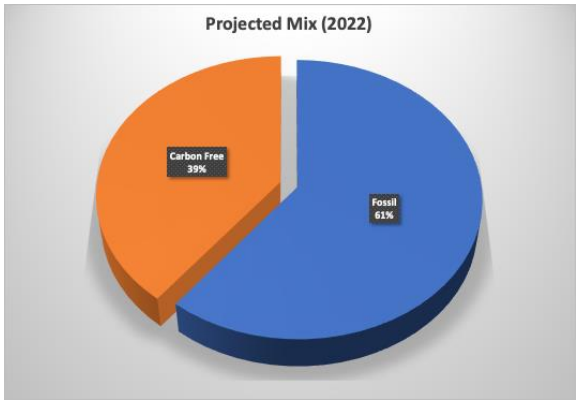
Immediate Recommendations



The DPU and BPU should develop a strategy that prevents the uncertainty in the Los Alamos Power Pool relationship from hindering LAC's achievement of its net carbon zero goals. Climate change represents an existential threat to our community with impacts becoming evident at an accelerating rate. The Board of Public Utilities (BPU) made the original commitment to become a net-zero electricity provider in 2013. Since that time the Department of Public Utilities (DPU) and BPU have made measurable progress in decreasing Los Alamos County's (LAC) carbon footprint by entering into the Power Purchase Agreement (PPA) with Uniper, which goes into effect in 2022. This is important progress. The accompanying figure shows the distance LAC still must go.

1. In line with an increasing number of countries, states and communities the County Council and BPU should formalize the net-zero carbon electrical power commitment and adopt a more ambitious timeline to achieve net-carbon zero electricity by **2035**, rather than 2040. The new goal should become an explicit constraint for studies of future County power generation.

2. The county should fund a short-term (1 year) study to look at the implementation of Preferred Resource Plan S9, described in the 2017 Integrated Resource Plan (IRP). As a result this study should compare the cost, siting, and feasibility of constructing solar power as follows:

    a. The 2017 IRP recommended that LAC develop 27 MW of solar energy generation capacity with storage by 2030. Siting options, such as outside LAC, within LAC, LANL owned land, or distributed areas, etc should be considered. This study should consider the two potential systems below:
        i. a centralized power system

        ii. a distributed power system using residential solar combined with county rooftop systems

    b. Study the feasibility, costs, and benefits of a stand-alone energy storage system on the scale of 10-20 MW with 40-80 MWh capacity. This study should investigate two possible configurations:

i. a centralized storage system

ii. a distributed system (similar to the Green Mountain Power system in VT)

c. The energy storage systems should include the capability to shift the power from the peak production times (mid-day) to the peak use times (currently, 6-10pm on winter evenings).

3. The county should fund a short term (6 mos) study to determine the feasibility of prioritizing market purchases of electricity from renewable sources rather than coal and natural gas.

4. Los Alamos County should conduct a study to ascertain the total potential for rooftop solar generation capacity for all properties (residential, commercial and county-owned) within LAC.

Background

Currently, Los Alamos County (LAC) owns several power generation assets representing a total of 73.9 MW of generation capacity. Of those resources, four are sources of carbon-free electricity, hydroelectric power from Western Area Power Administration (WAPA), El Vado and Abiquiu dams, and the 1 MW PV installation on the Los Alamos Eco Station. Using only the headline electricity production shows ~38% of our electricity is from renewable sources. However, when examining the actual electricity purchase in 2020, the combined contribution from these assets decreases the carbon free portion of LAC's usage substantially to only 21%. The two largest sources of electricity are the San Juan Generating Station (SJGS) and short term contracts purchased from the free energy market (42% and 30%, respectively).

This picture will change significantly when the power purchase agreement (PPA) with Uniper comes into effect in 2022, and the DPU no longer purchases power from SJGS. The proportion of carbon-free electricity assets will increase to ~81% of owned assets, and the estimated carbon-free electricity purchases will increase from 21% to 39%. This is a tremendous step and LAC and DPU/BPU should be commended for taking it.

The major motivation for transitioning to carbon-free energy within the county is the imminent threat of climate change. Climate change models of the Southwest United States predict a higher likelihood of droughts and high temperature events. Lower precipitation will directly impact Los Alamos County's ability to generate hydro-electric electricity. The predictions are for Los Alamos to experience 100 degree plus heat

waves within the next 20 years and higher after that. Given these predictions we don't look forward to the partial desertification of the County—loss of Ponderosa Pines, encroachment of pinon-juniper trees.

