AMERICAN INDIAN CULTURE AND RESEARCH JOURNAL 30:4 (2006) 115–132

Energy Planning for Indian Nations within the WRAP: A Field Guide

THOMAS L. ACKER, CHIAN JONES, AND DEAN HOWARD SMITH

INTRODUCTION

Energy in the form of electricity is a hot topic among tribes within the Western Regional Air Partnership (WRAP). For too many people, energy is too expensive, not reliable, or even nonexistent. For many tribal members, up to 20 or 30 percent of income is spent on energy, which is unbelievably high compared to nontribal people in the same area. Many houses and buildings within Indian nations connected to the existing electrical power grid are at the end of these lines and far away from the power source. As a result, any interruptions throughout the line will disrupt power to these houses and buildings. Thousands more homes and buildings are not connected to the existing grid and have no electricity. Creating energy plans specific to the needs of the tribal members will help bridge the gap between the current energy situation and the energy system tribes envision.

The initial critical step in establishing an energy plan is to have a complete and specific energy destination in mind. A stock of what is currently possessed needs to be determined in order to understand the resources needed to reach the destination. This destination must meet the common needs of members of the tribe and should go hand-in-hand with other tribal objectives, such as economic development, creation of jobs, and cultural values.

It is necessary to define the baseline electrical energy profile for the tribe. This profile should include inventory of total current, expected, and peak load electricity use expressed in megawatts (MW) and megawatt hours (MWh). An

Thomas L. Acker is associate professor of mechanical engineering and director of Sustainable Energy Solutions (SES) at Northern Arizona University, Chian Jones is a graduate student of economics at Colorado State University, and Dean Howard Smith is professor of economics and applied indigenous studies and director of business and policy programs at SES.

inventory of renewable energy electricity-generation capacity and production needs to be determined. Also, the percentage of total electricity-generation capacity and production due to renewable energy needs to be established.

This article provides an overview of the process for developing a tribal energy plan. The process includes the following steps: development of a tribal energy vision, energy efficiency (EE) programs, renewable energy resource development, electrification programs, and energy plan implementation. Working with the Hualapai tribe in Arizona, the workshop curriculum was presented and led to instantaneous EE projects. Tribes should begin the process of energy planning for economic development (cost savings, revenue generation, job creation, and profit creation), energy independence, cultural integrity, and to increase tribal sovereignty.

BACKGROUND

The Grand Canyon Visibility Transport Commission (GCVTC), created by the 1990 Clean Air Act amendments, quickly agreed to address regional haze in the Grand Canyon National Park and fifteen other national parks, monuments, and wilderness areas on the Colorado Plateau. WRAP was created in 1997 in response to the specific GCVTC recommendation to do so. Research done under WRAP showed that the foremost recommendation was for the 237 tribes within the WRAP to complete energy plans.[1]

The Technical Committee of the GCVTC has prepared the most comprehensive estimations of the causes of regional haze in the West, which show in part that pollution from utilities in the West during 1990 contributed to approximately 17 percent of the "human-caused (light) extinction on an annual average at Hopi Point" in Grand Canyon National Park.[2] Although WRAP was organized and the studies were produced in response to the haze issues at the Grand Canyon, tribes can get involved with the process of energy planning for other purposes.

The most obvious reasons for developing energy plans are costs and revenues. Creating an energy plan that incorporates EE and renewable energy programs can lead to increased tribal revenues or cost reductions but also leads to environmental improvement and helps the GCVTC reduce regional haze in national parks and monuments. Electrification is another type of energy program that might be of interest to some tribal governments because tribal lands have the highest level of households without access to electricity.[3] Along with other advantages, energy planning can lead to more economic and political sovereignty for tribes.

EE programs can reduce expenses by 10 to 50 percent, which can provide substantial savings for tribes and tribal members. These direct savings are monies that can be used for alternative purchases and thus improve the economic well-being of the tribe. Many efficiency programs can be developed with ease, at low cost, and with short payoff periods.[4]

Indian lands hold huge potentials for the development of renewable energy sources. Renewable energy development can have both cost-saving and revenue potential. Instead of purchasing electricity from off-reservation sources, tribes

might be able to begin producing their own, whereby electricity payments stay within the local economy. A tribe might be able to reduce the overall electricity bill by piecing together various renewable energy programs. Alternatively, lower electricity rates may be available to tribal members. Combining efficiency savings, the multiplier effect, and reduced rates, tribes might realize substantial economic benefits from the domestic production of electricity.

Thus an energy plan can motivate a tribe toward an improved and expanded economy, all the while developing clean and safe energy that does not violate cultural norms and values such as mineral and fossil fuel extraction and use. Developing an energy plan allows tribes to negotiate from positions of strength for the effective exercise of sovereignty. The following is a brief overview of the rationale behind energy use reduction through efficiency measures and the development of renewable energy sources.

