Concept Paper for Santa Fe County:
A comprehensive approach for managing energy development and implementation with a Smart Electric Grid and a County Energy Park

The CEC offers this concept paper as more than merely an alternative to the Rancho Viejo Solar Project currently proposed by AES Corporation. As the County is aware, CEC opposes the AES Project not because it is solar and not because it has BESS, but because it attempts to place solar and BESS in a risky location without benefit to the community. While we are not specifically opposed to the solar component of the project, we object to the inclusion of lithium-ion battery storage because of the risk of fire and toxic fume release and the location of the proposed project, which is close to 10,000 homes, four schools and a prison; the water required for construction; the miniscule tax revenue ($547 per day); and the lack of guarantee that the energy produced will serve customers in Santa Fe County.

As an alternative, we offer here a concept paper for a comprehensive approach to energy development and management, one that will deliver to all residents and businesses in Santa Fe County the benefits of an optimized approach that…

- Is modular and offers scalability through federated and distributed design,
- Is consistent with the land use principles of the Sustainable Land Development Code,
- Aligns with guidelines for community and commercial renewable energy projects,
- Shares responsibility and cost with Santa Fe energy customers and potential investors and partners,
- Easily fits into the Santa Fe County Sustainable Growth Management Plan (SGMP),
- Most important, is future-proof and safe for all communities within Santa Fe County.

The hope is that this concept paper will begin serious discussion around disrupting the current state of the electric grid in the county. This concept paper builds on four primary concepts, brought together to envision a holistic approach to a future energy landscape in Santa Fe County. Not one of these concepts is new or unproven. Enabling these concepts will take time, resources including money, innovation (public and private), changes in Laws, Regulations and Policy (LRP), and leadership. The primary concepts addressed in this concept paper are:

- A Smart Electric Grid constructed around the concept of Smart Micro-grids, grids that are organized around a unifying context, each with the ability to produce electricity from renewable sources, the ability to store electricity, consumers, and the ability to share and respond to the needs of the larger electric grid.
- A Smart Electric Grid that is hierarchically structured, made up of Smart Nodes that aggregate into natural groupings of distributed and federated networks of Smart Nodes.
- A Smart Electric Grid that can detect and respond to different levels of problems or inefficiencies based on real-time aggregated data from the system Smart Nodes. A centralized capability to manage the overall reliability and stability of the entire county system. The capability could be in the hands of the County itself, as described in this concept paper, or accomplished by some other construct that could be assembled over time.
- A Smart Electric Grid that supplements the system of distributed and federated Smart Nodes with renewable bulk-energy production and storage capability.

Synopsis

Santa Fe County currently depends on outside entities such as the state and private and public providers to manage the distribution network and deliver the electric power on which its citizens and businesses rely.[1] Now is the perfect time for the County to enact a new vision for energy development, management, and delivery by transitioning to a Smart Electric Grid. The current electric grid is aging and monolithic, there is an urgent need to respond to climate change, and there are also many useful state and federal renewable-energy initiatives and incentives available. To move to a Smart Electric Grid, the County can partner with current electricity providers, local communities, and private entities to manage its electric power production, transmission, distribution, and demand. With a centralized energy management capability, a **Santa Fe County Smart Electric Grid** will allow the County to coordinate and respond to available and future renewable-energy initiatives, resulting in a coherent, effective system that provides electricity affordably, reliably, and sensibly in both the short- and long term.

Background

Four main providers deliver electricity to commercial and residential customers in Santa Fe County, along with smaller projects owned by individual customers. Our existing electric grid, especially the transmission and distribution components, has a limited ability to respond to growing demand for electricity or opportunities for new generation sources.

At the same time, the climate crisis has given rise to many renewable-energy initiatives from a variety of sources. Our State and Federal governments are offering programs, direct funding, land trusts, and grants. New standards for efficient energy production and consumption are emerging as technology advances, and communities, businesses, and individuals are investing in renewable energy production. Also, providers of electricity are replacing fossil-fueled generation with generation from renewable sources.

These efforts are likely to increase, and they are doing so on an ad-hoc basis, i.e., without a well-coordinated County process for managing the resulting projects. While all these projects can benefit electricity consumers in Santa Fe County, the County can optimize those benefits and mitigate negative impacts if it develops a Smart Electric Grid.

