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# LOCALIZING THE GREEN ENERGY REVOLUTION

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ABSTRACT

*The United States is on the verge of a new industrial revolution. Renewable energy could replace more than 60% of our current energy generation infrastructure in fifteen years. This change is critical, yet it risks failure. The renewable generation already built in the United States consists primarily of large-scale projects connected to transmission lines in rural areas. The expansive new generation needed to reduce carbon emissions must also be predominantly large-scale, and rural, for reasons of efficiency. But a revolution that focuses nearly exclusively on "big energy" is likely to encounter obstacles, and it has downsides that could be mitigated with a stronger focus on small-scale energy.*

*Many rural Americans—predominantly Republican—oppose Democratic policies, particularly climate policies. Even avowedly green liberal communities have mounted stiff opposition to renewable energy in some areas. Many landowners—particularly farmers—welcome the income from renewable energy leases, but residents often object to the blinking lights, landscape disruption, unsightly wires, and other impacts of these projects. Beyond facing political opposition, a projected buildout of more than 200,000 miles of new transmission lines to support new large-scale renewable projects threatens to create negative infrastructural path dependence. This could be analogous to the federal highway network expansion of the 1950s, which largely cemented U.S. reliance on cars rather than mass transit and divided communities. We need a nationwide network of new long-distance transmission lines to connect large renewable energy generation to population centers. But small energy projects could replace the need for some of these wires.*

*Policymakers should place greater emphasis on "small" distributed energy in the form of solar and wind generation over or near parking lots, roadways, and buildings; community-scale renewables and microgrids; and energy efficiency projects, such as weatherization of apartment buildings. This effort is likely to be more politically feasible than a revolution focused too heavily on*

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*large-scale projects. And when targeted properly, small-scale clean energy can reduce the crushing energy burdens faced by low-income communities, whether rural or urban.*

*For the energy transition to be feasible and less objectionable from a community and present-day environmental perspective, energy policies should also ensure that large-scale renewable generation is built in ways that reduce host community impacts. Renewable or clean energy policies should prioritize projects on polluted or abandoned brownfields, as New York requires; on marginalized farmlands; or offshore. Policies should also require large-scale renewable energy developers to negotiate with host communities and offer benefits—another strategy followed in New York.*

## INTRODUCTION

The United States is on the verge of another industrial revolution. In the first decade of the twenty-first century, domestic fossil fuel development expanded rapidly due to hydraulic fracturing and new drilling techniques.[1] Just over a decade later, the federal government and states are rolling out plans for a nationwide "green" energy revolution involving the development of massive renewable energy infrastructure and associated transmission lines.[2] President Biden has set an aggressive goal of achieving 100% carbon-free power by 2035 in the United States, a move that would require replacement of more than 60% of U.S. power generation in just under 15 years.[3] He has also directed federal agencies to investigate the expansion of federal authority over the siting of new transmission lines.[4] 200,000 or even 400,000 miles of new transmission lines

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1 These shock waves were both positive and negative. Many residents objected to noise, spills, air pollution, and other impacts. But many local officials welcomed the beneficial local economic effects that fracking had in many places. *See* Richard Newell & Daniel Raimi, *Shale Public Finance: Local Government Revenues and Costs Associated with Oil and Gas Development* (Natl. Bureau of Econ. Research, Working Paper No. 21542, Sept. 2, 2015), https://www.nber.org/system/files/working_papers/w21542/w21542.pdf?utm_campaign=PANTHEON_STRIPPED&amp%3Butm_medium=PANTHEON_STRIPPED&amp%3Butm_source=PANTHEON_STRIPPED (observing that "increas[ing] revenues . . . have generally outweighed" costs arising from new service demands for local governments experiencing oil and gas development as part of the hydraulic fracturing boom, but noting "net negative fiscal effects" for "most local governments in North Dakota and Montana's Bakken region" and similar struggles for local governments in "very rural parts of Colorado and Wyoming").

2 *See infra* notes 3–4 and accompanying text.

3 *See The Biden Plan to Build a Modern, Sustainable Infrastructure and an Equitable Clean Energy Future*, JOEBIDEN.COM, https://joebiden.com/clean-energy/ (declaring the goal of 100% carbon-free power by 2035); *Frequently Asked Questions (FAQ's): What is U.S. Electricity Generation by Source?*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/tools/faqs/faq.php?id=427&t=3 (showing that carbon-free nuclear and renewable energy sources currently make up approximately 38% of the U.S. energy generation mix). Although this goal is aggressive as measured against past U.S. climate action (namely, inaction), it might not be aggressive enough from the standpoint of avoiding potentially catastrophic climate change. As the International Energy Agency emphasizes, even with a growing number of pledges to achieve net-zero carbon emissions from countries around the world, 22 billion tons of carbon would still be released into the atmosphere in 2050, causing an estimated temperature increase of 2.1 degrees Celsius by 2100. The consensus among climate scientists is that *negative* carbon emissions will likely be necessary to avoid potentially catastrophic climate effects. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, GLOBAL WARMING OF 1.5 C at 114, https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_Low_Res.pdf.

4 *See* Exec. Order No. 14,008, 86 Fed. Reg. 7,619 (Jan. 27, 2021) (directing some agency heads to "identify steps that can be taken, consistent with applicable law, to accelerate the deployment of clean energy and transmission projects in an environmentally stable manner"); *see also* H.R. Res. 109, 116th Cong. § 2(C)(i) (2019), https://www.congress.gov/116/bills/hres109/BILLS-116hres109ih.pdf (as part of the proposed Green New Deal, proposing a mandate of 100% clean energy within 10 years by "dramatically expanding and upgrading renewable power sources," among other measures); Clean Energy Act of 2019, S. 1359, 116th Cong. § 610(c)(2)(C) (2019), https://www.congress.gov/bill/116th-congress/senate-bill/1359/text (proposing a bill that would require large utilities, which rely almost wholly on large scale generation, to provide 90% clean energy annually by 2040).

could be required to support a carbon-free U.S. power generation sector.[5] States and local governments, too, are moving forward with their own zero- and low-carbon energy policies, many of which aim to rapidly increase the number of large-scale renewable energy and transmission projects.[6]

This frenzied transition will largely replace fossil fuels with low-carbon, low-pollution energy, and it is essential if we wish to mitigate the widespread, increasingly catastrophic impacts of climate change—more wildfires, flooding, saltwater intrusion, temperature extremes, and deadly storms, for example.[7] Large-scale renewables will likely have to be the dominant strategy to a zero-carbon future.[8] This is because serious efforts to decarbonize require electrification of major energy consuming activities such as transportation, heating of buildings, and cooking, thus substantially increasing electricity

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5 *See* Dan Shreve & Wade Schauer, *Deep Decarbonisation Requires Deep Pockets: Trillions Required to Make the Transition*, WOOD MACKENZIE, http://www.decarbonisation.think.woodmac.com/section1/ ("Assuming 200,000 miles of new HVT at an average price of US$3.5 million/mile adds US$700 billion."); ERIC LARSON, ET AL., PRINCETON UNIV., NET-ZERO AMERICA: POTENTIAL PATHWAYS, INFRASTRUCTURE, AND IMPACTS, INTERIM REPORT 106 (2020), https://environmenthalfcentury.princeton.edu/sites/g/files/toruqf331/files/2020-12/Princeton_NZA_Interim_Report_15_Dec_2020_FINAL.pdf (finding that transmission capacity would have to expand by 60% to reach the 2030 goal of 100% zero-carbon energy and that it would have to triple to reach the 2050 net-zero carbon goal).

