



**Electric Department**  
**Integrated Resource Plan**  
**2013**

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## INTRODUCTION

The City of Aztec Electric Department is a small municipal electric utility located in the northwest corner of New Mexico. It is approximately 10 miles east of Farmington, New Mexico, 30 miles south of Durango, Colorado, and about 200 miles northwest of Santa Fe, New Mexico. It has a compact electric system with only 39 miles of distribution line. The City does not own any generation facilities; however, it does own a short segment of 69 kV transmission line within its service territory and receives all of its power through a single substation. Its system losses average about 6.2 percent as compared with the 6.5 percent national average for electric utilities that have the same annual energy sales per mile of line. Its rates are comparable to those of neighboring utilities.

The City of Aztec is a wholesale power customer of the Western Area Power Administration (WAPA). Over the last five years, it has purchased an average of approximately 20 percent of its annual energy requirements from WAPA. The Energy Policy Act (EPA) of 1992 requires all Western Power Administration customers to submit an Integrated Resource Plan (IRP) every five years, with progress reports submitted annually. The City of Aztec's most recent IRP was submitted to WAPA in 2007.

Integrated resource planning is a planning process for new energy resources that evaluates the full range of alternatives, including new generating capacity, power purchases, energy conservation and efficiency, cogeneration, heating/cooling applications, and renewable energy resources. It is intended to provide adequate and reliable service to the electrical consumers of WAPA's customers (e.g. the City of Aztec). An IRP supports customer-developed goals and schedules and must take into account necessary features for system operation such as diversity, reliability, dispatchability, and other risk factors. It also must take into account the ability to verify energy savings achieved through energy efficiency and the projected durability of such savings measured over time and must treat demand and supply resources on a consistent and integrated basis.

Each IRP submitted to WAPA must include the following subjects which are detailed in Section I through Section VI of this report:

- Identification of resource options
- Action plan
- Environmental effects
- Public participation
- Load forecast
- Measurement strategies

The City's power supply contracts with WAPA will not expire during the next five year period. The contract with PNM will, however, expire near the end of the IRP time period in 2016 with a new one being negotiated prior to that time. It is intended that the City will continue to purchase the bulk of its electrical demand and energy requirements from

wholesale power suppliers. However, the City also plans to investigate the possibility of adding both solar and hydro generation to the system to locally generate some its energy requirements via renewable resources. These facilities would likely be in service by 2016.

Demand-Side programs planned for the 2013-2017 period include:

1. Continuing with the conversion of high pressure sodium street lights to LED units,
2. Install a second substation which will provide needed transformation capacity, increase service reliability by establishing a second power source in town and lower system line losses by reducing the average circuit length,
3. continued power correction to over 98 percent during peaking conditions,
4. Life cycle loss evaluation of distribution transformer losses,
5. Load balancing between circuits and between phases on a given circuit,
6. Operating the primary distribution system at 121-122 volts to minimize distribution transformer losses and maximize the efficiency of customer's electric devices,
7. Proper economic sizing of primary conductors and distribution transformers.

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## IDENTIFICATION OF RESOURCE OPTIONS

The identification and comparison of resource options is an assessment and comparison of existing and future supply-side and demand-side resource options available to a WAPA customer based upon its size, type, resource needs, geographic area, and competitive situation. Supply-side options include, but are not limited to, purchased power contract and conventional and renewable generation options. Renewable energy means any source of electricity that is self-renewing and includes plant-based biomass, water-based biomass, geothermal, hydropower, active and passive solar, and wind. Demand-side options alter the customer's use pattern to provide for an improved combination of energy services to the customer and the ultimate consumer.

### Supply-Side Options

Presently the City of Aztec purchases all of its demand and energy requirements from a combination of WAPA and the Public Service Company of New Mexico (PNM). Over the past five years, purchases from WAPA have been as shown in the following table with the remainder purchased from PNM:

#### Annual Energy Supplied by WAPA

Year	Total Annual Energy (kWh) Requirements	WAPA Energy	
		Amount (kWh)	Percent
2007	45,484,223	7,830,791	17.2%
2008	45,883,436	8,588,750	18.7%
2009	45,292,347	8,152,442	18.0%
2010	45,113,640	8,104,246	18.0%
2011	45,514,087	11,841,001	26.0%

The term of the present wholesale power supply contract between the City of Aztec and WAPA will expire on September 30, 2024. The term of the present wholesale power supply contract between the City of Aztec and PNM will expire on June 30, 2016. The City expects to either renew or re-advertise and receive proposals for the demand and energy requirements presently supplied by PNM prior to the expiration of that contract.

