COMMONWEALTH OF KENTUCKY
BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

ELECTRONIC JOINT APPLICATION OF KENTUCKY UTILITIES COMPANY AND LOUISVILLE GAS AND ELECTRIC COMPANY FOR CERTIFICATES OF PUBLIC CONVENIENCE AND NECESSITY AND SITE COMPATIBILITY CERTIFICATES AND APPROVAL OF A DEMAND SIDE MANAGEMENT PLAN	))))))))	**CASE NO. 2022-00402**

TESTIMONY OF ANDY MCDONALD

ON BEHALF OF JOINT INTERVENORS METROPOLITAN HOUSING COALITION, KENTUCKIANS FOR THE COMMONWEALTH, KENTUCKY SOLAR ENERGY SOCIETY AND MOUNTAIN ASSOCIATION

July 14, 2023

I. INTRODUCTIONS & QUALIFICATIONS

Q. Please state for the record your name and business address.

A. My name is Andy McDonald. My business address is 316 Wapping St., Suite 204, Frankfort, KY 40601.

Q. By whom are you employed and in what position?

A. I am employed by Apogee – Climate & Energy Transitions, a program of Earth Tools Inc.

Q. On whose behalf are you testifying in this proceeding?

A. I am testifying on behalf of Metropolitan Housing Coalition, Kentuckians for the Commonwealth ("KFTC"), Kentucky Solar Energy Society ("KYSES"), and Mountain Association (collectively, "Joint Intervenors").

Q. Are you a member of any of the organizations you are testifying on behalf of here?

A. Yes, I am, and I currently serve on KYSES's Board of Directors.

Q. Please describe your professional background.

A. I have been working to address climate change and sustainability for thirty years. My experience spans solar energy system design and installation; green building and energy efficiency; state and local energy policy; and community outreach and education. I have written technical and public-education documents on energy issues, including co-authoring the Kentucky Solar Energy Guide in 2004 with Joshua Bills. For twenty years I have been actively involved in efforts to establish, expand, and defend net metering in Kentucky. I have participated in multiple utility rate cases and Integrated Resource Planning processes as a concerned citizen, intervenor, and expert witness.

I was the Director of the Kentucky Solar Partnership for Appalachia-Science in the

Public Interest from 2004 to 2012. In 2013, I joined Earth Tools, where I established our Sustainable Systems Program, and in 2020, founded Apogee-Climate & Energy Transitions.

I am a Certified Energy Manager and I hold an M.Sc. in Sustainable Systems from Slippery Rock University of Pennsylvania and a B.A. in Philosophy from the University of Buffalo. I am attaching my resume as Exhibit AM-1.

Q. Have you previously filed expert witness testimony in other proceedings before this Commission or before other regulatory commissions?

A Yes. I have provided expert witness testimony before the Kentucky Public Service Commission in Case Nos. 2020-00174 and 2013-00287.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to demonstrate that the Kentucky Utilities Company and Louisville Gas & Electric (the "Companies" or "LGE & KU") have significantly under-estimated the potential role of distributed energy resources ("DERs") in reliably and affordably meeting their customers' electricity needs. My testimony will focus on distributed solar generation ("DSG") and battery storage systems.

II. JOINT INTERVENORS' WITNESSES AND RECOMMENDATIONS

Q. Who will be testifying on behalf of Joint Intervenors in this proceeding?

A. In addition to my testimony, Joint Intervenors are offering testimony from three witnesses:

- Jim Grevatt's testimony considers the reasonableness of the Companies in development of the proposed 2024–2030 Demand-Side Management and Energy Efficiency Program Plan ("DSM/EE Plan"), and demonstrates that increased levels of energy efficiency and demand response are achievable and in the best interests of the Companies' customers.

- John Wilson's testimony evaluates the Companies' proposed retirement of seven fossil-fired electric generating units, namely E.W. Brown Unit 3, Ghent Unit 2, Haefling Units 1 and 2, Mill Creek Units 1 and 2, and Paddy's Run Unit 12.
- Anna Sommer's testimony discusses and provides perspective on the Companies modeling in support of the proposed Certificates of Public Convenience and Necessity, including a survey of mistakes, conservatisms, and limitations of the Companies' modeling exercises.

Q. Can you summarize the Joint Intervenors' recommendations in this proceeding?

A. Yes, Joint Intervenors offer the following recommendations in this proceeding:

1. Modify and approve an expanded portfolio of DSM/EE, as recommended by Witness Grevatt.
2. Direct the Companies to seriously encourage customer-sited resources, as I will discuss in my own testimony.
3. Approve the requested CPCNs for the Mercer County Solar Facility, Marion County Solar Facility, and Brown Battery Electric Storage System; ***and*** encourage the Companies to immediately (a) evaluate potential to increase the size or number of storage units and (b) evaluate potential for hybrid solar and storage resources to cost-effectively meet system needs.
4. Approve the proposed fossil-fired unit retirements for each of Mill Creek Units 1 and 2, Haefling Units 1 and 2, Paddy's Run 12, E.W. Brown Unit 3, and Ghent Unit 2.
5. Deny the requested CPCNs for the proposed Mill Creek natural gas combined cycle

("NGCC") unit and the proposed E.W. Brown NGCC unit.

Q. How do you square the final two recommendations in particular?

A. Well, to some extent, that is a legal question outside my area of expertise. More practically, all year, representatives of each organization participating here as the Joint Intervenors, our counsel, and our expert witnesses have been engaged in considering the Companies' evidence and argument in support of their proposal. Ultimately, Joint Intervenors were not persuaded that the Companies' proposed course is adequately supported, and not persuaded that the Companies' proposed course can be trusted to reliably and durably serve customers' needs at reasonable direct and indirect costs. That is not a conclusion we reached lightly, in part out of recognition that the introduction of Senate Bill 4 does confuse what had been a more technology-neutral standard for utility resource planning in Kentucky; and in part because we appreciate that the Companies do face a practical challenge. We cannot disagree when the Companies say there is precious little time left to take action here. For that reason, Joint Intervenors continue to encourage immediate and robust analyses from the Companies. Joint Intervenors also look forward to reconsidering as the development of the technical record continues in this proceeding. We cannot, however, go back in time to correct all the inadequacies and blind spots we find in the Companies' originally filed analysis; and we have not the time, resources, or capacity as intervening public interest organizations to re-do all the necessary analyses from the ground up.

Based on the information available and analyses we could do, Joint Intervenors reached some conclusions. Joint Intervenors are convinced that there is every reason to aggressively pursue cost-effective DSM/EE programs. Surely, public utilities in this

Commonwealth can deploy these programs at least as well as average utility performers consistently manage to do in other states. Joint Intervenors support an accelerated transition to clean, renewable, and distributed resources for LG&E/KU and their customers and remain convinced that there are untapped solutions and unexamined alternatives that could diminish stranded asset risks, along with climate- and health-harming emissions. Joint Intervenors remain convinced that the economic advantage of retiring the fossil units at issue in this proceeding has been repeatedly shown in recent years, persists today, and will remain so over the long-term. And Joint Intervenors worry that LG&E/KU are neglecting real and substantial stranded asset risk and regulatory risk with their billion-dollar proposal for two new gas plants.

III. DISTRIBUTION SOLAR GENERATION

Q. How do the Companies treat distributed solar generation in the load forecast for this Certificate of Public Convenience and Necessity ("CPCN") Application?

A. In the load forecast for the 2022 CPCN application, the Companies estimated how much distributed solar generation would be installed annually and the impact that would have on total load requirements.[1] The Companies state:

> distributed generation capacity and customers grow rapidly through mid-2026 when net metering-eligible capacity reaches 1% of the Companies' peak load. Growth continues at a more moderate pace thereafter, reaching 87 MW by 2028 and almost 185 MW by 2052 . . . including the impact of all qualifying facilities ("QFs")

[1] *In re Electronic Joint Application of Kentucky Utilities Company and Louisville Gas and Electric Company for Certificates of Public Convenience and Necessity and Site Compatibility Certificates and Approval of a Demand Side Management Plan*, Case No. 2022-00402, Direct Testimony of Tim A. Jones, Exhibit TAJ-1, at 6–7 (p.40 of pdf) (Dec. 15, 2022) ("Jones Direct").

> raises the total of all forecasted distributed generation to about 100 MW by 2028 and over 200 MW by 2052.[2]

A critical assumption in this load forecast is that the Companies will cease offering net metering after installed net metering ("NM") capacity reaches 1% of their annual peak load. The growth rate of distributed solar drops significantly after this point because all future solar customers would be treated as Qualifying Facilities and offered substantially reduced compensation for energy they supply back to the grid.[3]

Q. Are the Companies required by law to stop offering net metering after NM installed capacity reaches 1% of their previous year's peak load?

A. No. Kentucky's net metering statute, as amended in 2019, *allows* utilities to stop offering net metering after reaching 1% of their annual peak load, but *does not require* them to stop. KRS 278.466(1) states:

> Each retail electric supplier shall make net metering available to any eligible customer-generator that the supplier currently serves or solicits for service. If the cumulative generating capacity of net metering systems reaches one percent (1%)of a supplier's single hour peak load during a calendar year, the supplier shall have no further obligation to offer net metering to any new customer-generator at any subsequent time.[4]

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[2] *Id.* at 7.