The Santa Fe County Smart Electric Grids: The Basics

In a traditional electric power grid, providers produce and deliver electricity to their customers over a network of transmission lines and a distribution system the provider owns. Providers manage the power grid by using an Energy Management System (EMS) to detect real-time demand for electricity and respond with the best mix of generation at the lowest cost. The provider periodically collects data from customers' meters to bill them for their power usage. This approach to energy management covers the entire span of control of the provider and results in optimizing the provider's total system but not necessarily the needs of its individual consumers.

[1] Technically, "electricity," "power" and "energy" are not synonyms. This document defines energy and power as including not only solar generated electricity, but other sources such as wind and hydro.

The Santa Fe County Smart Electric Grid, like all smart grids, will be an evolved and sophisticated version of the traditional power grid with a focus on the consumers within the county. This enables the operator of the county smart grid to detect and respond to local problems or inefficiencies, which enhances the overall reliability and stability of the entire county system and reduces the dependency on provider management and control. One of the best features of a county-level smart electric grid is its ability to integrate diverse sources of energy, including renewables like wind and solar, from big providers, small providers, and even individual customers. The smart grid can manage the intermittent and variable nature of renewable sources and balance them with fluctuations in power demand.

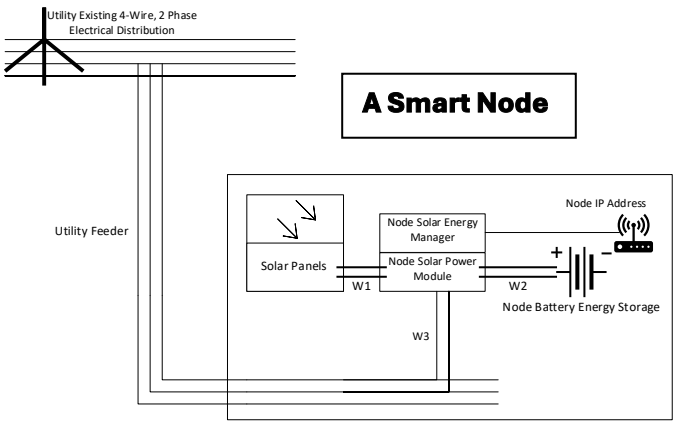
Another attractive feature of the smart grid in Santa Fe County is that customers can monitor their individual energy use in detail in real time, allowing them to make better decisions about how they consume and, in some cases, produce and store electricity. This contributes to more predictable patterns of power use on the grid as a whole and reduces costs for both customers and providers.

Santa Fe County Smart Electric Grid: The Details

Smart electric grids have characteristics that distinguish them from traditional grids and allow them to deliver the benefits described above. First, smart electric grids are hierarchical. Hierarchies establish relationships where individual consumers and producers form *Distributed Networks* that are based on common, shared attributes, and Distributed Networks form *Federations* based on higher-level shared attributes. An effective Smart electric grid is *hybrid*—it contains the distributed and federated electric networks and micro-grids, but also contains bulk components such as distribution lines and utility-scale generation elements needed to support the baseline grid. Below is a discussion of what it means for the Santa Fe County Smart Electric Grid to be *distributed*, *federated*, and *hybrid*.

Distributed

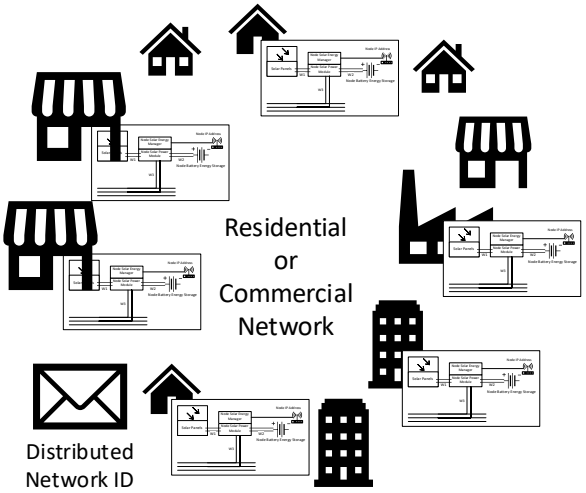
The Smart electric grid consist of nodes, which are specific consumer or producer end-points within the network or grid. Nodes not only consist of electricity providers and customers, they also produce and consume information or data about energy production and consumption. There are two types of nodes, standard and smart.