OVERVIEW OF THE PLANNING PROCESS

For tribes that do not have one, it is recommended that they consider developing an energy plan or policy.[5] To be effective, this plan needs support from the highest levels within the tribe and, among other things, should set down goals for EE, renewable energy development, and electrification. Establishing an energy plan is the first necessary step in gaining control over energy use and costs incurred by a tribe.

Through public hearings and conversations with tribal members, program directors, and relevant others, the council should create a broad vision regarding energy, which should set the policy direction for tribal action. A tribal champion should emerge, empowered and supported, to lead the strategic energy-planning process forward. The vision should be specific enough to set clear direction but should not be prescriptive in the specific methods used to achieve the vision. Where do you want to end up, and how can you get there? A key step in understanding your energy journey is to envision your destination. What does that place look like? Take stock of where you are now to understand the resources you will need to get to your destination. The difference between these two points, where you are and where you want to be, defines the work that needs to be done. A thorough understanding of the energy-planning template can help guide the visioning process because this template discusses numerous energy issues. However, the template in no way implies what any single tribe's vision should be. The vision is a sovereign decision of each specific tribe.

The task of the tribal champion—energy manager—is to develop, implement, and maintain a program focused on tribal energy use and energy development. An energy manager within an energy authority can direct and manage energy programs. As such, the energy manager is a logical choice for assuming the responsibility of selecting, evaluating, and implementing appropriate EE programs and renewable energy development for the tribe. The energy manager can also recommend policies for consideration by the tribal council. For tribes without an energy authority, an energy manager position can be created elsewhere within the tribal government.

It is important that a single person or office within an organization assumes the responsibility for energy issues and EE and renewable energy, and that this person or office has support and commitment from the highest levels of the tribe. This plan should include, but not be limited to, identifying and tracking energy uses, recommending EE programs and equipment, and conducting education and/or rebate programs. When implementing energy measures and programs it is generally best to begin by setting some goals and then implementing low-cost, high-return projects first. The manager will design and implement such an electrification program for tribes that need one.

Tribes without an energy (utility) authority might consider establishing such an entity either individually or in collaboration with other tribes. The energy authority will be an advocate for tribal electricity (and energy) customers, possibly negotiating lower rates from outside sources and improving the reliability of the service. An energy authority will also create jobs, build tribal expertise about energy, and help retain some of the money expended on energy for the reservation. A tribal energy authority also holds promise to advance tribal self-determination. The energy authority will make decisions and implement plans that lead to a more successful future based on the tribal vision.

In order to begin an energy authority and create a position for an energy manager, it may be necessary for a tribe to pass a tribal resolution, including budgetary considerations. Alternatively, especially for smaller tribes, the natural resource manager—or similar position—might be given the tasks of an energy manager. As discussed extensively within the literature on tribal governance, the energy authority should report to the tribal council frequently, but the manager should maintain a level of autonomy for the day-to-day management of the authority.[6]

A Tribal Implementation Plan (TIP) is a formal agreement between a tribe and the Environmental Protection Agency (EPA).[7] Agreeing to complete a TIP commits the tribe to developing an energy plan instead of an informal internal decision to complete one. There are costs and benefits to agreeing to a TIP that need careful weighing. The potential benefits are cost sharing with the federal government; however, the costs include some loss of decision making due to the formal requirements of the agreement. The TIP would address the same issues discussed in the preceding text regarding a less formal plan.

Creating a comprehensive and effective TIP is a significant undertaking that requires involvement of tribal officials, staff, and members. It is important that all tribal members are educated. Therefore, education programs for all residents, including children, and training programs may be needed to ensure that everyone properly understands the need for and role of an energy plan (fig. 1).

ENERGY EFFICIENCY

EE is broadly interpreted as being synonymous with energy management. The intent of energy management is to implement strategies that maximize the effective utilization of energy while minimizing the costs of that energy.