[3] Qualifying Facilities ("QF") are cogeneration or power production facilities with capacity no more than eighty megawatts, which are powered at least seventy-five percent by biomass, waste, or renewable resources. Electric utilities are obligated to purchase energy and capacity from QF's under tariffs approved by the Kentucky PSC. Net metering enables eligible generators, such as solar PV systems up to 45 KW capacity, to receive net metering service ("NMS") rather than QF service. The LGE&KU purchase price for generation from QF's is about $0.04/kWh while NMS-2 compensation credits for excess generation are about $0.07/kWh. 807 KAR 5:054; Louisville Gas & Electric, *Rates, Terms, and Conditions for Furnishing Electric Service* (effective July 1, 2021), https://psc.ky.gov/tariffs/Electric/Louisville%20Gas%20and%20Electric%20Company/Tariff.pdf; Kentucky Utilities Company, *Rates, Terms, and Conditions for Furnishing Electric Service* (effective July 1, 2021), https://psc.ky.gov/tariffs/Electric/Kentucky%20Utilities%20Company/Tariff.pdf.

[4] KRS 278.466(1).

While the Companies are not obligated to offer net metering to new customers beyond 1%, they are not prohibited from doing so. If allowing distributed solar to grow beyond 1% is found to be in their customers' and the Companies' best interest, the Companies have the opportunity to do so. In both their 2021 Integrated Resource Plan ("IRP")[5] and the 2022 CPCN Application, the Companies have assumed they would choose to stop offering net metering upon reaching the 1% threshold. As my testimony demonstrates, this choice would prevent the Companies from accessing hundreds of MW of low-cost solar power over the next decade, which would provide significant load reductions and peak demand savings at minimal capital outlay to the utilities.

Q. Is distributed solar generation a low-cost resource for the Companies?

A. Yes. Like energy efficiency measures that customers install at their own expense, net metered solar energy systems are installed by customers using their own financial resources. Customer-generators are responsible for all capital, operating, and maintenance expenses for these systems throughout their operational life, and bear the risk for these investments, not the utility, nor other ratepayers. This contrasts with the supply resources the Companies are proposing to develop in this CPCN proceeding, for which the Companies (and ultimately the ratepayers) would be financially responsible, either through ownership (incurring the costs of capital and long-term operations and maintenance) or through long-term power purchase agreements with third-party developers.

Following changes to Kentucky's net metering statute in 2019, utilities now have a

[5] 2021 IRP, Electronic 2021 Joint Integrated Resource Plan of Louisville Gas and Electric Company and Kentucky Utilities Company, Case No. 2021-00393 (Oct. 19, 2021) ("2021 IRP").

mechanism for recovering their costs to serve net metering customers through the ratemaking process.

> Using the ratemaking process provided by this chapter, each retail electric supplier shall be entitled to implement rates to recover from its eligible customer-generators all costs necessary to serve its eligible customer-generators, including but not limited to fixed and demand-based costs, without regard for the rate structure for customers who are not eligible customer-generators.[6]

In Case No. 2020-00174, the Commission established the principles and a methodology for utilities to use in setting rates to recover their costs to serve eligible customer-generators. This avoided cost methodology factors in the costs and benefits associated with net metering based on the following avoided cost components: Energy, Ancillary Services, Generation Capacity, Transmission Capacity, Distribution Capacity, Carbon Cost, Environmental Compliance Cost, and Job Benefits.[7]

In their most recent rate cases, 2020-00349 and 2020-00350, the Companies established new NMS-2 rates following these changes in statute and the Commission's Orders.[8] As a result, NMS-2 customers now receive reduced compensatory credit for excess solar energy supplied back to the utility. As such, the Companies now have a net metering structure which provides for the recovery of their costs and ensures no cross-subsidization by non-participating ratepayers. Furthermore, in the future as customer

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[6] KRS 278.466(5).

[7] Ky. PSC, Electronic Application of Kentucky Power Company for (1) A General Adjustment of Its Rates for Electric Service; (2) Approval of Tariffs and Riders; (3) Approval of Accounting Practices to Establish Regulatory Assets and Liabilities; (4) Approval of a Certificate of Public Convenience and Necessity; and (5) All Other Required Approvals and Relief, Case No. 2020-00174, Final Order at 25 (May 14, 2021).

[8] Ky. PSC, Electronic Application of Kentucky Utilities Company for an Adjustment of Its Electric Rates, a Certificate of Public Convenience and Necessity to Deploy Advanced Metering Infrastructure, Approval of Certain Regulatory and Accounting Treatments, And Establishment of a One-Year Surcredit, Case Nos. 2020-00349 and 2020-00350, Final Order (Sept. 24, 2021).

adoption of net metering expands, the Companies will have the ability to return to the Commission to request adjustments to their customer charges and to propose adjustments to net metering rates, maintaining net metering as a low-cost resource.

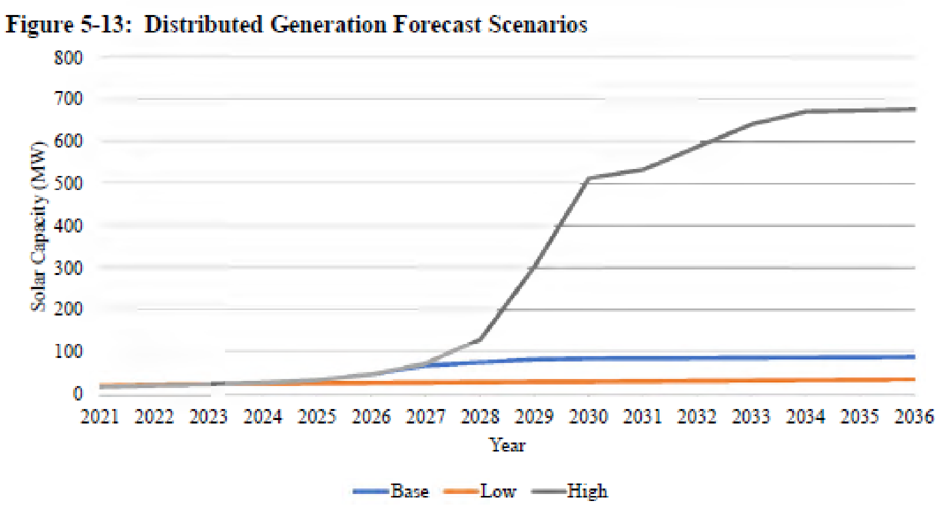
Q. What is the potential growth of distributed solar generation if the Companies allow net metering to continue beyond the 1% threshold?

A. The Companies have made three recent forecasts of the growth of distributed solar generation on their system – in the Load Forecast for the 2022 CPCN Application,[9] in their 2021 IRP,[10] and in this case in response to a question from the Joint Intervenors.[11] In the 2021 IRP, the Companies' Base Scenario assumes minimal new solar installations after the 1% limit is reached and forecasts total distributed solar capacity will remain under 100 MW through 2036.[12] The 2022 CPCN Forecast also imposes the 1% limit but sees solar growing slightly more, to about 125 MW by 2036.

The 2021 IRP also presented a High Scenario which assumed a new federal law requiring utilities to eliminate the 1% limit. Under the IRP High Scenario, distributed solar capacity grows to 690 MW by 2036.[13] Figure 1 reproduces the IRP's Distributed Generation Forecast Scenarios.[14]

[9] Jones Direct, Exhibit TAJ-1 at 7.
[10] LGE & KU IRP 2021, Volume 1, at 5-29.
[11] Response of Kentucky Utilities Company & Louisville Gas & Electric Company to Joint Intervenors' First Supplemental Discovery Requests, Question 83 (May 4, 2023) ("LGE & KU Response to JI First Supplemental Q").
[12] 2021 IRP, Vol. 1, at 5-29.
[13] LGE & KU IRP 2021, Volume 1, at 5-29.
[14] *Id.*

Figure 1 – IRP Distributed Generation Forecast Scenarios



In response to a data request from the Joint Intervenors in the present case, the Companies provided another forecast of distributed solar generation in the absence of the 1% limit. In this "No Cap" scenario they forecast solar growing to 269 MW by 2036,[15] less than half of their IRP High Scenario projection, yet still more than double the scenarios where the cap is imposed. In their response, the Companies stated that "instead of changing the customer growth rate when the 1% cap is hit, this alternate NMS-2 scenario continues to grow at what was the near-term rate for the duration of the forecast period."[16] This presumably explains why this new forecast was so much lower than the IRP's High Scenario.

However, a review of the Companies' historic net metering customer data shows the more recent "No Cap" forecast did not use the "near-term rate" for net metering growth. Actual NM solar capacity grew at an average annual rate of 57% from 2010–2022 and 63% from 2021–2022, but the Companies' "No Cap" Scenario used an average annual

[15] LGE & KU Response to JI First Supplemental Q83.
[16] Id.

rate of only 17% from 2023–2036. No explanation is offered as to why customer solar adoption would suddenly slow down beginning in 2023.

Q. How much distributed solar generation could be installed by 2036 if solar continued to grow at the same historic rate seen from 2010–2022?