6 *See, e.g.*, S.B. 100, 2017–18 Reg. Sess. (Cal. 2018), https://leginfo.legislature.ca.gov/faces/billVersionsCompareClient.xhtml?bill_id=201720180SB100 (requiring 100% of retail electricity sales to come from zero-carbon energy source by 2045); S. 7508-B, 2020 Gen. Assemb. § 2 (N.Y. 2020), https://nyassembly.gov/2020budget/2020budget/A9508b.pdf (consolidating environmental review and permitting renewable energy projects in New York to achieve the mandate of limiting carbon emissions to 15% of 1990 emissions by 2050); S. 7508-B § 2 (2.b) ("[T]he state shall provide for timely and cost effective construction of new, expanded, and upgraded distribution and transmission infrastructure as may be needed to access and deliver renewable energy resources, which may include . . . high voltage direct current transmission[.]"); S.B. 5116, 66th Leg., 2019 Reg. Sess. (Wash. 2019), http://lawfilesext.leg.wa.gov/biennium/2019-20/Pdf/Bills/Session%20Laws/Senate/5116-S2.SL.pdf?q=20201029071502 (mandating carbon-free electricity in Washington State by 2045); S.B. 5116 § 14 (1)(f), (h), http://lawfilesext.leg.wa.gov/biennium/2019-20/Pdf/Bills/Session%20Laws/Senate/5116-S2.SL.pdf?q=20201029071502 (requiring retail utilities, which primarily rely on centralized generation, to develop plans for achieving the carbon-free electricity mandate, and requiring those utilities to assess both centralized generation and transmission and the possibility of distributed projects); H.B. 50, 2020 Reg. Sess. (N.M. 2020), https://legiscan.com/NM/text/HB50/id/2161656/New_Mexico-2020-HB50-Enrolled.pdf (enabling bonds for transmission line projects to support centralized renewable energy).

7 WORKING GROUP III CONTRIBUTION TO THE FIFTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2014 MITIGATION OF CLIMATE CHANGE 10 (2014), https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_full.pdf (observing that to keep a global temperature increase of less than two degrees Celsius compared to pre-industrial levels—which could avoid potentially catastrophic effects of climate change—requires "substantial cuts in anthropogenic GHG [greenhouse gas] emissions by mid-century through large-scale changes in energy systems").

8 *See, e.g.*, Michael B. Gerrard, *Legal Pathways for a Massive Increase in Utility-Scale Renewable Generation Capacity*, 47 ENV'T L. RPTR. 10591, 10591 (2017) (observing that "[d]ecarbonizing the U.S. energy system will require a program of building onshore wind, offshore wind, utility-scale solar, and associated transmission that will exceed what has been done before in the United States by many times, every year out to 2050," and also noting the importance of "rooftop photovoltaics and other distributed generation").

demand.[9] And utility-scale renewable energy is far less expensive than distributed energy, although the magnitude of the price difference is debated.[10]

Despite the clear necessity of large renewable energy generation and a major transmission expansion to support this generation, a revolution focused too heavily on utility-scale has avoidable downsides. It could create negative infrastructural path dependence akin to the construction of the federal highway system in the 1950s. The extensive highway buildout solidified reliance on cars over public transit and divided communities along racial and income-based lines.[11] An energy revolution that fails to include all feasible small-scale energy measures will similarly have greater-than-necessary social and environmental impacts.[12] Some scholars and policymakers correctly emphasize that the impacts of climate change on landscapes and species will be far larger than the immediate, physical impacts of clean power generation and transmission lines. But this is unlikely to curb many local environmental groups' and residents' opposition to large renewable energy installations.[13]

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9 *See, e.g.*, *id.* (noting "the added electricity that will be needed as many uses currently employing fossil fuels (especially passenger transportation and space and water heating) are electrified"); Richard Audoly, Adrien Vogt-Schilb, Celine Guivarch & Alexander Pfeiffer, *Pathways Toward Zero-Carbon Electricity Required for Climate Stabilization*, 225 APPLIED ENERGY 884 (2018) (describing the important role of electrification in the carbon transition).

10 For estimates that show high costs of distributed solar, see *infra* note 146. A study of U.S. decarbonization using both large and small-scale renewables and storage finds $88 billion in savings as compared to continuing today's approach to energy. VIBRANT CLEAN ENERGY, COALITION FOR COMMUNITY SOLAR, VOTE SOLAR & LOCAL SOLAR FOR ALL, WHY LOCAL SOLAR FOR ALL COSTS LESS: A NEW ROADMAP FOR THE LOWEST COST GRID 20 (2020), https://static1.squarespace.com/static/5f4637895cfc8d77860d0dbc/t/5fd39999439c7c5ec221499b/1607702942515/Local+Solar+Roadmap+White+Paper+as+PPT+FINAL.pdf.

11 *See, e.g.*, Deborah N. Archer, *"White Men's Roads Through Black Men's Homes": Advancing Racial Equity Through Highway Reconstruction*, 73 VAND. L. REV. 1259, 1275 (2020) ("Robert Moses, an influential New York public official who shaped urban development and public works projects both in New York and around the country, was a leader among those who believed infrastructure projects and physical barriers would be effective, semipermanent barriers to access for poor people of color."). Archer noted that Moses purposefully planned for bridges over some highways to be lower to ensure that buses, which Black and Puerto Rican individuals tended to ride, could not access those highways, which led to parks and beaches. *Id.*; Alexandra B. Klass, *Future-Proofing Energy Law*, 94 WASH. U. L. REV. 827, 830 (2017) (noting concerns about "path-dependency" in energy transport decisions, including the construction of transmission lines). For extensive discussion of how a failure to "foreground" justice issues in the clean energy transition could once again cause industrial burdens to fall most heavily on low-income communities, including black and brown communities, see Shalanda H. Baker, *Anti-Resilience: A Roadmap for Transformational Justice Within the Energy System*, 54 HARV. C.R.-C.L. L. REV. 1, 15–19 (2019).

12 U.S. DEP'T OF THE INTERIOR, FINAL PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT (PEIS) FOR SOLAR ENERGY DEVELOPMENT IN SIX SOUTHWESTERN STATES, at ES-23 (2012), https://solareis.anl.gov/documents/fpeis/Solar_FPEIS_Volume_1.pdf (summarizing impacts of potentially extensive western solar energy development on wildlife).

13 *See generally* Jeff Thaler, *Fiddling as the World Floods and Burns: How Climate Change Urgently Requires a Paradigm Shift in the Permitting of Renewable Energy Projects*, 42 ENV'T L. 1101 (2012) (arguing for abbreviated environmental review of renewable energy projects due to the urgency of these projects); David

A green energy revolution that marginalizes small-scale approaches could also exacerbate existing political economic tensions and psychological barriers to climate initiatives.[14] Further, this movement could heighten energy justice concerns despite concerted efforts to enhance equity in the energy sphere.[15] And without adequate attention to grid reliability and resiliency, which small-scale energy can enhance, further grid crises caused by weather extremes could fuel opposition to large-scale renewables even when renewables are not to blame for outages.[16]

The green energy revolution of the 2020s represents a critical crossroads in infrastructural decision-making. An extensive buildout of both large- and small-scale zero-carbon energy will be necessary for real progress on the climate

B. Spence, *Regulation and the New Politics of (Energy) Market Entry*, 95 NOTRE DAME L. REV. 327 (2019) (identifying local environmental groups' opposition to wind energy projects through an empirical study); *Renewable Energy Legal Defense Initiative,* SABIN CTR. FOR CLIMATE CHANGE L., COLUM. L. SCH./COLUM. UNIV. EARTH INST., https://climate.law.columbia.edu/content/renewable-energy-legal-defense-initiative (last visited May 21, 2021) (describing projects in which the Renewable Energy Legal Defense Initiative helped proponents of renewable energy projects overcome opposition).

[14] *See infra* Part I.