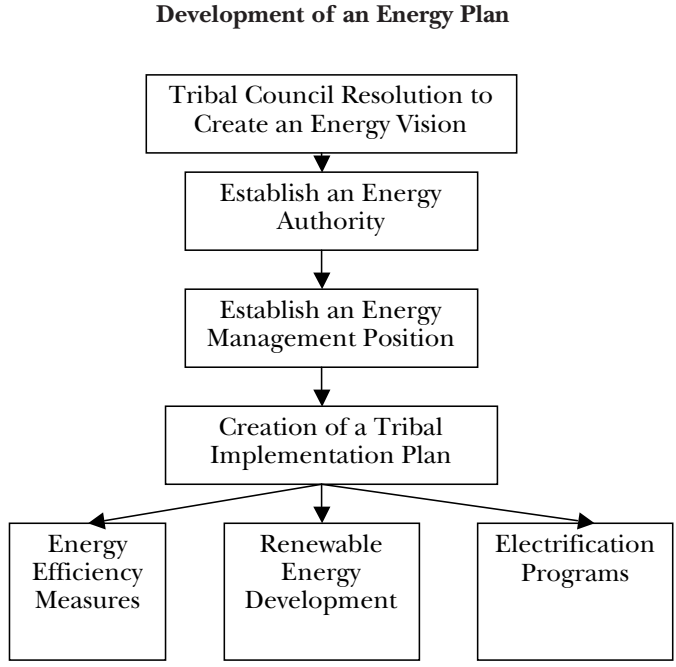

FIGURE 1. *An overview of the energy planning process.*

When considering reduction of electricity consumption, a good place to start is with the identification of the main uses of electricity. From the perspective of a tribal administrator, the biggest uses of electricity may be divided best into the following categories or sectors: residential, commercial (which includes tribal and federal government facilities as well as gaming and recreation facilities), industrial, and agricultural. For most tribes, residential and commercial building loads consume a significant portion of the electricity budget. However, the amount consumed within other sectors varies significantly for each tribe.

The next level of electricity use consideration is from the perspective of a person (energy manager) responsible for tracking and understanding electricity consumption. This person will be interested in knowing the actual uses of electricity so as to determine the opportunities for EE and the associated cost savings. From this perspective, electricity use is typically divided into categories within each sector (for example, lighting, space heating, space cooling, refrigeration, hot water, office equipment, pumps, fans, motors). A good source of information for identifying how much energy and electricity is used within these categories in each of the various sectors is the US Energy Information Administration (EIA). An important consideration

when evaluating any potential EE measure is the required functionality of the system being considered. It is crucial that the EE measure not compromise functionality. In order to understand energy use fully, it may be cost-effective to invest in additional usage meters.

EE has the potential to impact electricity consumption and related electricity costs significantly. Considering that $454 million was spent on electricity in all Indian households in the United States in 1997, a decrease of only 10 percent in consumption of electricity due to EE programs could produce savings on the order of $45 million per year. Given the fact that Indian populations are rapidly increasing and that tribes are actively engaged in economic development, the amount of resources spent on energy will only increase.

A primary benefit of improvement in EE is cost savings. Expenditures toward EE today will result in substantial future savings. After an energy management program is initiated, 15 percent of energy costs can be saved with little capital investment. Thirty percent of savings are routinely obtained through energy management programs, but sometimes savings as high as 50 to 70 percent can be achieved.[8] Thus current savings can be achieved, and future usage growth, and expenditure, can be avoided by achieving increased levels of EE. Decreasing the energy-related costs through efficiency improvements in a household, business, or government office may also further the economic development of a region or change its pattern of economic activity by freeing resources for other, more productive tasks.[9]

Many tribes face two major needs: employment and economic development. EE proposals will lead to the creation of jobs for local workers to repair or weatherize buildings, and, if some of the materials used are locally produced or processed, work is generated in those sectors as well. Tribal colleges are perfect locations to hold classes to teach people about how the energy-efficient applications work. With this highly specialized niche of the local economy filled by tribal members, business is developed and skills are refined that provide opportunities to export products and services off the reservation.

At least for the next few years, and until significant new electricity generation comes becomes available, the general ability of the electric power system in the western region to meet peak demand is at risk. The most effective means of avoiding brownouts and service interruptions may be to manage the demand side of the market place, which will be encouraged through EE measures.[10]

EE opportunities exist with all new electrification projects that tribes undertake. More than 14 percent of Indian households in the United States lack electricity, as opposed to 1.4 percent of all US households. Eight of twelve tribes with the greatest need for electrification (by percentage of households) are located in the WRAP region.[11] It is estimated that eighteen thousand homes on the Navajo Reservation do not have electricity available.[12] The Native American population throughout the country is rapidly increasing and will require additional housing in the future. As reservation economies develop, new commercial and industrial buildings will also be developed. This combination of existing need and expected growth makes the need for EE designs ever more important.

Successfully evaluating the economic merit of an EE measure or several EE measures will assist in determining whether or not to implement a given measure or in deciding which of several measures is best. When evaluating an EE measure, it is important to employ a consistent, reliable method for evaluating the economic merits (fig. 2):

- Identify the opportunities for EE
- Develop feasible alternatives for EE improvements
- Select the decision criteria
- Analyze and compare the feasible alternatives
- Select the preferred alternatives
- Assign responsibility for implementation and evaluation
- Revisit your decision

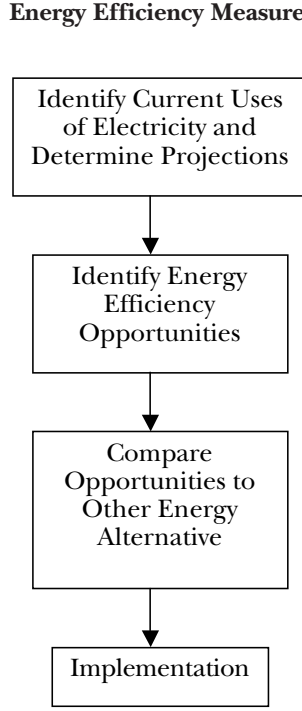

Figure 2. *Energy efficiency planning.*

RENEWABLE ENERGY

Generally speaking, the term *renewable technology* refers to any technology that utilizes a renewable resource system as a type of fuel to generate either electricity or heat.[13] A renewable resource system is defined as a system in which the energy source replenishes itself, often naturally. The most popular sources for renewable technology are solar, wind, hydro, geothermal, and biomass.