The City has decided to investigate the feasibility of two forms of renewable energy. The first is solar. The weather in the area provides many clear, relatively cloudless days that are favorable to solar, or photovoltaic, generation. The second is hydro generation. The City owns water rights that are currently not being used that could be used to power small scale hydro generation. However, plant-based and water-based biomass, geothermal and reliable wind generation options within Aztec's service areas are not presently available or not feasible if available such as wind.

By the end of the five year period, the City will attempt to bring to fruition two renewable energy generation projects. The first is a 1.0 MW photovoltaic project that would be

located on a 10 acre site. This project would take advantage of the excellent solar characteristics present in northwest New Mexico. The second project would make use of the water rights owned by the city to power one or more small scale hydro generators (about 500 kW per unit). The City has been setting aside between \$20,000 and \$50,000 on an annual basis for approximately the past five years to fund renewable energy and plans to continue to set aside funds in the upcoming years. To efficiently implement these projects, the City plans to investigate number of means of constructing the facilities including partnering with private firms in some way.

The City is investigating the best way to implement net metering on the system by allowing a net metering arrangement with one large power customer. This customer uses solar power to offset most, if not all of his monthly usage. The City would like to encourage customer owned renewable generation by allowing net metering as long as it is done in an electrically safe manner and appropriately recovers the cost of providing electric service to the customer. When these issues have been resolved, it will be made available to other customers. However, there has not been much interest to date.

### **Demand-Side Options**

The City of Aztec currently has several ongoing programs as well as planned new programs to reduce its demand and energy requirements. These include the following:

- Power factor correction. The City corrects its peak load power factor to a minimum of 99 percent lagging with a combination of fixed and automatically switched capacitor banks. The City has three 600 kVAR automatically switched capacitor banks plus several smaller kVAR fixed banks. By maintaining high power factor, the magnitude of line current is reduced resulting lower losses in the City's distribution primary circuits and in the substation power transformer. The high power factor also reduces losses in the transmission facilities needed to transmit power to the Aztec electric system.
- Life cycle cost evaluation for transformers. In order to determine the lowest cost transformers for the City's system, new transformer purchases are evaluated using the present worth value of both the no-load and load losses and the initial transformer purchase price. In conjunction with the life cycle transformer cost evaluation program, the City plans to replace older, less efficient transformers.
- Conductor loss evaluation. The primary conductor sizes for the City's distribution lines are determined using a present worth economic analysis of initial conductor cost and the value of load losses.
- System operating voltage. The primary system is operated at a relatively low level (121 to 122 volts on a 120 volt base) to improve the efficiency of consumer's appliances such as refrigerators or lights and to reduce the City's distribution transformer no-load losses. Many utilities operate their primary distribution system at 123 to 126 volts on a 120 volt base, particularly in those areas where loading on long feeder lines causes excessive volt drop. The City of Aztec relatively short feeder lines with a high primary voltage, thus feeder loading causes minimal volt drop.

- Conversion of primary system voltage. The primary system was converted several years ago from 4.14/2.4 kV to 12.5/7.2 kV reducing line losses and replacing older, inefficient transformers.
- Street light conversion. The City has changed out approximately 100 high pressure sodium street lights with more efficient LED lights. The older high pressure sodium lights are typically each rated 150 watts and the newer LED lights are each rated 35 watts. In addition the LED fixtures have a much longer (twenty year) lifecycle than the high pressure sodium lights. The City plans to replace 20 to 50 fixtures per year as the high pressure sodium fixtures fail.
- Air conditioners. The City encourages the use of swamp (evaporative) coolers for new installations instead of the compression-type coolers. In areas with very low humidity such as Aztec, swamp coolers are more energy efficient than compression-type air conditioners. Currently, approximately 90 percent of air conditioning in Aztec uses swamp-type coolers; however, some of the installations for new buildings are using compression-type units, particularly in commercial applications.
- Water heating and space heating. Most space and water heating in buildings within the City of Aztec service area is done by natural gas thus eliminating opportunities for demand-side electric reduction. However, there is the potential that a small amount of solar water heating may occur in the future.
- Electric Rate Design. The City's electric rates are designed to discourage inefficient use of electricity. The City energy rates are flat or increase slightly with increase monthly usage.
- Energy Efficient Appliances. In addition to higher efficiency lighting, the electric users of the City are benefiting from the higher USA government mandated energy efficiency standards on new electric appliances, including compressor type air conditioning units, refrigerators, freezers, motors and other devices. The staff of the electric department encourages users to not only consider higher efficient appliances but also to consider the replacement of old less efficient units.
- Energy Audits. The City does not have the qualified staff to make thorough residential and commercial electric energy audits, but the employees have assisted users on numerous occasions from general evaluation of electric usage to specific recommendations on the proper economical selection and use of electric appliances.
- Net Metering. The City is investigating the best way to implement net metering on the system by allowing a net metering arrangement with one large power customer. This customer uses solar power to offset his total energy requirements. In this particular case, the solar system generates more power than the plant needs during the day with the surplus being back fed on to the City's system. During the night, power is pulled from the grid to operate the facility. The net effect in this case is no energy being billed to the customer.

