



Renewable Taos 2016 Annual Report

Past annual reports have really been a recounting of what we accomplished during the year. This year we are passing a milestone and beginning a new phase in our local transition to clean energy. So, in Part 1 of the report we want to explain where we are and what has to be done to go forward. In Part 2 we'll recount some of our accomplishments for the year and talk about our projects for 2017.

Before getting into the report, here are some comments on climate, the elections, and renewable energy technology.

Important Events for Renewable Energy during 2016

2016 was another record setting year for warmth with month after month of record setting temperatures. That makes three record-setting years in a row. More ominously the extent of Arctic sea ice is at a record low in November. This reflects the scientific observation that most of the increasing warmth resulting from CO₂ and other greenhouse gases is being absorbed by the oceans, not the atmosphere. That in turn increases the threat of sea level rise, one of the most politically and socially disruptive consequences of climate change.

The incoming president and his administration may slow meaningful action on climate, but the harsh reality of climate change will continue to make itself felt all over the world. Progress on climate and renewable energy can continue to deepen if we stick to our principles and take advantage of all the local and regional opportunities to support clean energy and protect our environment. Climate change affects us all equally and action to prevent its worst consequences is not a partisan issue.

Renewable energy, *especially solar photo-voltaic (PV)*, is on a dramatic roll, not just in the U.S. but all over the world. We have almost passed the point where solar and wind

need incentives to compete in energy markets. Wind and solar are now the cheapest sources of electricity and that means their spread will continue pretty much unabated. Moreover, prices for both continue to fall, and in the not too distant future that will do the unthinkable – drive most fossil fuels out of energy markets. For the first time, investment in renewables exceeded investment in fossil fuels in early 2016.

Another piece of good news is improvement in the electric vehicle (EV) market. One moderately priced all-electric vehicle, the Chevrolet Bolt, is already on the market and has won the *Motor Trend* 2017 Car of the Year award. Tesla's Model 3 will arrive next year and has reservations for 325,000 vehicles, around the peak annual sales for the Toyota Prius. Both have more than 200 mile ranges and sell for around \$35,000. Prices are also falling for lithium ion batteries ensuring that we will see even cheaper EVs on the market in the next few years. And, that will contribute to lower prices for battery storage of solar electricity. There are a lot of virtuous feedbacks in the energy market, and they will persist into the future.

Part One – a Transition to Local Renewable Energy in North Central New Mexico

When Renewable Taos started five years ago we envisioned some of the events that have taken place in 2016. We formulated our mission statement – a 100% transition to locally produced clean renewable energy – and this year our community has taken the first major step in that direction. That step consisted of three parts.

First, and really foremost, Kit Carson Electric Cooperative negotiated an acceptable exit from its 40-year contract with Tri-State Generation and Transmission Association. We forget how significant this step was, but it was necessary to clear the way for clean energy. Tri-State remains committed to electricity generation from coal and natural gas. They impose steady wholesale electricity rate increases every 18 months on their members. We had to clear this hurdle to make real progress on clean energy.

Second, Kit Carson replaced Tri-State with Guzman Renewable Energy Partners (GREP), a wholesale supplier that shares our clean energy goal. The GREP contract has a relatively short term for the utility industry-- only 10 years -- and has excellent provisions for withdrawal should we find better sources for clean wholesale energy.

But, Guzman appears to be a good partner for the transition to clean energy. They are searching for wind and solar generators to supply our power.

Third, Kit Carson has developed a plan to transition to solar energy within the next six years. The plan projects building around 30 1-megawatt solar arrays throughout the service area. These arrays will provide all or most of our energy during sunny daylight hours. The plan is now being reviewed with Kit Carson members, local governments, business leaders, and religious leaders. It will appear on our web-site in January. We encourage everyone to read, understand and comment on the plan. Kit Carson and Renewable Taos want the plan to be community-driven and supported.

This is the first large step in our local transition to clean energy. Over the next 4-6 years we will go from less than 5% of our energy supply coming from the sun to around 35% solar powered. Every watt of electricity distributed during daylight hours on sunny days will come from solar PV panels distributed around our service area.

