A New Era for Rural Electric Cooperatives:

New clean energy investments, supported by federal incentives, will reduce rates, emissions, and reliance on outside power

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Introduction

Rural electric cooperatives are vital to modern life in rural America, serving 56 percent of the country's landmass, including more than 90 percent of counties experiencing persistent poverty.[1] Today, the rural electric cooperative system has grown to more than 800 distribution cooperatives that deliver electricity to 12 percent of electricity consumers in the United States via 42 percent of the country's distribution lines.[2] These distribution cooperatives are served by 63 generation and transmission cooperatives (G&Ts), which generate around 5 percent of the nation's electricity and own 6 percent of its transmission lines.

Cooperatives have been working to transition to clean energy across the country, with the share of renewable energy increasing from 17 percent of generation in 2016 to 22 percent of generation in 2021. Simultaneously, cooperatives' coal-fired generation decreased to 32 percent of generation in 2021 from 41 percent in 2016.[3] However, the cooperative transition from coal lags the rest of the country—nationwide, only 22 percent of electricity came from coal in 2021.[4] Within G&Ts, coal resources are highly concentrated in just 16 cooperatives owning 85 percent of the 17 gigawatts of coal capacity still unannounced for retirement. Furthermore, while carbon dioxide emissions from cooperatives decreased from nearly 200 to 165 million tons in 2021, natural gas generation increased in share to 29 percent in 2021 from 26 percent in 2016.

The Inflation Reduction Act (IRA) has several provisions that help electric cooperatives bring affordable clean energy to rural communities across the country. First, through the extended and expanded investment and production tax credits, the legislation made wind, solar, and storage the cheapest sources of electricity by far.[5] It also made key changes to how nonprofit entities like cooperatives can take advantage of these credits. Specifically, it permits nonprofit, tax-exempt organizations to be refunded in cash for the value of the tax credits, which will allow cooperatives to own resources directly instead of relying on power purchase agreements. The IRA also created an additional 10 percent adder for the production and investment tax credits, respectively, for projects located in energy communities, which have a high overlap with communities served by electric cooperatives.[6] With some of the best wind and solar resources in the country located in G&T member territories, there is a significant opportunity to use tax credits to purchase renewable energy at a cost savings to member utilities.

In addition to simply making clean energy cheaper, the IRA created a $9.7 billion fund for cooperatives to purchase clean energy and zero-emission systems. These funds can be distributed as grants, loans, or other financial assistance in a highly flexible competitive grant program administered by the U.S. Department of

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[1] "Electric Co-Op Facts & Figures - America's Electric Cooperatives," accessed January 25, 2023, https://www.electric.coop/electric-cooperative-fact-sheet.

[2] "Rural Electric | Research on the Economic Impact of Cooperatives," accessed June 8, 2023, https://reic.uwcc.wisc.edu/electric/.

[3] "Electric Co-Op Facts & Figures - America's Electric Cooperatives."

[4] "Electricity Data - U.S. Energy Information Administration (EIA)," accessed June 8, 2023, https://www.eia.gov/electricity/data.php.

[5] Michelle Solomon, Eric Gimon, and Mike O'Boyle, *Coal Cost Crossover 3.0: Local Renewables Plus Storage Create New Opportunities for Customer Savings and Community Reinvestment* (Energy Innovation, January 2023), https://energyinnovation.org/wp-content/uploads/2023/01/Coal-Cost-Crossover-3.0.pdf.

[6] Mike O'Boyle, Dan Esposito, and Michelle Solomon, *Implementing the Inflation Reduction Act: A Roadmap for State Electricity Policy* (Energy Innovation, October 2022), https://energyinnovation.org/publication/implementing-the-inflation-reduction-act-a-roadmap-for-state-electricity-policy/.

Agriculture (USDA). This "Empowering Rural America" (New ERA) program will accept letters of interest from applicants from July 31 through August 31, 2023. Applicants can seek grants for up to 25 percent of project cost, and no applicant will be able to receive more than 10 percent of available funding, or $970 million.[7] With this short window, cooperatives will need to move fast to qualify for this funding that has the potential to entirely shift the electric generation mix and greenhouse gas emissions across rural America.

There are additional rural energy investment programs under the IRA to consider as well in conjunction with those addressed in this analysis. Under the Powering Affordable Clean Energy (PACE) program USDA Rural Development's Rural Utilities Service (RUS) will forgive up to 60 percent of loans for renewable energy projects that use wind, solar, hydropower, geothermal, or biomass, as well as for renewable energy storage projects, funded at $1 billion.[8] The Rural Energy for America Program (REAP) will provide more than $2 billion for renewable energy systems and energy efficiency improvement grants for agricultural producers and rural small business owners through 2031, through six ongoing quarterly competitive applications.[9] Finally, rural cooperatives have access to low-cost capital to finance investments in clean energy infrastructure under the Loan Program Office's Energy Infrastructure Reinvestment program, if such investments retool, repower, repurpose, or replace energy infrastructure that has ceased operations or enable operating energy infrastructure to avoid, reduce, utilize or sequester air pollutants or greenhouse gas emissions.[10] In aggregate, these several IRA programs represent the largest investments in rural electricity systems since the New Deal.

To help G&T cooperatives and their members understand the immense benefits of capitalizing on this opportunity, this paper analyzes the IRA's impact by conducting an optimal capacity expansion and dispatch analysis through 2032 to assess the least-cost electricity generation resource mix for the following 11 medium and large G&Ts: Basin Electric Cooperative, Big Rivers Electric Corporation, Buckeye Power, Inc., Dairyland Power Cooperative, Great River Energy, Oglethorpe Power Corporation, Old Dominion Electric Cooperative, San Miguel Electric Cooperative, Inc., Seminole Electric Cooperative, Inc., Tri-State G&T Association, Inc., and Wabash Valley Power Association. This is a representative cross-section of the G&Ts that supply most of rural America's electricity based on location, size, and generation mix. Note that the analysis is conducted without considering the grants and financing available under the New ERA program.

The analysis shows an opportunity to achieve three goals:

- Promote rural development and investment
- Lower costs for consumers
- Reduce pollution and GHG emissions

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[7] "Empowering Rural America New ERA Program," Rural Development, May 11, 2023, https://www.rd.usda.gov/programs-services/electric-programs/empowering-rural-america-new-era-program.
[8] "Powering Affordable Clean Energy PACE Program," https://www.rd.usda.gov/programs-services/electric-programs/powering-affordable-clean-energy-pace-program#to-apply.
[9] "Rural Energy For America Program (REAP)," https://www.rd.usda.gov/inflation-reduction-act/rural-energy-america-program-reap.
[10] "Title 17 Clean Energy Financing – Energy Infrastructure Reinvestment," https://www.energy.gov/lpo/energy-infrastructure-reinvestment.

With direct-pay tax credits and New ERA, cooperatives can own the transition and pass the benefits of reliable clean energy portfolios to their members and communities. We find four key results:

First, the least-cost electricity generation portfolio for rural electric cooperatives, if all coal generation is retired by 2032, includes 80 to 90 percent clean electricity and reduces wholesale electricity costs by 15 to 20 percent on average compared to 2022. Declines in renewable energy and storage costs, IRA incentives, and the availability of high-quality solar and wind power in rural cooperative service territories are key drivers of wholesale cost savings.

Second, due to the deployment of batteries alongside renewable energy generation that occurs largely at the same time as peak demand, the reserve margin of most utilities substantially increases from approximately 15 to 20 percent below peak load on average in 2022 to approximately 15 to 20 percent above peak load in 2032, even as all coal retires. Greater self-reliance also reduces the need for purchases on the wholesale market from about 40 percent in 2022 to about 15 to 20 percent in 2032.

Third, G&Ts can leverage the excellent renewable resource potential in their regions to directly own resources and invest in their member cooperatives, with up to $80 billion in investment between the 11 utilities. Half of this investment could be offset by IRA tax credits, and loans and grants from the New ERA program could further reduce utilities' debt exposure. For cooperative utilities investing up to $4 billion in clean energy, the combination of tax credits and the New ERA program could pay down up to 80 percent of clean energy project costs.