A. Figure 2 provides a graph forecasting distributed solar growth under four scenarios:

Scenario A – CPCN Base Forecast, LGE & KU 2022

Scenario B – IRP High Scenario (No Cap), LGE & KU 2021

Scenario C – CPCN "No Cap" Forecast, LGE & KU, provided in response to LGE & KU Response to JI First Supplemental Q83

Scenario D – Continuing Historic Growth with No Cap

Figure 2 – Distributed Solar Generation Forecast Scenarios[17]

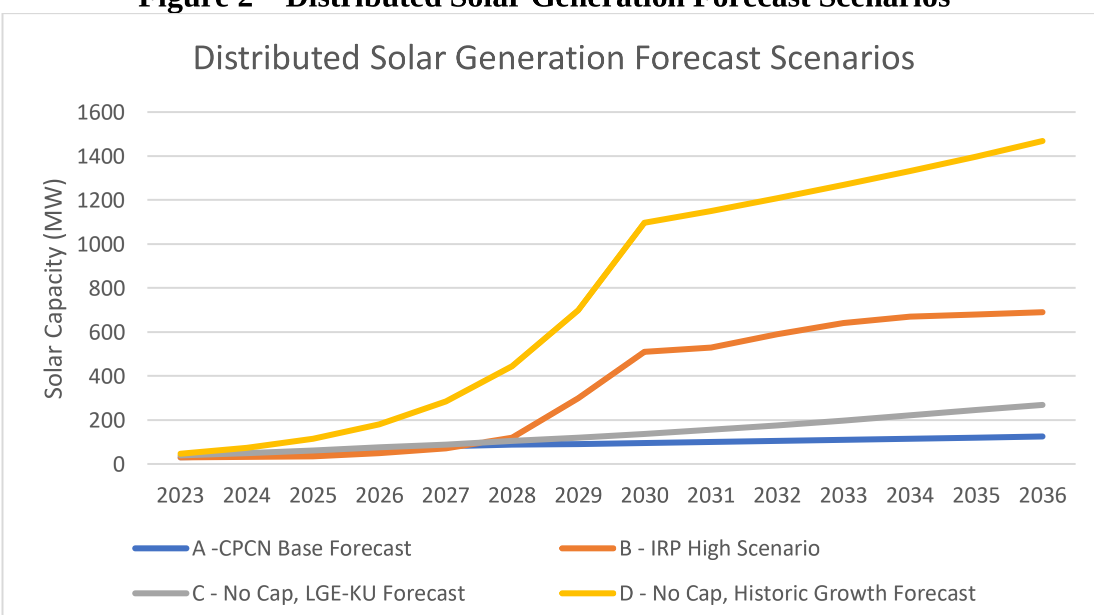


Figure 2 illustrates that there is enormous potential for distributed solar to grow into a substantial component of the Companies' resource supply, if the Companies determine to

[17] Figure 2 prepared by the author using data from the 2021 IRP at 5-29 and CPCN filing.

continue to offer NMS beyond the arbitrary permissive limit of the 1% cap. If allowed to grow unimpeded at recent rates, distributed solar capacity could reach 445 MW by 2028, and supply 560,000 MWh/yr. This level of energy savings would place distributed solar on par with all efficiency and DSM savings expected in the Companies' load forecast (510,000 MWh in load reductions due to DSM-EE in 2028).[18] Under the slower growth rates of the IRP High Scenario, distributed solar would reach 510 MW in 2030 and supply about 642,600 MWh/year.

Table 1 – Distributed Solar Capacity (MW) and Energy Generation (MWH/yr) Potential in 2028 & 2030 [19]

	2028			2030		
	MW	MWH/yr	% Annual Peak Load	MW	MWH/yr	% Annual Peak Load
B- IRP High Scenario	120	151,200	1.9%	510	642,600	8.0%
D – Historic Growth Scenario	445	560,149	7.0%	1096	1,380,710	17.3%

These forecasts demonstrate that distributed solar is a potentially significant resource capable of substantially reducing customer loads and the Companies' need for new generation capacity.

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[18] Figure 4, Jones Direct, Exhibit TAJ-1 at 6.

[19] Estimates of annual energy generation are based on *NREL 2023 Annual Technology Baseline v1*, which estimates the annual energy production for residential PV systems in regions throughout the United States. PV systems in Kentucky (Class 7) are expected to produce 1266 kWh/kW per year (averaging annual figures for 2024 – 2030). LGE & KU's Annual Peak Load in Summer 2027 is projected to be 6347 MW. Direct Testimony of Tim A. Jones, *In re Electronic Joint Application of Kentucky Utilities Company and Louisville Gas and Electric Company for Certificates of Public Convenience and Necessity and Site Compatibility Certificates and Approval of a Demand Side Management Plan*, Case No. 2022-00402, at 7 (Dec. 15, 2022) ("Jones Direct").

Q. How do these solar growth rates compare to the experience in other states that have more advanced solar markets?

A The possibility for distributed solar to grow until it reaches 500–1000 MW by 2030 is feasible when one considers the experience of numerous other smaller states with electricity customer numbers on par with the Companies' customer base. Kentucky ranks 39th in installed capacity of small-scale solar (solar photovoltaic technology ("PV") systems under 1 MW),[20] with a still-immature solar market. This means there is enormous room for growth simply to catch up to other states. Table 2 lists the installed small-scale solar capacity in 10 smaller states and Washington, DC, along with the total electric customers and installed KW per customer in each state.

- Despite having fewer electric customers than LGE & KU, Maine and Rhode Island each have nearly thirteen times as much distributed solar as LGE & KU.
- Hawaii has twenty-seven times as much distributed solar and fifty-one times as much solar capacity per customer.
- If LGE & KU had as much distributed solar per customer as Rhode Island, the Companies would have 733 MW of solar.

[20] Energy Information Administration, Form EIA-861M (formerly Form EIA-826), from https://www.eia.gov/electricity/data/eia861m/ (last updated June 28, 2023 for Apr. 2023).

Table 2 – Small-Scale PV Capacity in Selected Smaller States and LGE & KU – April 2023[21]

State	Residential MW	Commercial MW	Industrial MW	Total MW	Electric Customers Total	KW PV/customer
Hawaii	513	280	2	795	504,287	1.577
Rhode Island	113	269	5	386	508,062	0.760
Maine	70	312	0	381	822,840	0.464
Vermont	108	60	1	169	380,095	0.445
DC	79	45	-	124	325,124	0.380
Utah	405	74	7	486	1,326,298	0.367
New Mexico	267	71	1	339	1,070,078	0.317
New Hampshire	122	70	8	200	751,450	0.266
Delaware	92	21	-	121	512,975	0.236
Idaho	111	8	17	136	952,718	0.142
LGE & KU				30	964,475	0.031

EIA defines "small scale PV" as net metered and non-net metered solar PV systems less than 1 megawatt in size (AC capacity).

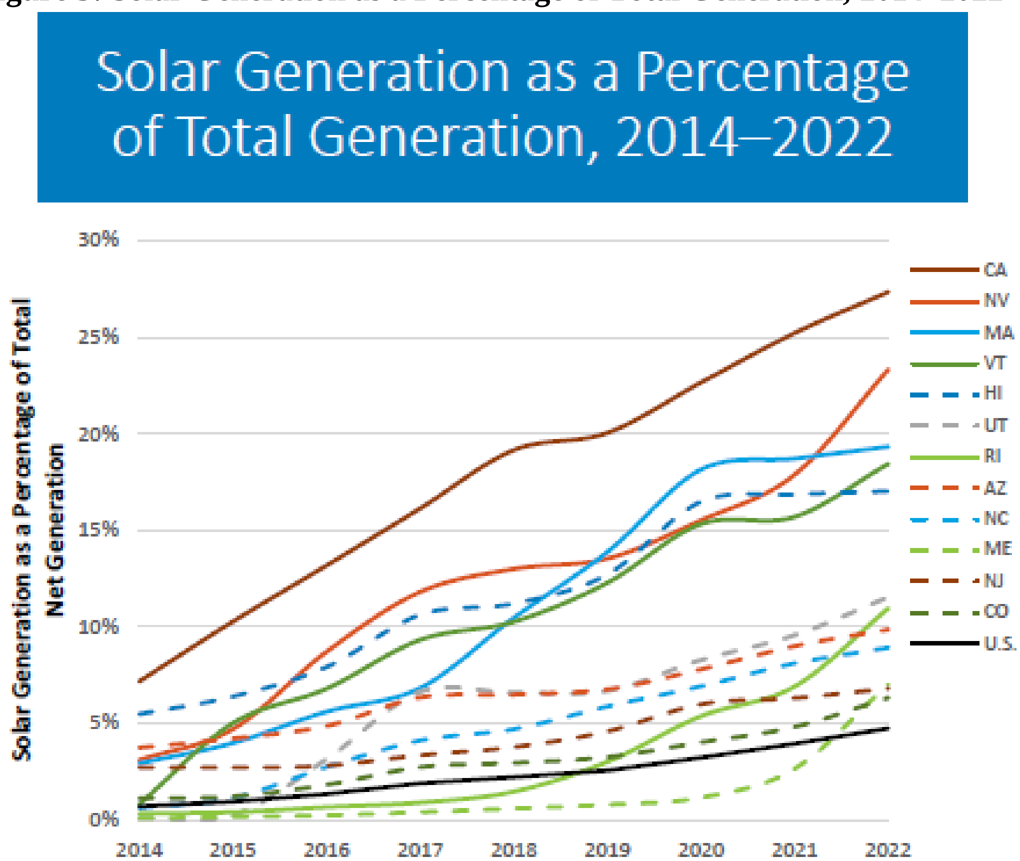
Q. Is a 1% limit on net metering needed to protect the utility grid?

A. No. The 1% threshold was established when Kentucky's net metering law was established in 2003. In the original version of the statute, utilities were given the right to request permission from the PSC to cease offering net metering service after reaching 1% of their annual peak demand. At that time, net metering was still fairly new and the solar PV industry as a whole was in its infancy. The 1% threshold was included as a safety measure while utilities and the electricity industry learned how to incorporate distributed resources into the grid. Twenty years later, the solar PV industry is established as the fastest growing new energy resource in the world. Extensive real-world experience has

[21] Data sources: U.S. Energy Information Administration, *Estimated Small-scale Solar PV Capacity and Generation: Current Month*, Form EIA-861M (formerly Form EIA-826) (Apr. 2023), downloadable from https://www.eia.gov/electricity/data/eia861m/; *Sales to Ultimate Customers: Year, 2023 (April)* Utility customer data: https://www.eia.gov/electricity/data.php#sales. LGE & KU Customer Data from U.S. Energy Information Administration, Forms EIA 861– Schedules 4A & 4D and EIA-861S (2021), https://www.eia.gov/electricity/sales_revenue_price/pdf/table10.pdf.

demonstrated that grid penetrations of solar much higher than 1% can be handled safely and effectively. Figure 3 shows solar generation as a percentage of total generation in the twelve leading states plus the United States as a whole. Solar generation ranges from 6%–28% among these states and the United States as a whole is at 5%.[22] While this data includes utility-scale and distributed solar, it demonstrates that our utility grids can manage large percentages of variable solar generation.

