

Implementation Planning for the Electrification of the Housing Stock on the Navajo Nation

Principle Investigator: Dean Howard Smith, Professor of Economics and Applied Indigenous Studies

Lead Investigator: Craig Bain, Professor of Accountancy

Co-Investigators: Frank Caliendo, Assistant Professor of Economics, Susan Norman, Assistant Professor of Management

Research Assistants: Kayla Priest,

Overview

Using 1990 Census data, in 2000 the Energy Information Administration estimated that 36.8 percent of the 29,375 occupied housing units on the Navajo Nation lacked electricity. Since the Navajo Nation has very low population densities, the large distances separating homes make the cost of providing conventional sources of electricity prohibitive.¹ Arizona Public Service, the primary provider of electricity in Arizona, estimates the cost of erecting power lines to be roughly \$25,000 to \$30,000 per mile, an impossible sum for most families in this region where the unemployment rate hovers around 50 percent. Given the extremely low population densities, it is simply inconceivable that many houses could be connected to the power grid. More recent estimates, using 2000 Census data, show that between 10,000 and 23,000 homes need some type of electricity provision system that is not connected to the grid. An estimate of 18,000 homes appears to be a reasonable current target figure (this number could very well increase as the population grows). The estimated cost of any program providing electricity and the associated appliances to these homes falls between \$115 and \$350

¹ Energy Information Administration. 2000. Energy Consumption and Renewable Energy Development Potential on Indian Lands. Office of Coal, Nuclear, Electric and Alternate Fuels, U.S. Department of Energy. April 2000, www.eia.doe.gov/cneaf/solar.renewables/page/pubs.html.

million². Using the baseline estimate of 18,000 homes, the estimate is roughly \$235 million. These are costs above the typical construction costs for the expected new housing units.

The Principle and Lead Investigators have completed an analysis of the potential success of a small business operating on the Navajo Nation installing self contained solar systems, including battery storage, for these 18,000 homes.³ Several scenarios were analyzed and the individual prices of the systems ranged from \$10,000 to \$19,000 depending on the size of the system and the level of retail markup. In all cases, the pro forma income statements show profitable business opportunities *if the revenue stream can be assured*.

However, even a rudimentary understanding of the current demographic, economic and social conditions experienced by the residents of the Navajo Nation points to a clear conclusion that many individual families will be overwhelmed by the financial requirements of paying for these systems. The most favorable estimate is roughly \$60/month over 15 years and this does not cover regular maintenance costs. As such, it will be imperative for outside funding and subsidies to be made available if the people of the Navajo Nation are going to be able to participate in an electrified 21st Century.

² See Craig Bain, Crystal Ballentine, Anil DeSouza, Lisa Majure, Dean Howard Smith, and Jill Turek, "Economic and Social Development Stemming from the Electrification of the Housing Stock on the Navajo Nation" College of Business Administration Working Paper Series, (Northern Arizona University, 2002. ref. 02-34) http://www.cba.nau.edu/faculty/workingpapers/pdf/Smith_electrif.pdf for detailed calculations for the demand estimates and details on the cost estimates contained herein. Reviewers of this proposal are invited to refer to the feasibility study for additional background.

³ Ibid

Arizona is moving forward with the development of the renewable energy industry. That 18,000 families live in 3rd World conditions in the midst of the strongest economy in the world is a disgrace. The next step in improving the living conditions of these families is designing an implementation plan. The proposed project will continue from the feasibility phase into the implementation planning for an electrification program.

Benefits to Navajo Families⁴

The Navajo Nation and Navajo families will benefit immensely from an electrification program. As Bain et al. determined, there is a large profit potential for small businesses to succeed with an installation, maintenance and repair business located on reservation lands. Thus the first benefit will be an increase in jobs and income for selected tribal members.

The economic benefits will multiply due to the basic economic action of the multiplier. Employees will spend their wages at the increasingly available retail and service outlets on the reservation. Additionally, as families receive electricity they will need to purchase various items such as appliances and light bulbs.

The availability of electric lighting will improve conditions within the home. Improved studying and craft work conditions will lead to educational and economic development. Improved air quality – reducing the burning of kerosene lamps – will improve health conditions.