Fourth, with significant investments in battery storage and a good correlation between wind and solar resources with load, utilities will be capable of meeting the load requirements at all hours of the year, including periods of peak load and low renewable generation.

These findings show that the IRA, via tax credits and funding from the New ERA program, has created a window of opportunity for rural America—one that can increase economic standing while reducing carbon emissions. While the tax credits will be available for the next 10 years, rural utilities should act now to take advantage of the $9.7 billion available through New ERA to maximize savings and member-owned assets.

The 11 Cooperative Utilities

We analyzed 11 G&Ts that make up a representative cross-section of the 63 G&Ts in the U.S. The selected B&Ts are Basin Electric Cooperative, Big Rivers Electric Corporation, Buckeye Power, Inc., Dairyland Power Cooperative, Great River Energy, Oglethorpe Power Corporation, Old Dominion Electric Cooperative, San Miguel Electric Cooperative, Inc., Seminole Electric Cooperative, Inc., Tri-State G&T Association, Inc., and Wabash Valley Power Association. Their service territories are shown in Figure 1.

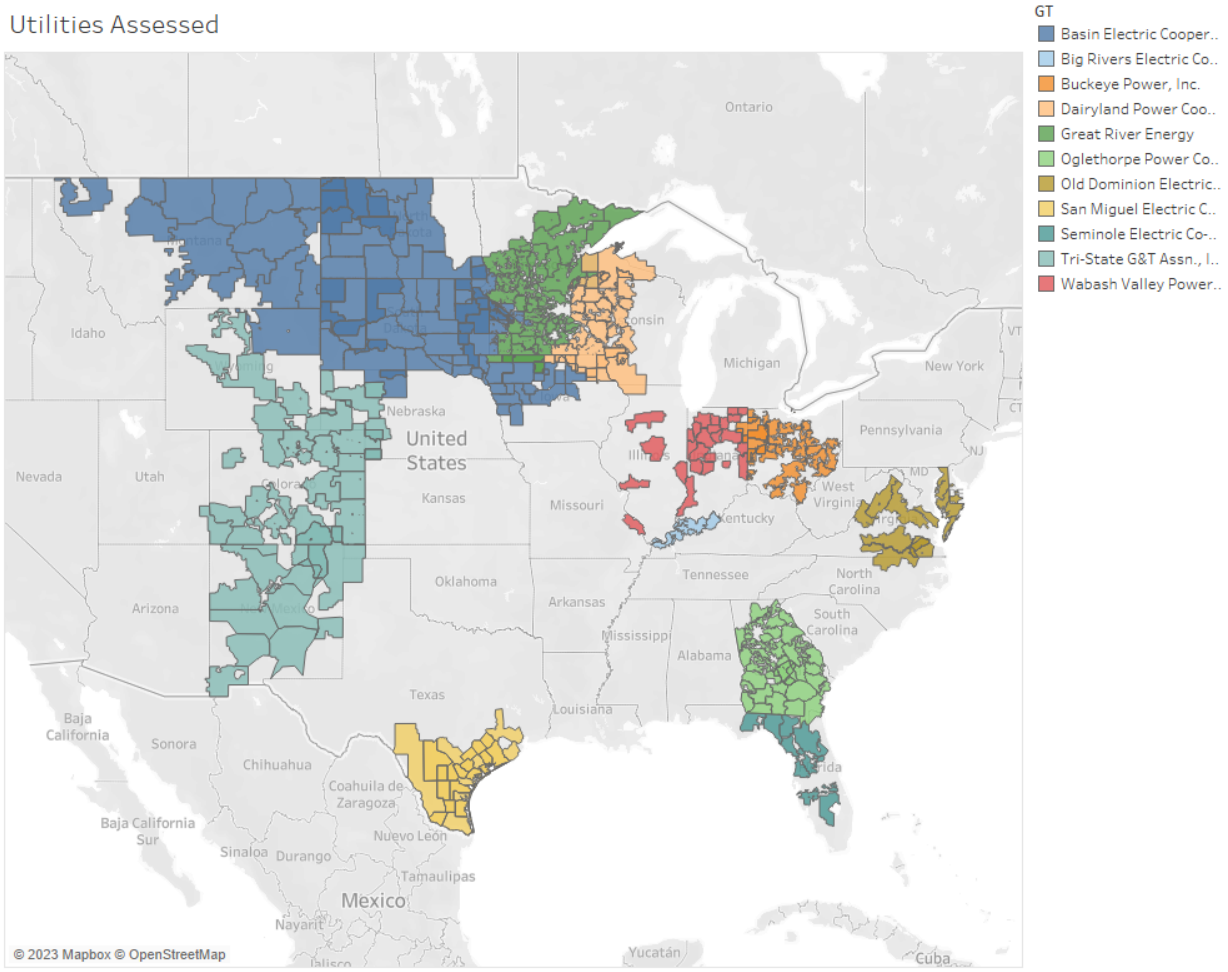

Figure 1. Map of rural electric utilities assessed in this study.

We chose 2022 as the baseline year for this analysis. Electricity demand data for each utility was sourced from U.S. Energy Information Administration (EIA) form 861 (utility-level details and operational data). Unfortunately, 2021 is the latest year for which form 861 was available. Therefore, we estimate the 2022 demand using the 2021 actual data and a demand forecast for 2032 based on the National Renewable Energy Laboratory (NREL) Electrification Futures Study (EFS) (see Appendix for details on demand forecast). Electricity generation data was taken from EIA form 860 (generator-level specific information, including ownership status), EIA form 923 (power plant-level monthly generation), and Sierra Club's Mapping Electric Cooperatives database.[11] See Appendix for baseline year (2022) electricity demand, capacity, and generation data for each utility.

[11] Jeremy Fisher, "Mapping Electric Cooperatives - Public," accessed June 8, 2023, https://public.tableau.com/views/MappingElectricCooperatives-Public/CoopLoadDash1?%3Adisplay_static_image=y&%3AbootstrapWhenNotified=true&%3Aembed=true&%3Alanguage=en-US&:embed=y&:showVizHome=n&:apiID=host0#navType=0&navSrc=Parse.

Methodology

We used the NREL ReEDS model to assess a least-cost capacity and generation mix from 2022 through 2032. ReEDS models the continental U.S. power system split into 134 balancing areas (BA) with 300 transmission corridors, as shown in Figure 2.

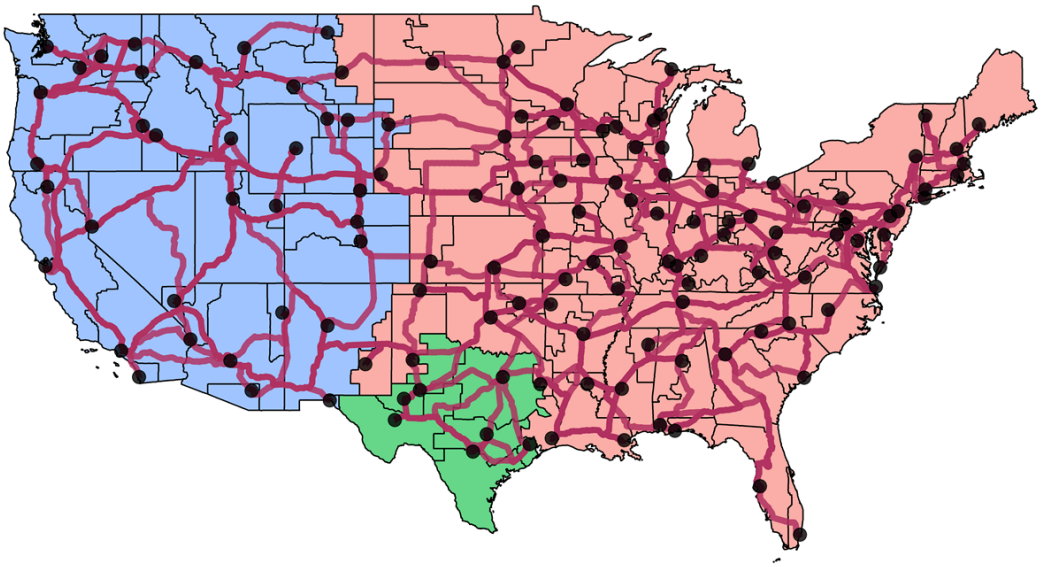

Figure 2. BAs (denoted by thin black lines) and transmission links (denoted by red lines) in the ReEDS model.