Figure 3: Solar Generation as a Percentage of Total Generation, 2014–2022



Source: Spring 2023 Solar Industry Update (slideshow), David Feldman, NREL, Krysta Dummit, BGS Contractor for SETO, Jarett Zuboy, NREL, Robert Margolis, NREL, April 27, 2023.

[22] David Feldman et al., *Spring 2023 Solar Industry Update*, NREL, at 37 (Apr. 27, 2023), https://www.nrel.gov/docs/fy23osti/86215.pdf.

Q. Is a 1% limit on net metering needed to prevent cost-shifting and cross-subsidization of customer-generators?

A. No. Another rationale utilities have offered to justify imposing a 1% cap on net metering is to prevent cross-subsidization between non-customer-generators and net metering customers. While there are many weaknesses to these claims, this has been a common argument utilities have made for imposing various limits on net metering.[23] However, the question of cross-subsidization for the Companies has been resolved through the ratemaking process that established the Companies' NMS-2 rates. As was discussed earlier in my testimony, the Commission's approval of the Companies' NMS-2 rates has provided the Companies with cost-recovery for serving their net metering customers, so that any question of possible rate impacts on non-participating ratepayers within a class has been resolved. Therefore, allowing net metering to continue to higher capacities beyond 1% should have no cost-shifting implications. In the future as PV installations increase, if the Companies believe this is leading to changing cost impacts, they can apply to the Commission to adjust their net metering rates, using the ratemaking process that produced the current NMS-2 rates, consistent with the legacy protections for NMS-2 customers with respect to rate structure.

[23] Ky. PSC, *In re Electronic Application of Kentucky Power Company or (1) A General Adjustment of Its Rates for Electric Service; (2) Approval of Tariffs and Riders; (3) Approval of Accounting Practices to Establish Regulatory Assets and Liabilities; (4) Approval of a Certificate of Public Convenience and Necessity; and (5) All Other Required Approvals And Relief*, Case No. 2020-00174, Direct Testimony of Andrew McDonald, at 5–9 (Oct. 7, 2020); Ky PSC, Karl Rábago, *Consideration of the Implementation of the Net Metering Act*, Public Comments on KY PSC Implementation of KY GA SB 100 – Net Metering Act of 2019 on behalf of Kentuckians for the Commonwealth (KFTC) and Mountain Association for Community Economic Development (MACED), Case no. 2019- 00256 (Nov. 13, 2019).

Q. Are there policies the Commission and Companies could use to support and drive the growth of distributed solar resources?

A. There are several policies the Commission and Companies should implement to support the ongoing growth of distributed solar generation.

1. The Companies could eliminate the 1% limit on net metering as an official Company policy. This will signal to the solar industry and investors that there will continue to be a strong market for distributed solar in LGE & KU's territories.
2. Allow and encourage third-party ownership of distributed solar systems (e.g. solar leases and power purchase agreements) to expand access for residential, commercial, and industrial customers.
3. Allow and encourage Virtual Net Metering to expand access to solar, especially for residents of multi-family housing.
4. Focus on equity and access to low- and moderate-income ("LMI") customers with policies to reduce up-front costs and finance expenses (e.g., on-bill financing).
5. Collaborate with community partners on education, consumer protection, and workforce development programs.

Q. How would third-party ownership support the growth of distributed solar generation?

A. One of the primary barriers to solar adoption is the high up-front cost for installing PV systems. Solar leases and power purchase agreements ("PPAs") address this barrier by eliminating the up-front cost and, instead, enable the customer to gradually pay for the installation over time. "Under a solar lease arrangement, a homeowner enters into a service contract to pay scheduled, pre-determined payments to a solar leasing company, which installs and owns the solar system on the homeowner's property."[24] With a solar PPA, the customer contracts with a developer that installs, owns, and operates the solar system on the customer's property. The customer purchases all the energy produced by the solar array at a specified rate per kWh, potentially lower than the local utilities' kWh rate. Solar leases and PPAs can be structured so that the customer achieves immediate and ongoing savings on their utility bills, with no up-front cost.

Enabling third-party ownership would increase access to distributed solar for commercial, industrial, and institutional customers, such as public schools, universities, churches, government facilities, and other non-profit organizations. In states where solar PPAs are allowed, "[r]etail solar PPAs are often the model of choice for local government solar projects."[25] Measures that expand solar access for non-residential customers would support a goal of attaining 500–1000 MW of distributed solar by 2030. This would help to expand the solar market for the vast number of commercial and institutional roofs, in addition to ground mount structures in locations such as parking lots. As shown in Table 2, above, commercial-scale solar represents a large share of the solar market in many states with higher solar penetrations (e.g., 21% in New Mexico, 35% in Hawaii, and 82% in Maine).

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[24] Nate Hausman, *A Homeowner's Guide to Solar Financing: Leases, Loans, and PPAs,* Clean Energy States Alliance, at 4 (updated Nov. 2018), https://www.cesa.org/wp-content/uploads/Homeowners-Guide-to-Solar-Financing.pdf.

[25] IREC, *SOLAR POWER PURCHASE AGREEMENTS: A Toolkit for Local Governments*, at 3-1 (Mar.2015), https://irecusa.org/wp-content/uploads/2021/07/Solar-Power-PPA-Toolkit_FINAL_041015.pdf.

As of 2018, forty percent of residential solar systems in the United States were installed using third-party ownership.[26] However, these financing mechanisms are not generally available in Kentucky due to ambiguities in state regulations and statute. If the Commission could resolve these ambiguities and establish that third-party ownership is permissible in Kentucky, a major barrier to the distributed solar market would be removed. This would not only expand the solar market, but would make solar much more accessible to low- and moderate-income customers.

Q. What is virtual net metering?

A. Virtual net metering is a utility rate structure that allows the credits from a single solar array to be allocated to multiple customers' accounts. For example, in a multi-family apartment building, virtual net metering would allow the solar energy from a rooftop array to be credited to individual tenant's accounts, in proportion to their contractual share of the solar array. Each participating tenant would receive credits on their utility bill just as they would in a traditional net metering arrangement. There are variations to how virtual net metering programs can be structured. For example, a program may require participants to live in the building where the solar array is located. Alternately, the utility may allow a solar array to be shared among any mix of its customers regardless of their location, so long as the array is on the utilities' distribution system and all participants are their customers. Virtual net metering is another means of expanding access to solar to renters and the many people who live in multi-family housing.

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[26] *Id.*

Q. How would these policies work together to increase equity and access to solar for low- and moderate-income populations?

A Low-income customers face numerous barriers when it comes to accessing the benefits of solar energy. This includes the high up-front cost of installation, lack of access to capital and low-cost financing, low credit ratings, the fact that many low-income customers are renters, and many live in multi-family housing. In a report for the Public Service Commission of Wisconsin, Cadmus identified key policies for expanding the rooftop solar market and increasing access for low-income customers.[27] Those policies included:

> **Third-party ownership** – removes the up-front cost barrier and provides immediate utility bill savings.
>
> **Virtual net metering** – makes net metering available to tenants in multi-family housing and can be combined with third-party ownership.
>
> **Provide incentives for low-income customers to cover up-front costs, as well as home-readiness improvements.** Cadmus recommends the use of financial incentives, such as rebates, to assist low-income customers with the up-front cost of solar. Additionally, many low income homes require energy efficiency investments and structural improvements (e.g., roof repair or replacement) prior to installing solar. Cadmus recommends that solar programs aimed at serving low-income customers should offer incentives for home-readiness improvements, in addition to incentives for solar installation costs.

Financial incentives for low-income customers to install solar are already being offered to the Companies' customers in Lexington and Louisville, thus, the Companies would not be on their own in offering programs to support solar development. Both Lexington and

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[27] Jeremy Eckstein et al., *Focus on Energy 2021 Rooftop Solar Potential Study Report*, Cadmus, at 8 (Oct. 4, 2021), https://apps.psc.wi.gov/ERF/ERFview/viewdoc.aspx?docid=421984.

Louisville are sponsoring "Solarize" campaigns, in partnership with the Kentucky Solar Energy Society, to encourage residents to install solar on their properties.[28] These programs provide discounted solar installations with pre-selected, rigorously vetted contractors. In each city, rebates are available to assist low-income customers to participate in the program. Lexington Fayette Urban County Government ("LFUCG") has allocated $1 million to their Solarize Lexington rebate program, while Louisville Metro government has allocated more than $100,000.[29]

Q. What role could on-bill financing play in expanding access and deployment of solar energy systems?

A. On-bill financing (i.e., "Pay As You Save" or "Inclusive Utility Investments") programs offer another avenue for making solar more accessible for customers. Through on-bill financing, the up-front cost of the installation is covered by the utility and paid back over time via a charge on the utility bill. Payments can be structured to provide immediate and ongoing utility bill savings for the customer. The charge for the solar investment remains with the meter until it is paid off, rather than with the customer, which makes the program available to renters. If a customer moves away and closes their account, the next

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[28] *See Solarize*, Kentucky Solar Energy Society, www.kyses.org/solarize (last visited July 8, 2023); *Solarize Lexington*, Lexington Kentucky, https://www.lexingtonky.gov/solarize-lexington (last visited July 8, 2023); and *Solar Over Louisville*, Louisville Sustainability Council, https://www.louisvillesustainabilitycouncil.org/solaroverlouisville, (last visited July 8, 2023). Frankfort also hosts a Solarize Campaign in 2023, but does not have rebates available for participants.

