community buildings. The wells collect the rain water run-off and assist in recharging the water table. They are also in the process of implementing tubewells.</p>	<p>Implemented public policy to make sure that all building from now on have 100 m roof allowing the greatest possible rain water to be harvested.</p>	<p>N/A</p>
<p>Millers Creek Rainwater Project Use Porous Pavement</p> <p>http://www.hrwc.org/millerscreek/capture-rainwater.php</p>	<p>On Going</p>	<p>Michigan</p>	<p>Permeable Pavement allows rainwater to soak into the ground recharging the water table instead of running off and into the nearest deposit location. It assists in decreasing erosion, replenishing groundwater, prevents snow and ice buildup, along with many other benefits to the user.</p>	<p>They often have a longer lifespan the normal pavement and are inexpensive than other options.</p>	<p>Pam Labadie Marketing Director Huron River Watershed Council NEW Center 1100 North Main Street Ann Arbor, MI 48104 Tel: (734) 769-5123 x 602 Email: plabadie@hrwc.org</p>

<p>Millers Creek Rainwater Project Land Scape with Native Plants</p> <p>http://www.hrwc.org/millerscreek/capture-rainwater.php</p>	<p>On Going</p>	<p>Michigan</p>	<p>Native roots help capture rainwater on site. It's simple to create low maintenance borders around your gardens, which gives it stability and decreases erosion. It also provides link to pages to explain native plants.</p>	<p>Native plants, no matter where the location is, will always use less water than non-native species. They also have the ability to retain water and access it in drought. Did we mention it's inexpensive!</p>	<p>Pam Labadie Marketing Director Huron River Watershed Council NEW Center 1100 North Main Street Ann Arbor, MI 48104 Tel: (734) 769-5123 x 602 Email: plabadie@hrwc.org</p>
<p>Rain Water Harvesting for Landscape Use</p> <p>http://ag.arizona.edu/pubs/water/az1052/harvest.html</p>	<p>On Going</p>	<p>Arizona</p>	<p>Through collecting rain water the dependence on ground water, cost of municipal water bills, flooding, and erosion are all reduced. This resource allows a user to learn about homemade options as well as professional options that can be implemented.</p>	<p>Collecting rainwater for irrigation has agricultural benefits as well as cost effective benefits.</p>	<p>Pam Labadie Marketing Director Huron River Watershed Council NEW Center 1100 North Main Street Ann Arbor, MI 48104 Tel: (734) 769-5123 x 602 Email: plabadie@hrwc.org</p>
<p>Tribal Connections</p> <p>http://www.wa.nrcs.usda.gov/partnerships/Tribes/index.html</p>	<p>On Going</p>		<p>The NRCS Partnership with Native American Tribes in Washington aid landowners and operators within Native American and Native Alaskan tribal communities.</p>	<p>They provide technical assistance as well as funding. They also hold forums for tribal members to attend and address issues.</p>	<p>Robin Slate NRCS Tribal Liaison Natural Resources Conservation Service 1835 Black Lake Blvd. SW, Suite D Olympia, WA 98512-5607 Tel : 360.704.7780 Email: robin.slate@wa.usda.gov</p>