It is in this context that we make these recommendations. We face a new era where concerns about cost must be minimized in favor of innovative and effective action. This may mean changing charters and codes, but is the only way to avoid the worst of the warming. In this spirit we recommend a variety of actions that may at first sound somewhat radical, but in the current situation are really not.

Recommendations of the Electric Subcommittee:

1) The County Council and the BPU formalize the net-zero carbon commitment and adopt a more ambitious timeline to make LAC net-carbon zero by 2035.

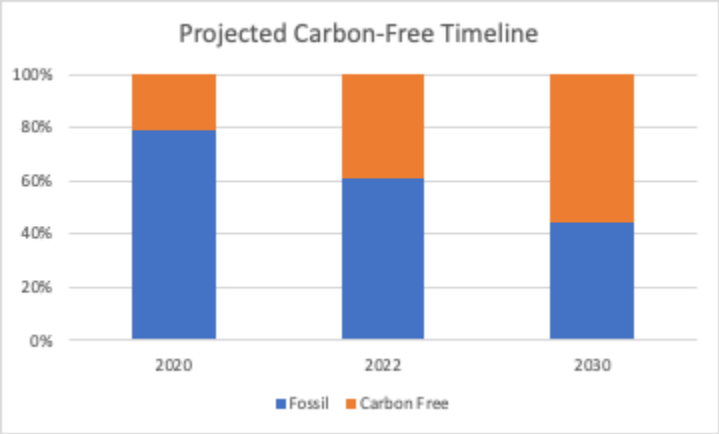


Figure 2. Estimate of the share of carbon-free electricity for LAC as of 2020, after SGJS goes offline and the Uniper contract goes into effect in 2022, and the CFPP small modular reactor comes online in 2030. (Note: electricity demand was assumed to be flat)

Background:
The current pledge to be a net carbon zero electricity provider by 2040 constitutes a goal of the BPU for the DPU. This goal was voted on and adopted by the BPU in late 2013, and then reaffirmed in 2014 and 2016. Since its adoption, LAC formed the Future Energy Resources Committee to provide recommendations as to the paths to achieve the 2040 goal. LAC, in cooperation with LANL, developed the 2015 Renewable Energy Photovoltaic Feasibility Study which identified five potential sites for solar installations that when combined could be the source of ~60 MW. LAC also hired Pace Global to produce the 2017 Integrated Resource Plan (IRP), assessing paths to achieve the 2040 goal. As noted earlier, the Uniper contract is a big step forward, the most significant since the net carbon neutral goal was adopted about 9 years ago. We strongly suggest building upon this. An administrative means of doing so is to have the County Council to formalize this net-zero carbon commitment with a timeline and benchmarks for its implementation.

Local effects of global warming are already becoming apparent in Los Alamos, including the heat waves of 2020 and 2021. LANL has recently adopted the goal of being carbon-free by 2035. A new report from America is All In, a coalition of climate leaders pushing for action across government and every other part of society proposing a national goal of 100% clean electricity by 2035. In addition, to be inline with current federal guidance on the issue and the US's commitment to the Paris Climate Accord, the carbon neutrality timeline for electricity generation should be accelerated from 2040 to 2035.

Outcome:
LAC DPU is at least 75% net-zero carbon electricity provider by 2030, and fully net-zero by 2035.

Challenges & Anticipated Barriers:
Reducing the amount of power purchased from the grid.
Exiting the PPA with the Laramie River power plant in WY.

References/Resources:
DOE Los Alamos National Laboratory - PV Feasibility Assessment, NREL 2015.
Future Electrical Energy Resources for Los Alamos County, July 2015.
Integrated Resource Plan Report, Pace Global, June 2017.

2) The county should fund a short-term (1 year) study to look at the implementation of Preferred Resource Plan S9, described in the 2017 Integrated Resource Plan (IRP).