Perhaps the most important benefit will come from improved health care opportunities. Complications from diabetes are major causes of death and health problems in the majority of Native American populations. These complications include

⁴ A much expanded description of the benefits to Navajo families can be found in Bain *et al.* (2002)

kidney disease, blindness, heart attack and stroke, and amputation. According to the National Institute on Health, amputation rates among Native Americans are 3-4 times higher than the rest of the population and kidney failure is six times higher. The rate of diabetes and resulting complications can be directly traced to a number of factors including the household environment.

Both prevention and treatment of diabetes require a proper diet and exercise. A proper diet requires frequent servings of fruit, vegetables, dairy, meats, and bread. Maintaining a proper diet is impossible for many Native American due a lack of refrigeration in the home because many fruits, vegetables, meats and dairy products require refrigeration to stay fresh. Refrigeration is essential in reducing the rate and severity of diabetes. Those individuals with pre-diabetes can prevent the development of type 2 diabetes by making changes in diet and exercise. Studies indicate that this is even more effective than medication.

For those individuals who develop type 2 diabetes, treatment involves diet control and exercise, home blood glucose testing, and insulin medication. Unfortunately, insulin must be refrigerated. For people living in homes without refrigeration, insulin treatment is not an option. This lack of treatment is responsible for the above average rates of amputation and kidney failure.

Nutritional variation will be greatly improved with refrigeration. Fresh milk, vegetables and fruit can be stored for extended periods. These foods can substitute for the current high levels of dried and canned foods, which tend to be of much lower nutritional value. A better diet will enable families to avoid some of the causal sources of diabetes and other diseases that are prevalent within the Navajo population.

Refrigeration can be used to maintain a variety of medicines in addition to insulin.⁵ Children, elders and everyone in between use refrigerated medicines for a variety of illness: antibiotics, glaucoma, hepatitis A&B, thyroid, and cancer were itemized.

As detailed in Bain *et al.* (2002) there will also be cultural and social benefits to Navajo families gaining access to the modern *convenience* of electricity.

Environmental and Economic Benefits to Arizona

The primary reason for Arizona's investment in the renewable energy sector is improving air quality for visibility and health reasons. A result of the electrification of the Navajo Nation will be the development of an industrial infrastructure and the training of technicians to expand the use of renewable energy within and without the State.

Scientific Merit

The feasibility study and the above discussion on benefits are clearly applications of economic development processes – as modified for Native American Tribes. Dr. Smith has written the leading textbook on Native American economic development. The feasibility report was based on Dr. Smith's work and that of the preeminent development economist Jane Jacobs.

Once reached, the implementation phase will create ample opportunity to expand knowledge as the industrial infrastructure is developed. Very few, if any, projects of this scale, 18,000 homes, have been undertaken to date. Since most of the installations will involve will be stand alone – as opposed to village based distributed systems – substantial

⁵ Frederick A. Hirth, RPH. Interviewed March 31, 2004

lessons will be learned that can then be applied – by trained technicians – outside the Navajo Nation.⁶

Feasibility

The timeline, detailed, below indicates that the various components of the project will be completed in a purposeful order. For example, Tasks 1, 2 and 7 need to be completed prior to meeting with possible funding outlets in Tasks 5 and 6.

The principle and lead investigators initiated this project in 2000. As is demonstrated in the attached resumes, Dr. Smith has extensive experience in Native American economic development and energy economics, and Dr. Bain has extensive experience in project implementation. The other investigators have also worked on various components of this project for the past year.

Collaborators

Various offices and divisions of the Navajo Nation will be instrumental in developing the implementation plan. These include the president's office, the Speaker's office, NTUA, NTHA and the Divisions of Economic Development and Natural Resources. Additionally, collaboration with Sandia National Laboratories and BP, partners on the feasibility study, will continue.

Task 0: Administration

July-June: Dean Smith, Pat Ponce, Craig Bain, Levi Esquerra, Susan Norman, Frank Caliendo, Betsy Putnam, Kayla Priest

Task 1: Identification of Target Population

July-October: Bain, Smith, Caliendo

⁶ See Bain *et al.* for a further discussion of this point.

Working in conjunction with the Navajo Tribal Utility Authority (NTUA), maps will be developed in an effort to locate the households in need of electrification. The previous estimates were determined using census and informal estimates based on NTUA service areas. With a better idea of where the households are located, it will be easier to determine the types of electrification systems. Remote isolated systems will be targeted for stand alone units. Clustered housing can be targeted for shared distributed systems – mini sun/wind farms. Installation and maintenance schedules can be determined that minimize travel and other costs. As such, it is necessary to generate an estimated map of the locations.