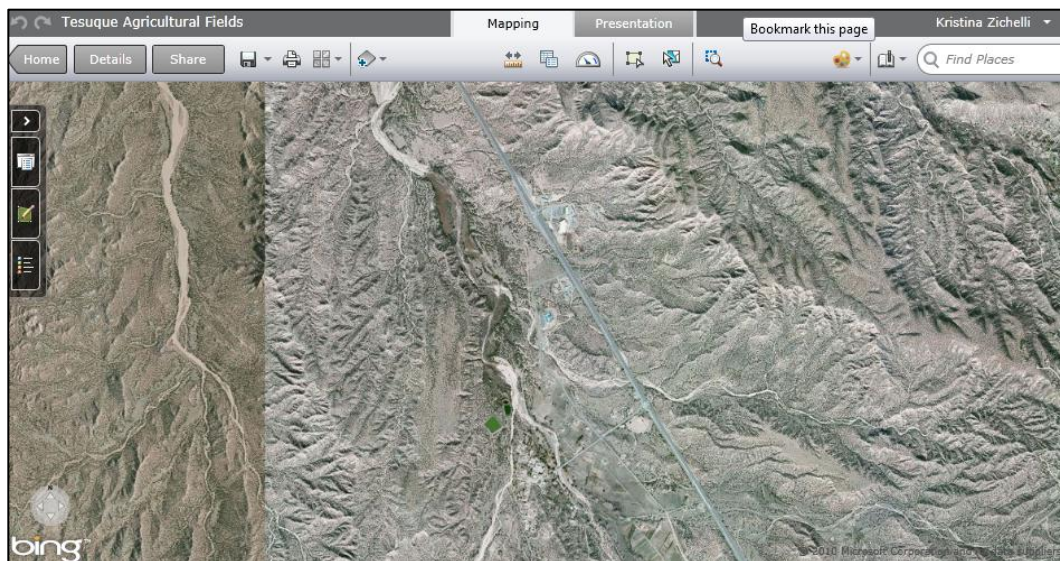
Implementation

This section of the action plan framework highlights different practices and tools that can be used to effectively incorporate the previously mentioned topics in sustainability: energy, water conservation, and food systems.

GIS Mapping

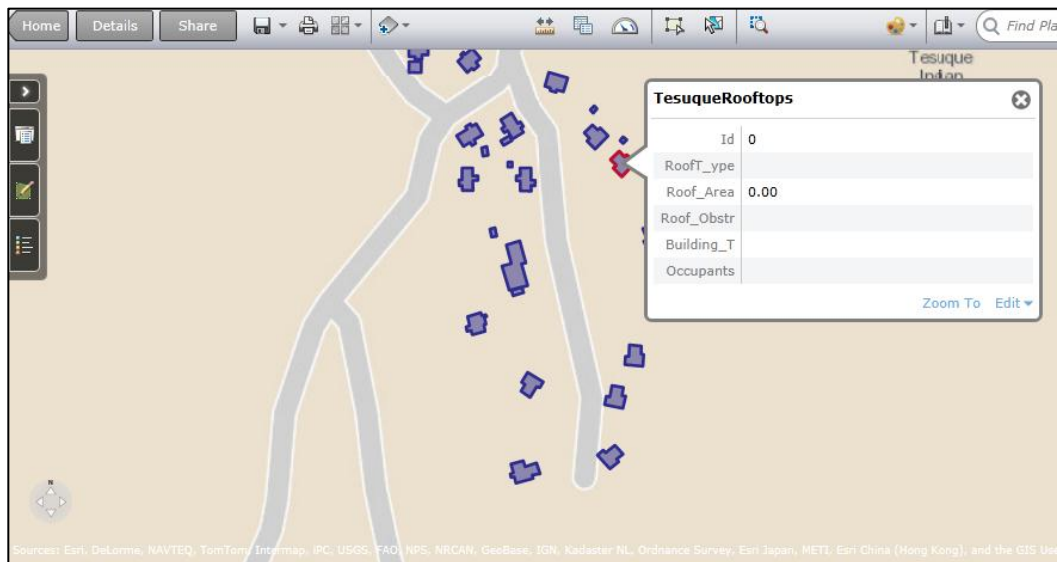
GIS is Geographic Information System. It is a computer tool, used both on and offline, that allows the user to map out his or her desired features. This tool is easy to learn and use. There is also a help feature which makes it great for users of all abilities. Through the use of GIS, a community can map out its resources and occupied land to determine the best location for renewable energy implementation. We suggest using a free online version called ArcGIS explorer. This version allows you to share the maps with other members of your community. Through the use of explorer, a user can create a map and share it with a private group of other users. This allows many people to work on the same map while also keeping it private from those outside the group. ArcGIS explorer provides various privacy settings that the creator of the group can chose. It is important to note that ArcGIS will not allow you to export any maps or create attributes which are two functions that we wanted but may not be necessary for your project. Our team used the full desktop version which does cost money and was available to us through the Santa Fe Indian School. On this version we were able to create our shape files and attributes and upload them into ArcGIS to share with our private group. These files were eventually also uploaded into a private group in GIScloud through which they can be layered and exported. GIScloud also provided the same privacy settings, but does not allow the creation of shape files with the draw and polygon functions.