## ACTION PLAN

This action plan describes the specific actions the City of Aztec will take to implement its IRP and includes a time line the City expects to take in accomplishing its identified goals. It also includes milestones to evaluate the accomplishment of those actions during the implementation period and estimates the energy and capacity benefits for each action planned.

### Supply-Side Options

The City of Aztec does not own any electric generation facilities. It currently relies entirely on purchasing its demand and energy requirements from a combination of WAPA and Public Service Company of New Mexico (PNM). The terms of the wholesale power contract with WAPA will expire in June 2026 while the contract with PNM expires in June 2016. The supplemental contract with PNM was specifically written and negotiated to allow the City to develop and integrate renewable energy resources within their electric system.

- Solar generation. The City has been considering a solar generation facility for some time and has investigated a number of options recently including a 3.0 MW facility. The City plans to move forward with constructing a smaller (1.0 MW) facility located on a 10 acre site already owned by the city. Once a feasibility study has been completed and once project funding is secured the City plans to start the project, completing the project by the end of 2015. The total annual energy generated from the project is estimated to be about 3,100,000 kWh or about 7.0 percent of the City's annual energy requirement.
- Hydro generation. The City plans to begin investigating the possibility of installing one or more small scale hydro generators on a long ditch owned by the City. Water rights already owned by the City would be used to operate the generator(s). This project is in the preliminary stages at this point but it is hoped that it would also be in operation by the end of 2016. The total annual energy generated per 500 kW unit is projected to be around 1,100,000 kWh or about 2.5 percent of the City's annual energy requirement.

It will, however, still be necessary to have a firm generation backup agreement in place with the wholesale power supplier to provide power in the event that either or both of these facilities are not operating when needed.

### Demand-Side Options

The City of Aztec will continue its ongoing power factor correction, transformer life cycle cost evaluation, load balancing between circuits and between phases on circuits and conductor loss evaluation programs which reduce system losses. Similarly, it will continue to operate its system at a relatively low voltage (121-122 volts on a 120 volt base) to improve the efficiency of customer's appliances and minimize distribution transformer no-load losses. The City of Aztec is restricted in its ability to promote energy conservation because State of New Mexico State law prohibits municipals from

gifting. This prohibition applies to all municipal functions including electric utilities. Therefore, it is not possible for the City to provide economic incentives to promote energy conservation.

- Street light conversion. The City will continue to replace high pressure sodium street lights with more efficient LED units as the older fixtures fail. The failure rate is estimated to be between 20 and 50 fixtures per year. About 100 fixtures or 10.0 percent of the total fixtures have already been converted. Assuming that 35 fixtures will be replaced each year, then the total number of LED fixtures on the system will be 275 by the end of the IRP five year period. Since the average wattage per fixture will decrease from 150 watts to 35 watts, the total annual savings for 275 fixtures is projected to be about 140,000 kWh. It will continue to increase as more fixtures are replaced over time.
- Addition of new substation. The City of Aztec is currently in discussions with the City of Farmington about the best location for a new substation. This location needs to meet the City of Aztec's need to integrate well with the existing distribution system as well as being located as near as possible to an existing transmission line operated by the City of Farmington to integrate as smoothly as possible with their transmission system. Furthermore, the line has to have adequate capacity to serve the new load. It is expected that this substation will be completed within the next two to three years. When complete, it will likely reduce distribution system line losses by about 0.5 percent (measured as a percent of sales) because the circuits will be shorter in length and not as heavily loaded which will reduce the thermal line losses. This reduction corresponds to about 250,000 kWh per year. The primary driving factors driving the project are the need for additional transformation capacity as the City continues to grow and improved service reliability by having two delivery points to serve the town. The reduction in distribution line losses is a side benefit.

## ENVIRONMENTAL EFFECTS

To the extent practical, the City of Aztec will minimize any adverse environmental effects associated with new resource acquisitions. The City's efforts to take advantage of solar and hydro resources in the area to generate power for the City will help reduce the impact to the environment presently caused by burning fossil fuels at distant power plants and transmitting the power to the City. Despite the likely addition of the renewable resources by the City, the majority of City's energy requirements will continue to be purchased from outside suppliers including the hydropower provided by WAPA and power generated primarily from fossil fuels by PNM.