[15] The Biden administration has expressly focused on addressing energy justice issues, creating a new Deputy for Environmental Justice within the Department of Energy and planning for a large portion of the $2 trillion investment in clean energy to go to disadvantaged populations. *See* Department of Energy Announces New Senior Leaders, DEPT. OF ENERGY (Jan. 21, 2021), https://www.energy.gov/articles/department-energy-announces-new-senior-leaders; Juliet Eilperin, Brady Dennis & Darryl Fears, *Biden to Place Environmental Justice at Center of Sweeping Climate Plan,* WASH. POST (Jan. 27, 2021, 12:51 PM), https://www.washingtonpost.com/climate-environment/2021/01/26/biden-environmental-justice-climate/. But the siting and construction of large renewable energy projects and transmission lines in rural communities around the United States will require a herculean community engagement effort. Reliance on localized, distributed energy placed first in disadvantaged communities would similarly require extensive engagement. Many communities, understandably, distrust government-subsidized companies or government employees coming into their homes and apartment buildings and proposing changes. But making clean energy a more local project could also empower communities, in contrast with large energy companies coming into communities and industrializing portions of these communities. *See, e.g.*, Diana Hernández & Stephen Bird, *Energy Burden and the Need for Integrated Low-Income Housing and Energy Policy*, 2 POVERTY PUB. POL'Y 5 (2010) (noting community energy outreach and energy literacy pilot programs that gave residents tools and options for reducing their energy use and bills); Baker, *supra* note 11, at 12 (noting how "endogenous" resources such as local solar and wind could empower low-income Black and brown communities if implemented in transformative ways that avoid perpetuating existing inequalities in the energy system).

[16] Frozen wind turbines were a small part of a much larger problem during Texas's Polar Vortex incident, but they received much of the blame. Although the crisis in Texas was not primarily caused by renewable energy, it exposed the difficulty of relying heavily on any one form of energy to fulfill widespread and variable demand for energy. In this case, natural gas—which usually serves to fill in the energy demand ("load") not covered by wind—failed to deliver, in part due to frozen equipment and electricity outages at gas wells, gas storage areas, and pipelines. With wind and natural gas generators producing less electricity than usual and demand spiking, the grid operator was forced to impose short-term blackouts to avoid system failure. *See, e.g.*, Bill Magness, *Review of February 2021 Extreme Cold Weather Event — ERCOT Presentation*, at 14 (Feb. 25, 2021), http://www.ercot.com/content/wcm/lists/226271/Texas_Legislature_Hearings_2-25-2021.pdf (showing natural gas outages exceeding outages for solar and wind during the Polar Vortex event).

front.[17] But given the dominance to-date of large-scale measures, this movement should place more emphasis on three smaller-scale green energy forms: (1) solar and wind generation over or near parking lots, roadways, and buildings; (2) community-scale renewable energy projects (mid-sized projects, which residents subscribe to or collectively own) and microgrids; and (3) energy efficiency measures such as weatherization and the installation of modern air-conditioners.[18] For the many large-scale projects that will also be necessary, green energy policies should require the least intrusive forms of this development, such as building on abandoned lots and marginally productive farmland.[19] And to address the diverse local concerns that arise when developers build large infrastructure in communities, these policies should require

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[17] *See, e.g.*, LARSON ET AL., *supra* note 5, at 4–5 (observing that to hold the global-average surface temperature increase to two degrees Celsius—a level that would "entail climatic disruption and impacts considerably greater than those currently being experienced at just half of that increase"—major industrial nations will have to cut emissions of greenhouse gases by "80 to 100 percent by around 2050"). Rooftop solar on existing buildings that have the proper roof orientation for solar would cover approximately 40% of current U.S. electricity use. *See* PIETER GAGNON, ROBERT MARGOLIS, JENNIFER MELIUS, CALEB PHILLIPS & RYAN ELMORE, NATL. RENEWABLE ENERGY LAB. ROOFTOP SOLAR PHOTOVOLTAIC TECHNICAL POTENTIAL IN THE UNITED STATES: A DETAILED ASSESSMENT, at vii (2016), https://www.nrel.gov/docs/fy16osti/65298.pdf. Of course, many residential and commercial building occupants lack the motivation or funds to install rooftop solar. But the 40 percent figure ignores the possibility of solar placed along highways and over parking lots. Photovoltaic solar panels installed on only seven percent of *all* existing built infrastructure in the United States—highways, parking lots, and so on—would be needed to cover all existing U.S. demand for electricity. U.S. DEPT. OF ENERGY, NATL. RENEWABLE ENERGY LAB., PV FAQS, at 1 (2004), https://www.nrel.gov/docs/fy04osti/35097.pdf. Given the efficiencies of large-scale zero-carbon generation and growing electrification, however, large-scale generation will likely still need to be the predominant electricity source.

[18] For definitions of these approaches, see, e.g., Sara Bronin, *Curbing Energy Sprawl with Microgrids*, 43 CONN. L. Rev. 547, 559 (2010) (defining distributed generation as "the production of electricity by a small-scale source located at or very near the end users it serves."); *id.* at 549-50 (defining microgrids as "small-scale, low-voltage distributed generation," which typically power a portion of a neighborhood using "sources such as solar collectors, wind power systems, microturbines, geothermal wells, and fuel cells"); Hannah J. Wiseman & Sara C. Bronin, *Community-Scale Renewable Energy*, 4 SAN DIEGO J. CLIMATE & ENERGY L. 165, 165–66 (2012-13) (defining community renewables as "mid-sized energy sources supported by resources pooled from several private parties in close geographic proximity"); HEATHER PAYNE, JONAS MONAST, HANNAH WISEMAN & NICOLAS EASON, UNC CTR. CLIMATE, ENERGY, ENV'T, AND ECON., TRANSITIONING TO A LOWER-CARBON ENERGY FUTURE: CHALLENGES AND OPPORTUNITIES FOR MUNICIPAL UTILITIES AND ELECTRIC COOPERATIVES 9 (2017), https://law.unc.edu/wp-content/uploads/2019/09/fsuuncmuni.pdf (describing community solar projects in Sacramento in which the city builds local projects and allows customers to subscribe to these projects by purchasing electricity from them); U.S. DEPT. OF ENERGY, COMMUNITY WIND BENEFITS (2012), https://www.nrel.gov/docs/fy13osti/56386.pdf (describing locally owned community wind projects with applications at "schools, hospitals, businesses, farms, ranches, or community facilities").

[19] Policy requirements for siting renewables on "marginalized lands" must be undertaken with caution, however. Lands that are considered marginal under broad-brush metrics developed by policymakers are often highly valued by individuals and communities. *See* Jennifer Baka, *Do Wastelands Exist? Perspectives on Productive Land Use in India's Rural Energyscapes*, *in* RCC PERSPECTIVES: TRANSFORMATIONS IN ENVIRONMENT AND SOCIETY, ENERGIZING THE SPACES OF EVERYDAY LIFE: LEARNING FROM THE PAST FOR A SUSTAINABLE FUTURE (Vanessa Taylor & Heather Chappells eds., 2019), http://www.environmentandsociety.org/sites/default/files/2019_i2_web.pdf.

community-engaged development and payments for impacts, whether through taxes, payments in lieu of taxes, community benefits agreements, or electricity rate reductions.[20]

A greater emphasis on small-scale energy will reduce the amount of durable infrastructure needed to support a large transition to renewables, and it could overcome many existing political economic barriers to clean energy. If targeted to the right populations—by prioritizing energy efficiency and distributed solar on multi-family properties, for example—small-scale clean energy measures would also lower the energy burdens shouldered by millions of the most disadvantaged Americans, thus addressing rather than exacerbating energy justice.[21] Many U.S. residents must choose between turning on the heat and buying medicine or food.[22] Lowering these residents' energy bills lifts some of the energy-related monetary obligations that create this unreasonable choice.[23] Small-scale energy also tends to produce more jobs within communities, as opposed to jobs within national corporate headquarters.[24] And particularly in the

[20] Some state energy transition policies already include these requirements, thus providing a helpful model. New York's Accelerated Renewable Energy Growth and Community Benefit Act requires host community benefits, rate reductions, or alternative forms of compensation to residents of host communities. *See* N.Y. EXEC. LAW § 94-c(f) (McKinney 2020); N.Y. PUB. AUTH. LAW § 1902(6) (McKinney 2020). New Mexico's Energy Transition Act requires that developers of "replacement resources" (renewables that replace coal and other power plants) pay local taxes or payments in lieu of taxes. *See* S.B. 489 § 3(E) (N.M. 2019). These payment schemes should be carefully designed and implemented to provide meaningful community investments, not mere "buy-outs."