We supplemented the base ReEDS model with the following inputs and constraints:

- **Cost and tax incentives:** The analysis used the NREL Annual Technology Baseline for 2022, specifically the moderate cost scenario. Additionally, the analysis incorporated incentives provided under the IRA.
- **Coal power plant retirement by 2032:** The least-cost scenario assumed that all coal power plants in the country will retire by 2032. This indicates a shift away from coal generation toward other sources of energy.
- **No retirement of gas power plants after 2023:** To ensure utilities maintain their firm capacities and meet resource adequacy obligations, the analysis assumed that no gas power plants will retire between 2023 and 2032. This implies that existing gas power plants will continue operating during that period.
- **Maintaining 2022 generation levels within each BA:** The analysis required that, in each simulation year from 2022 to 2032, each BA should generate at least the same amount of electricity as it did in 2022. This condition ensured that generation levels are maintained without the need for excessive imports and potentially considers regional transmission constraints.

To assess the technical and operational feasibility of the least-cost portfolio, the analysis employed PLEXOS, an industry-standard production cost simulation model. PLEXOS enabled the evaluation of hourly dispatch at the individual power plant level in the year 2032, allowing for a detailed assessment of the least-cost portfolio's ability to meet demand with generation throughout the year. See Appendix for

additional modeling assumptions on load growth, load shapes, renewable capacity and capacity factors, and rural cooperative energy generation.

Allocation of Model Results to Individual Utilities

ReEDS and PLEXOS results were generated at the ReEDS BA level. These results were then allocated to each utility we assessed using the spatial intersection of the cooperative utilities with ReEDS BAs. This is illustrated in Figure 3.

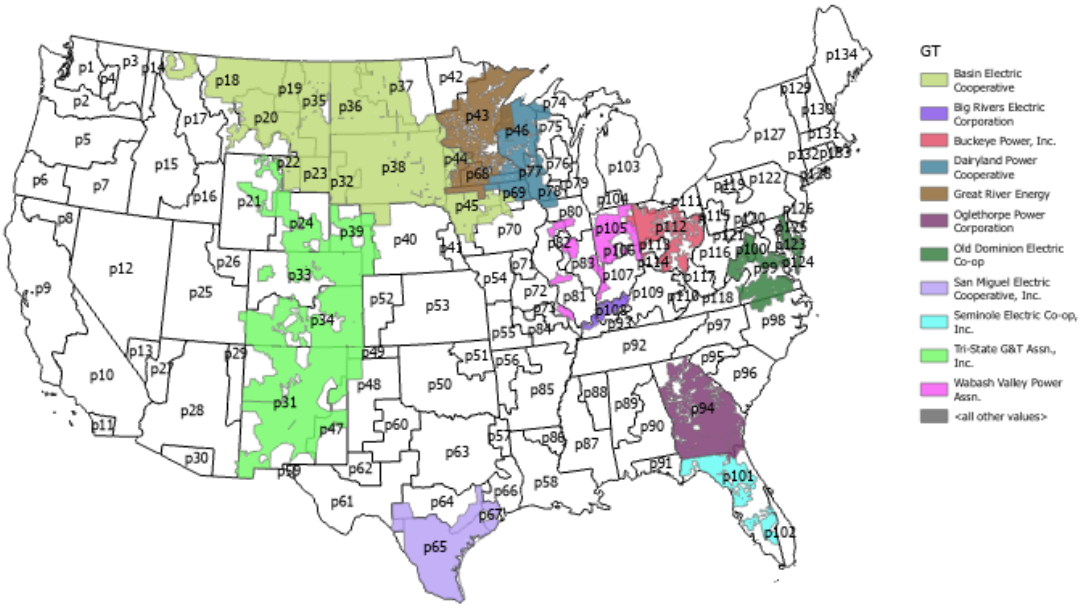

Figure 3. Spatial overlap of electric cooperatives and ReEDS BAs. Note: Basin Electric Cooperative does not include Tri-State G&T Association, unless stated otherwise.

Results

We found that in aggregate, rural cooperatives represented by these 11 utilities can cost-effectively transition to newer, cheaper electricity resources, thereby reducing costs, investing in their members, and improving their resilience. The falling cost of renewables and storage, coupled with a unique opportunity to leverage IRA incentives including New ERA grants and financing, means now is the time to act boldly. Because they are proximate to some of the country's highest-quality renewable resources, G&Ts can own the transition and pass health, climate, tax revenue, and employment benefits directly to their members.

Cost Savings

The IRA makes wind, solar, and storage the lowest-cost electricity resources available to utilities today—especially for utilities with access to high-quality renewable resources. Electric cooperative utilities have access to some of the best wind energy in the country, creating an even larger opportunity for a cost-saving energy transition. We find that the 11 cooperatives we sampled can reduce wholesale electricity costs by ~20 percent on average in 2032 if they take full advantage of a least-cost portfolio of clean energy resources. Cost savings for each cooperative are shown in Figure 4, while 2032 least-cost capacity portfolio

and generation are shown in Figure 5 and Figure 6, respectively. Savings could be even higher if cooperatives couple these investments with up to $970 million in New ERA funding available for each utility from USDA.

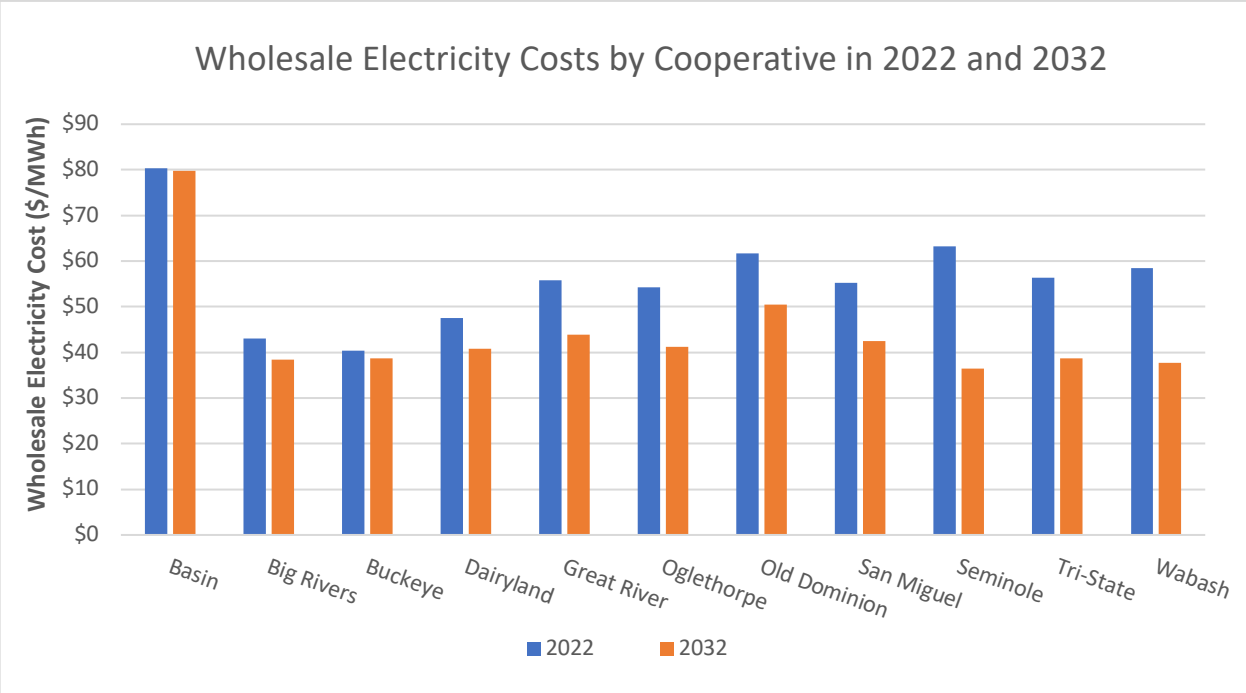

Figure 4. Wholesale electricity costs at each electric cooperative in 2022 and 2032.