Regardless of a tribe's size, location, or other demographic variables, a formal energy policy statement that incorporates specific provisions for renewable electric energy is an important beginning to a larger set of strategies. A program to stimulate renewable energy generation will be most effective as part of a more comprehensive energy policy developed by and adapted to each tribe.

Virtually every tribe in the WRAP region enjoys an abundance of harvestable renewable energy resources, such as wind, solar, biomass, or geothermal. Some tribes with an established tribal electric utility are already well positioned to expand the role of that utility to develop viable sources of renewable energy. There are several potential advantages to creating or expanding the tribal government's direct role in renewable energy development and marketing: increased opportunities for new electrification services to members and others on tribal lands, improved reliability of existing electric supplies, acquisition of low-cost electricity that is competitive with traditional energy sources, acquisition of electric supplies that reflect the tribal energy policy and support other tribal objectives, and increased employment for tribal members in a skilled workforce. The development process of renewable energy as an energy source is based on criteria that examine the viable production possibilities of renewable energy as it relates to the needs, wants, and available resources of the individual community considering renewable energy as an energy source.

The type of system refers to the physical size of the system and its energy production capacity. There are three types of systems available for the respective accessible resources and energy demands. The different systems can be generalized as small or site specific, medium or village sized, and large or utility scale. Small/site-specific energy systems are designed to accommodate the energy needs of a small number of houses or buildings, generally those that are not already connected to the grid. Communities larger than a few houses, however, are in the market for an energy supplier larger than residential-sized systems. Large systems are generally more efficient because of economies of scale; in particular the fixed costs of design, construction, and operation can be spread over more units of produced energy. Enough energy is generally produced to satisfy the energy demands of the larger communities as well as excess energy to be sold on the market, which, of course, requires the community to be connected to the grid.

Communities already connected to the grid should also consider renewable energy as an alternative to their current imported energy supply. Many remote communities connected to the grid experience blackout periods from any interruption or malfunction at any point in the power grid due to their subsequent locations in relation to their power source. Regardless of

the electricity service quality and expenses, there are numerous economic development benefits to having an independently produced electricity supply, which a medium or large system would provide.

After obtaining an understanding of the different types of renewable energy sources and systems that are available, it is necessary to assess what resources are available for the implementation of an energy system that would efficiently process the resource into electrical energy. Renewable resources are generally used at their location, with the exception of biomass, such as wood, which can be shipped from its source to a use site, so they must be locally available and able to maintain the input level satisfying the energy needs of the community and the production level of the system implemented to do so. To indicate the resources that are locally present, resource maps such as those provided by the US Department of Energy (DOE) are available for different states.[14] The energy assessment of these maps is done at a large scale so they can only give an estimate of the resources available in a general area. However, they do indicate which resources are most prevalent in a certain area, and this is the first step to determining the best and most viable resource for any given area.

Given the variant nature of renewable energy and renewable energy systems, there is no general method for taking the second step: selecting a site location. There are many different conditions and variables ranging from geographical to social and cultural issues that may or may not factor into a tribe's decision depending on the relevance of these conditions and variables to the specific profile of each tribe. It is a case-by-case evaluation, but there are some factors that all tribes will need to consider. The site chosen for energy production must be proximal to the location of consumption, or connection costs could devastate the budget of the project, which would make renewable energy no longer feasible.

In the future, it is likely that tribes may add electrical generation capacity, especially as they move toward energy independence and consider sale of electricity on the deregulated electrical power market. There are two basic scenarios for tribes interested in, or actively involved in, electricity generation: tribal use and sale on the competitive electric market.

Tribes seeking to add electricity generation for tribal use or to achieve energy independence (with or without existing generating capacity) will likely want to assess their electrical energy consumption. For tribes seeking to sell electricity on the open market, internal consumption data is not as important as information about the electricity market and how to participate in the generation and sale of electricity. This will require economic and resource planning and possibly interaction with agencies such as the Federal Energy Regulatory Committee (FERC), the DOE, the Council of Energy Resource Tribes (CERT), and state corporation (or utility) commissions. Regardless of the motivation for adding electrical generation capacity, information about the projected generating capacity and production by the tribe will be needed in the tribal energy plan.