To start, the user must create an initial map with the boundaries of their land. For example, we started with a map of the Tesuque Pueblo that included the boundaries of the reservation. This map can be seen below:



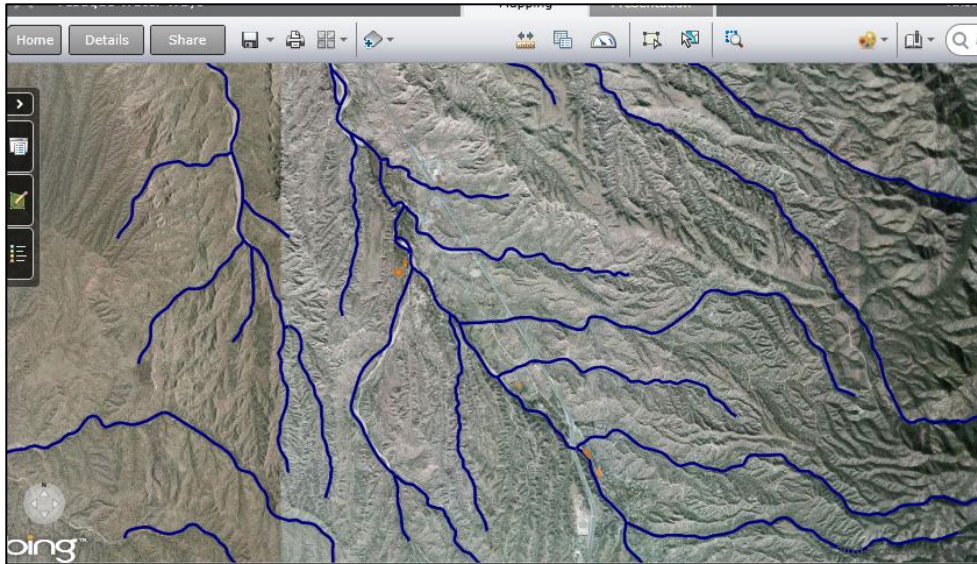
From there, users can start to use shape files to map out different details of the land. We chose to map out rooftops, waterways and water sources, as well as agricultural fields. These should be done using the editor. It is best to use the polygon or free hand feature to create these maps. It is also possible to use a GPS to locate specific features which can be uploaded into GIS and show the specific points.

By mapping rooftops, the user gains two valuable types of information. He or she learns where buildings are located, as well as the potential for placing solar panels on these roofs for renewable energy. Some communities may be against placing panels on their rooftops for various reasons so this shape file will at least indicate occupied land. It is important that attributes are created for this shape file so that when users click on a building, they can see important information. We chose to have roof type (slanted, flat, directs north, south, east, or west), area, occupancy, any roof top obstructions (trees, etc.), and building type (community or individually owned) as the attributes associated with each rooftop. The information gained from these attributes allows the user to know more details about each building mapped and who owns the land, as well as a person to contact about further use of that building. The map below shows the buildings covered in blue with an attribute box, which users can edit to insert the correct information. This shape file was initially created on the desktop version of GIS and then uploaded into explorer.