Purely traditional grids consist only of standard nodes. In *standard nodes*, customers are completely dependent on the provider's electric distribution system to supply electricity to their home or business. The owner of the grid controls the generation, transmission, and distribution components, and it receives information about customers' energy use from periodically reading customers' meters.

Smart nodes include customers who not only consume power from the grid but who can also generate their own electricity, usually through renewable means like solar panels, and store energy on their own. In a smart node, a customer can supply excess power to the grid, provide real-time data

about usage to the grid, and allow the provider's energy management system to control some parts of its own node.



Micro-grids

Nodes, both standard and smart, can be grouped within a community, building, or electric distribution circuit to form micro-grids. Micro-grids are smaller-scale power systems that can generate, distribute, and manage electricity on their own.

A smart grid includes not only smart nodes but also a Smart Energy Distribution System (Smart EDS) to manage the flow of both electricity and information on the grid. The Smart EDS is what allows a smart grid to deliver energy resiliency and reliability, optimizing both performance and cost-effectiveness for providers and customers. In a smart grid, micro-grids are identifiable parts of the full electric grid that a smart EDS can control, providing the full grid owner with the ability to coordinate control on a larger scale.

Encouraging Smart Node Development in Santa Fe County

A smart grid consists of both a Smart EDS and smart nodes, so Santa Fe County, presented as an example of a Grid Manager in this paper, should encourage the development of smart nodes. There are already several ways to do this:

- *Net metering*, which is a smart billing process,
- *Tax incentives* to offset customers' cost of installing smart node components,
- *Grants* that directly pay the full or partial cost of customers' smart node components,
- *Communication standards* that make it easy for customers to share data about how much electricity they are using or generating,
- *Incentives in Power Purchase Agreements* that provide a financial benefit when customers choose to operate as smart nodes,
- *Hardware standards* that make it easier and simpler for a customer's system to become a smart node,
- Promoting the use of *approved components* to ensure customers' smart node devices are reliable, safe, and can easily communicate with and be managed by the Smart EDS.

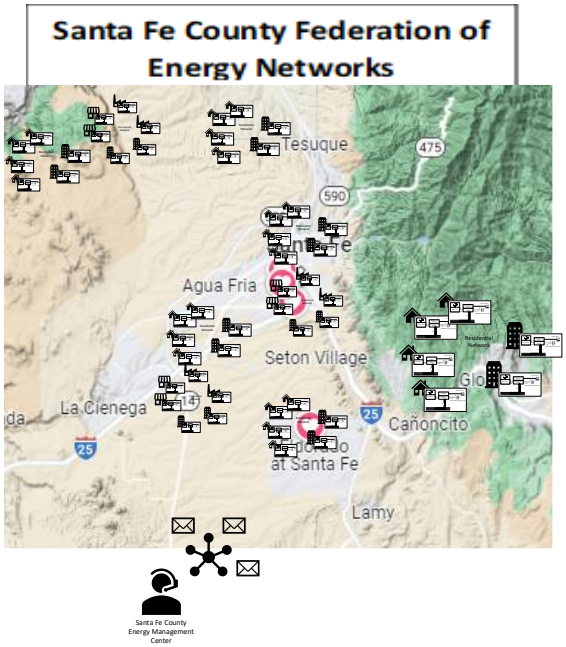
Federated

Groups of micro-grids can exist within one of the four bulk energy providers; within a region, city or town; or within other geopolitical boundaries, such as districts or counties. These groups of micro-grids are called *federations*. Federations can have unique power distribution requirements from each other. For example, cities' and towns' power requirements are typically different than those that agricultural or Native Land federations may require. Federation of micro-grids allows the smart grid

manager to coordinate control at a larger scale than micro-grid by micro-grid. The total of all County federations represents the total set of energy consumers within Santa Fe County.