Several steps will help evaluate the economic merit of renewable energy resources (fig. 3):

- Identify the opportunities for renewable energy using the DOE maps
- Assess the possible local resource availability
- Select the decision criteria
- Analyze and compare the feasible alternatives
- Select the preferred alternatives and necessary negotiations
- Build the necessary infrastructure
- Revisit your decision

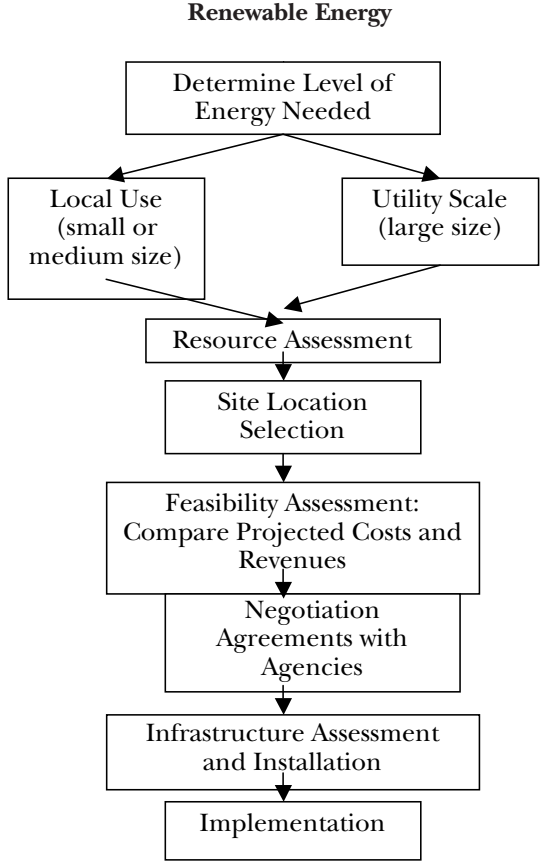

Figure 3. *Renewable energy development.*

ELECTRIFICATION

If tribes determine that they have a possible electrification problem, the tribal energy plan needs to include electrification. Once it is decided that a tribe has electrification problems an initial estimate is determined, and then it is necessary to ascertain the locations of the target households. This will be a much more difficult task depending on the dispersal patterns of the population. Modern Geographic Information Systems (GIS) may facilitate the location process. Once the target households begin to emerge from the mapping process, the transmission lines should be overlaid onto the maps. Estimates should be made as to when it might be reasonable to connect households to the existing grid. Those households located in proximity to the existing lines should be pooled in a "grid-connected potential" category.[15] The remaining households should be analyzed with respect to the type of electrification possible. Advances in the various technologies of electricity provision are moving quickly. Two types of systems are becoming increasingly available at lower costs. These are clustered or village-based systems and stand-alone systems. Stand-alone systems are the only likely manner of electrification for households that are not clustered or within the swaths of connectivity. Various types of systems should be investigated based on the initial resource assessment. Small solar, wind, and biomass systems are becoming increasingly available for these types of situations.

The electrification program will necessitate an extensive education program. Households slotted for the program will have many questions and concerns. Repeated workshops, possibly bilingual, will have to occur.

Depending on the number of households in question, an electrification program is likely to be very expensive. A single stand-alone system was estimated to cost between $7,200 and $12,400 for the equipment alone—without installation costs or profits to the installation business.[16] Given the financial conditions of most tribal governments and most targeted households, it is unlikely that the requisite funds are readily available. Thus additional funding sources probably need to be identified.

Several steps will help evaluate an electrification plan (fig. 4):

- Identify buildings needing electrification
- Identify proximity to existing transmission
- Evaluate transmission capacity
- Determine types of systems
- Select the preferred alternatives and necessary negotiations
- Build the necessary infrastructure
- Revisit your decision

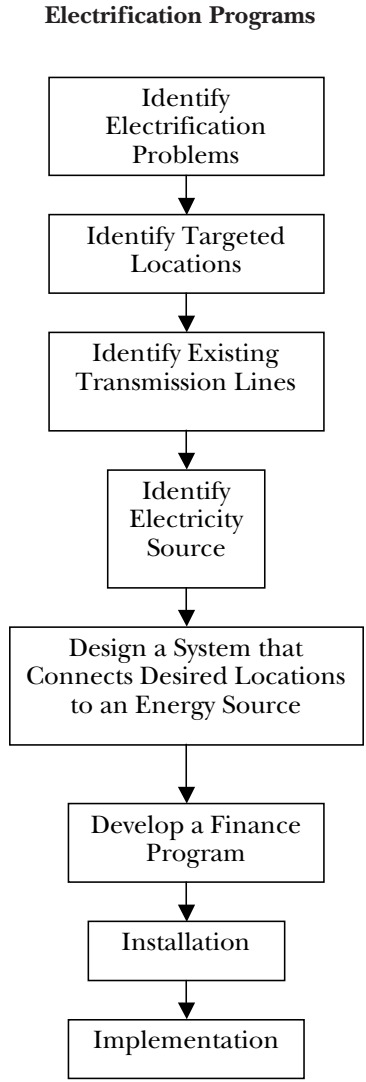

Figure 4. *Electrification planning.*

IMPLEMENTATION

Once an energy plan has been decided upon, the final step is the actual implementation of the project. The keys to any project are to identify an available and reliable funding source and create a time line and schedule before the project can be finalized. Although most energy-efficient measures will result in cost savings over time, it can be difficult to come up with the initial finances for the project. Several methods can be used to identify or establish a funding source including finance and technical support, a revolving fund, utility and state rebate programs, and grant programs.