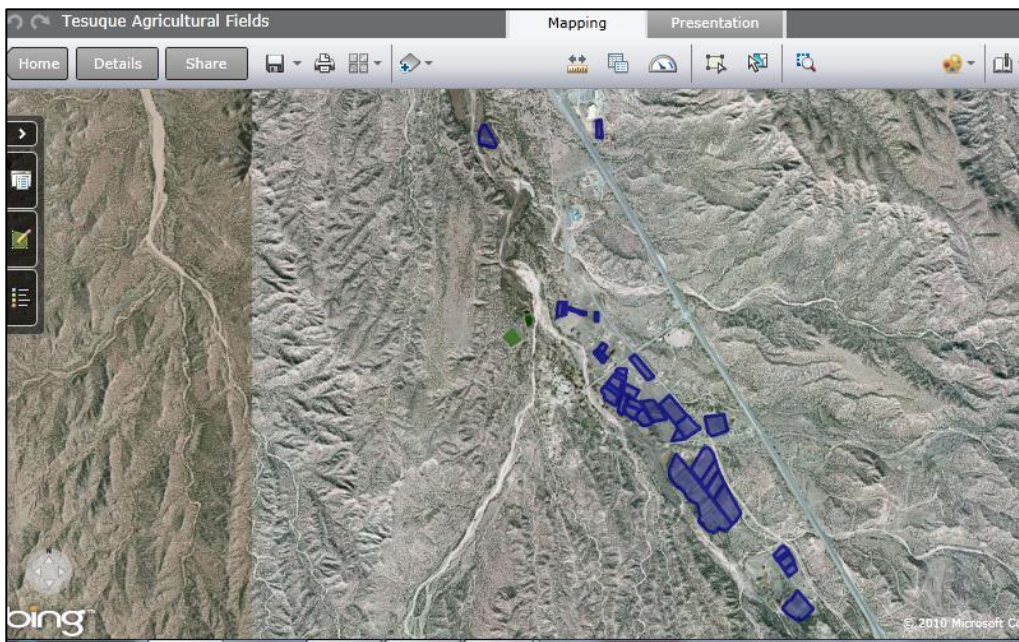


Water sources in New Mexico are very valuable and can often be difficult to come by. Therefore, it is important to map out all useable water sources so as to avoid harming them in any process of implementation with renewable resources. The team created a second shape file that contains all the waterways, ponds, and lakes within the Tesuque Reservation. It was important to map out all possible water sources that exist, including those that are seasonal or no longer providing water, but at one point did, and could possibly again. In the map below, the blue lines map out the rivers and water ways while the orange covers the lakes and ponds.

This shape file was initially created on the desktop version of GIS and then uploaded into explorer.



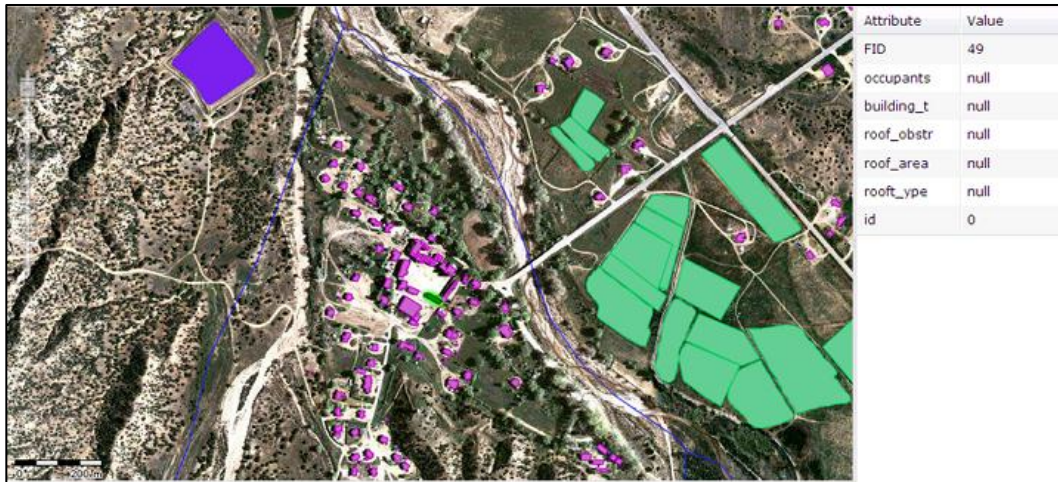
Finally, we determined that agricultural land should also be mapped out. Agricultural land is extremely important to small communities with the goal of being self-sustaining. For communities that provide a significant amount of their own food, it is important to include this in occupied land. This shape file was initially created on the desktop version of GIS and then uploaded into explorer.



It is also suggested that the community map out the ownership of the land. This will allow the community to see who the land belongs to, whether it's an individual or the community as a whole, when trying to determine their options for renewable energy sources.

Once the shape files of information deemed important by the users are finalized, they can be layered together in one map. This map can show each layer desired individually or as many

as desired by using the tool bar feature on the side and checking those that want to be viewed. Through this function the designer can observe any unused land and consider it as a possibility for renewable energy. The map below shows all the shape files layered together. The waterways can be seen in blue, bodies of water in purple, roof tops in pink, and fields in green. Each shape file contains its own attributes that will pop up when clicked on the information, circle i, tool. The attributes seen on the right of the image below are for the roof top highlighted green in the center of the map. This map was created in GIScloud through uploading the shape files created on the desktop version.



It is important that before following through with placing anything on an unused land location that it is observed physically as well. When it is surveyed, the land should be ruled out as a possibility for future agricultural fields or an area that may provide water. An ideal location for renewable energy is one that cannot provide any other resource and is otherwise unusable. The GIS map provides a great starting point when considering renewable energy as an option within a community because the community can see where it is located in relation to all other resources and homes.