[29] Aaron Mudd, *Lexington launches program to encourage solar power. Who qualifies for discounts, grants*, Lexington Herald Reader (Mar. 20, 2023), https://news.yahoo.com/lexington-launches-program-encourage-solar-100000321.html; Roberto Roldan, *Citing Success, Louisville Plans to Sign up more residents for solar*, Louisville Public Media (Dec. 26, 2022), https://www.lpm.org/news/2022-12-26/citing-success-louisville-plans-to-sign-up-more-residents-for-solar.

resident becomes responsible for paying the solar charge on the bill (and receives the benefit of the solar savings, too).

On-bill financing has been used for energy efficiency improvements by electric utilities in multiple states, including Kentucky, and could readily be expanded to include solar PV. On-bill financing should be of particular interest to the Companies because it provides an opportunity to earn a return on investments from power supplies located on their customers' properties. While the Companies plan to build multi-MW solar facilities in large central locations, they could also be investing in distributed solar plants on their customers' homes.

> Tariffed on-bill programs treat improvements to the energy performance of homes and buildings as an investment in system reliability and as a development of lower cost distributed energy resources, such as energy efficiency. The utility employs its established authority to make investments and seek cost recovery through tariffs using existing mechanisms for issuing bills and collecting revenue. The investment in energy savings is tied not to an individual customer but to the location until the value of the utility's investment is recovered. A tariffed investment does not add to the debt profile of the location owner the way a bank loan would. A notable benefit of this model is that it can be utilized by renters and LMI customers, especially those with limited credit or low credit scores, because the utility's investment is based on the cost effectiveness of the upgrades and not the socio-economic status of the billpayer at that location. . . . Customers, vendors, and capital providers using the PAYS system have produced an unprecedented rate of resource efficiency investment while also improving options for low cost, local, clean energy resources. PAYS is the most widely used form of tariffed on-bill programs for energy efficiency. [30]

[30] *Utility Guide to Tariffed On-Bill Programs*, Southeast Energy Efficiency Alliance, at 3 (Wesley Holmes et al., eds., Feb. 2020), https://www.seealliance.org/wp-content/uploads/SEEA_TOBGuide_FINAL_UPDATED_2020_04_13.pdf.

Q. How can the Companies collaborate with community partners to support the solar market?

A. There is strong support for distributed solar generation in the communities served by the Companies, as evidenced by the aforementioned Solarize campaigns in Lexington, Louisville, and Frankfort. The Companies should leverage this community support and collaborate with partners in the non-profit, private, and public sectors to drive sustained growth in the solar market. Specific areas that the Companies and community partners can work on would include public education, consumer protection, permitting and codes, and workforce development.

Q. Are you suggesting that a comprehensive set of policies could drive the growth of distributed solar as a major resource for meeting customers' energy needs?

A Yes. It is a testament to the value of net metering as an enabling policy that distributed solar has grown at an average annual rate of 57% over the past twelve years, despite the lack of other policy support or incentives from the state or utilities. I invite the Commission and Companies to recognize that distributed solar is a valuable, low-cost resource that brings benefits to the utilities and their customers, and which could grow to become a very important element of their resource portfolio. The Companies could and should play a proactive role in the expansion of distributed solar generation.

IV. CUSTOMER-SITED BATTERY STORAGE SYSTEMS

Q. What role can battery storage play as a distributed energy resource?

A. Customer-sited battery storage can play a significant role as a demand response resource. As stated in the *Pennsylvania Energy Storage Assessment* (2021), "Energy storage deployment has grown rapidly across the United States over the last decade and can address many priorities and challenges currently facing the energy sector. Energy storage can help integrate increasing levels of renewable energy into the grid and reduce the environmental impacts of electricity production. Additionally, energy storage can improve the resilience of the electrical grid, ensure reliable service, and decrease costs to ratepayers."[31] Utilities in multiple states are now integrating customer-sited batteries into "Virtual Power Plants" that can be remotely discharged by the utilities as a DR resource to reduce peak loads.[32]

Q. Can you point to states where utilities are using customer-sited batteries as a demand response resource?

A. As shown in Figure 4, as of 2021, at least eleven states had programs to incentivize customer battery storage systems: California, Connecticut, Florida, Maine, Maryland, Massachusetts, New Hampshire, New York, Oregon, Rhode Island, and Vermont.[33] Maine added its battery storage program after publication of the Program Assessment for Massachusetts.[34]

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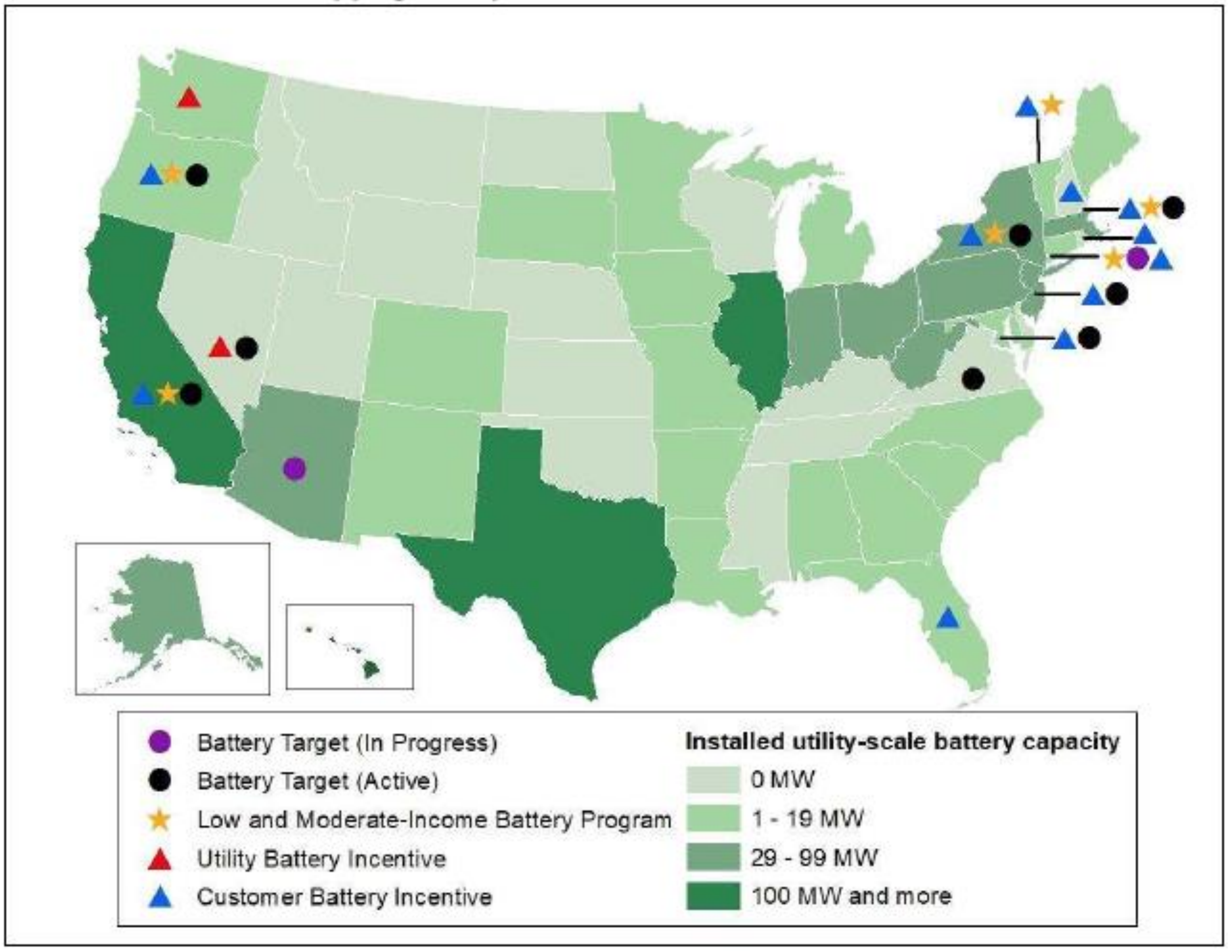
[31] Stratagen, *Pennsylvania Energy Storage Assessment: Status, Barriers, and Opportunities*, at 1 (Apr. 2021), https://files.dep.state.pa.us/Energy/Office%20of%20Energy%20and%20Technology/OETDPortalFiles/EnergyAssurance/Strategen_PA_Energy_Storage_Assessment_April_2021.pdf.

[32] Bryndis Wood et al., ConnectedSolutions: A Program Assessment for Massachusetts, Applied Econ. Clinic, at 5, 26 (Sept. 2021), *https://www.cleanegroup.org/wp-content/uploads/ConnectedSolutions-An-Assessment-for-Massachusetts.pdf* ("Mass. Program Assessment").

[33] *Id.* at 26 (Figure 4, reproduced here).

[34] Energy and Environmental Economics, *Maine Energy Storage Market Assessment*, Maine Governor's Energy Office, at 7 (Mar. 2022), https://www.maine.gov/energy/sites/maine.gov.energy/files/inline-files/GEO_State%20of%20Maine%20Energy%20Storage%20Market%20Assessment_March%202022.pdf.

Figure 4 – 2019 installed utility-scale battery storage, battery storage targets, battery incentives, and low- and moderate-income battery programs by US state



All six New England states offer customer battery incentive programs. Although specific program details vary in each state, they share three common features:[35]

1. All programs offer participating customers performance payments through contracts with their electric utility, based on the utilities' ability to discharge the batteries during peak times. Some also provide up-front incentives such as rebates or low-cost financing.

[35] Mass. Program Assessment at 5.

2. All programs are deployed as “virtual power plants – that is, a system of aggregated distributed battery resources that can be dispatched by the utility in concert during peak demand hours to lower costs associated with serving regional demand peaks.”[36]
3. All New England programs support customer resilience, enabling customers to use the batteries for back-up power during grid outages.