Deliverable: Stand alone report and journal submission

Task 2: Analysis of Potential Resources

July- December: Norman

The original feasibility study was partially supported by a solar panel manufacturing company, and therefore focused on solar production. In conjunction with the existing NREL solar map and the new SES wind map, the potential renewable energy resources on the Navajo Nation will be estimated and geographically located. This analysis will allow for a better determination for where solar, wind and co-generation systems can be placed. Once the estimates are determined, specifically located testing can take place. In conjunction with the SES anemometer loan program, site specific tests can take place prior to actual implementation.

Deliverable: Stand alone report and journal submission

Task 3: Working with Navajo Nation

July-June: Smith, Bain, Esquerra

Various offices and divisions of the Navajo Nation will be instrumental in developing the implementation plan. These include the president's office, the Speaker's office, NTUA, NTHA and the Divisions of Economic Development and Natural Resources. In a companion project, SES is working with the Navajo Nation to determine the opportunities for harvesting renewable energy at the industrial level.

Deliverable: Included in overall report

Task 4: Working with APS (AZ EPS)

November-February: Norman, Smith, Caliendo

Arizona Public Service (APS) has adopted an EPS Credit Program. Customers in APS service territory that live in remote areas without access to electricity from APS' distribution system (the grid) and who purchase and have installed complete solar systems to provide their electricity are also eligible for the EPS Credit Purchase Program. Customers purchasing a new solar electric system of 5 kW or less for their remote (off-grid) homes can receive an EPS Energy Purchase rebate of \$2.00 per photovoltaic watt of DC electricity. Remote solar customers must sign an EPS credit Purchase Agreement assigning APS access to the EPS credits for 12 years.⁷ Again, as an example, a 1,000-watt solar system qualifies the customer to receive a direct payment of \$2,000 from APS. It should be pointed out that this is a private transaction between APS and the purchaser of the solar system. It is not a tax credit of any kind. Additionally, the supplier of the solar equipment need not be related to APS: the buyer can purchase a system from any supplier. By purchasing the rights to the solar panel, APS gets credit from the State government towards the renewable portfolio requirements

⁷ This will be limited to the Arizona portion of the Navajo Nation.

New Mexico has recently passed an EPS. This new policy will be investigated to see how it might impact the implementation plan.⁸

Deliverable: Included in overall report

Task 5: Working with Congress

November- June (Post election): Bain, Priest, Smith

A main component of the implementation planning will be the effort at securing federal funding. Following the federal election, the congressional delegations from Arizona and New Mexico will be contacted. Congressional representatives of appropriate committees will also be contacted. Professor Bain will make at least one trip to Washington with MBA student Kayla Priest. In addition to her work on this project, said trip will be a valuable educational experience.

Deliverable: Included in overall report

Possible: Federal legislation and funding

Task 6: Working with Philanthropic Organizations

October-June: Bain, Priest, Smith, Putnam

Similar to the emphasis on securing federal funding, philanthropic organizations and foundations will be approached as an effort to fund the implementation. Whereas federal funding will be targeted at purchase and installation of the systems, the philanthropic organizations will be approached with regard to developing the workshop curricula and educational programs.

Deliverable: Included in overall report

Possible: Funding for education implementation

⁸ SB 43. <http://legis.state.nm.us/newsite/session04r.asp?chamber=S&type=++&number=43>

Task 7: Health Issues Development

August-December: Priest, Smith

A major benefit of the electrification program will be improved health. The potentials for improved health practices and remediation will be fully documented.

Deliverable: Stand alone report and journal submission

Task 8: Needs Assessment Process Development

January-May: Priest, Smith

Due to the current lack of sustained economic activity and the corresponding low income levels on the Navajo Nation, few of the targeted households will be able to fully purchase and maintain the electrification systems. However, many households will be able to make regular monthly partial payments. As such a family needs assessment process will be developed to determine each family's ability to pay.

Deliverable: needs assessment policy and procedures. Sample agreement documents.

Task 9: Workshop development- initial phases – scoping out the process

January-June: Smith, Student (AIS) researchers, Priest (health issues)

Deliverable: Action plan for bilingual curriculum development (Possible TRIF project for 2005-06.)

Overall Report: Will include the stand alone documents and a description of the individual tasks. Will include an action plan for implementation.