These savings are possible because local renewable energy costs, coupled with federal incentives, have fallen well below the marginal cost of operating each of the coal plants we examined.[12] These savings allow for significant storage investments to complement these clean energy resources , supplementing reliability of the clean energy portfolio and allowing cost-effective retirement of coal plants while enhancing resource adequacy. IRA incentives are most impactful for rural utilities because nonprofit utilities such as rural cooperatives can collect these incentives without seeking financing from a third-party tax equity provider—a provision known as "direct pay" tax credits.

[12] Solomon, Gimon, and O'Boyle, *Coal Cost Crossover 3.0*.

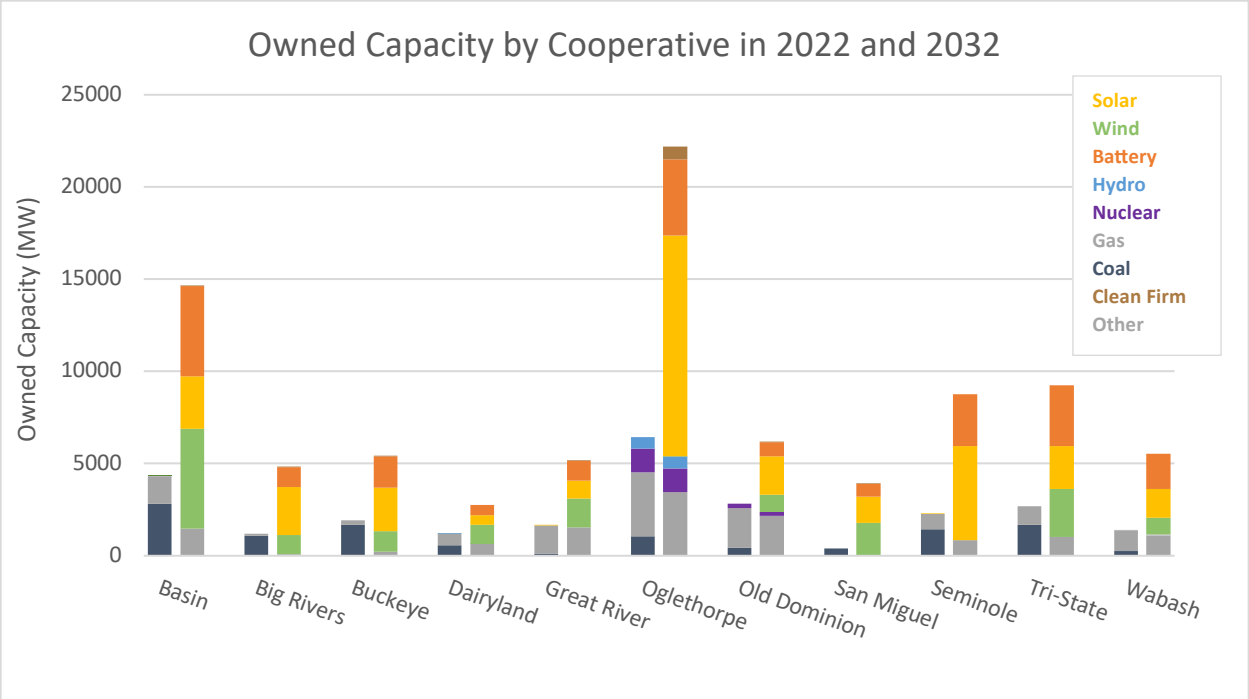

Figure 5. Capacity owned by each cooperative in 2022 (left) and 2032 (right).

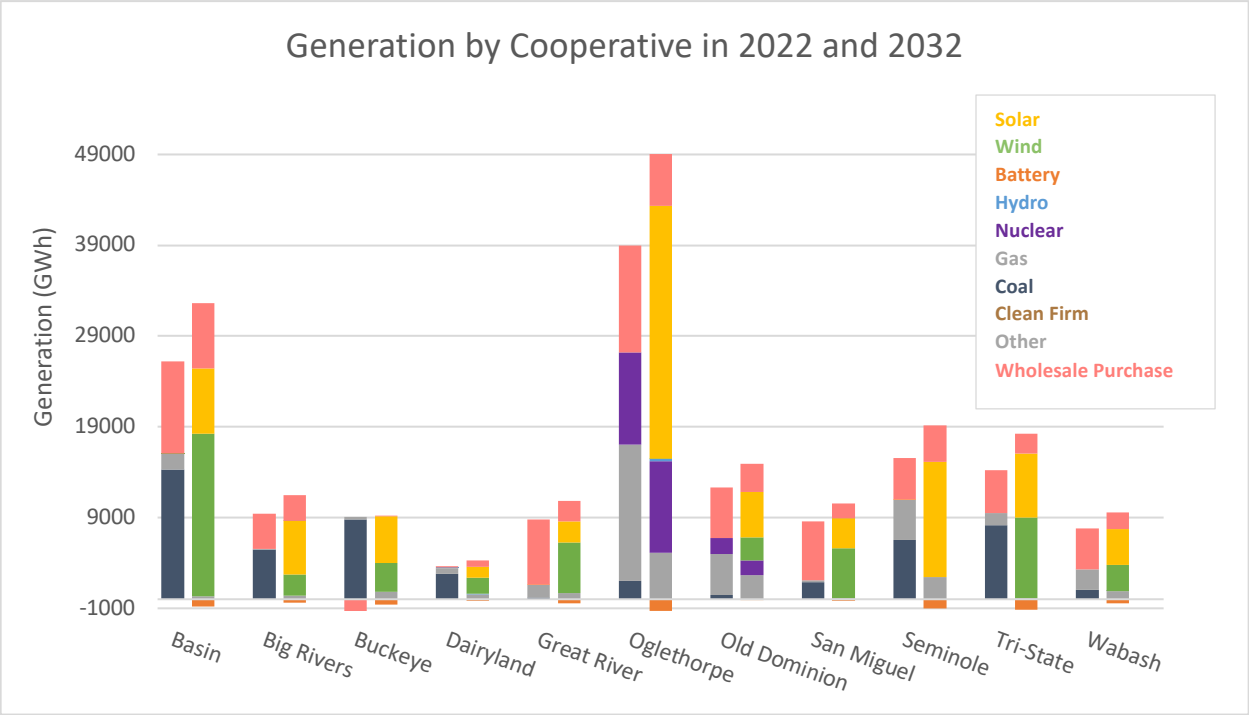

Figure 6. Generation owned by each cooperative in 2022 (left) and 2032 (right).

Improved Reserves and Firm Capacity

Each of the utilities examined improves their capacity positions markedly, as the analysis required the cooperatives to maintain or enhance their peak-coincident capacity in 2032. Today, resource adequacy

needs are largely covered through ownership of coal, gas, and nuclear plants. The least-cost portfolio in 2032 does more than replace the capacity obligations of existing coal—it increases the reserve margin (considering only utility-owned resources) of most utilities substantially from roughly 15 to 20 percent below peak load on average in 2022 to roughly 15 to 20 percent above peak load in 2032, as seen in Figure 7. And while these 11 utilities currently provide about 38 percent of their energy through the wholesale market, the least-cost portfolio increases self-supply substantially—each utility would only use the wholesale market for around 15 to 20 percent of generation by 2032.