Q. What are some examples from specific states?

A. The following examples discuss customer-sited battery storage programs in Massachusetts, Connecticut, and Vermont.

Massachusetts ConnectedSolutions

The Massachusetts ConnectedSolutions program offers a DR program utilizing customer-sited batteries. The program offers electricity customers incentives to allow their utility to discharge their customer-owned (or leased) batteries.[37] Participating customers receive an up-front incentive when they install their battery, and performance payments when the utilities discharge the battery during peak periods. The ConnectedSolutions program operated as a pilot from 2016–2019, after which it was fully deployed. As of 2020, the program had 1,105 commercial and industrial participants with a total of 286 MW of battery capacity, and 844 residential participants with a total of 2.8 MW of battery capacity.[38]

Connecticut Energy Storage Solutions Program

In January 2022, Connecticut launched the Energy Storage Solutions program, a customer-sited battery DR program available to residential, commercial, and industrial

[36] *Id.*
[37] *Id.* at 8.
[38] *Id.*, Table 5 at 9, Table 7 at 21.

customers.[39] The state's goal is to install 1,000 MW of battery storage by year-end 2030.[40] The program provides an online dashboard for reporting data about participating projects, with information including numbers of participants, battery capacity (kW), battery energy storage (kWh), battery costs, program incentives, and demographics about participants (e.g., the number of small businesses, the number of low- to moderate-income projects).[41] As of July 13, 2023, there were 36 commercial and industrial customer participants totaling 76 MW of battery capacity (204,186 kWh storage) and 194 residential customers totaling 1.562 MW of battery capacity (3578 kWh storage).[42]

Green Mountain Power, Vermont

Green Mountain Power ("GMP") in Vermont offers a home battery program with a number of options for customers. The bring your own device ("BYOD") program provides up-front rebates to customers who buy their own batteries.[43] With the Powerwall and Enphase programs, customers lease the batteries from GMP through monthly payments or a one-time up-front payment.[44] Through the program, GMP gains the ability

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[39] Taren O'Connor & Joe Cooper, Connecticut Launches Statewide Battery Storage Program with Green Bank and Utilities to Jointly Administer Incentives to Improve Resilience and Benefit Ratepayers, Conn. Pub. Utils. Reg. Auth. (Jan. 18, 2022), https://portal.ct.gov/PURA/Press-Releases/2022/Connecticut-Launches-Statewide-Battery-Storage-Program.

[40] *Id.*

[41] Energy Storage Solutions, *Energy Storage Solutions Performance Report [Dashboard]*, https://energystoragect.com/ess-performance-report/(last accessed July 13, 2023).

[42] *Id.*, Total Tables, https://energystoragect.com/ess-performance-report/ ("Conn. Energy Performance Report: Total Tables").

[43] *Bring Your Own Device*, Green Mountain Power, https://greenmountainpower.com/rebates-programs/home-energy-storage/bring-your-own-device/ (last accessed July 13, 2023).

[44] *Tesla Powerwall*, Green Mountain Power, https://greenmountainpower.com/rebates-programs/home-energy-storage/powerwall/ (last accessed July 13, 2023); Enphase IQ Battery, Green Mountain Power, https://greenmountainpower.com/rebates-programs/home-energy-storage/enphase-battery/ (last accessed July 13, 2023).

to discharge the battery as needed to reduce peak demand and the customer is able to use the battery for back-up power during grid outages. GMP estimates their batteries provided customers more than 10,000 hours of back-up power during winter 2022-23.[45] As of April 2023, about 2,500 customers were participating in the GMP home battery programs.[46] State regulations limit their battery programs to 500 new customers per year and as of April 2023 their Powerwall program was full, with a waiting list until 2025.[47] GMP reports approximately $3 million in annual savings for ratepayers from their battery program and has asked the Vermont Public Utility Commission to lift the limit on participation, noting the evident popularity and cost effectiveness of the program.[48]

Q. Have customer-sited battery storage programs been found to be cost-effective?

A. Yes. An assessment for the Massachusetts ConnectedSolutions program concluded that "(a)mong the supply-side and demand-side measures reviewed in this report, customer-sited battery storage is by far the lowest priced new winter peaking resource now available to utilities."[49] In an accompanying report, the Applied Economics Clinic ("AEC") reported that the Commercial & Industrial program's planned benefits exceeded costs by a ratio of 4:1.[50] The residential battery program's planned benefits exceeded

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[45] Kristin Carlson, GMP Requests Removal of Cap on Powerwall and BYOD Home Battery Programs to Expand Customer Access to Cost-Effective Backup Power, Green Mountain Power (Apr. 26, 2023), https://greenmountainpower.com/news/gmp-requests-removal-of-cap-on-powerwall-and-byod-home-battery-programs/ .
[46] *Id.*
[47] *Id.*
[48] *Id.*
[49] Joshua R. Castigliego et al., *Energy Storage for Winter Reliability: How Batteries Became the Low-Cost Solution for Power Assurance in Massachusetts*, Applied Economics Clinic for Clean Energy Group, at 4 (Dec. 2021), https://static1.squarespace.com/static/5936d98f6a4963bcd1ed94d3/t/61a922c432b9410b85d074a8/1638474442164/Energy-Storage-for-Winter-Reliability_AEC_2Dec2021.pdf.
[50] Mass. Program Assessment at 18.

costs by a 2:1 ratio.[51] As was noted above, GMP in Vermont reports ratepayer savings around $3 million per year from their battery programs.

This is not to say that if a program is cost-effective in Massachusetts, it will necessarily be so in Kentucky, because there are clearly significant differences between the electricity systems in these regions. Rather, the experience in other states suggests that batteries used in virtual power plants represent an opportunity worthy of serious investigation.

Q. Can VPP's use of customer-sited batteries help to meet the reliability and resilience standards established in SB4, related to coal-plant retirements?

A. Yes. Customer-sited battery storage improves grid reliability by serving as a dispatchable resource for utilities during times of peak demand. Thousands of batteries distributed among customer homes and businesses can be aggregated by the utility and operated as a virtual power plant to support the grid when needed. These same batteries can supply back-up power to customers during grid outages, further improving the reliability and resilience of the electricity system.

Q. What benefits could be gained through a robust Distributed Energy Resource strategy supporting local solar and battery systems?

A. Combined solar and storage systems offer enhanced values to the utility and customers. For the customer, a solar plus storage system provides greater resilience and increases the availability of the battery-solar system. During a grid outage, a solar-only system will cease producing power for safety reasons to prevent power from back-feeding the grid, thereby leaving the customer without power (a frustrating reality for many net metering

[51] *Id.* at 20.

customers). In battery-only systems, the customer will have back-up power but be limited by the storage capacity of the battery. If the outage drags on long enough, eventually a battery can become discharged.

Combining solar plus storage creates a more resilient system – the solar array can recharge the batteries even when the grid is down, providing the customer with a limited but indefinite supply of electricity until the grid is repaired, which can be used to serve critical loads. (That is to say, the solar array and battery will have maximum limits as to how much energy they can supply in a day, but if consumption is kept within those limits, the battery can continue to be recharged by sunlight each day, indefinitely).

Solar plus storage systems can play an increasingly important role providing community resilience. "In communities across the United States, public buildings, such as hospitals, police departments, fire stations, and other facilities, provide critical services that require continued operations during natural disasters or malicious attacks that disable the electric grid. In many areas, schools or other large public buildings serve as emergency shelters for prolonged recovery periods. While onsite diesel generators have historically powered a majority these sites, other DER options can support a microgrid system to provide the dual benefits of both backup power during an emergency and efficient, onsite energy that reduces utility bills year-round."[52]

[52] U.S. Dep't of Energy, *How Distributed Energy Resources Can Improve Resilience in Public Buildings: Three Case Studies and a Step by-Step Guide*, at 2 (Sept 2019), https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/How%20DERs%20Can%20Improve%20Resilience%20in%20Public%20Buildings_Three%20Case%20Studies%20and%20a%20Step-By-Step%20Guide_APRIL%20EDIT%20v3.pdf (citations omitted).

A report by NARUC identifies eight traits of resilient DERs. These resilience traits are also referenced in John Wilson's testimony, but their relevance to solar plus storage systems is such that I will cite them here, as well.

> These traits include:
>
> 1. Dispatchability: Resilient DERs can respond to a disruption at any time with little to no advance warning.
>
> 2. Islanding Capability: Resilient DERs have the ability to island from the distribution grid and serve load during a broader outage.
>
> 3. Siting at Critical Loads/Locations: Resilient DERs reside at critical loads or at critical points on the grid (e.g., areas of high residential density).
>
> 4. Fuel Security: Resilient DERs do not rely on the availability of a limited physical fuel to provide power.
>
> 5. Quick Ramping: Resilient DERs are capable of changing output quickly to match rapidly changing load.
>
> 6. Grid Services: Resilient DERs can provide voltage support, frequency response, and other grid services.
>
> 7. Decentralization: Resilient DERs are sized and sited to support a load in the distribution system.
>
> 8. Flexibility: Resilient DERs can be deployed quickly and cheaply (when compared to centralized generation, transmission, and/or distribution) at locations and times where resources are needed.
>
> Resilient DERs offer distinct advantages from 'non-resilient' DERs – those not designed with resilience as an explicit objective. All DERs, resilient or not, are decentralized and offer benefits distinct from large centralized generators. Single or aggregated DERs can both offer resilience benefits, although aggregated DERs have increased ability to provide grid services. Islanding capability is a unique trait of resilient DERs that requires intent during project design to configure the resource to island from the distribution grid. Several traits are enabled by energy storage paired with a generating DER: dispatchability, quick ramping, and flexibility. Renewable

> DERs remove the need to rely on a physical fuel supply, but they do exhibit intermittency driven by limited availability of sun or wind. Pairing these resources with battery energy storage enables access to electricity for longer or different time periods than when it is generated, although durations are limited by what the battery can provide. (Typical commercially available batteries provide up to four hours of storage, although many installed batteries have shorter durations (U.S. EIA, 2018d)).”[53]

This resilience potential is an important feature of DERs and battery storage that can provide direct benefits to customers in their communities. The ability to provide power at local critical facilities when the larger grid is down can be a life-saving function of these distributed energy systems, such as during natural disasters.