Background:
The DPU/BPU, in order to develop a strategy to address upcoming power generation challenges, commissioned the 2017 Integrated Resource Plan. Key findings from that report related to these recommendations are below:

- **New Solar Generation:** The most balanced portfolio that meets renewable goals and carbon reduction targets is a portfolio that relies on solar PV and battery storage (based on current indicative bids and market expectations). However, there are uncertainties whether sufficient local federal land for utility scale solar PV resources.
- **Relying on Market Purchases:** The RIRP results show that relying on some market purchases result in lower NPV costs in the current low market price environment. Adding no new capacity, however, not only compromises LAC and LANL's goals of increasing renewable generation, but also results in unacceptably high negative reserve margins to ensure a reliable means of serving load.

Exhibit 2: Key Elements of the Preferred Resource Plan

Portfolio	San Juan 4 Exit Date	LRS Exit	LAPP New Builds	Reserve Margin (2017-2036)
S8: Solar Firmed with RICE Short Capacity	2022	No Exit	**Large RICE:** • 2017- 18 MW; 2025- 18 MW; 2030- 18 MW **Solar PV:** • 2017- 25 MW; 2025- 25 MW; 2030- 25 MW	LAPP Summer: 9% LAPP Winter: -5%
S9: Solar with Storage Short Capacity	2022	No Exit	**Solar with Storage (onsite):** • 2017- 13 MW; 2025- 8 MW • 2030- 6 MW	LAPP Summer: -11% LAPP Winter: -26%
S10: SMR, Solar with Storage Short Capacity	2022	No Exit	**Solar with Storage (onsite):** • 2017- 13 MW; 2025- 4 MW **Nuclear (offsite):** • 2026- 16 MW	LAPP Summer: -9% LAPP Winter: -23%

Source: LAC, Pace Global.

With the San Juan Generating Station (SJGS) going offline in 2022 the single largest contributor to LAC's fossil electricity portfolio will be market purchases. In total, those market purchases are the equivalent of an ~18 MW generation facility. Additionally, market purchases were the second most expensive power LAC purchased in 2020, only behind SJGS. At present the DPU has said that electricity from solar and wind installations are not available for purchase on the electricity markets. If this is indeed true, and is anticipated to remain so, the only way for BPU to achieve its state goal of becoming net-carbon zero while remaining in the LAPP will be to pursue the construction of new renewable generation resources as recommended in the 2017 IRP.

Luckily, capital costs of solar generation and battery storage have come down considerably faster than the 2017 IRP anticipated. Utility-scale wind and solar are among the lowest cost methods of electricity generation with costs around $30/MWh. When integrated with storage, those costs increase, but remain reasonable. The National Renewable Energy Laboratory's "U.S. Solar Photovoltaic System and Energy Storage Cost Benchmark: Q1 2020" put the cost of utility-scale solar with battery storage at $57/MWh with the 30% investment in solar tax credit. This cost is slightly less than the current targeted price of the CFPP. Factoring in additional transmission costs due to the nuclear power being located in Idaho, the total cost of solar backed with battery storage could be less than from the small modular reactor.

2a) The 2017 IRP recommended that LAC develop 27 MW of solar energy capacity with onsite storage by 2030. Siting options, such as outside LAC, within LAC, LANL-owned land, or distributed areas, etc should be considered. The report should

1. a centralized power system

   If LAC were to invest in building its own solar resources, the main consideration would be where to put them. Both the 2016 Future Energy Resources Committee and the 2017 IRP relied on earlier estimates of up to 60 MW of solar capacity available on LANL property. However, since that original report the potential area for a PV installation has been reduced by over 50% due to the existence of sensitive archeological areas. Building such resources within County-owned property would be difficult due to the general lack of space in LAC. One way of addressing the space requirements would be by locating generation anywhere else in our balancing area. Situated properly, a solar installation could generate ~20% more solar energy annually than if it were located in LAC. This could decrease the size of the installation and thus the capital investment required. However, transmission costs and routing are also important considerations.

2. a distributed power system using residential rooftop solar combined with county rooftop systems.

   A distributed system is already underway with many Los Alamos residences and property owners willing to install solar panels. Adoption has led the BPU/DPU to increase the installation ceiling from 2 MW to 6 MW. When residents build their

own solar capacity the financial risk in doing so is held by the resident. But relying on residents building their own solar capacity limits adoption to those with the means to pay for it, unless some sort of incentive structure could be established to encourage wider adoption. The main inducement beyond the appeal of reducing one's own carbon footprint is that the resident is currently paid full retail price ($0.1155/kWh) for the electricity generated. There are other benefits associated with putting solar panels on roofs besides the potential for power generation such as shading the roof and thus decreasing the demand on air conditioning.