That is an important point about the Kit Carson plan – ***our clean energy will be generated locally***. It will not involve access or upgrades to the big transmission line that serves Kit Carson. Nor will it involve major upgrades to Kit Carson’s distribution grid because the arrays will be placed near the points where the energy will be used. Local generation brings with it many benefits from construction and maintenance jobs to tax revenue for local government.

More Steps on the Way to 100% Renewables – Energy from Other Renewable Sources

Kit Carson’s Solar Plan is a big step, but it will not take us all the way to our goal. We need to blend clean energy from other sources with solar to reach 100% clean local energy.

The best candidate is ***wind***, especially the new very tall wind turbines that generate over 4 megawatts (MWs). Taos County and the Moreno Valley are not the best sites in the region for wind, but we think there is enough potential for local wind to encourage surveys at heights appropriate for modern wind-generators.

The Rio Grande Gorge is also ***a hot-spot for geothermal energy***. Both wind and geothermal require prospecting expenses. With wind, it's relatively simple and inexpensive once you have a site. Geothermal prospecting is more expensive and financially risky, but geo-thermal has two big advantages. One, it can generate a consistent base-load of power, and that makes it an important supporting partner for wind and solar energy. Two, geo-thermal can combine heat and electricity generation. Some of the heat can be used in greenhouse agriculture, an industry that has real potential in our area.

Finally, we may not be able to generate 100% of the energy we use locally from clean sources due to the intermittent nature of solar and wind. There are two other alternatives to reach 100%: First, we can generate many times our local usage if we can gain *access to the transmission grid* and export energy to other areas. Second, we can store excess energy in *batteries or other storage mediums* and use it at night or when the sun and wind are not sufficient.

Electric vehicles (EVs) have tremendous potential not just for transportation but as storage devices. The Chevy Bolt batteries stores 60 kilowatt-hours (kWhs), enough for a 238-mile trip before recharging. But those kWhs also are enough to power an energy-efficient house for a week and less efficient house-size buildings for several days. Think of the potential for using this energy to power our houses in the evening, then re-charging the EV batteries beginning around 11pm. Another brief charging period during the day will handle the round-trip to and from work. Our fiber optic network will enable this kind of efficiency in the future, and we may conclude that is its most valuable feature.

Electrify Everything!

As get deeper into the transition to clean energy, it becomes more and more clear that the main way to beat back climate change is to use electricity from clean, renewable sources as our sole power supply. We have already demonstrated it for lighting and home power. Now we need to complete those sectors and move into heating, transportation and industrial uses. It's clear what we have to do, so let's just do it!

Understanding the Limits of Solar Power

Kit Carson gave Renewable Taos data on their electricity sales for each 15-minute period during 2014. This is called load data. Our members put the load data into a modeling tool where it was compared with generation data for solar PV in our region. This analysis is available in a paper by John Gusdorf and other RT members on our website.

Solar PV only produces electricity when the sun is shining. You can increase the output of a solar panel by placing it on a 1- or 2-dimensional tracking device. That increases output per panel, and extends the time of peak production. But solar generation is still limited to day-time.

Unfortunately for us Kit Carson's load profile has peaks in December and January in the early evening when the ski resorts are in full swing. Snow-making peaks the demand for electricity in our area just as evening irrigation peaks demand in some agricultural areas during growing season. Meanwhile the generation profile for solar PV peaks in the summer during mid-day and afternoon. This mismatch between load and generation is a limiting factor for solar generation for local use.

On the other hand, *our solar generation profile does match up well with the load profiles of all the urban areas of the Southwest.* That creates the possibility of producing many times more energy locally and shipping it other areas.

Excess Solar Energy – What Can We Do With It?

Once we produce more solar electricity than the entire system can use, there are only three options – ***Sell, Store, or Curtail.*** Curtailing production effectively increases the cost of energy, so that is the last option.

Selling excess production makes sense, but it has to be shipped over transmission lines to places where there is demand for clean energy. Plus, in order to be sold, electricity is typically packaged in megawatt-hour sized chunks. That in turn requires sizing generation to produce that much excess and finding a willing customer to purchase it.