Q. Is it your view that customer-sited batteries can play a substantial role in meeting LGE & KU’s capacity and reliability requirements?

A. Yes. There is now ample evidence from many states that customer-sited batteries can be integrated into the utility grid as an aggregated resource which can be dispatched by the utility to support grid reliability and reduce peak loads. Consider that two years into their program, Massachusetts had added nearly 300 MW of customer-sited batteries. Connecticut has a target of 1000 MW of battery storage by 2030. Maine has a target of 400 MW by 2030 (representing 20% of their annual peak demand). Battery storage, along with other DR resources such as smart thermostats, water heater controls, and EV chargers, have the potential to provide substantial peak load reductions and savings to ratepayers.

[53] Kiera Zitelman, *Advancing Electric System Resilience with Distributed Energy Resources: A Review of State Policies*, National Association of Regulatory Utility Commissioners, at 9, (Apr. 2020), https://pubs.naruc.org/pub/ECD7FAA5-155D-0A36-3105-5CE60957C305.

Table 3 – Customer-sited Battery Deployment in Massachusetts and Connecticut

Customer-sited Battery Storage Deployment in Massachusetts and Connecticut. Showing MW of installed battery capacity, number of participating customers, and average battery capacity per customer.

	Massachusetts (2020)[54]			Connecticut (2023)[55]		
	MW	Customers	Avg KW/ Customer	MW	Customers	Avg KW/ Customer
Commercial & Industrial	286	1105	259	76	36	2115
Residential	2.8	844	3	1.563	194	8
Totals	288.8	1949		77.563	230	

DR resources also have the ability to scale up and be deployed quickly, in comparison to centralized power plants (whether fossil or renewable). Consider that Massachusetts deployed 286 MW of customer-sited batteries within two years of program launch.[56] Or that GMP has reached its enrollment cap of 500 new participants per year and has a waiting list until 2025 for new enrollments. With about 270,000 customers, GMP has one-third as many customers as LGE & KU.[57]

If LGE & KU began a battery DR program and enrolled residential customers at the same rate as GMP, they would install 1500 batteries per year. Table 4 presents a scenario in which an LGE & KU battery DR program starts with 500 participants in 2024 and expands to reach 1500 by 2026, matching GMP's rate. If the program then expands by

[54] Mass. Program Assessment, at 19, 21.
[55] Conn. Energy Performance Report: Total Tables *supra* n.46. Connecticut's customers are somewhere in the process of having applied to the program to having completed inspection.
[56] Mass. Program Assessment, at 19, 21. The ConnectedSolutions program was first deployed as a pilot program from 2016-2019 with 57 participants. *Id.* at 16. The report does not specify the capacity of batteries installed, but notes the maximum discharge during the pilot was a total 3.14 MW, *id.*, suggesting this was the scale of the batteries installed. If so, this means about 285 MW were installed in 2019–2020.
[57] GMP Requests Removal of Cap on Powerwall and BYOD Home Battery Programs to Expand Customer Access to Cost-Effective Backup Power, Green Mountain Power (Apr. 26, 2023), https://greenmountainpower.com/news/gmp-requests-removal-of-cap-on-powerwall-and-byod-home-battery-programs/. 2021 EIA Form 861 LGE & KU has 817,327 customers in 2021, as reported on EIA Form 861.

50% annually until 2030, the utilities would deploy 212.8 MW of residential batteries through 2030.

Table 4 – Residential Customer-Sited Battery Deployment Scenario –Annual Growth 50% After 2025

Residential Customer-Sited Battery Deployment Scenario - Annual Growth 50% After 2025							
	2024	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Annual Increase - Residential Customers w/ Batteries	500	1000	1500	2250	3375	5063	7594
Annual Increase - Batteries KW	5,000	10,000	15,000	22,500	33,750	50,625	75,938
Cumulative Total Customers	500	1,500	3,000	5,250	8,625	13,688	21,281
Cumulative Total Batteries KW	5,000	15,000	30,000	52,500	86,250	136,875	212,813
Total Batteries MW	**5.0**	**15.0**	**30.0**	**52.5**	**86.3**	**136.9**	**212.8**

The experience of Massachusetts and Connecticut illustrates that compared to the residential sector, the commercial and industrial (C&I) sectors have a much larger potential for hosting battery capacity, which can also be deployed fairly quickly. In Massachusetts, the C&I sector has 100 times as much battery capacity as the residential sector, while in Connecticut the C&I sector has 49 times as much. If LGE & KU deployed a battery DR program at even a fraction of this rate, the utilities could have more than 1000 MW of batteries installed at customer locations by 2030, with all the attendant resilience benefits on top of the capacity and reliability values.

A study by NREL examined where the best potential markets for behind-the-meter ("BTM") storage might be, based on utility demand charges. According to the study, "high demand charges are often cited as a critical factor in battery project economics,"[58]

[58] Joyce McLaren et al., *Identifying Potential Markets for Behind-the-Meter Battery Energy Storage: A Survey of U.S. Demand Charges*, National Renewable Energy Laboratory, at 1 (Aug. 2017), https://www.nrel.gov/docs/fy17osti/68963.pdf.

because the batteries can be used to shave peak loads, reducing customer demand charges. NREL identified demand charges in excess of $15 per kilowatt (kW) as creating especially favorable economics for BTM storage. Their study analyzed demand charges from utilities throughout the United States and noted Kentucky as one of the most favorable locations. Kentucky had the sixth-greatest number of commercial customers (41,000) eligible for rates with demand charges greater than $20/KW.[59] Indeed, LGE & KU's Power Service Rates fall squarely into this category, as shown in Table 5. This analysis suggests that LGE & KU could have a strong market for deploying customer-sited batteries among their C&I customers. (Note that this would also provide direct financial benefits to participating customers via reduced peak demand charges).

Table 5 - LGE & KU Power Service Rates - Demand Charges ($/KW)

LGE & KU Power Service Rates - Demand Charges ($/KW)			
		Secondary	Primary
KU	Summer	$ 25.30	$ 25.27
	Winter	$ 22.66	$ 22.68
LGE	Summer	$ 27.57	$ 24.14
	Winter	$ 24.28	$ 21.02

This review indicates that customer-sited batteries represent a very large, untapped reservoir of peak demand savings for LGE & KU.

Q. What does this mean in the context of the utilities' application to build 1200 MW of new NGCC power plants?

A. The Companies are proposing to spend over $1 billion to build two new NGCC power plants, totaling 1200 MW, to meet a projected capacity shortfall due to the planned

[59] *Id.* at 6.

retirements of several coal and natural gas power plants. However, the Companies' have failed to analyze the potential for dispatchable customer-sited batteries, deployed ambitiously and at scale, to meet their customer's needs for safe, reliable, and affordable power.

They have also failed to consider the role distributed solar generation could play in their portfolio, if net metering were allowed to continue unimpeded beyond the 1% minimum threshold required by statute. Considering that both distributed solar and customer-sited battery storage are now widely available and used at-scale in numerous states, this represents a major shortcoming in the Companies' resource planning process.

Q. Do DER's offer any advantages in terms of rate of deployment and execution risk?

A. A significant feature of DERs, including solar and batteries, but also many other technologies, is their ability to be installed in small, modular units, but in large quantities and at a relatively rapid pace compared to large, centralized, utility-scale facilities. Utility-scale solar and batteries will be very important elements of our electricity grid as it develops in the coming years, but the utilities have acknowledged that there are execution risks for these large projects.[60] Permitting, interconnection, and transmission all present potential barriers to large projects. Investing in DERs provides the utilities with valuable diversity and a hedge against execution risk for their utility-scale projects.

[60] *See, e.g.*, Direct Testimony of Stuart A. Wilson, In re Electronic Joint Application of Kentucky Utilities Company and Louisville Gas and Electric Company for Certificates of Public Convenience and Necessity and Site Compatibility Certificates and Approval of a Demand Side Management Plan, Case No. 2022-00402 (Dec. 15, 2022) ("Wilson Direct"), Exhibit SAW-1 at Section 4.6.1.

Q. What recommendations would you offer with respect to DERs?

a. Prepare a comprehensive cost-benefit analysis of customer-sited battery storage to identify its value as a capacity resource and assess its potential to meet the Companies' future capacity and reliability needs.

b. Prepare a market potential study for customer-sited battery storage for use as a dispatchable DR resource.

c. Investigate Battery-DR program design options to identify the optimal program features to achieve greatest benefits to customers.

d. Develop a program to deploy solar plus storage for resilience at critical facilities and to support essential community services.

e. Engage with community stakeholders in the above processes to ensure greater program success.

Q. Does that conclude your testimony?

Y. Yes.

VERIFICATION

The undersigned, Andrew McDonald being first duly sworn, deposes and says that he has personal knowledge of the matters set forth in the foregoing testimony and that the information contained therein is true and correct to the best of his information, knowledge, and belief, after reasonable inquiry.

Andrew McDonald

Subscribed and sworn to before me by Andrew McDonald this 13th day of July, 2023.