Research on similar energy projects can help determine how long the project will take to complete. The builders, contractors, and employees who will be hired to implement the program will also help in determining how long the project will take to complete. Once an estimated length is established, a time line with a specific beginning date and projected ending date needs to be specified and a schedule of production created that details when each portion of the project is to start and end. A schedule and time line cannot work toward efficiency without management. Management of the project will ensure that each portion is completed when scheduled, and, if any delays are imminent, then each of the following portions are also delayed accordingly so there are no wasted efforts. For a wind turbine to be built, for instance, the base and trunk need to be in place before the blades can be secured on top. But if there is no management of the schedule, if the base is delayed for some reason, and workers arrive to install the blades when scheduled, then extra time and resources are wasted. Schedule management will ensure that the project is implemented in the most cost- and time-efficient manner.

Once the energy project has been implemented, reassessment and evaluation of the project needs to be ongoing and should be reexamined every quarter, year, or allotted time period. All aspects of the project should be examined to identify both success and potential improvements. In essence, the evaluation will change every time period to reflect the project over the previous time period. Ideally, the reassessment and evaluation will show more successes and fewer improvements over time. A project will never be perfect, so the reassessment and evaluation stage needs to continue to ensure the most cost- and time-efficient energy plan (fig. 5).

THE HUALAPAI WORKSHOP: A NARRATIVE

Once the energy-planning template as described above was developed, it became obvious that tribes would need support in developing their energy plans.[17] Thus it was decided to create an energy-planning workshop curriculum. Sustainable Energy Solutions (SES) research assistants culled through the template described in the preceding text and created an "all-day" workshop. A more condensed version of the curriculum has also been developed for a ninety-minute formal presentation followed by thirty minutes of discussion.[18]

The longer workshop allows for good interaction between the SES staff and the participants from the tribe. An example of this collaboration

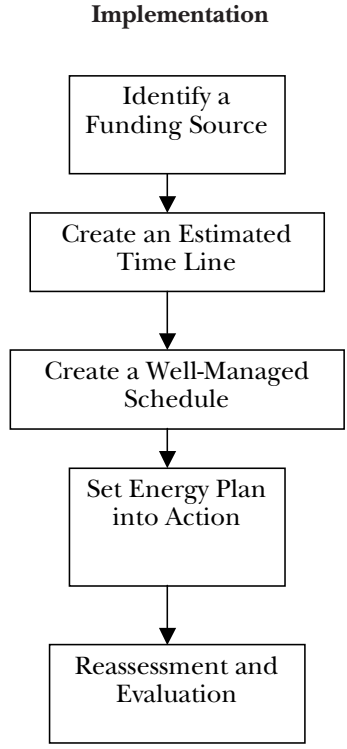

FIGURE 5. *Energy planning implementation.*

occurred at the initial workshop in April 2005. Councilman Waylon Honga and Planning Director Jack Ehrhardt of the Hualapai tribe invited the team to provide a workshop for the Hualapai in Peach Springs, Arizona.[19]

The drive from Flagstaff to Peach Springs includes a severe elevation decrease down from 7,000 feet (2,300 meters), which normally allows for some wonderful vistas of the high desert. However, the day was particularly hazy. Upon arrival in Peach Springs, the workshop began with a discussion of electricity production and air quality. The poor air quality that day made for a very good example of how electricity production influences air quality. Peach Springs is very rural and distant from any sizable population base, but is roughly 100 miles from the Fort Mohave Generating Station, which is a coal-fired production site.[20] The northern border of the Hualapai Reservation is the Grand Canyon; therefore, the source of the haze was probably those sources identified by the GCVTC.

Research Assistant Megan Trout was presenting the material on the case studies included in the template.[21] The first case study concerns upgrading the Yurok tribe's Head Start building with efficient florescent light bulbs. One of

the Hualapai participants asked what the difference was. It just so happened that the florescent lights in the council chamber, where the meeting was taking place, were unshielded. It was obvious that some new efficient replacement bulbs had been used to replace burned out bulbs because there were different bulbs side by side. This led to an interesting discussion about the possible savings and the quality of light emitted from each type of the bulb. (The efficient bulbs also appeared to provide better lighting.) Thus the first EE project was identified: replace the older bulbs with cost-saving bulbs by the end of the month.

Trout then presented the case study of the Pasqua Yaqui tribe's new Head Start building, which concerns installing motion sensors on the light switches in the classrooms. After a break, Jim Arwood (Solar/Rebuild America coordinator, Energy Office, Arizona Department of Commerce) introduced the idea of placing motion sensors in the restrooms in the tribal administration building. Some quick calculations were done and it was determined that this second EE project was worth investigating.