If GIS is not an option for your community, the following field form can be utilized to help map out open land. It can also be used when completing the physical observation of the land.

Field Form

What are the coordinates of this location? _____

Who owns the land? _____

Is anything being grown on this land? If so what?

Is the land near houses? _____

How far from the nearest house? _____

Are there houses on this land? _____

Is there a resource available on this land? If so which resources? (water, agriculture, etc.)

What are the land dimensions?

Are there any specific geographical details that would affect implementation of renewable resources? Ex: Hill, plateaus, valleys, rivers

etc. _____

Field Survey

(On a scale from one to ten, with one being the least and ten being the greatest)

Would you be ok with renewable energy resources on the Pueblo land? _____

Would you be ok with solar panels on land within the Pueblo? _____

Would you be ok with Windmills? _____

Would you be willing to implement a device on your house to capture and reuse rainwater?

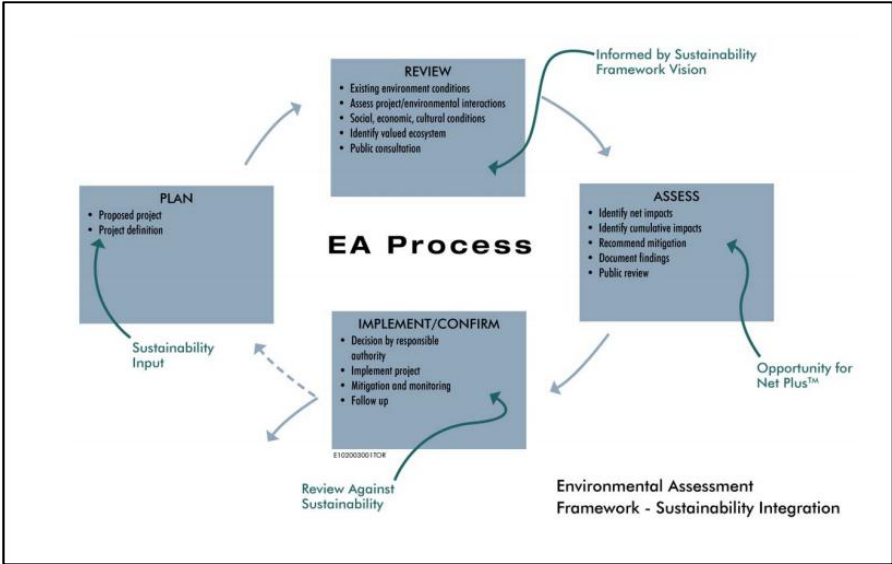
Would you be willing to use solar panels on your home? _____

Would you be ok with solar panels on community buildings? _____

If a website were designed would you use it to learn more about sustainability within Pueblo Communities? _____

Environmental Assessment Planning

This diagram explains the process of environmental assessment planning and how a person must plan, review, assess, and implement his or her environmental plans.



Sustainability Plan Construction

A sustainability plan should include all of the following:

A vision, mission and/or commitment statement that highlights the overall goal of the plan

An overview of existing sustainability practices

A set of practices your organization will do in the future to become more sustainable (make sure to outline responsibilities, a system of how to measure progress, and a specific timeline that these practices will be operating in)

A communication framework (a distinct system that will assure that all members of the organization are aware of the sustainable goals set in place)