Teresa K Salchli
Notary Public

My commission expires: 9-16-2026

TERESA K. SALCHLI
NOTARY PUBLIC
COMMONWEALTH OF KENTUCKY
ID. KYNP56766
MY COMMISSION EXPIRES SEPT 16, 2026

Andrew McDonald – Résumé

Exhibit AM-1

ANDREW SCOTT MCDONALD, CEM, M.SC.

7134 Owenton Rd. (502)223-7936
Frankfort, KY 40601 andyboeke@yahoo.com

EDUCATION & CERTIFICATIONS

- **Certified Energy Manager, Association of Energy Engineers, 2020, #26142.**
- **Slippery Rock University of Pennsylvania, 2003, *M.S. in Sustainable Systems.***
- **State University of New York at Buffalo, 1992**. ***B.A. Philosophy.***

WORK EXPERIENCE

- September 2013 – present. ***Director, Apogee-Climate & Energy Transitions, Earth Tools, Inc.***
  Providing design, consulting, project development, and installation services for solar energy, energy conservation, green building, and other sustainability-related projects. Performing research, advocacy, and education on sustainable energy issues, especially concerning Kentucky electric utilities.
- January 2013 – September 2013. ***Independent consultant***.
  Provided consulting services for green building and solar energy projects.
- January 2004 – January 2013. ***Director, Kentucky Solar Partnership, Appalachia – Science in the Public Interest*.**
  Implemented programs to advance the use of solar, other renewable energy resources, and energy efficiency in Kentucky. Responsibilities included public education, organizing contractor training, policy research and advocacy, technical consulting, and development of demonstration projects.
- January 2003 – January 2004. ***Independent Contractor***.
  Provided research, design, and construction services for green building projects.
- August 2001 - December 2002: ***Graduate Assistant, Robert A. Macoskey Center for Sustainable Systems Education and Research at Slippery Rock University of PA*.**
  Responsible for monitoring resource use at Center and developing strategies for increased resource conservation; special focus on energy systems.
- January 2001 - May 2001: ***Graduate Assistant, Pennsylvania Center for Environmental Education, Slippery Rock University.***
  Performed data analysis and edited a published report concerning environmental education.
- January 2000 - July 2000: ***Conservation Assistant, Frontera Audubon Society, Harlingen, Texas.***
  Provided research, networking and logistical support for a federal lawsuit.
- April 2000 - June 2000: ***Crew Leader, U.S. Census Bureau, Harlingen, Texas.***
- October 1995 - May 1999: ***Staff and Resident, Proyecto Fe y Esperanza/Casa Juliana, Alamo, Texas.***
  Proyecto Fe y Esperanza (PFE) operated a demonstration center for sustainable living and environmentally appropriate technology. Located in a low-income, Mexican-American immigrant farm-worker community, PFE worked in various ways to improve the quality of life in this community.
  - January 1998 - May 1999: ***Project Director***
    Coordinated the reorganization of PFE during transitional period. Managed merger of PFE with a program offering experiential education tours of the US/Mexico border.
  - May 1997 - May 1999: ***Appropriate Technology Program Coordinator***
    Maintained and developed PFE's Appropriate Technology (AT) Demonstration Center; consulted with regional groups and individuals regarding AT and sustainable living; contracted to build various AT systems (i.e. solar water heaters, solar cookers, cisterns, compost toilets); collaborated with local organizations, e.g. Habitat for Humanity, on community development projects; designed and co-authored technical manuals and other educational materials.

- October 1997 - December 1997: ***Member, Solar Cooker Team, Cuzco and Arequipa, Peru.***
  Introduced solar cookers in three communities, trained local people in their construction and use, and did follow-up work in two communities we had worked with in 1994 (see below).
- July 1996 - October 1996: ***Educator for Composting Program, City of Alamo, Texas.***
- January 1995 - September 1995: ***Volunteer, United Farm Workers Organic Farm Cooperative, Alamo, Texas.***
  Assisted in all aspects of farm operations, management, and organizational development.
- January 1994 - June 1994: ***Member, Solar Cooker Team, Arequipa, Peru.***
  At invitation of Medical Mission Sisters, we worked to design an economical, efficient solar cooker using locally available materials. We trained local people in construction and use of solar cookers; helped design Spanish-language pamphlet explaining use and construction of cooker.
- September 1992 - October 1993: ***Waste Watch Coordinator, Appalachia - Science in the Public Interest, Livingston, Kentucky.***
  Performed research, authored publications, and organized workshops.

Other Relevant Work Experiences

- Performed complete renovation of farm house using green building strategies to achieve an energy efficient, net-zero-electricity passive solar home for my family (2010 – present).
- Installed 2.1 KW solar photovoltaic system at my home, achieving net-zero electricity usage for our home and farm (2011, expanded in 2017). Expanded solar photovoltaic system to 7.3 KW in 2020.
- Assisted my wife in operation of a certified organic vegetable farm (2005 – 2022).
- Designed and installed battery-based PV system, solar water heater, and water pumping system from rainwater cistern for off-grid straw-bale house, Frankfort, Kentucky, 2013.
- Designed and developed 30 grid-tied or off-grid solar PV systems, including first solar lease in Kentucky, 2014 – present.
- Provided consulting services for Stonebridge Hospitality, Inc., owner of four hotels in Frankfort, Kentucky, regarding energy efficiency and sustainability improvements to their hotels (2010 – 2011).
- Designed 12 KW solar photovoltaic system for Earth Tools, Inc. and provided technical support in drafting a successful USDA REAP Grant application. Installation completed September 2011. Have prepared four successful USDA REAP Grant applications in total.
- Designed and managed installation of 17 solar water heating systems, serving 68 apartments, for the Housing Authority of Owensboro, Kentucky, 2010.
- Consulted with the Frankfort YMCA on renovation of solar thermal pool heating system, 2007 – 2010.
- Managed installation of solar water heaters on homes of seven families in Eastern Kentucky, 2008 – 2009.
- Developed and managed statewide rebate program for solar water heaters, 2006 – 2007.
- Provided educational presentations to the public about solar electric and solar water heating systems.
- Co-chaired the Frankfort Mayor's Task Force on Energy Efficiency and Climate Change, 2007.
- Participated in Al Gore's Climate Reality Project training (2008) and have made numerous public presentations about climate change and the energy transition.
- Consulted on green design features for the CHIPS Group Home in Pulaski, Pennsylvania, for RCI Company Architects, 2002 - 2003.
- Have implemented and managed multiple Federal and state grant projects, including from US Departments of Energy, Agriculture, EPA, and Kentucky Office of Energy Policy.

- Co-authored "Greening the New Science and Technology Center" for the Dean of the College of Health, Environment and Science at Slippery Rock University, April 2002.
- Designed and installed a solar electric system at the Robert A. Macoskey Center for Sustainable Systems Education and Research, April 2002, Slippery Rock, Pennsylvania.
- Led reconstruction of a root cellar, summer 2001, Frankfort, Kentucky.
- Assisted construction of a passive solar, timber frame house, including installation of a solar electric system and composting toilet in Frankfort, Kentucky, 2000.
- Led Composting Toilet Design workshop at Cedar Ring Congress, Frankfort, Kentucky, April 1997.
- Co-hosted weekend solar oven construction workshops, Frankfort, Kentucky, October 1994 and 1995.

PUBLICATIONS

- *Local Solar, Local Savings: How to Cut Electricity Costs in Half for Public Schools and Local Governments in Frankfort, Kentucky*, with Walt Baldwin, February 2021.
- *Frankfort's Energy Future: Exploring the Benefits of Renewable Energy and Energy Efficiency for the Frankfort Plant Board*, with Daniel Holder and Nathan Shuler, August 2016.
- *Recommendations to the City of Frankfort from the Mayor's Task Force on Energy Efficiency and Climate Change*, co-author, December 2007, Frankfort, KY.
- *The Kentucky Solar Energy Guide*, with Joshua Bills. 2005. Appalachia – Science in the Public Interest, Mt. Vernon, KY.
- *High Performance Buildings: Bringing Environmentally Sound Building Practices Into the Mainstream in Kentucky*. 2004. Appalachia – Science in the Public Interest, Mt. Vernon, KY.
- *Developing a Strategic Plan for the Implementation of a Campus Sustainability Initiative at Slippery Rock University of Pennsylvania: A Master's Thesis*. 2003. Slippery Rock University (SRU), Slippery Rock, PA.
- *A Study of Energy Use at the Macoskey Center for Sustainable Systems Education and Research: Social Costs, Ecological Impacts, and Sustainable Energy Solutions*. 2002. [A series of four posters with accompanying Power Point presentation and pamphlet.] SRU, Slippery Rock, PA.
- *Inclusion of Environmental Education in Pennsylvania Teacher Preparation Curricula* (with Dr. Thomas Mastrilli and Dr. Paulette Johnson). 2002. Pennsylvania Center for Environmental Education, Slippery Rock, PA.
- "In Memory of Lorenzo Cleofas Mejia." *Mesquite Review: International Literature, Art and Culture*. August/September 2000, no. 18.
- *The Casa Juliana Solar Water Heater* (with David Omick). 1998. Proyecto Fe y Esperanza, Alamo, Texas.
- *The Casa Juliana Compost Toilet* (with David Omick). 1997. Proyecto Fe y Esperanza, Alamo, Texas.
- *A Solar Cooker* (with Mark Schimmoeller). 1996. Self-published.
- "Solar Cooking in Southern Peru" (with Mark Schimmoeller), *Home Power Magazine*. December 1994/January 1995, no. 44.

Boards and Memberships

- Center for Renewable Energy and Environmental Stewardship, Board member, 2009 – 2011.
- Kentucky Conservation Committee, Board Member, 2008 – 2015. President, 2014 – 2015.
- Kentucky Solar Energy Society, Founding Member, Board Member and Chair, 2008 – 2009, Board Member, 2019 - present.
- Envision Franklin County, 2004 – present.