Santa Fe County Smart Energy Management Center (SEMC)

In order to manage and control the smart grid, whether at the level of federations, micro-grids, or smart nodes, Santa Fe County can establish a Smart Energy Management Center. Within the SEMC, there will be a data center that collects and analyzes individual node and network usage data. Continuous analysis allows the County to control and optimize the flow of power to fulfill all customers' energy needs and to take intelligent advantage of excess generation capacity from providers, micro-grids, and smart nodes. The SEMC can receive data about power being imported into the County, and it will have the ability on county-wide, federated, and distributed micro-grid levels to perform various energy management functions.



Energy Management Functions

The most important energy management functions that the SEMC can perform include:

- Enforcing and optimizing Power Purchase Agreements
- Managing demand for power
- Regulating energy flow and voltage across the power network
- Synchronizing the grid so it delivers power at the proper voltage and electrical frequency
- Ensuring the physical and cybersecurity of critical infrastructure components of the entire county-wide grid
- Acquiring data from all components of the county-wide grid
- Detecting and responding to alarms about emerging or actual problems
- Managing and optimizing the performance of the entire grid
- Collecting and analyzing data to produce reports that can inform business decisions (business intelligence).

Hybrid

Like all smart grids, the Santa Fe County Smart Grid will combine different technologies and approaches for managing and distributing electricity. It will blend traditional power grid infrastructure with modern digital technologies, allowing for better integration of renewable energy sources, improved efficiency, and enhanced reliability, especially in response to disruptions or changes in all levels of the hierarchical network.

It will also require four other elements to fully realize the County's vision for renewable energy:

- **Interconnection to the New Mexico electric grid** - includes oversight by the New Mexico Public Regulation Commission (PRC), agreements with existing providers like Public Service Company of NM (PNM) or any of the providers and co-ops, and the ability to clearly distinguish renewable and fossil-fuel generation sources.
- **Utility-scale or bulk renewable energy generation and storage capability** - To close gaps that occur when energy demand exceeds the energy generated on the electric grid.
- **Bulk energy delivery to micro-grids** - The ability to transmit substantial amounts of energy (bulk energy) to the federations and distributed networks within the electric grid.
- **Fail-over capability** - A County-wide ability to transfer operations smoothly and quickly from centralized energy management to control by means of micro-grids and/or Smart Nodes in case of a failure or disruption to the primary grid.

Interconnection to the New Mexico electric grid

Though ultimately Santa Fe County would benefit from full energy self-sufficiency, ensuring the highest possible reliability requires interconnection with other utilities on the New Mexico grid. (Consider the Texas power grid crisis in February of 2021, where the lack of interconnection meant that when part of the grid failed due to adverse winter weather, there was no way for the State of Texas to obtain power from providers outside Texas.) And to meet Santa Fe County and New Mexico's targets for reducing the amount of electricity that comes from fossil fuels, Santa Fe County will need data from other grids to which it connects.