The existing and proposed supply as well as demand-side programs and projects will result in demand and energy savings thus lowering the amount of electricity it purchases from Public Service of New Mexico (PNM). It should be pointed out that wholesale power suppliers such as PNM have efficient generating facilities which minimize the production of particulates, CO<sub>2</sub>, NO<sub>x</sub>, and SO<sub>2</sub> which are known to have negative impacts on the environment. This would also apply to another wholesale power supplier if they are chosen instead when it comes time to sign a new five year power agreement in 2016.

The City's planned photovoltaic project was chosen to demonstrate the feasibility of using the area's abundant renewable resource, solar power. The City's ongoing and new programs to reduce demand and energy will have a positive effect on the environment by reducing the amount of generation needed to meet the City's electrical power requirements. These programs show the City's commitment to save resources and meet its environmental goals.

## **PUBLIC PARTICIPATION**

The Aztec municipal electric system serves all of the residential, commercial and government consumers with the city limits. An ample opportunity for full public participation in preparing and developing this IRP will be given by the City of Aztec. The Integrated Resource Plan will be posted on the City's website and comments can be forwarded on to the Electric Department staff. The City Commission meets every two weeks and the public is invited to attend these meetings and voice any concerns they have regarding any of the City's utility services. This IRP will be on the City Commission agenda for discussion and approval in the month of January of 2013. Comments regarding the IRP will be welcome at that meeting as well. Should any significant comments arise; the IRP will be changed to address them.

## LOAD FORECASTING

The table shown below summarizes the historic demand and energy requirements for the City of Aztec from 1997 through 2011. Based on an analysis of this information, both the demand and energy requirements have increased at an annual rate of about 2.0 percent during the recent past. Since there are no significant system loading changes expected in the near future, the historic growth rate of 2.0 percent will be projected to continue throughout the five year planning horizon of this study. The projected results are also shown in the table located below.

### Historic and Projected Demand and Energy Requirements

Year	Annual Energy (kWh) Purchases	Annual Peak (kW) Demand	Annual Load Factor
<b><i>Historic Data</i></b>			
1997	32,628,672	5,129	72.6%
1998	32,798,880	5,560	67.3%
1999	34,157,942	5,940	65.6%
2000	37,351,127	6,528	65.3%
2001	38,127,871	6,746	64.5%
2002	38,753,698	6,924	63.9%
2003	39,149,390	7,248	61.7%
2004	40,838,122	7,280	64.0%
2005	42,023,561	7,712	62.2%
2006	43,530,675	8,069	61.6%
2007	45,484,223	8,348	62.2%
2008	45,883,436	8,348	62.7%
2009	45,292,347	8,176	63.2%
2010	45,113,640	8,680	59.3%
2011	45,514,087	8,648	60.1%
<b><i>Projected Data*</i></b>			
2012	46,424,369	8,821	60.1%
2013	47,352,856	8,997	60.1%
2014	48,299,913	9,177	60.1%
2015	49,265,912	9,361	60.1%
2016	50,251,230	9,548	60.1%
2017	51,256,254	9,739	60.1%

\* Based on 2.0% growth in demand and energy

## MEASUREMENT STRATEGIES

The measurement strategies to determine whether the IRP's objectives are being met must identify the baseline from which the City will measure the benefits on implementing the action plan items. To be an economically viable program, the savings from avoided supply costs, avoided participant costs and tax credits, if any, must be greater than the utility program costs, the participant costs and increased supply costs if the program was not implemented. In other words, the benefit to cost ratio must be greater than one. This can be shown as the Total Resource Cost Ratio (TRCR) test in the following formula:

$$\text{TRCR} = (\text{ASC} + \text{APC} + \text{TC}) / (\text{UPC} + \text{ISC} + \text{PC})$$

Where:

ASC = avoided supply costs  
APC = avoided participant costs  
TC = tax credits  
UPC = utility program costs  
ISC = increased supply costs  
PC = participant costs

As the City purchases all of its demand and energy requirements from wholesale power suppliers, it is reasonable to compare the total present worth value of annual energy savings for each program over their estimated life (20 years) against the initial cost of labor and material installation plus the present worth value of operation, maintenance and replacement costs of each program to determine the benefit to cost ratio.

In some cases, other factors such as reduced impact on the environment must be taken into account but are hard to quantify since exact economic values can not be assigned.