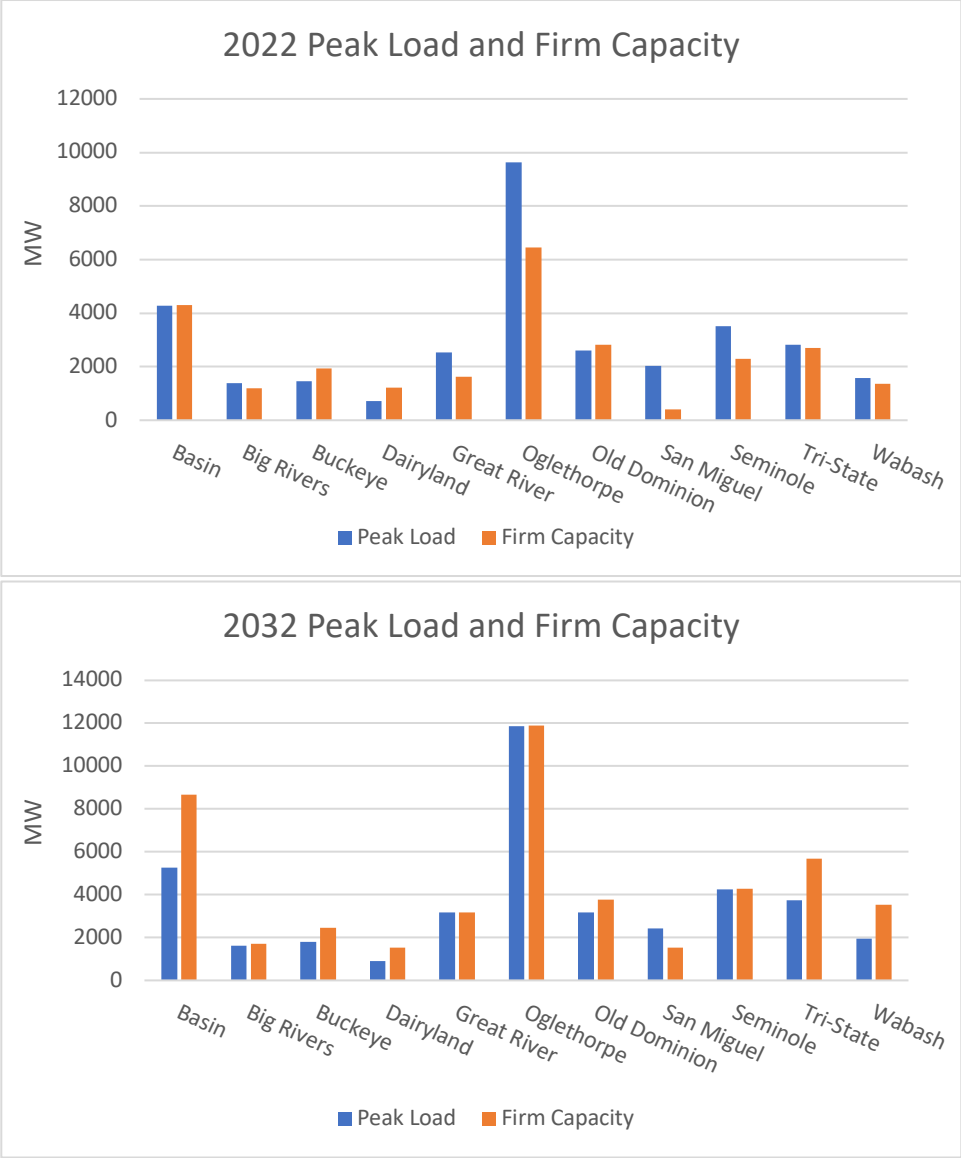

Figure 7. Amount of firm capacity for each cooperative in 2022 and 2032.

Even though each utility loses 100 to 2,800 MW of coal capacity, the additional clean energy and storage add enough peak-coincident "firm" capacity to increase reserve margins with utility-owned resources. The model also demonstrates that each utility has sufficient energy to meet demand in every hour of the seven wind and solar weather-years studied (see Appendix for dispatch results). Firm capacity is a matter of

accreditation—we assign effective load-carrying capacities to wind and solar resources, which decrease as penetrations increase, and credit storage greater than 4 hours at 100 percent of its rated capacity.

We find that significant battery storage capacity will be needed to balance the new renewable energy capacity and to maintain grid dependability after the retirement of the coal fleet. Interestingly, coal retirements spur a need for battery duration to increase significantly to maintain or enhance resource adequacy. More than 50 percent of the battery capacity added needs to be 6 hours or longer to meet firm capacity requirements, as seen in Figure 8.

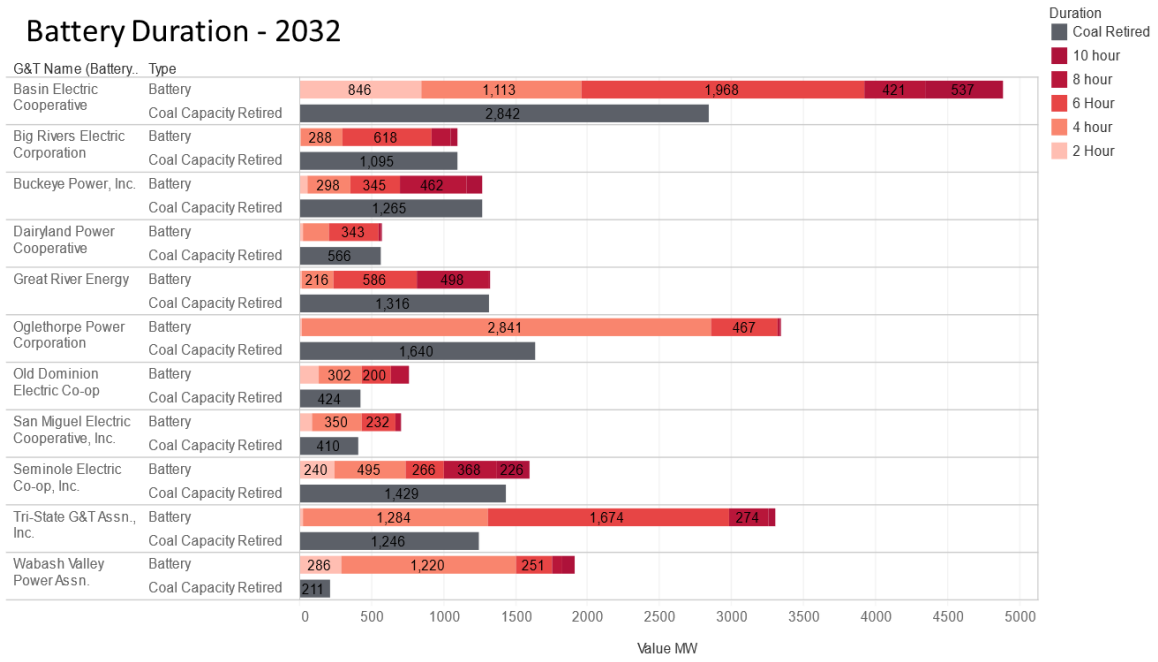

Figure 8. Battery capacity (from 2-hour to 10-hour duration) at each cooperative in 2032 compared to coal capacity retired.

Investments in Member Rural Communities, with Limited Debt Exposure

Embracing the least-cost electricity mix that retires all of these expensive coal plants, many of which would not survive current or future environmental rules, would result in an $80 billion investment in member communities. The 11 utilities we examined owned 11.5 GW of coal power plants in 2022. These assets are economic anchors for many of the communities in which they sit. Many of these same communities are rightly worried about economic transition as the energy mix changes. Our analysis shows that embracing the incentives in the IRA could drive deployment of 50 GW of new wind and solar plants, and up to 20 GW of new storage, located within the cooperative service territories.