[21] *See* Hernandez & Bird, *supra* note 15, at 2 (describing "energy burden," which is "the disproportionate allocation of financial resources among low-income households on energy expenditures" that often involves difficult trade-offs such as turning on the heat or buying food for children); ARIEL DREHOBL, LAUREN ROSS & ROZANA AYALA, AM. COUNCIL FOR AN ENERGY-EFFICIENT ECON., HOW HIGH ARE HOUSEHOLD ENERGY BURDENS? (2020), https://www.aceee.org/sites/default/files/pdfs/u2006.pdf (showing the highest burdens among low-income and minority groups).

[22] *See, e.g.*, U.S. DEPT. OF ENERGY, LOW-INCOME HOUSEHOLD ENERGY BURDEN VARIES AMONG STATES – EFFICIENCY CAN HELP IN ALL OF THEM 1 (2018), https://www.energy.gov/sites/prod/files/2019/01/f58/WIP-Energy-Burden_final.pdf (noting that "[h]igh energy burdens" can "force tough choices between paying energy bills and buying food, medicine, or other essentials").

[23] *Id.*

[24] *See, e.g.*, HOWARD GELLER, JOHN DECICCO & SKIP LAITNER, ENERGY EFFICIENCY AND JOB CREATION: THE EMPLOYMENT AND INCOME BENEFITS FROM INVESTING IN ENERGY CONSERVING TECHNOLOGIES, REPORT NUMBER ED922, at III (1992), https://www.aceee.org/sites/default/files/publications/researchreports/ED922.pdf (concluding that widespread energy efficiency measures produce the highest job gains in the "construction, retail trade, and services industries"); BW RSCH. PARTNERSHIP, NASEO, & ENERGY FUTURES INITIATIVE, WAGES, BENEFITS, AND CHANGE; A SUPPLEMENTAL REPORT TO THE ANNUAL U.S. ENERGY AND EMPLOYMENT REPORT 5 (2020), https://static1.squarespace.com/static/5a98cf80ec4eb7c5cd928c61/t/606b8771c7ee880d3110085f/1617659768456/The+Wage+Report.pdf (noting that "[e]nergy efficiency installation, maintenance, and repair jobs are unique in that they are ubiquitous across the United States," with jobs in all 3,000 U.S. counties with the exception of 6).

context of energy efficiency, small energy is strongly linked to positive health outcomes in low-income communities.[25]

Getting to "net zero" carbon emissions will require changes well beyond the electricity sector. It will also necessitate electrification of stoves, heating, and the vehicle fleet (thus demanding even more renewable energy generation), or the expansion of renewable fuels such as "green" hydrogen, which is hydrogen produced from renewable energy.[26] Furthermore, it will require major changes in the industrial sector, where fossil fuels directly power processes such as cement, iron, and steel production, and are used as ingredients in some production processes, such as plastics manufacturing.[27] This Essay focuses solely on the electricity sector, however, because this sector is at the forefront of federal and state policy efforts to transition the United States to a lower carbon society.

Part I of this Essay explores the extent to which the green energy revolution threatens to repeat the mistakes of past industrial transitions from an infrastructural, political, economic, and environmental justice perspective and proposes solutions to these challenges. Part II analyzes the technological and economic factors that have converged to make this an ideal time for a better, more localized revolution. Finally, Part III briefly identifies legal hurdles to a localized energy revolution but concludes that all of these hurdles are surmountable.

The burgeoning green revolution does not have to follow a predominantly large-scale industrial path. Rather than intensifying and expanding classic "locally undesirable land uses," or LULUs, the transition away from carbon can and should incent desirable energy development that directly benefits electricity consumers.[28] Without this approach, the urgent project of combatting potentially

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[25] *See, e.g.*, Jill Breysee, Sherry Dixon, Joel Gregory, Miriam Philby, David E. Jacobs & James Krieger, *Effect of Weatherization Combined With Community Health Worker In-Home Education on Asthma Control*, 104 AM. J. PUB. HEALTH 57, 63 (2014) (showing that education about asthma triggers coupled with energy efficiency and other home improvements reduced the percentage of children with not-well-controlled or poorly-controlled asthma from 100% to 28.8% in the study group, as compared to 100% to 51.6% in the comparison group).

[26] Plug-in electric and hydrogen vehicles will be an essential part of the mix because transportation is the largest carbon-emitting sector in the United States, but this paper focuses on the electric generation aspects of the green energy revolution. *See* U.S. ENV'T PROT. AGENCY, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS 1990-2018, at ES-7, https://www.epa.gov/sites/production/files/2020-04/documents/us-ghg-inventory-2020-main-text.pdf (showing transportation as the leading greenhouse gas emitter).

[27] *See, e.g.*, Jeffrey Rissman et al., *Technologies and Policies to Decarbonise Global Industry: Review and Assessment of Mitigation Drivers Through 2070*, 266 APPLIED ENERGY 1, 6 (2020).

[28] *See, e.g.*, Vicki Been, *Locally Undesirable Land Uses in Minority Neighborhoods: Disproportionate*

cataclysmic climate scenarios could face problematic delay and leave important benefits on the table.

## I. INFRASTRUCTURE, POLITICS, AND JUSTICE: THE CHALLENGES OF LARGE-SCALE ENERGY DEVELOPMENT

Communities in the United States are no stranger to rapid economic and infrastructural transformations. In the 1950s, the General Motors Corporation, seeking more and faster roads for the cars that it produced, announced a national essay competition on the planning and finance of highways.[29] The winner was Robert Moses, a New York "power broker" who had built New York's large parkways along with a massive network of bridges and parks.[30] This award-winning essay and Robert Moses's real-life examples from New York, paired with other authors' advocacy for a national highway system, strongly influenced President Eisenhower's highway expansion.[31] The result was a massive network of federal highways that provided larger and safer roads but also literally divided communities along racial lines.[32] The construction of a highway system also cemented in place a U.S. path dependency on cars.[33]

More recent development booms have had similarly powerful effects. The "fracking revolution," which reached full force around 2010, transformed relatively quiet cities and towns in places like North Dakota and Pennsylvania into boomtowns.[34] As with highways, fracking has important upsides—it has enhanced the U.S. gross domestic product (GDP), poured millions of dollars into communities, and (in the case of natural gas produced from fracked wells) allowed a quick transition away from coal-fired power.[35] But oil and gas

*Siting or Market Dynamics?*, 103 YALE L.J. 1383, 1384 (1994) (introducing the challenge of "waste dumps, polluting factories, and other locally undesirable land uses (LULUs)" and their location).

[29] *See GM's Better Highways Award*, U.S. DEPT. OF TRANSP. https://www.fhwa.dot.gov/infrastructure/gmaward.cfm (last visited May 12, 2021).

[30] TOM LEWIS, DIVIDED HIGHWAYS 28–29, 37–38 (2013).

[31] Norman Bel Geddes successfully advocated for a national highway system, whereas Moses preferred the more regional (yet still sprawling and grandiose) highways such as those that he built in New York. *See id.* at 43–45.

[32] Robert Moses purposefully designed bridge heights in New York to prevent buses—which commonly carried Black and Puerto Rican New Yorkers—from accessing highways that led to public amenities such as beaches and parks. Archer, *supra* note 11, at 1275.