The other constraint on selling excess generation is access to transmission lines. That is a problem for us since the only realistic transmission line for shipping energy in this quantity is owned by Tri-State Generation and Transmission.

Storing energy for later use has tremendous potential. The cost of lithium ion batteries is on a downward slope similar to the cost of solar PV panels, and that decline is driven by rising demand in several **huge! Industries** – consumer electronics, transportation, home energy, and utility scale energy.

For every doubling of production, the price for solar PV and lithium ion storage the price decreases 20%, and solar PV has been doubling every 2+ years. **To say that storage prices are falling rapidly is really an understatement.**

Because of the high marginal cost of matching generation to peak loads, there are already cost-effective applications for batteries on utility grids and more will appear as we work our way down the cost curve. All the 1 MW solar arrays projected by Kit Carson will have space set aside to add battery storage as it becomes cost-effective.

The Role of Electric Vehicles (EVs)

EVs really fit into clean energy plans perfectly. There is no question that their price will continue to fall, and the day of EVs with ranges of 200 or 300 miles and prices in the \$20,000 range are not too far away. Why am I so certain? First, the price of batteries is the main component in the price of EVs, and the price of batteries is dropping fast. Also, EVs will prove to be very easy to manufacture. The Tesla Model S has around 20 moving parts! EVs will have very low costs of ownership. Fuel for an EV is around \$1/10kw, enough for a 40-mile round trip. And, maintenance costs will also be very low.

EVs also fit into the grid in a really complementary fashion. The new Chevrolet Bolt has a battery that stores 60 kWh. Remember two simple facts. One, the average daily drive is actually less than 40 miles leaving 50kWh on the Bolt's battery to play around with on most days. Two, that is more than enough to power most homes for several days. So, our electric cars provide us with a great source of ready electricity for the

grid. No additional home storage needed. With deep penetration of EVs we'll be able to easily shave peaks and avoid costs for larger transmission and distribution grids.

Large-Scale Solar Arrays

Remember that Kit Carson's profile for solar generation fits very well with the load profile of Southwest urban centers? Well that creates the possibility of building large-scale solar arrays – 50 or 100mW or more – in our service area and shipping the energy to load centers including Arizona, California and Colorado. Given access to sufficient transmission we could be producing much more energy than is consumed locally within a few years. 100s or 1000s of MWs more. There are lots of sites close to the high voltage 345kv transmission line that runs from Taos to Espanola and from there connects to the rest of the Southwest and California. This is a tremendous opportunity for relatively low impact economic development of the kind that saves our planet from climate disruption.

Where Are We in the Transition? – Just Beginning

We know that Kit Carson is at the 5% point on its way to 35% locally produced clean energy in a few years. The U.S. generates a little more than 7% of its energy from wind, solar, hydro, and geothermal. In part that's because traditional electricity plays a small role in transportation. Despite all the wind turbines in Texas and Iowa, we are just beginning the transition to clean energy in the U.S. Given where we are and the potential consequences of climate disruption, the only appropriate emotion in regard to the transition to clean energy is ***urgency!***

Especially in clean energy rich areas like ours, we should shoot to be more than 100% transitioned by 2030. We have to show the way and support other parts of the country. What an opportunity though – a chance to play a small part in leading humanity to a sustainable future.

And, make no mistake, there will be great economic benefits for areas leading the way.

Our Environment and the Look and Feel of our Community

Many of us feel that humanity has already built too much and that we are trampling over other species of animals and plants so much that it threatens our very existence. We appreciate this position. Our members want to work on that problem once we're assured that clean energy has replaced fossil fuels and limited impacts on our climate.

In the meantime, we have to build wind farms and solar arrays and geo-thermal plants and transform our transportation system. Fast. For those of us who love the wilderness and mountains, it does well to remember that wind and solar arrays and EV charging stations are enormously friendly to the environment compared to the alternatives. Not just cleaner in the sense of producing energy without CO₂ and other toxic emissions, but also doing it in a much smaller space.

Further, almost no new renewable energy generation and transmission facilities need be built on protected lands. Most can be built on private lands, on public land already designated for other types of development, and abandoned industrial and agricultural lands.