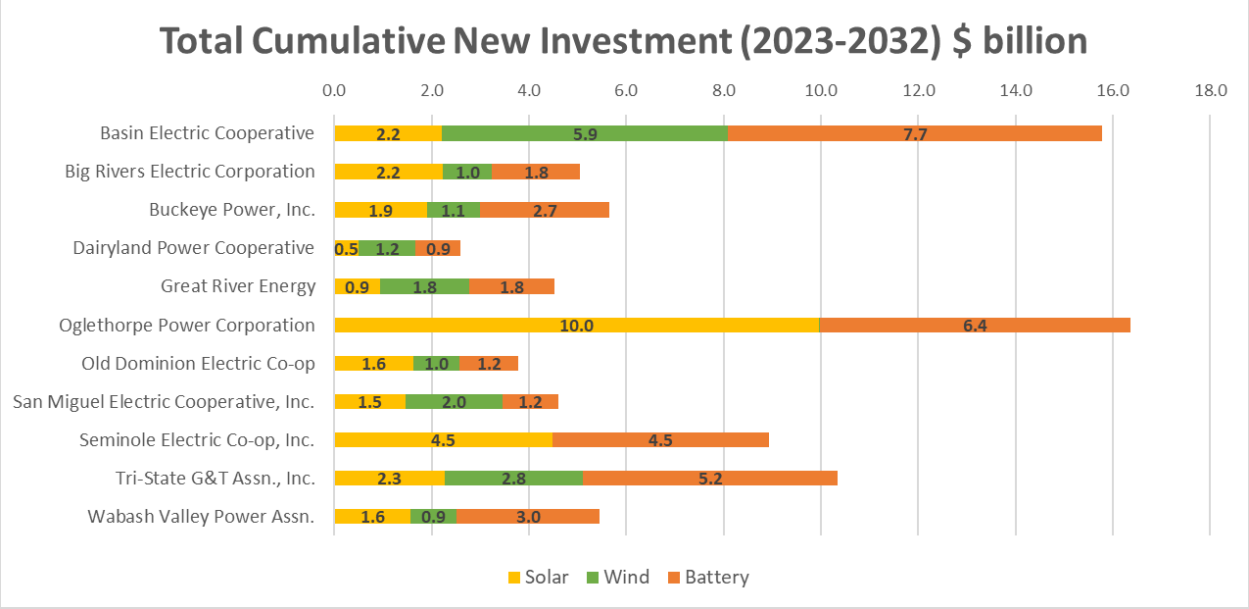

Figure 9. New cumulative investment in solar, wind, and batteries at each cooperative studied.

A significant portion of the $80 billion investment could be paid for by the production and investment tax credits bolstered by the IRA. In total, these 11 cooperatives could collect more than $40 billion in IRA tax incentives or 50 percent of the costs, and as much as $970 million additionally per utility from the USDA's New ERA program (not reflected in this analysis). As Figure 10 shows, IRA incentives are broadly available to cooperatives across diverse geographies, reducing costs for customers.

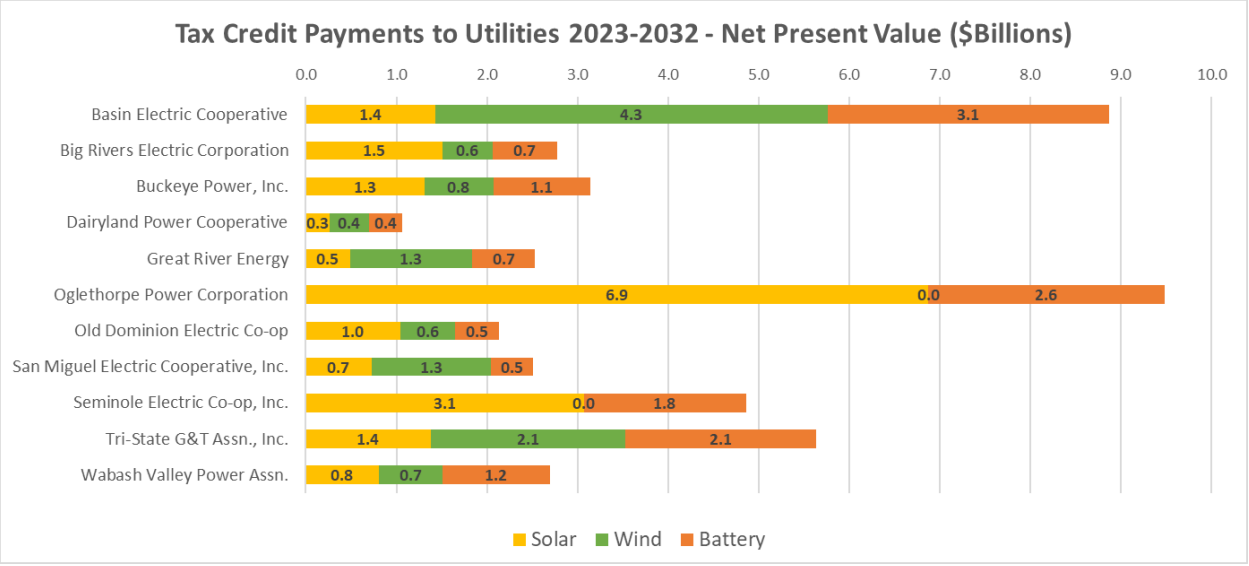

Figure 10. Tax credit direct payments to rural electric cooperatives studied for wind, solar, and batteries.

Together, IRA incentives coupled with New ERA funding available from USDA could offset 60 to 80 percent of the up-front capital cost over the lifetime of the assets, limiting cooperative utility exposure to long-term debt. This is a once-in-a-generation investment opportunity for rural communities, with much of the cost covered by the federal government.

Rural energy investments examined in this report would cover growing load, and the low-cost, abundant renewable energy could be a lever to attract additional investment. A recent report from Energy Innovation finds that wind-rich areas in rural America will be by far the best sites to develop low-cost green hydrogen, a feedstock for zero-carbon industries such as steel that require high heat, or fertilizer and chemicals that require hydrogen as a feedstock.[13] In addition to reducing costs, these investments could even be expanded in partnership with industries that need direct access to high-quality, low-cost renewable resources, further broadening the opportunities for direct rural investment and job creation.

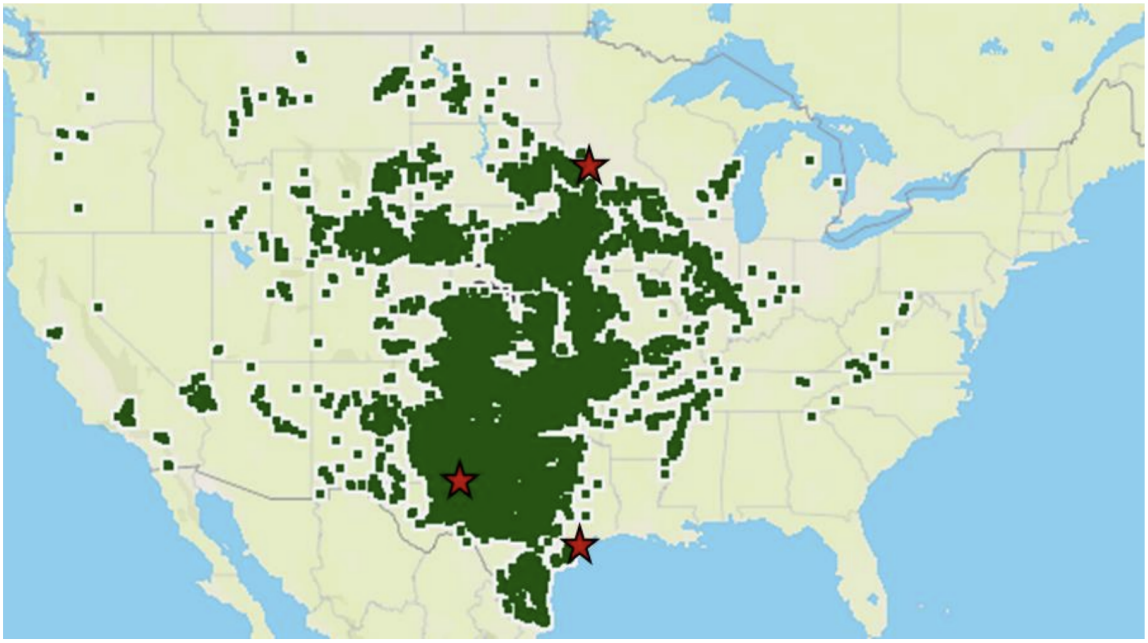

Figure 11. Locations where solar and wind resources have combined average levelized costs of electricity less than $25/MWh (including IRA clean energy tax credits), as denoted by green squares. Sites are identified using exclusion criteria from NREL's ReEDS model. Green squares are not to scale; each one is 11.5 km by 11.5 km. Source: Energy Innovation.[14]