[33] *See* ANDRES DUANY, ELIZABETH PLATER-ZYBERK, & JEFF SPECK, SUBURBAN NATION: THE RISE OF SPRAWL AND THE DECLINE OF THE AMERICAN DREAM (2000).

[34] *See Fort Worth City of Fort Worth – Gas Well Status*, CITY OF FORT WORTH, https://cfw.maps.arcgis.com/apps/webappviewer/index.html?id=8487c19655cd40d08d57f64de3f4339f (last visited May 12, 2021).

[35] *See, e.g.*, Daniel Raimi, *The Economic Impacts of the Shale Revolution*, RESOURCES FOR THE FUTURE (2018), https://media.rff.org/documents/RFF-IB-18-03_1.pdf (noting that oil and gas production caused a $294 billion increase in GDP in 2014, although the GDP effects decreased substantially when oil and gas prices

development has substantial environmental impacts and could create thousands of abandoned "legacy" wells, which sometimes leak methane.[36] Additionally, the burst of U.S. oil and gas production activity triggered a widespread expansion of pipelines, with 41,000 miles of new pipelines to be constructed within the next 20 years.[37] Although most pipelines are buried, they sometimes trigger fatal explosions and dangerous spills, and open corridors above the pipelines remain for maintenance purposes.[38]

A true revolution in the growth of renewable power generation will be similarly expansive. In 2013, when wind power was rapidly expanding in the Midwest, utilities constructed a record high 4,500 miles of new transmission lines.[39] Yet in 2013, wind represented only 4.1% of U.S. electricity generation.[40] Policies that aim for 100% wind, solar, and other zero-carbon resources (most of them large scale) would require a doubling or tripling of the current 200,000 miles of transmission lines in the United States, to the tune of $700 billion.[41] The effects of this revolution, like others, run along a continuum. Large-scale renewable development has powerful upsides in the form of economic growth in rural communities. Renewable energy, although displacing some farmland, can allow some struggling farmers to stay in business due to lease payments from the energy company.[42] And wind energy, in particular, is compatible with

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declined).

[36] *See, e.g.*, *Abandoned & Orphan Well Program*, PA. DEPT. OF ENV'T PROTECTION, https://www.dep.pa.gov/Business/Energy/OilandGasPrograms/OilandGasMgmt/LegacyWells/Pages/default.aspx (last visited May 12, 2021) (noting that "there are instances in which an oil and gas company files for bankruptcy protection or moves out of the commonwealth, leaving its wells improperly abandoned"); PA. DEPT. OF ENV'T PROT., 2017 OIL AND GAS ANNUAL REPORT, https://gis.dep.pa.gov/2017oilandgasannualreport/ (estimating that "between 100,000 and 560,000 abandoned oil and gas wells exist in Pennsylvania that remain unaccounted for").

[37] KEVIN PETAK, JULIO MANIK & ANDREW GRIFFITH, NORTH AMERICAN MIDSTREAM INFRASTRUCTURE THROUGH 2035: SIGNIFICANT DEVELOPMENT CONTINUES 2 (2018), https://www.ingaa.org/File.aspx?id=34658.

[38] *Pipeline Incidents 20 Year Trends*, U.S. DEPT. OF TRANS., PIPELINE & HAZARDOUS MATERIALS SAFETY ADMIN. (Feb. 17, 2021), https://www.phmsa.dot.gov/data-and-statistics/pipeline/pipeline-incident-20-year-trends (follow "Serious Incident 20 Year Trend" hyperlink; then filter System Type field for "Gas Transmission") (describing 1,404 significant gas pipeline incidents in the past 20 years).

[39] Jeff St. John, *Transmission Emerging as Major Stumbling Block for State Renewable Targets*, GREENTECH MEDIA (Jan. 15, 2020), https://www.greentechmedia.com/articles/read/transmission-emerging-as-major-stumbling-block-for-state-renewable-targets.

[40] *Twelve States Produced 80% of U.S. Wind Power in 2013*, U.S. ENERGY INFO. ADMIN. (April 15, 2014), https://www.eia.gov/todayinenergy/detail.php?id=15851.

[41] *See* Shreve & Schauer, *supra* note 5.

[42] *See, e.g.*, Z. BEDNARIKOVA, R. HILLBERRY, N. NGUYEN, I. KUMAR, T. INANI, M. GORDON, & M. WILCOX, AN EXAMINATION OF THE COMMUNITY LEVEL DYNAMICS RELATED TO THE INTRODUCTION OF WIND ENERGY IN INDIANA 16 (2020), https://cdext.purdue.edu/wp-content/uploads/2020/09/Wind-Energy_Final-report.pdf (estimating $7.5 to $15 million in annual lease payments to landowners in Indiana who host wind farms).

some agricultural uses of land such as cattle grazing.[43] Furthermore, when renewable energy generation is built in struggling communities, such as those losing coal mining or other fossil fuel jobs, tax payments and other proceeds from renewable energy development can provide at least a partial lifeline.[44] But there are substantial downsides to large renewables too, such as aesthetic and non-climate environmental impacts, changes in the culture and character of communities, and potential safety hazards from inadequate decommissioning.[45]

All types of major infrastructural expansions, whether they involve highways, pipelines, or towering transmission lines, have enduring effects, as explored here in the context of a green revolution.

### A. *Durable Renewable Energy Infrastructure: Land Use and Environmental Impacts and Path Dependence*

Energy is a notoriously land-intensive activity. Growing U.S. demand for energy will be the largest driver of land conversion over the next two decades.[46] New domestic energy development in the form of natural gas and oil wells, renewable generation, and other power sources will occupy an area larger than Texas.[47] Large-scale renewable energy built as part of the green revolution will therefore be a major contributor to the conversion of "greenfields"—currently undeveloped land.[48] Indeed, in 2015, 1.4 million U.S. homes were located within

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[43] *See* Cathy Svejkovsky, *Renewable Energy Opportunities on the Farm*, ATTRA 10 (2006), https://attra.ncat.org/product/Renewable-Energy-Opportunities-on-the-Farm/.

[44] *See* BEDNARIKOVA ET AL., *supra* note 42, at 22–25 (noting property tax payments); Silvio Marcacci, *Renewable Energy Job Boom Creates Economic Opportunity as Coal Industry Slumps*, FORBES (Apr. 22, 2019, 7:20 AM), https://www.forbes.com/sites/energyinnovation/2019/04/22/renewable-energy-job-boom-creating-economic-opportunity-as-coal-industry-slumps/?sh=75c79e543665.

[45] *See, e.g.*, Uma Outka, *Environmental Justice Issues in Sustainable Development: Environmental Justice in the Renewable Energy Transition*, 19 J. ENV'T & SUSTAINABILITY L. 60, 77–79 (2012) (noting aesthetic and cultural concerns). Some renewable generation facilities are repowered (with the addition of new solar panels on top of existing racks, for example) rather than decommissioned, but some of the old equipment still must be scrapped. For a discussion of decommissioning and repowering, see, e.g., Billy Ludt, *How to Decommission a Solar Array, and Why It's Important to Plan Ahead*, SOLAR POWER WORLD (Mar. 11, 2019), https://www.solarpowerworldonline.com/2019/03/how-to-decommission-a-solar-array-and-why-its-important-to-plan-ahead/.

[46] Anne M. Trainor, Robert I. McDonald & Joseph Fargione, *Energy Sprawl Is the Largest Driver of Land Use Change in the United States*, PLOS ONE (2016). https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0162269.

[47] *Id*. This figure includes the need to space apart wells and energy generation infrastructure.