The footprint of clean energy generators, electric transmission and distribution grids, and EV charging stations is a very small fraction of the space currently used by fossil fuels. Self-driving EVs may also allow us to shrink the space devoted to parking and highways.

But, most of all clean energy will help stop global warming and climate disruptions. Perhaps we'll be able to stabilize the climate and pull some of the CO₂ out of the atmosphere in the future. But, our first and highest priority is to stop fossil fuel emissions.

How will that recognition affect our aesthetic sense and our deep concern for our environment? Wind and solar energy will displace fossil fuel and nuclear on transmission lines to our cities for the most part. New transmission will always first be added to existing corridors. Wind and solar farms will necessarily occupy new spaces. We need to adapt to clean energy sources through careful siting while at the same time recognizing the value of wind and solar in preserving our environment. Re-envisioning our landscape also will involve recapturing spaces currently devoted to fossil fuels.

There will be a lot more solar arrays and wind generators in our future. We can work hard to make them as environmentally harmless as possible, but we really must remember that they are replacing fossil fuel electric plants and gasoline powered vehicles whose emissions are killing our planet.

Part Two – What Renewable Taos Accomplished in 2016

1. Our Monthly Newsletter started this year in January 2016. Bill Brown is the editor and inspiration behind the newsletter. If you want to keep up with what is going on with clean energy in North Central New Mexico, the RT monthly newsletter is the place to go. If you are on our main mailing list, you will receive a copy each month.
2. We continue our weekly meetings and have attracted new members. A couple of retired engineers attend most meetings and provide a lot of depth. We work hard on keeping on top of business, technical, scientific, and political developments that affect the transition to clean energy. We continue to meet with solar installers and energy efficiency pros. An energy efficient home developer and one of the pioneers in solar education in NM attends many of our meetings. We are also serving as a model for renewable energy advocates in other areas including Rio Arriba County. We also attend conferences like the Energy Storage conference sponsored by Senator Heinrich in Albuquerque.
3. We investigated large-scale solar arrays and what it would take to build them in our area. There are ample sites close to our large transmission line that would make great homes for 100 MW arrays. A 1-square mile section, 640 acres, would be sufficient for a 100+ MW array, and there are many sites that would have minimal to no impact of current residents. This is a project we want to continue to work on in the coming year. We estimate that around 200 MW will supply the basic electricity, heating, industrial and transportation energy for the Kit Carson Service Area.
4. We investigated transmission lines coming into and out of the Kit Carson service areas. We looked at their potential for bringing us wind power as well as supporting sale of energy from large-scale solar. We worked with Lucky

Corridor, the company that is planning a transmission line from a large-scale wind facility in Eastern NM. Their line would cross Moreno Valley, come through Taos Canyon, and connect to the Los Cordovas substation in Taos. It would also require upgrading the 345 kilovolt (kV) transmission line from Los Cordovas to the Ojo substation near Espanola. That would provide a corridor for 100s of MWs of clean energy that could be sold to the Western grid and boost our local economy. We talked about the project with environmental groups, Kit Carson, and Town and County governments. The Lucky Corridor project is in the planning stage, and we give it our qualified support.

5. Since September 2016, Renewable Taos has been sending a letter statewide urging support for a regional market for renewable energy. Our letter asks for:
 - New Mexico's participation in a regional market for energy services for the Western Interconnection electric power grid.
 - Renewable energy infrastructure and upgrades with an emphasis on utility-scale renewable energy generation and transmission throughout New Mexico.
 - Substantial investment of State Investment Council (SIC) and other New Mexico funds in renewable energies – notably wind and solar power – that are now in strong demand throughout our region.

We will continue sending this letter to a substantial list of federal, state and local political representatives plus federal and state agencies, businesses, NGOs and other selected parties. The letter will be part of an invitation package for a renewable energy planning meeting to be hosted by Taos County in early 2017.