Following lunch, Research Assistant Will Lankford presented the background on renewable energy development. This led to a discussion of the ongoing plans for solar development and wind resource testing, which led to a further discussion of transmission agreements and the like. Most importantly, the workshop is designed to begin a conversation among the council members and between them and various community members and program managers.

CONCLUSIONS

This article describes the tribal energy-planning template as designed by the SES team. It shows how the template workshop can be used to begin the conversation within communities. The WRAP reports strongly recommend that each of the 237 tribes within the region complete an energy plan. The template and workshop curriculum have been designed to aid tribes not only in this region but throughout the United States in this development.

Energy planning for a tribe can be a very worthwhile and productive process. By no means does this mean it will be easy or inexpensive. Beginning with the creation of a tribal energy vision and the identity of the energy champion, the planning process described herein is fairly straightforward. At the same time, the specific issues facing a tribe can be quite complex, requiring very specialized knowledge and technical skills. For example, in an effort to assess renewable resource potentials it can take more than a year to collect wind data using test anemometers. Similarly, evaluating the possible schedule for EE retrofits of light bulbs, heat pumps, and irrigation systems can be rather detailed and complex depending on the size of the tribe. However, early success can allow the EE program to flourish and gain momentum as energy savings are realized.

Some tribes may have to engage in an electrification program. Such a program may be very difficult if the number of households increases due to the political difficulties inherent with scheduling some families ahead of others. However, having access to electricity can lead to a variety of personal,

cultural, social, and economic developments for those families and the tribe as a whole.

Acknowledgments

Sustainable Energy Solutions provided partial funding for this project. See the SES Web site for an introduction to our various projects: www.ses.nau.edu. Additional funding for this project was provided by the Arizona Department of Commerce. The authors wish to thank Bill Auberle and Earl Duque who provided invaluable insight on many issues. The SES faculty and student researchers also developed much of the background material used herein. The two WRAP teams working on the AP2 recommendations on Native American lands also provided invaluable background information. Nic Ratliff provided background on the consequences of coal use. Megan Trout and Will Lankford did a wonderful job at Peach Springs. Two referees offered important suggestions on earlier copies of this report. Thanks to all.

NOTES

1. See Thomas L. Acker, William M. Auberle, Earl P. N. Duque, William D. Jeffery, David R. LaRoche, Virgil Masayesva, and Dean Howard Smith, "Recommendations of the Air Pollution Prevention Forum to Increase the Generation of Electricity from Renewable Resources on Native American Lands," Air Pollution Prevention Forum, 2003, http://www.wrapair.org/forums/ap2/projects/tribal_renew/Tribal_Renewables_Report_7-03.pdf (accessed 10 May 2005); Thomas L. Acker, William M. Auberle, John D. Eastwood, David R. LaRoche, Amanda Ormond, Robert P. Slack, and Dean Howard Smith, "Reducing Energy Consumption and Improving Air Quality through Energy Efficiency in Indian Country: Recommendations to Tribal Leaders from the Western Regional Air Partnership," Air Pollution Prevention Forum, 2003, http://www.wrapair.org/forums/ap2/projects/tribal_renew/TribalEEReport_7-03.pdf (accessed 5 May 2005); Acker, Auberle, Eastwood et al., "Economic Analysis of Energy Efficiency Measures: Tribal Case Studies with the Confederated Salish and Kootenai Tribes of the Flathead Reservation, the Pascua Yaqui Tribe, and the Yurok Tribe" (College of Business Administration working paper series, Northern Arizona University, 2004a); Acker, Auberle, Eastwood et al., "Identification and Implementation of Potential Energy Efficiency Programs in Indian Country" (College of Business Administration working paper series, Northern Arizona University, 2004b); Acker, Auberle, Eastwood et al., "Recommendations for Reducing Energy Consumption and Improving Air Quality through Energy Efficiency in Indian Country" (College of Business Administration working paper series, Northern Arizona University, 2004c); and Acker, Auberle, Eastwood et al., "Economic Analysis of Energy Efficiency Measures: Tribal Case Studies with the Yurok Tribe, the Confederated Salish and Kootenai Tribes of the Flathead Reservation, and the Pascua Yaqui Tribe," *American Indian Culture and Research Journal* 29, no. 1 (2005): 79–96.

2. See Grand Canyon Visibility Transport Commission, "Recommendations for Improving Western Vistas, 1996," http://www.wrapair.org/WRAP/reports/GCVTCFinal.PDF (accessed 27 February 2006).

3. See the Energy Information Agency (April 2000), "Energy Consumption and Renewable Energy Development Potential on Indian Lands," US Department of Energy, SR/CNEAF/2000-01. Available online at http://www.eia.doe.gov/cneaf/solar.renewables/ilands/ilands_sum.html (accessed 27 February 2006).