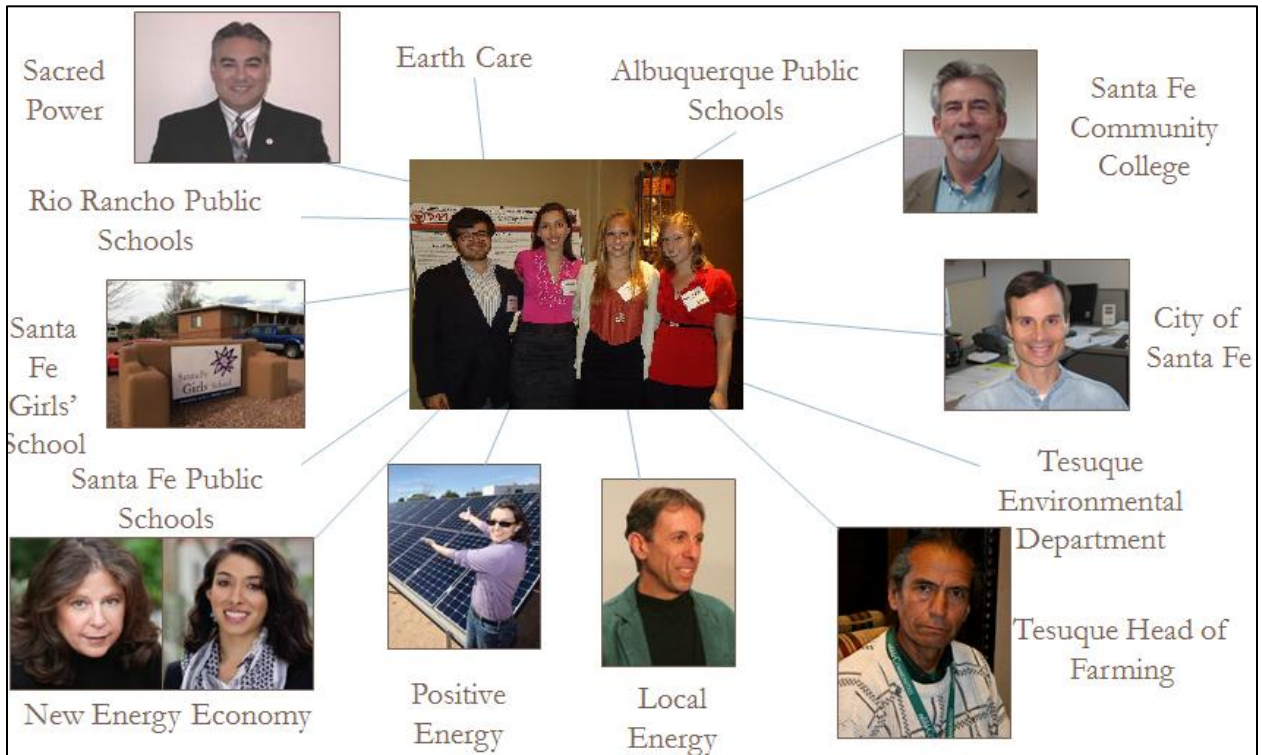
Organization director/coordinator approval (having the outline document reviewed, revised, dated, and signed)

Useful Resources

There are many available resources for groups hoping to achieve sustainability. These include local businesses and organizations that focus on sustainability implementation, as well as online resources for financial options and suggestions.

Businesses and Organizations

The following image shows businesses and organizations in the Santa Fe, New Mexico area that focus on implementation of renewable resources. Some focus mainly on Native American communities.



Financial Resources

The following list consists of multiple calculators that can tell people how much money they will save, and how much they will help the environment, if they make specific changes in their lives. It also contains information about grants and incentives that are available.

For Native American communities:

The American Indian Environmental Office Tribal Portal was designed by the EPA for tribal governments to easily access the related information on environmental policies, practices, and laws. It provides links to information that may be of interest and help to tribal communities including leverage grant resources. <http://www.epa.gov/tp/>



The Federally Recognized Indian Tribal Organizations Federal Grants page is made available by Federal Grant Wires. It provides 381 federal grants, government grants, and government loans for tribal organizations to utilize and apply for.

<http://www.federalgrantswire.com/federally-recognized-indian-tribal-organizations-federal-grants.html>



New Mexico Energy Conservation and Management Division is a site providing technical assistance and information for Native American tribes and pueblos. This division aids in the development and implementation of clean energy systems

<http://www.emnrd.state.nm.us/ecmd/>

Your Source for Energy Efficiency and Clean Energy Information

The Energy Conservation and Management Division develops and implements effective clean energy programs – renewable energy, energy efficiency and conservation, clean fuels and efficient transportation – to promote environmental and economic sustainability for New Mexico and its citizens.

By statute (Sections 9-5A-1 through 7, NMSA 1978), the New Mexico Energy Conservation and Management Division (ECMD) "shall plan, administer, review, provide technical assistance, maintain records and monitor state and federal energy conservation and alternative energy technology programs." Included are programs related to the development and use of solar, wind, geothermal, and biomass resources as well as alternative fuels and transportation. In addition, this division provides technical assistance and information in these areas to government agencies, Indian tribes and pueblos, educational institutions, and the general public. ECMD receives U.S. Department of Energy funding support through its State Energy Program (SEP) to accomplish our division's clean energy goals.