6. We worked with the NM Public Regulation Commission and solar installers from around the NM on two issues. The staff at the PRC has taken the position that net-metering and rooftop solar result in higher electricity rates for non-rooftop electricity users. Some states are imposing special tariffs on behind-the-meter customers of utilities, and, remarkably, the NM PRC seems to be lining up with them. This despite the fact that the solar installation industry is the fastest growing employer in NM. We looked into the cost shifting claims, and are convinced that they are not correct. One 2014 study by the Lawrence Livermore National Laboratory found the rooftop solar provides significantly more benefits than costs. We prepared a research paper with the recommendation that the PRC sponsor an objective study into the issue. The research paper and a

discussion paper are available on our sites. We're continuing to work on this issue because it would harm NM if the PRC started to place obstacles in the path of the transition to clean energy.

7. Community solar is another issue where the PRC has adopted a position that we do not support. The PRC staff claims that Kit Carson's community solar array at the Charter School is in violation of State Law. Energy lawyers in Taos and Santa Fe that we've consulted reject that assertion. There is no place in NM law that states that utilities cannot develop community solar projects. With new Democratic majorities in the House and Senate, and supporters of clean energy in leadership in both houses, we are hopeful that the PRC objections to voluntary community solar will be withdrawn.
8. Finances and fund-raising have not been a central focus for Renewable Taos. Our core members have paid their own travel expenses and conference fees and helped with our events. We do receive support from PPC Solar, Sol Luna Solar and Go Solar Go. We really value the work of these two companies and their staff as well as all the other solar professionals in our community. Our primary expense in years past have been public lectures which have drawn up to 200 people.
9. We prepared a modest stage 1 proposal for erecting EV charging stations in the Enchanted Circle. The Ski Valley has plans to build charging stations in their parking lot this year. We suggest that the Towns of Taos, Angel Fire, and Red River build one or two charging stations with two chargers each within easy walking distance of central shopping areas. Jonathan Hansen and Jay Levine have led this work. It will be one of our focuses in 2017.
10. RT now has a board member who is also a Board member at Kit Carson Electric. Bob Bresnahan ran for the open seat that Peter Adang won in 2012. Renewable Taos members worked on the campaign and Bob won one of the two seats from District One by more than 100 votes. During the campaign, we talked about renewable energy with more than 1500 people. Of the 1000 people Bob spoke to during the campaign only 1 opposed renewable energy. Bob has continued Peter's practice of writing a blog about Kit Carson with monthly entries.

11. RT supported Kit Carson's rate increase. We've seen it coming for years because of declining electric sales, but when the Chevron Moly Mine in Questa unexpectedly closed its doors in 2014 the increase became a pressing necessity. We've attended Kit Carson Board meetings for five years and have a pretty accurate picture of its financial status. By the way, by far the best source of information on the rate increase is Peter Adang's blog. Since the Board election took place in the middle of the protest against the increases, we think it is a good read on the actual sentiment of the membership. Six seats were open. Five incumbents who had voted for the rate increase were reelected. The sixth seat was won by Bob Bresnahan, an open supporter of the rate increase.
12. Some RT members are researching renewable energy storage options. We look forward to their report.
13. RT has been following Kit Carson's new contract and Guzman Renewable Energy Partners. We have questions that we're confident will be answered in the next few months. When they are we'll share the information with our members.
14. We are investigating energy efficiency and have become convinced that the best focal point for a community-wide effort is Kit Carson itself. The PRC rejected a Kit Carson proposal to de-couple fixed expenses from the cost of energy in its rate structure. This would mean that Kit Carson would simply pass through the wholesale cost for energy to members. The monthly service charge would increase, but the overall change would be revenue neutral for the coop. The best outcome would be freeing Kit Carson from reliance on squeezing out a profit on energy sales to support its distribution and business infrastructure. More work will come on this topic next year.

Our Focus for 2017

1. Education. We want to resume the RT Lecture Series. Possible topics include EVs and Clean Energy, a local smart grid that includes EVs and demand management, energy efficiency.

2. Large-scale solar and transmission.
3. Decoupling energy from grid expenses for Kit Carson. We think this will help free Kit Carson to more aggressively pursue energy efficiency services for its members.
4. Support for the Kit Carson Solar Plan.
5. Work with local governments to advance clean energy, EVs, and regional cooperation.