Reducing Emissions

Cost-effective investment in new clean energy resources would drastically reduce carbon pollution for all 11 cooperative utilities we examined – 90 percent on average by 2032. Clean energy investments replace all coal generation and significantly reduce reliance on gas for generation, even as existing gas capacity remains to bolster reliability, with clean energy reaching 80 to 90 percent of total generation serving these

[13] Dan Esposito, Eric Gimon, and Mike O'Boyle, *Smart Design of 45V Hydrogen Production Tax Credit Will Reduce Emissions and Grow the Industry* (Energy Innovation, April 2023), https://energyinnovation.org/wp-content/uploads/2023/04/Smart-Design-Of-45V-Hydrogen-Production-Tax-Credit-Will-Reduce-Emissions-And-Grow-The-Industry.pdf.

[14] Esposito, Gimon, and O'Boyle, *Smart Design of 45V Hydrogen Production Tax Credit*.

utilities. Similar studies have found reduced coal and gas generation would also markedly reduce pollution in nearby communities,[15] though to what degree was beyond this analysis.

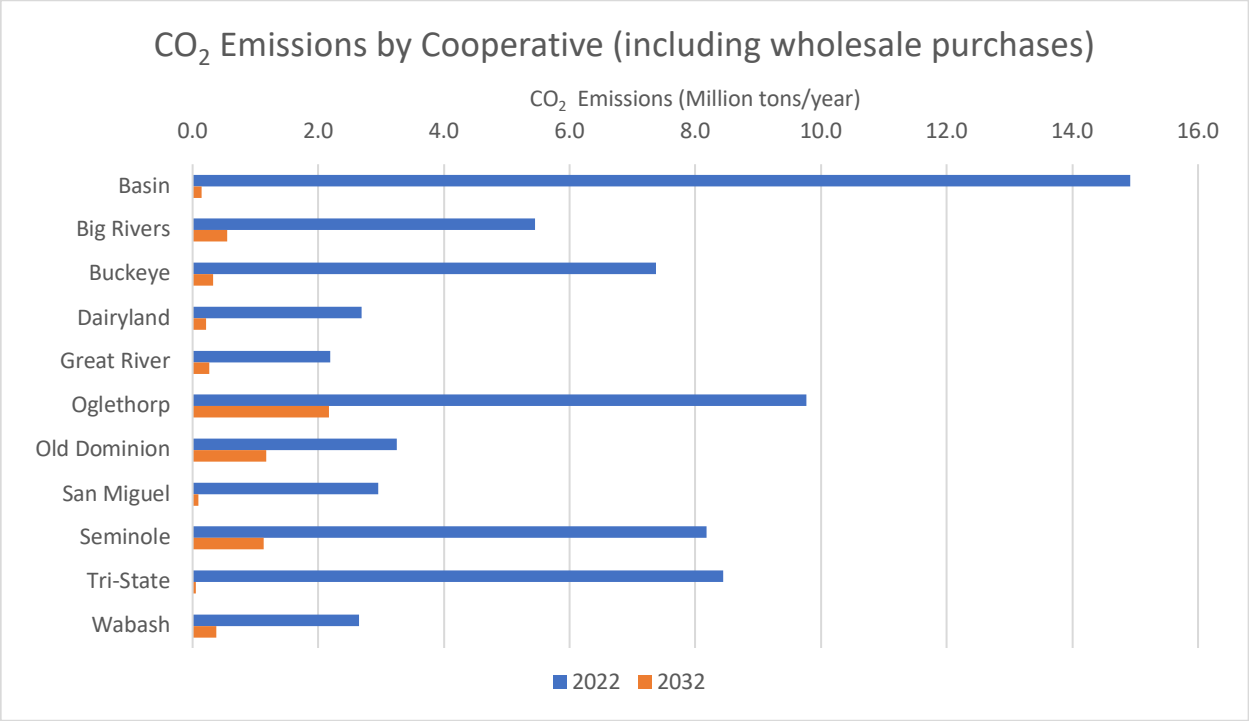

Figure 12. CO_2 emissions for each cooperative in 2022 and 2032.

In addition to the environmental benefits, reducing carbon emissions would de-risk cooperative utilities that are facing tightening pollution rules from the U.S. Environmental Protection Agency (EPA) and reduced market appetite for their coal plants. The EPA is working on at least seven rules that would affect power sector pollution: carbon standards for new and existing plants, Mercury and Air Toxics Standards, a national soot standard, national smog standards, toxic water pollution rules, the Regional Haze Rule, coal ash rules, and the Good Neighbor rule.[16] In addition, member cooperatives are increasingly adopting carbon goals of their own and trying to extricate themselves from must-take contracts that involve expensive coal power. For example, several member distribution cooperatives in Tri-State have attempted to leave the cooperative due to high coal power prices.[17] Moving toward lower-emissions sources would insulate G&Ts from both environmental and member defection risks.

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[15] Amol Phadke et al., *2035 2.0: Plummeting Costs and Dramatic Improvements in Batteries Can Accelerate Our Clean Transportation Future* (Goldman School of Public Policy, University of California, Berkeley, GridLab, April 2021), https://www.2035report.com/transportation/downloads/.

[16] "EPA Power Sector Report Card" (Evergreen Action, May 2023), https://www.evergreenaction.com/documents/May2023-Evergreen-EPAReportCard.pdf.

[17] Mark Jaffe, "After Long Battle, 3 Colorado Electric Co-Ops May Renegotiate with Tri-State Instead of Leaving Outright," *The Colorado Sun*, April 22, 2022, http://coloradosun.com/2022/04/22/tri-state-fight-co-op-break-up-renewables/.

Seizing the Opportunity

The New ERA program and direct-pay tax credits offer a unique opportunity for rural electric cooperatives to become America's clean energy leaders, boosting rural economic development and lowering costs to members. These 11 electric cooperatives – and likely others like them – can acquire clean energy to meet growing load and reliability obligations and still retire their coal plants by decade's end. The federal incentives offered to rural cooperatives—rivaled in scope only by the New Deal electrification program—hold the promise to modernize energy systems in rural America. These investments can be the start of an energy-centric development strategy that embraces new energy sources and revitalizes communities that need it.

Appendix

Baseline Demand, Capacity, and Generation

Table 1. Retail sales and peak load (2021 actual and 2022 estimated)

	2021 (Actual)		2022 (Estimated)	
	Peak Load MW	**Retail Sales MWh**	**Peak Load MW**	**Retail Sales MWh**
Basin Electric Cooperative	4,248	25,152,652	4,278	25,332,719
Big Rivers Electric Corporation	1,373	9,308,945	1,377	9,336,145
Buckeye Power, Inc.	1,464	7,299,361	1,468	7,319,315
Dairyland Power Cooperative	719	3,349,686	722	3,365,849
Great River Energy	2,524	8,518,111	2,539	8,565,763
Oglethorpe Power Corporation	9,563	37,759,413	9,641	38,067,876
Old Dominion Electric Co-op	2,596	11,742,204	2,615	11,828,588
San Miguel Electric Cooperative, Inc.	2,005	8,161,170	2,029	8,257,677
Seminole Electric Co-op, Inc.	3,490	14,882,498	3,516	14,990,291
Tri-State G&T Assn., Inc.	2,794	13,571,698	2,822	13,705,756
Wabash Valley Power Assn.	1,581	7,541,407	1,586	7,564,838

Note: Basin Electric Cooperative does not include Tri-State G&T Association, unless stated otherwise.