ECMD partners with citizens, businesses, industry, schools, universities, and research laboratories to invest in clean energy infrastructure and to conduct clean energy programs. Our staff develops and implements effective clean energy programs – renewable energy, energy efficiency and conservation, efficient transportation and clean fuels – that reduce energy use and utility expenditures by increasing and diversifying energy supplies to promote environmental and economic sustainability for New Mexico.

HOT TOPICS


Energy Performance Contract Approved!


SAVE THE DATE!
Next meeting, New Mexico Energy Services Coalition
March 27 (check back for details)

RFA - Clean Energy Projects Audit Program

Newsletters


ECMD and the American Recovery and Reinvestment Act





LEED Tool Kit

Energy Efficiency Tips




For all communities:

Calculators

You Sustain offers many sustainable actions calculators. It covers conservation and efficiency, transportation, recycling, renewable energy, and consumer productions. It's very easy to use. For example, under conservation and efficiency, if you choose replacing lights with CF light bulbs, you can choose details or calculate. The details button returns various information including costs and benefits. Then if you press calculate and enter the number of light bulbs you plan to change, it returns a monetary value of savings for the year and the amount of CO2 emissions that are cut. A view of the light replacement example can be seen below. <http://www.yousustain.com/footprint/actions?calcInput0=6>

Replacing lights with CF bulbs [close](#)



Input the number of CF bulbs you will install. The calculations assume an average daily usage per bulb of approximately 3-6 hours.

See the [Full details](#) of this sustainable action.

How many bulbs?

[Calculate](#)

✓ Each year you could save up to **924 lbs** or **420 kg** of CO2 emissions and up to **\$42**

[Log in](#) or [Sign Up](#) to save to your impact.

Transportation



Bike or Walk to Work

[Calculate](#) [Details](#)

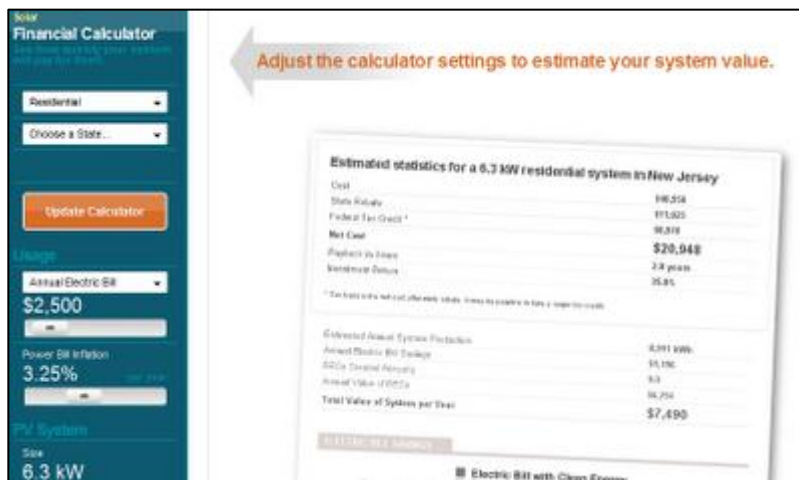
Household Emissions Calculator put out by the U.S Environmental Protection Agency, allows you to estimate your current household emissions, and then explore options to reduce them. You can also see how much you can save from these actions.

http://www.epa.gov/climatechange/emissions/ind_calculator.html



Clean Energy USA allows you to put in information about where you live, current energy usage, and the PV system. It then returns an estimate for initial costs, any state and federal rebates available, the net cost, and the years it will take to return the investment.