Other Considerations

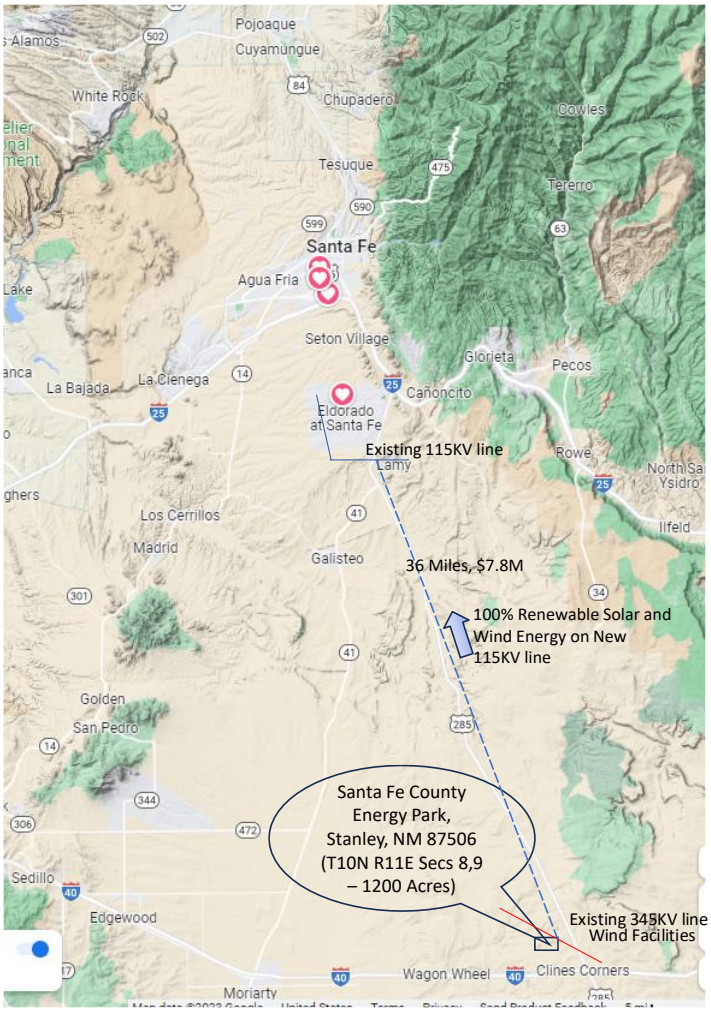
The Clean Energy Coalition for Santa Fe County (CEC), like Santa Fe County itself, is committed to safe, reliable renewable energy that meets the needs of our residents and businesses. The County must also deliver tangible benefits, such as lower energy costs. With its abundant open land and sunshine and low population density, New Mexico is a leading generator of solar energy in the United States. According to the US Energy Information Administration, New Mexico accounts for 20% of total US solar power generation. But renewable energy within our state still accounts for only 38% of our total generation. Consistent with Santa Fe County's vision, we can and should continue to replace fossil fuel generation with solar and other renewable generation sources.

Doing so requires forethought, informed insight, and a well-coordinated strategy. It is important that the County transitions to a smart electric grid and that it thoughtfully allows projects that contribute benefits to customers within Santa Fe County without exposing them to unnecessary risks.

Large-scale or bulk renewable energy generation and storage capability -
A Concept for Added Energy Resilience: The Santa Fe County Energy Park

Having studied locations throughout Santa Fe County, CEC has identified sites well suited for large scale or bulk solar generation and energy storage. We have prioritized locations that are close to existing power distribution lines but that are both away from large numbers of homes and businesses and on land available to the County.

Possible Location for the Santa Fe County Energy Park



One **site** we identified is state trust land near Stanley, NM (87506), where Santa Fe County could construct a **Santa Fe County Energy Park**. Located at T10N R11E Sections 8 and 9, the site comprises 1,200 acres of open space, without proximity to any communities. Additionally, an existing high-voltage (345 kV) power distribution line from southwestern wind power generators passes directly through the northeast corner of Section 9. The identified location could access that line without any risk to the communities of Santa Fe, and the site would be ideal for establishing a 100 MW solar generation facility and a 100 MW energy storage system using batteries. Such a storage facility could even scale up to 400 MW, providing significant back-up capability to the county power grid.

Bulk energy delivery to micro-grids

A **substation** at the proposed site could connect to the existing 345 kV transmission line. To serve the county even better, an additional 115 kV transmission line could run along US Highway 285 to join with a 115 kV transmission line that already exists at Eldorado at Santa Fe.

In addition to the costs of the proposed solar array and energy storage facility, there are costs of deeding State Trust land and running the additional 115 kV transmission line. Specifically, the proposed 115 kV transmission line would be approximately 36 miles in length and would cost an estimated $7. 6 M. The County will need to secure funding to obtain the land, and constructing the substation would also be a consideration. Offering a responsible green-energy firm or company the

opportunity to partner with the County on the development of the proposed energy park location might be one way to share the costs.

Fail-over capability

Two forms of **fail-over** could be put in place to ensure that in the case of systemic failure, the County would continue to have access to electrical energy, even if it is only capable of being supplied from outside the County. A system level "kill switch" would take the Smart EMC off-line and return control of energy management completely to the Smart Nodes. This is the beauty of a federated and distributed system: *the ability to isolate and self-repair as situations require, without disruption to the rest of the system*. Another form of fail-over would be the strategic placement of gas-driven electrical generators that can supplement local solar generation to maintain the health of the system. Santa Fe County has an extensive gas distribution system and gas generators can be remotely controlled and monitored. (Note that CEC has not taken a position on the current use of gas generators.)