Data source: EIA form 861 for 2021 and authors' forecast based on NREL EFS High Electrification for 2022.

Table 2. Installed capacity (2022)

G&T Name	Coal	Gas	Other	Nuclear	Hydro	Wind
Basin Electric Cooperative	2,817	1,487	0	0	0	5
Big Rivers Electric Corporation	1,095	99	0	0	0	0
Buckeye Power, Inc.	1,696	236	0	0	0	0
Dairyland Power Cooperative	566	632	2	0	22	0
Great River Energy	106	1,526	0	0	0	0
Oglethorpe Power Corporation	1,069	3,463	0	1,283	632	0
Old Dominion Electric Co-op	424	2,162	0	227	0	0
San Miguel Electric Cooperative, Inc.	410	0	0	0	0	0
Seminole Electric Co-op, Inc.	1,429	853	0	0	0	0
Tri-State G&T Assn., Inc.	1,671	1,021	0	0	0	0
Wabash Valley Power Assn.	256	1,103	47	0	0	0

Note: Basin Electric Cooperative does not include Tri-State G&T Association, unless stated otherwise, and table includes only capacity that is owned by the cooperative utilities.

Table 3. Electricity generation (2022)

G&T Name	Coal	Gas	Other	Nuclear	Hydro	Wind	Total Own Generation	Wholesale Purchases	Total Sourced Power	Retail Sales
Basin Electric Cooperative	14300	1722	0	0	0	16	16038	10329	26367	25333
Big Rivers Electric Corporation	5441	101	0	0	0	0	5542	3893	9435	9336
Buckeye Power, Inc.	8818	242	0	0	0	0	9060	-1405	7655	7319
Dairyland Power Cooperative	2772	648	11	0	69	0	3500	131	3631	3366
Great River Energy	172	1443	0	0	0	0	1620	7227	8848	8566
Oglethorpe Power Corporation	2007	15017	0	10186	0	0	27210	12097	39307	38068
Old Dominion Electric Co-op	446	4514	0	1783	0	0	6744	5653	12397	11829
San Miguel Electric Cooperative, Inc.	1903	216	0	0	0	0	2119	6545	8663	8258
Seminole Electric Co-op, Inc.	6551	4402	0	0	0	0	10958	4681	15639	14990
Tri-State G&T Assn., Inc.	8180	1317	0	0	0	0	9497	4862	14359	13706
Wabash Valley Power Assn.	1039	2260	8	0	0	0	3307	4497	7804	7565

Note: Basin Electric Cooperative does not include Tri-State G&T Association, unless stated otherwise.

Data sources: EIA forms 860 and 923 and Mapping Electric Cooperatives database.

Additional Modeling Assumptions

We attribute the following characteristics to the 11 examined utilities to understand how they might change from the 2022 baseline over time:

- **Load growth:** We use 2021 baseline electricity demand numbers from EIA as shown previously and use the NREL EFS High Electrification case to project electricity demand through 2032. EFS/ReEDS offers a demand projection at the ReEDS BA level. Electricity demand growth for each utility between 2021 and 2032 is determined using the spatial intersection between ReEDS BAs and the cooperative utilities.
- **Hourly load shape**s**:** We use the ReEDS BA–utility spatial intersection approach to derive hourly load shape for each utility based on ReEDS BA-level hourly load.
- **Renewable and battery capacity:** We use the ReEDS BA–utility spatial intersection approach to determine the share of wind and solar generation in each utility based on the ReEDS results. We use a combination of two approaches to allocate new clean energy installations to individual utilities. First, we calculate the spatial area intersection between the ReEDS regions and the G&Ts, which gives us an intersection matrix indicating what fraction of each utility's total service territory falls within each ReEDS region. For each clean technology, we estimate its generation share in total sourced power in each ReEDS region. We then use the intersection table fractions to determine the clean technology generation contributions in each utility. This gives us a GWh and GW number for wind and solar in each utility. Using high-resolution ReEDS site-level capacity expansion results, we then determine wind and solar capacity that ReEDS builds within each utility territory. We take the minimum of these two numbers (site-level expansion GW and intersection table GW). Similarly, battery capacity is allocated to each utility using multiple factors—first, as a fraction of the solar/wind capacity and peak load, and second, ensuring that each utility has at least the same firm capacity (MW) after coal retirement. Both approaches are subject to the intersection table approach showing enough battery capacity is available. Other clean firm capacity (e.g., renewable energy combustion turbines, such as those powered by green hydrogen) is allocated based on the residual firm capacity, subject to the intersection table approach showing enough renewable combustion turbine capacity is available.
- **Renewable energy capacity factors:** Renewable energy capacity factors and hourly renewable energy generation profiles are allocated to each utility using a combination of the ReEDS BA-utility spatial intersection approach and considering high-resolution site-level capacity expansion results from ReEDS (over 50,000 potential renewable energy sites across the U.S.) that fall within the utilities we assessed.
- **Own electricity generation:** Each utility is required to maintain at least the 2022 level of own generation (in GWh terms).

Dispatch Results

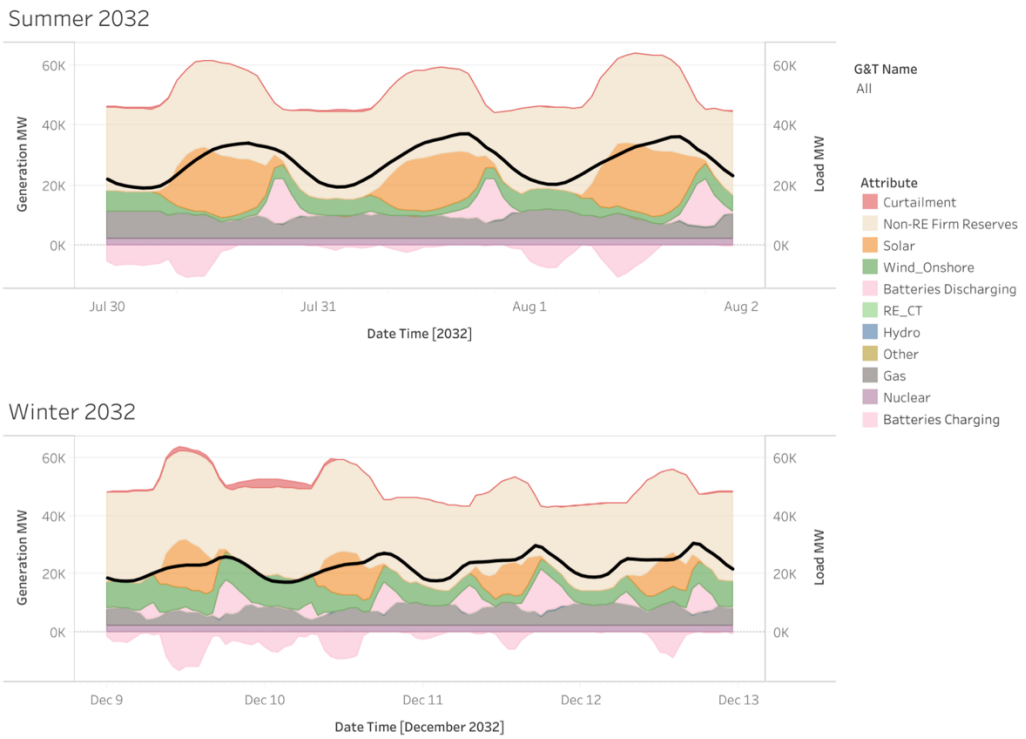

Figure 13. Hourly dispatch during stressed periods (highest net peak loads) in summer and winter 2032 across all cooperatives studied.