[48] Sara Bronin highlighted this problem even before the green energy revolution, noting "the ever-increasing consumption of land, particularly in rural areas, required to site energy generation facilities." Bronin, *supra* note 18, at 547; *see also* Uma Outka, *The Renewable Energy Footprint*, 30 STAN. ENV'T L.J. 241 (2011) (highlighting the land-intensive nature of large-scale renewables and transmission lines).

eight or fewer kilometers of wind farms—a figure that will rise if the United States moves toward 100% zero-carbon power.[49]

Some experts paint a rosier picture. For example, the National Renewable Energy Laboratory (NREL) notes that "[w]e would need only 10 million acres of land—or only 0.4% of the land area of the United States—to supply all of our nation's electricity" using solar photovoltaic (PV) panels.[50] When compared to the 30 million acres of farmland that the federal government purposefully takes out of production each year, or the 243 million acres of land in the Arctic National Wildlife Refuge, NREL experts view this land use requirement as relatively small.[51] And NREL emphasizes that in 2004, "cities and residences covered about 140 million acres of land" in the United States, which could easily house PV panels over parking lots and on rooftops.[52] Only 7% of existing built land in the United States, including, for example, roadways and parking lots, would be required to house PV panels that would fulfill all current U.S. demand for electricity.[53] Additionally, some scientists point out that the alternative to a renewable build-out—relying primarily on fossil fuels—can have similarly large landscape effects because new wells and mines must be drilled and dug as production decreases from existing extraction sites.[54]

Even if the acreage required for large-scale renewable energy is relatively minor as compared to other land uses, communities will still see major changes to their landscapes. More wind farms will sprout up in farm fields and on the ridges of hills and mountain, and acres of solar panels will cover fields and deserts.[55] Residents will also experience flashing lights on top of wind turbines, shadows from moving wind turbine blades, and in some cases, abandoned infrastructure if generation is not properly decommissioned.[56] Dolar PV panels

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49 Ben Hoen, Jeremy Firestone, Joseph Rand, Debi Elliot, Gundula Hübner, Johannes Pohl, Ryan Wiser, Eric Lantz, T. Ryan Haac, & Ken Kaliski, *Attitudes of U.S. Wind Turbine Neighbors: Analysis of a Nationwide Survey*, 134 ENERGY POL'Y. 1, 1 (2019).

50 *See* U.S. DEPT. OF ENERGY, NATL. RENEWABLE ENERGY LAB., PV FAQS, *supra* note 17, at 1.

51 *Id.*

52 *Id.*

53 *Id.*

54 *See* Trainor et al., *supra* note 46, at 6 ("Renewable energy sources can reuse the same land every year, such that there is no increase in cumulative land required. In contrast, the land required to acquire extractive energy sources expands every year.").

55 *Wind Turbine Heights and Capacities Have Increased Over the Past Decade*, U.S. ENERGY INFO. ADMIN. (Nov. 29, 2017), https://www.eia.gov/todayinenergy/detail.php?id=33912#:~:text=Since%202012%2C%20the%20average%20height,such%20as%20trees%20or%20buildings ("Favorable sites for wind turbines include the tops of smooth, rounded hills; open plains and water; and mountain gaps that funnel and intensify wind.").

56 *See, e.g.*, Sean F. Nolon, *Negotiating the Wind: A Framework to Engage Citizens in Siting Wind Turbines*, 12 CARDOZO J. CONFLICT RESOL. 327, 338–39 (2011) (summarizing some of the impacts of large-

will also cover thousands of acres of land, and, like wind, will change landscapes and impact wildlife habitat.[57]

This is not to say that large-scale renewables are predominantly objectionable. Indeed, many studies find that residents on the whole support these projects—particularly residents who move to communities after the projects have been built.[58] And many farmers, in particular, welcome the cash flow offered by renewables, making more money from lease payments than from crops.[59] But a non-trivial number of residents will object, and to the extent that impacts can be feasibly avoided through alternative, small-scale energy, more localized, small energy will be a preferable approach.[60]

Beyond occupying a substantial amount of land, a large-scale green energy revolution will create a *durable* infrastructural web. Indeed, more than 70% of existing transmission lines in the United States are 25 years old or older, demonstrating the long life of this type of infrastructure.[61] If increasingly common small-scale technologies such as home batteries, hydrogen fuel cells, and solar shingles become even cheaper and more accessible, stranded transmission lines could become an expensive, cumbersome project to decommission, somewhat analogous to the expensive nuclear plants that now sit idle, yet require billions in mothballing costs.[62] Still worse, a broad network of large-scale renewable farms and transmission lines could distract from or even outcompete further progress in the installation of small-scale renewables and energy efficiency. This could happen if limited government subsidies for energy focused too much on the large-scale side, leaving funding for distributed energy applications as an afterthought.

scale renewables).

[57] Airport authorities and other objectors have also expressed concerns about glare from solar panels, although NREL observes that "PV modules exhibit less glare than windows and water." *See* Megan Day & Benjamin Mow, *Research and Analysis Demonstrate the Lack of Impacts of Glare from Photovoltaic Modules*, NAT'L RENEWABLE ENERGY LAB. (July 31, 2018), https://www.nrel.gov/state-local-tribal/blog/posts/research-and-analysis-demonstrate-the-lack-of-impacts-of-glare-from-photovoltaic-modules.html.

[58] *See infra* note 83 and accompanying text.

[59] Gerrard, *supra* note 8, at 10602.

[60] *See, e.g.*, Bronin, *supra* note 17, at 561 (highlighting the benefits of microgrids, which require less sprawling infrastructure).

[61] *See* U.S. DEPT. OF ENERGY, *Chapter 3: Enabling Modernization of the Electric Power System*, *in* QUADRENNIAL TECHNOLOGY REVIEW 2015, at 3 https://www.energy.gov/sites/prod/files/2015/09/f26/QTR2015-3F-Transmission-and-Distribution_1.pdf.

[62] *See, e.g.*, Jeffrey Collins, *Mothballed Reactors: Fight over South Carolina Utility Fees*, AP (Apr. 25, 2018), https://apnews.com/article/cbd58bd29a6b4c8a83cb6d96d643954a.

Beyond creating durable infrastructure that occupies thousands of acres of land, renewable energy has environmental impacts, although it is important to contextualize these impacts.[63] The environmental impacts of renewable energy are lower than those of fossil fuels, and they pale in comparison to the mass wildlife extinctions likely to be wrought by climate change.[64] But solar and wind farms do disrupt the habitats of endangered species, and wind farms kill bats and birds (although fewer birds than some other types of power plants kill).[65] Further, the production of solar panels and batteries requires rare metals and produces hazardous waste.[66]

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[63] *See* Jeffrey E. Lovich & Joshua R. Ennen, *Wildlife Conservation and Solar Energy Development in the Desert Southwest, United States*, 61 BIOSCIENCE 982 (2011) (summarizing the environmental impacts of renewable energy).

[64] *See* José Antonio Sánchez-Zapata, Miguel Clavero, Martina Carrete, Travis L. DeVault & Virgilio Hermoso, *Effects of Renewable Energy Production and Infrastructure on Wildlife*, USDA NAT'L WILDLIFE RSCH. CTR. – STAFF PUBL'NS 97, 105–10 (2016), https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=2843&context=icwdm_usdanwrc (cataloguing the environmental impacts of solar and wind but noting that solutions for wildlife impacts from wind are "relatively straightforward" as opposed to solutions for the wildlife impacts of fossil-fuel and nuclear power plants, which are spread "across large scales"); Edgard G. Hertwich, Thomas Gibon, Evert A. Bouman, Anders Arvesen, Sangwon Suh, Garvin A. Heath, Joseph D. Bergesen, Andrea Ramirez, Bael I. Vega & Lei Shi, *Integrated Life-Cycle Assessment of Electricity-Supply Scenarios Confirms Global Environmental Benefit of Low-Carbon Technologies*, 112 PNAS 6277, 6278 (2014) (through a life cycle analysis of the environmental impacts of fossil-based and renewable technologies, which examines the impacts of manufacturing and operating generating equipment, concluding that "renewable energy technologies have significantly lower pollution-related environmental impacts per unit of generation").