4. See Acker, Auberle, Eastwood et al., "Reducing Energy Consumption and Improving Air Quality" and Thomas L. Acker and Dean Howard Smith, "Energy Planning for Indian Nations within the WRAP: A Template," with Michael Bishop and Chian Jones; for complete details on EE programs visit the SES Web site: www.ses.nau.edu (accessed 27 February 2006). Acker, Auberle, Eastwood et al., "Economic Analysis of Energy Efficiency Measures," 79–96.

5. More complete details are available in the full-blown energy-planning template available at the SES Web site. See Acker and Smith, "Energy Planning for Indian Nations."

6. This is modeled after the one developed by M. W. Cameron, "A Prototypical Development Corporation for American Indian Tribes: A Report to the Crow Tribe of Montana," The Harvard Project on American Indian Economic Development, John F. Kennedy School of Government, Cambridge, MA, May 1988 and D. Caliguire and K. Grant, "A Foundation for Economic Development for the Hualapai Nation: Building an Enterprise Board," The Harvard Project on American Indian Economic Development, John F. Kennedy School of Government, Cambridge, MA, April 1993. See also Stephen Cornell and Joseph P. Kalt, "Pathways from Poverty: Economic Development and Institution-Building on American Indian Reservations," *American Indian Culture and Research Journal* 14, no. 3 (1990): 89–125; Cornell and Kalt, "Where's the Glue? Institutional Bases of American Indian Economic Development," The Harvard Project on American Indian Economic Development, John F. Kennedy School of Government, Cambridge, MA, February 1991; Cornell and Kalt, "Reloading the Dice: Improving the Chances for Economic Development on American Indian Reservations," The Harvard Project on American Indian Economic Development, John F. Kennedy School of Government, Cambridge, MA, 1992a; Cornell and Kalt, eds., *What Can Tribes Do?* (Los Angeles: University of Los Angeles Press, 1992b); Dean Howard Smith, "The Issue of Compatibility between Cultural Integrity, and Economic Development among Native American Tribes," *American Indian Culture and Research Journal* 18, no. 3 (1994a): 177–206; Smith, "Native American Economic Development: A Modern Approach," *Review of Regional Studies* 24, no. 1 (Summer 1994b): 87–102; and Smith, *Modern Tribal Development: Paths to Self-Sufficiency and Cultural Integrity in Indian Country* (Walnut Creek, CA: AltaMira Press, 2000) for discussions of the importance of separating day-to-day management issues from strategic ones. The former should be the purview of the manager; the latter *are* the purview of the tribal council.

7. For the details concerning a TIP see Acker, Auberle, Duque et al., "Recommendations of the Air Pollution Prevention," 8.

8. For the details concerning a TIP see ibid., 10.

9. Acker, Auberle, Eastwood et al., "Economic Analysis of Energy Efficiency Measures," 79–96.

10. See Acker, Auberle, Duque et al., "Recommendations of the Air Pollution Prevention Forum to Increase the Generation of Electricity from Renewable Resources on Native American Lands."

11. See the Energy Information Administration (April 2000) report. Energy

Consumption and Renewable Energy Development Potential on Indian Lands. US Department of Energy, SR/CNEAF/2000-01, www.eia.doe.gov/cneaf/solar.renewables/page/pubs.html (accessed 8 September 2006).

12. See Craig Bain, Crystal Ballentine, Anil Desouza, Lisa Majure, Dean Howard Smith, and Jill Turek, "Navajo Electrification for Sustainable Development: The Potential Economic an Social Benefits," *American Indian Culture and Research Journal* 28, no. 2 (2004): 45–58 for complete details.

13. This report focuses on electricity consumption and production. It does not include details on other types of energy, such as heating and transportation; however, similar planning is possible within those energy areas.

14. See the National Renewable Energy Laboratory (NREL) Web site: Renewable Resource Data Center, http://rredc.nrel.gov/ (accessed 7 February 2006). This site can be cumbersome. Selected renewable energy maps for several western states are located at the SES Web site, http://ses.nau.edu/resources/maps/ (accessed 7 February 2006).

15. Analysis of the existing lines should be conducted to ensure that they are capable of carrying the added load. If the lines are not, then additional analysis will be necessary to address the financial requirements for upgrading the lines.

16. See Craig Bain et al., "Navajo Electrification for Sustainable Development."

17. Acker and Smith, "Energy Planning for Indian Nations."

18. Contact the authors if you are interested in obtaining copies of the curricula.

19. The Arizona Department of Commerce began supporting the project at this point in the process.

20. This substantial pollution source closed on 1 January 2006.

21. See Acker, Auberle, Eastwood et al., "Economic Analysis of Energy Efficiency Measures," 2004a and Acker, Auberle, Eastwood et al., "Economic Analysis of Energy Efficiency Measures," 2005, 79–96 for a formal presentation of the case studies.