This approach, as described here and implemented by the county, appears to be feasible with proof of concept for the SMART EMC and SMART Nodes in as little as 12-18 months. An initial cost or investment would certainly be less than $10M depending on the emphasis placed on its execution. The return on this investment is not measured in cost savings, but in cost avoidance.

Conclusion

CEC looks forward to using this concept paper as the basis for a fresh and meaningful series of conversations with Santa Fe County Growth and Land Management leaders. Going forward, we appreciate the opportunity to flesh out details and develop additional concepts to facilitate further progress in the move to renewable energy sources and their benefits. As a non-profit community organization, CEC also seeks to work with the New Mexico Climate Investment Center (NMCIC), New Mexico Economic Development, Santa Fe County Emergency Management, New Mexico Homeland Security, and other New Mexico state agencies to ensure that all Santa Fe County renewable energy initiatives are truly green, safe, and beneficial to all communities and stakeholders in Santa Fe County.

APPENDIX

Key Definitions

TERM	DEFINITION
Co-op	*See* ***cooperative***.
Cooperative	A type of ***utility*** owned and operated by its ***customers***, also known as members. Boards of directors managed cooperatives.
Consumer	*See* ***customer***.
Customer	Any entity, whether commercial or residential, that purchases power from a ***provider***. The end user or consumer of electricity.
Demand	The amount of electricity needed by one or more ***customers***. (*See* ***Energy Management System***.)
Distributed electric grid	A system of at least one electric power ***generator*** and ***transmission line*** that is located close to end customers or users.
Distribution	The delivery of lower voltage electricity from a ***substation*** to one or more ***customers***.
Electric Distribution System (EDS)	The collection of components that transports electricity from ***generation*** sources to ***customers***. It includes ***transformers***, ***transmission lines***, other equipment, and an ***Energy Management System***.
Electric power grid	*See* ***grid***.
Energy Management System (EMS)	A set of equipment and software, including a data management system, used to monitor, control, and optimize the ***generation***, ***distribution***, and consumption of electricity. An EMS allows a ***provider*** to monitor power flow, detect and manage its response to its customers' need for electricity, and ensure that its ***grid*** operates efficiently, reliably, and cost-effectively.
Federated	Refers to any ***federation***.
Federation	Any collection of various components and systems. In electric power grids, a federation is a group of ***micro-grids***. Federations typically include data and control components, as well as components for ***generation***, ***transmission***, and ***distribution***.
Generation	The process of producing electricity. Generation can be from any number of sources, such as coal, water (sometimes called hydro or hydraulic), natural gas, nuclear fission, solar energy, wind energy, biomass (burning of organic material like crop or food waste), or heat from geothermal sources (naturally occurring underground reservoirs of extremely hot water).
Generator	A device that produces electricity. Other names for a large generator are ***power plant*** or ***generating station***.
Grid	An interconnected ***network*** of components that work together to supply electricity to customers.

TERM	DEFINITION
Grid Manager	A concept, referred to as Santa Fe County in this paper. The Grid Manager performs the actions necessary to optimize the Federated and Distributed micro-grids across the county.
Hybrid	A mix of something. In this case, a mix of micro- and bulk ***generation*** sources and technology, along with information or data.
Meter	A device located at a ***customer*** that records the customer's consumption of electricity. ***Providers*** use meters to bill customers.
Micro-grid	A smaller-scale power ***network*** that can generate, distribute, and manage electricity on its own for one or more customers.
Net metering	A billing process that allows ***customers*** who produce some or all the electricity they need (such as customers who have solar panels) to use electricity from a ***provider*** any time and to reduce the customer's bill when customers produce more electricity than they are consuming.
Network	A collection of components that delivers electricity from the site of ***generation*** to the ***customers*** who use it. A network can include ***generators***, ***transmission lines***, ***substations***, ***distribution*** components and the data about them, and/or an ***energy management system***.
Node	Specific consumer or producer end-points within the network or grid. Nodes not only consist of electricity providers and customers, they also produce and consume information or data about energy production and consumption.
Power plant	See ***generator.*** Power plants tend to be large and are typically located at a distance from their ***customers***.
Power Purchase Agreement (PPA)	A long-term contract between a ***provider*** and a ***customer***. A PPA can be an agreement between third party that installs, owns, and operates a ***generation*** system on a customer's property for how that customer will purchase the electricity from the third party's system for a set period. Historically, the customer was another ***utility***, government, or company. Today, there are also PPAs that constitute an agreement for a ***provider*** to buy electricity produced by a residential or commercial ***customer***.
Provider	Entities that supply electricity to ***customers***. They may be investor-owned companies (***public utilities***), municipal or government entities (***private utilities***), or member-owned and controlled organizations (***cooperatives*** or ***coops***). Providers bill customers for the power those customers consume. A provider may own and operate its own ***transmission*** and ***distribution*** system. It also may manage those systems