<http://ceusa.com/financial-calculator/>



Wind Project Calculator is a website that allows a community to input specific information about the turbines in consideration. It also requires that you input the estimated average annual wind speed, electricity usage, and rates. If you input information about financing and income taxes, it will return estimates on cash flow for investment and your return on that investment. <http://www.windustry.org/your-wind-project/community-wind/community-wind-toolbox/chapter-3-project-planning-and-management/wi>



My Solar and Wind Estimator will estimate the cost and size for installing an energy system for any home or building. It takes into consideration the options for both solar and wind energy systems based on the zip code provided. After filling out the information requested, a financial estimate will be returned showing expected savings in bills and net cost after taxes and other incentives. http://www.solar-estimate.org/index.php?verifycookie=1&page=solar-calculator&subpage=&external_estimator=



Resources

Environmental Protection Agency Funding Opportunities is a resource that directly connects to the EPA webpage about funding opportunities. It lists all the grant categories as well as which grants are still open and accepting applications as well as applicable deadlines. <http://epa.gov/ncer/rfa/>



These pages are part of the larger resource called Federal Grant Wires. By clicking on the links in the list you can gain more information about each individual financial option, which includes federal grants, government grants, and government loans.

Agricultural Federal Grants - <http://www.federalgrantswire.com/agriculture-federal-grants.html>

Community Development Federal Grants - <http://www.federalgrantswire.com/community-development-federal-grants.html>

Cultural Affairs Federal Grants - <http://www.federalgrantswire.com/cultural-affairs-federal-grants.html>

Energy Federal Grants - <http://www.federalgrantswire.com/energy-federal-grants.html>

Environment Quality Federal Grants - <http://www.federalgrantswire.com/environment-quality-federal-grants.html>

Natural Resources Federal Grants - <http://www.federalgrantswire.com/natural-resources-federal-grants.html>

Clean Energy Incentives as a resource provides you with information on state and federal tax incentives. It also informs a viewer of other state and federal funding opportunities and incentives available.

<http://www.emnrd.state.nm.us/ECMD/CleanEnergyTaxIncentives/cleanenergytaxincentives.htm>

Clean Energy Incentives

Clean Energy Performance Financing

State Tax Incentives

- Solar Market Development Tax Credit
 - Solar Gross Receipts Tax Deduction
 - Property Tax Exemption for Solar Systems
- Sustainable Building Tax Credit
- Geothermal Heat Pump Tax Credit
- Biodiesel Facilities Tax Credit
- Gross Receipts Tax Exemption for Sales of Wind and Solar Systems to Government Entities

Other State Funding Opportunities

- PACE (Property Assessed Clean Energy) Bond Financing
The Federal Housing Finance Agency is challenging Property Assessed Clean Energy (PACE) programs that help homeowners cover the initial purchase and installation costs of renewable-energy systems. We will follow this developing situation.
- Energy Innovation Fund
- Clean Energy Projects

Other State Incentive Information

- Claiming Tax Credits for CRS Taxes and Business-Related Income (this Taxation and Revenue Department publication summarizes New Mexico's business-related tax credits and the procedures for claiming them)

Clean Energy Performance Financing is a resource that contains contact information for two contractors as well as various documents on Energy Efficiency Standards, Standards for Energy Efficient Schools, and other community buildings.

<http://www.emnrd.state.nm.us/ECMD/CleanEnergyPerformanceFinancing/CleanEnergyPerformanceFinancing.htm>

Clean Energy Performance Financing

STATE ENERGY PERFORMANCE CONTRACTING

ECMD Contacts: Brian Johnson
(505) 476-3313
brian.k.johnson@state.nm.us

Michael McDiarmid
(505) 476-3319
michael.mcdiarmid@state.nm.us

Statute
Public Facility Energy Efficiency and Water Conservation Act [Sections 6-23-1 to -10 NMSA 1978]

Recent News
Bernalillo County Press Release
Bernalillo County Resolution

Documents
Guidelines for Guaranteed Energy Efficiency Projects
Questionnaire for ESCO References
ESCO Qualifications Form
Energy Efficiency Standards for Public Buildings
Model Financing RFP for Issuance by Contractor
Model RFP for Issuance by Agency
Model Guaranteed Utility Savings Contract

New Mexico Grant Watch allows users to create an account and search for grants to improve environmental sustainability. It then provides you with a funding source, the deadline, and a description of the grant and application.

<http://newmexico.grantwatch.com/grant/126306/collection.php?region=all#g126306>



New Mexico Grant Watch brings you to the Grants to Promote Forest Sustainability Through Conservation of Water Resources page. It also provides information on a funding source, deadlines, and application description.
<http://newmexico.grantwatch.com/grant/127383/grants+to+promote+forest+sustainability+++through+conservation+of+water+resources.html>



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