[65] *See, e.g.*, W.F. Frick, E.F. Baerwald, J.F. Pollock, R.M.R. Barclay, J.A. Szymanski, T.J. Weller, A.L. Russell, S.C. Loeb, R.A. Medellin & L.P. McGuire, *Fatalities at Wind Turbines May Threaten Population Viability of a Migratory Bat*, 209 BIOLOGICAL CONSERVATION 172 (2017); LAURA E. ELLISON, U.S. GEOLOGICAL SURVEY, BATS AND WIND ENERGY—A LITERATURE SYNTHESIS AND ANNOTATED BIBLIOGRAPHY, 1–2 (2012), https://pubs.usgs.gov/of/2012/1110/OF12-1110.pdf (noting bird and bat deaths, although observing that with the introduction of newer forms of turbines, bird deaths have decreased); Benjamin K. Sovacool, *Contextualizing Avian Mortality: A Preliminary Appraisal of Bird and Bat Fatalities from Wind, Fossil-Fuel, and Nuclear Electricity*, 37 ENERGY POL'Y 2241 (2009) (noting that wind farms kill fewer birds than other forms of energy generation). *But see* Sánchez-Zapata et al., *supra* note 64, at 110 (noting that Sovacool's observation could become moot as wind energy becomes more commonplace).

[66] *See* Damien Giurco, Elsa Dominish, Nick Florin, Takuma Watari, & Benjamin McLellan, *Requirements for Minerals and Metals for 100% Renewable Scenarios*, *in* ACHIEVING THE PARIS CLIMATE AGREEMENT GOALS 437 (Sven Teske ed., 2019) (noting negative impacts of mining metals for PV panels, including, for example, the sourcing of metals from the Democratic Republic of Congo (where there are human rights-based concerns); INST. FOR SUSTAINABLE FUTURES, SUSTAINABILITY EVALUATION OF ENERGY STORAGE TECHNOLOGIES, at vii (2018), https://acola.org/wp-content/uploads/2018/08/wp3-sustainability-evaluation-energy-storage-full-report.pdf (noting that impacts from the mining, transport, production, and end use of energy storage technologies vary, but providing the example of impacts in China from mining, including "contamination of air, water and soil from lead, graphite and phosphate mining"). *But see* Hertwich et al., *supra* note 64, at 6280 (noting that initial materials requirements are higher per unit of renewable electricity but also noting "the long lifetime of the equipment, and the ability to recycle the metals," and concluding that a scenario involving predominantly renewable, as opposed to fossil, energy would require less cement and iron as compared to current materials requirements, but would increase reliance on aluminum and copper); Md. Shahariar Chowdhury, Kaz S. Rahman, Tanjia Chowdhury, Narissara Nuthammachot, Kuaanan Techato, Md. Akhtaruzzaman, Sieh Kiong

Regardless of the scales of renewable technologies prioritized, the green revolution will produce some of these impacts. The impacts are small compared to the sweeping changes to be wrought by climate change, and they do not justify stalling the move toward lower-carbon energy. But these impacts should not be ignored, and policymakers should follow pathways to renewable energy that produce fewer environmental and social effects.[67] A movement that prioritizes reductions in energy use through energy efficiency—better insulation in buildings and more efficient appliances, for example—will require fewer additions of generation infrastructure and transmission lines and will lessen environmental impacts.[68] And solar PV panels placed on rooftops, over parking lots (with the added benefit of protecting cars and their passengers from the elements), and along highways would only have to occupy approximately 7% of the nation's existing built infrastructure.[69] Airports, too, offer prime sites for solar energy. They already have large, open spaces with relatively little wildlife, and concerns about glare from the panels have largely proven to be unfounded.[70]

More nuanced analyses that investigate relatively uncluttered and unshaded rooftops—meaning that few changes would have to be made prior to panel installation—suggest that rooftop solar on existing buildings could cover an impressive 39% of U.S. electricity sales.[71]

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Tiong, Kamaruzzaman Sopian & Howshad Amin, *An Overview of Solar Photovoltaic Panels' End-of-Life Material Recycling*, 27 ENERGY STRATEGY REVIEWS 100431, at 4 (2020) (noting two types of commercially available solar photovoltaic recycling technologies but observing that few places, aside from the EU, have recycling requirements).

[67] *See, e.g.*, Sanchez-Zapata, *supra* note 60, at 114 (concluding that "[f]ighting climate change is one of the major challenges of contemporary society and renewable energies are a key instrument to reduce greenhouse emissions" but arguing for approaches to renewable energy that minimize and mitigate impacts).

[68] *See, e.g.*, *id.* (observing that "the greener energy is the one that is not consumed, so reducing energy consumption should be the highest priority to minimize the effects of energy production on ecosystems and wildlife").

[69] PV FAQS, *supra* note 50, at 1. For a discussion of the benefits of siting solar along highways, see, e.g., Tina Hodges & Amy Plovnick, *Renewable Roadsides*, U.S. DEPT. OF TRANSP.: FED. HIGHWAY ADMIN. (2019), https://www.fhwa.dot.gov/publications/publicroads/19winter/04.cfm.

[70] *See* Day & Mow, *supra* note 57 (concluding that "PV modules have been installed without incident at many airports"); Evan Riley & Scott Olson, *A Study of the Hazardous Glare Potential to Aviators from Utility-Scale Flat Plate Photovoltaic Systems*, 2011 ISRN RENEWABLE ENERGY 1, 4 (2011), https://downloads.hindawi.com/archive/2011/651857.pdf (concluding that "the potential for hazardous glare from flat-plate PV systems is similar to that of smooth water and not expected to be a hazard to air navigation").

[71] Gagnon et al., *supra* note 18, at v. This estimate is based on an investigation of accessible roof space in 128 cities; the survey covered "approximately 23% of U.S. buildings." *Id.*

### *B. Political Economy and Voter Psychology in the Energy Sphere*

Beyond its infrastructural and land-based impacts, an energy revolution that relegated small-scale energy to a minor position could perpetuate and exacerbate political economic problems.[72] Replacing more than 60% of U.S. energy infrastructure with large-scale renewables would change the character of many agricultural communities.[73] Indeed, utility-scale renewable development is already causing some consternation among rural residents concerned about the displacement of productive agricultural lands and the transformation of community character.[74] The "farming" of energy is positive in many ways, producing new economic opportunities and often allowing both farming and energy production on the same land, thus preserving struggling farms. But the social- and land-use-based changes driven by renewable energy development in rural communities are real, and not wholly positive.[75] Rural opposition to renewable energy is only heightened by the human psychological factors that serve as barriers to climate policies.

#### *1. The Psychology of Climate Change*

Human psychology is a broad-based obstacle for any policies focused on lowering carbon emissions. Even individuals who are passionately concerned about climate change take many actions that contribute to the climate crisis—

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[72] Matthew J. Burke & Jennie C. Stephens, *Political Power and Renewable Energy Futures: A Critical Review*, 35 ENERGY RSCH. & SOC. SCI. 78, 78 (2018) (noting that "[i]n many cases, local conflicts around renewables [sic] energy installations, especially wind power but also solar facilities, have delayed or even halted the uptake of renewables, mirroring the many worldwide historical conflicts around the development of technologies such as hydroelectric and nuclear power"); Uma Outka, *Fairness in the Low-Carbon Shift: Learning from Environmental Justice*, 83 BROOK. L. REV. 789, 793 (2017) (emphasizing that "there is a unique and time-sensitive context for justice concerns in the energy transition" because "change is happening quickly and discordant notions of fairness are competing for validation in the energy policy space").

[73] Note, however, that many farmers welcome renewable energy projects for the lease income that they produce. *See supra* notes 42 and 59 and accompanying text.