TERM	DEFINITION
Private utility	A ***provider*** owned by a municipal or government entity. They are accountable to the ***customers*** they serve and are managed by local officials or elected boards of directors.
Public utility	An investor-owned ***provider***. Public utilities are accountable to investors, and they are also accountable to ***customers*** through state and federal regulation.
Standard node	A common type of ***node*** in a ***grid***. Standard nodes provide data about the usage of electricity to a ***provider*** through a ***meter***.
Smart grid	An electric power grid that uses advanced technology in its physical components, software, and communications to enhance efficiency, reliability, and adaptability. Smart grids enable a more interactive and responsive relationship between ***providers*** and ***customers***.
Smart node	A type of ***node*** in which a ***customer*** can consume electricity from the ***grid***, ***generate*** and/or store electricity on its own, and supply excess electricity to the grid. A smart node provides real-time data to the ***Energy Management System*** of its ***provider*** about its ***demand*** and consumption. Smart nodes also allow the provider's EMS to manage and control parts of the node.
Storage	Refers to any mechanism that captures electricity and converts it to another form for later use. Batteries are a common storage solution, converting electricity to a chemical form. Other forms of storage exist; *see* https://www.epa.gov/energy/electricity-storage for a simple explanation.
Substation	A facility that converts high-voltage electricity to lower voltage for distribution to electric power consumers. Substations use ***transformers*** to accomplish this.
Transformer	A device used in electricity ***distribution*** and ***transmission*** that can change the voltage of electricity moving through the power ***grid***. Transformers can either increase ("step up") or decrease ("step down") the voltage levels of electricity.
Transmission	The sending of electricity at high voltage from the point of generation to electric ***substations***.
Transmission lines	Wires or cable along which high voltage electricity travels. Transmission lines are commonly above ground, but they can also be below ground. Underground transmission lines reduce the potential for power outages and fire due to wind, snow, and ice, as well as human-caused damage.
Utility	A commercial electricity ***provider***.

TERM	DEFINITION
Wheeling	The ***transmission*** of electricity from one location to another through an existing power ***grid***, usually from a ***generator***, ***power plant***, or any other source that produces electricity to a consumer located in a different geographical area. The consumer may be a ***customer*** or a ***provider***. Wheeling allows the ***transmission*** of electricity across different regions or between ***utilities*** or ***providers***. The practice allows a provider to sell electricity at a profit when there is a high ***demand*** for power.

Current Electricity Providers in Santa Fe County

Currently, there are four providers that serve residents and business customers in Santa Fe County:

1. Public Service Company of New Mexico (“PNM”), a public utility company, is the exclusive provider of electricity to residential customers in the city of Santa Fe and in Eldorado at Santa Fe. PNM generates electricity at several power plants located outside of the County and owns solar and wind generation facilities within the County.
2. Central New Mexico Electric Co-op serves Edgewood. The Co-op generates some electricity itself and purchases electricity from other utilities.
3. Jemez Mountains Electric Cooperative provides electricity to customers in Cuba, Española, Jemez Springs, and San Ysidro. The Cooperative does not generate electricity itself; it purchases power from other providers.
4. Mora San Miguel Electric (also a co-op) serves customers in other rural communities in Santa Fe County. Like Jemez Mountains Electric Cooperative, it does not generate electricity but purchases the electricity it provides through Power Purchase Agreements with providers.

Note that most of the electricity provided to Santa Fe County customers is generated at a significant distance from them.