2b) Study the feasibility, costs, and benefits of a stand-alone energy storage system on the scale of 10-20 MW with 40-80 MWh capacity. This study should investigate two possible configurations:

1. Centralized storage system

   To serve LAC, without considering LANL, an energy storage installation could be in the 10-20 MW output range with a usable capacity of 40-80 MWh. There are multiple ways to accomplish this goal depending on the technology used. A centralized storage system describes an installation of sufficient scale to serve the needs of the whole community. This could be built within the County, or it could be sited in close proximity to the generation resource used to power it. The ultimate cost of a centralized system is lower than for a distributed system. Current estimates from NREL put the cost of a lithium ion battery system of this scale between $27 million and $37 million. While this is a considerable investment, there would be important savings from having more flexibility in timing power purchases and shifting peak load.

2. Distributed system (similar to the Green Mountain Power system in VT)

   There is potential for distributed energy storage where the storage systems could be leased to homeowners and landlords. A large and very resilient system would be like that studied by NREL, a 5 kW battery with 20 kWh of storage. If such a system were installed into 2,000 homes and the DPU were able to manage them, the DPU would have a distributed battery array equivalent to the centralized storage case described above. While the cost would be higher than a centralized system, adoption could be much faster and allow for the maximum of community participation. A very successful pilot program has already been instituted by *Green Mountain Power in Vt*. Homes that have no suitable photovoltaic site could still contribute to the decarbonization of LAC's electrical demand.

References/Resources:

DOE Los Alamos National Laboratory - PV Feasibility Assessment, NREL 2015.
Future Electrical Energy Resources for Los Alamos County, July 2015.
Integrated Resource Plan Report, Pace Global, June 2017.
Green Mountain Power - https://greenmountainpower.com/network-of-powerwall-batteries-delivers-first-in-new-england-benefit-for-customers/

2c) The energy storage systems should include the capability to shift the power from the peak generation times (mid-day) to the peak demand times (currently, 6-10pm on winter evenings).

> The main challenge associated with the integration of renewable electricity generation is being able to balance generation with demand. As stated in the recommendation, there is a fundamental discontinuity between when power generation occurs, and when consumer demand exists. This fact will likely be exacerbated with the adoption of new technologies such as electric cars, and heat pumps. For a resilient system the ability to bridge the gap between peak generation and peak demand will be required. This could be accomplished using a combination of technologies, from net-metering, to virtual power plants, using energy storage resources. Finding the right approach to meeting this challenge is essential to meeting the zero carbon goals for LAC.

3) The county should fund a short term (6 mos) study to determine the feasibility and costs of prioritizing market purchases of electricity from renewable sources rather than coal and natural gas.

In conversations with the DPU market purchases of electricity are anticipated to remain a significant portion of the electricity delivered to customers. Once the SJGS is offline, market purchases will increase from ~30% to ~40%. Currently, these purchases come from coal and natural gas utilizing resources. DPU says that non-fossil resources are unavailable on the electricity market. If that remains the case then there will be no way for DPU to fulfill the net zero carbon-free goal absent building, or buying all of our own generation capacity. There are currently 1.2 GW of solar and 2.7 GW of wind generation in operation with another 1.6 GW of wind under construction in the state according to the New Mexico Energy, Minerals, and Natural Resources Department. We would like to know what flexibility is available to DPU in choosing which resources to purchase on the open market.

4) Los Alamos County should conduct a study to quantify the total potential for rooftop solar generation capacity for all properties (residential, commercial and county-owned) within LAC.

When residential solar installations became available for residents in LAC the DPU/BPU placed a limit on the total capacity of these residential systems at 2 MW. This limit has recently been increased to 6 MW. As an estimate, if 25% of the ~7,500 residences are situated such that they can support a 10 kW solar installation system then there is the potential for ~19 MW of generation from residential installations.

At present, the only new solar capacity that is being added to LAC's electricity generation is from residential installations. It may be important for the BPU/DPU's planning to know the total potential capacity that could be realized by local, distributed installations. NREL was able to conduct such a study for the City of Los Angeles. As we are a small community doing the same for Los Alamos should be feasible.