[74] *See, e.g.*, BEDNARIKOVA ET AL., *supra* note 42, at 73–78 (describing some Indiana rural communities' opposition to wind farms).

[75] *See, e.g.*, Jesse Fernandes, Natalie Flynn, Samantha Gibbes, Matthew Griffis, Takahiro Isshiki, Sean Killian, Laura Palombi, Nerissa Rujanavech, Sarah Tomsky & Meredith Tondro, Renewable Energy in the California Desert, Mechanisms for Evaluating Solar Development on Public Lands, (Apr. 2010) (Master of Science project, University of Michigan School of Natural Resources and the Environment) ch. 8, 5–7, http://webservices.itcs.umich.edu/drupal/recd/sites/webservices.itcs.umich.edu.drupal.recd/files/Chapter%208%20Socioeconomic%20Impact%20Analysis.pdf (full report available at https://deepblue.lib.umich.edu/handle/2027.42/69249) (summarizing the literature and noting positive impacts such as monetary contributions to the local tax base and individual landowners and negative ones such as community tensions "where the economic benefits of a wind farm are not shared equally among the residents," negative impacts on a "community's ability to hike and camp in the area," and, to some degree, declines in tourism, among other impacts, and describing similar potential impacts from solar).

flying for vacations, work, and family visits, for example, or purchasing a convenient, relatively large vehicle despite being able to afford an electric car. This is, in part, due to the free rider/public goods problem inherent to a crisis caused by the actions of more than 6 billion humans.[76] Rational individuals know that their actions, individually, do very little to stem the rising tide of carbon emissions. Although their actions might inspire others in a small community to also change their behavior, this is trivial compared to the major emissions reductions that global or national carbon abatement policies produce.[77] Relatedly, rational individuals know that the expenditures and sacrifices that they make to reduce carbon emissions provide benefits (albeit tiny ones) for a freeriding, nonpaying public, meaning that these individuals bear costs for which they are not wholly compensated.

Even the presence of national climate legislation would not erase this problem. Asking communities to endure a fast-paced, large-scale change for a global cause—on which many other countries can free ride—has been an unpopular proposition for some.[78] And although renewable energy in some regions is less expensive than coal and natural gas, in other regions electricity prices will rise.[79] Human psychology suggests that individuals prefer to avoid certain losses (such as the loss of money through higher electricity bills) over uncertain ones (such as potential injuries from climate change).[80] Further, residents in host communities for transmission lines and large-scale renewable energy generation will experience concrete, current injuries while seeing future, unpredictable, globally distributed benefits in the form of a lower threat of accelerated climate change and its impacts. And with the knowledge that even

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[76] Many other factors contribute, too. *See, e.g.*, JANET SWIM ET AL., AM. PSYCH ASS'N TASK FORCE ON THE INTERFACE BETWEEN PSYCHOLOGY AND GLOBAL CLIMATE CHANGE, PSYCHOLOGY OF GLOBAL CLIMATE CHANGE: ADDRESSING A MULTI-FACETED PHENOMENON AND SET OF CHALLENGES 84–85, https://www.apa.org/science/about/publications/climate-change.pdf (summarizing the literature and noting that in addition to humans' awareness of the "magnitude of climate change threats and perceived inability to affect their outcomes," other psychological barriers include, for example, "splitting" knowledge of the problem from emotional responses to the problem, in part as an emotional defense mechanism, and, for those who have not embraced climate change as a reality, active denial and "disinterest associated with external locus of control and fatalism").

[77] *See, e.g.*, Kimberly S. Wolske, Kenneth T. Gillingham & P. Wesley Schultz, *Peer Influence on Household Energy Behaviours*, 5 NATURE ENERGY 202, 203 (2020) (summarizing the literature that has documented peer effects "based on spatial proximity," such as rooftop solar installations inspiring others in a neighborhood to adopt similar technologies).

[78] *See, e.g.*, Jeffrey J. Rachlinski, *The Psychology of Global Climate Change*, 2000 U. ILL. L. REV. 299, 302 (2000).

[79] U.S. ENERGY INFO. ADMIN., LEVELIZED COSTS OF NEW GENERATION RESOURCES IN THE ANNUAL ENERGY OUTLOOK 2021, at 22, https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf (showing regional cost variation); Shreve & Schauer, *supra* note 5 (estimating the cost of a transition to 100% clean energy).

[80] Rachlinski, *supra* note 78, at 309.

major emissions reductions will not quickly reduce the amount of carbon in the atmosphere due to its atmospheric life, these benefits could seem even more tenuous.[81]

### 2. *Rural Politics*

Just as psychological factors present in all humans—regardless of their political ilk—serve as impediments to low-carbon energy policies, the specific geography of a green energy revolution focused on "big energy" is likely to make matters worse. A U.S. green revolution will not be evenly distributed. Because the areas with the most sunlight, wind, and open space tend to be rural, new development will predominantly occur in areas that overwhelmingly oppose Democratic policies, and particularly climate policies.[82] Nationwide surveys suggest overall positive attitudes toward large-scale renewable installations such as wind energy, particularly when developers adequately engage with and listen to community concerns.[83] But regardless of their political bent, a non-trivial number of residents find centralized, large-scale energy development to be aesthetically displeasing and object to its interruption of landscapes, impacts on wildlife, and transformation of rural economies.[84] In the

[81] *See, e.g.*, Piers M. Forster et al., *Current and Future Global Climate Change Impacts from COVID-19*, 10 NATURE CLIMATE CHANGE 913, 913 (2020) (describing how drastic emissions cuts during the COVID-19 pandemic will do very little to lower global temperatures by 2030).

[82] The vast majority of existing U.S. renewable power sources are large, centralized sources. *See, e.g.*, WOOD MACKENZIE, U.S. SOLAR MARKET INSIGHT EXECUTIVE SUMMARY Q4 2020, at 12–14 (noting that in the third quarter of 2020, 2.7 gigawatts of utility-scale solar photovoltaic (PV) were installed in the United States and 1,167 megawatts of distributed (residential and commercial) solar were installed during this same time period). Nearly all large-scale renewable energy to date is in rural areas, where voters tend to support Republican policies. *See* AM. WIND ENERGY ASS'N, WIND WORKS FOR AMERICA, http://windworksforamerica.awea.org/ (last visited January 6, 2021) (99% of U.S. wind capacity built to date is in the rural United States); Richard C. Schragger, *The Attack on American Cities,* 96 TEX. L. REV. 1163, 1167 (2018) (describing the growing urban-rural divide in politics and observing that in the 2016 election, "Clinton won the popular vote on the votes of urban citizens; Trump won the presidency on the votes of everyone else").

[83] Hoen et al., *supra* note 49, at 2 (noting that "[t]ypically, researchers have found local attitudes to be largely positive," but observing differences in terms of whether residents moved to a community before or after wind turbines were constructed).

[84] *See, e.g.*, Rankin v. FPL Energy, LLC, 266 S.W.3d 506, 510 (Tex. Ct. App. 2008) (noting plaintiffs' objections to the "visual impact" of wind farm in addition to "turbines' blinking lights, the shadow flicker affect they create early in the morning and late at night, and their operational noises"); Muscarello v. Winnebago Cnty. Bd., 702 F.3d. 909, 910–11 (7th Cir. 2012) (summarizing an agricultural land owner's objections to potential wind farms, including "subjecting [the property] to 'shadow flicker and reduction of light,' 'severe noise,' 'possible 'ice throw' (from buildup of ice on spinning blades), and 'blade throws' (the blades of the windmill might fly off while spinning); interfering with radar, cell phone, GPS, television, and other wireless communications; creating an increased likelihood of lightning damage and stray voltage; increasing electromagnetic radiation; preventing crop dusting (presumably the concern is that crop-dusting aircraft might be endangered by the wind turbines); drying out her land; and killing raptors, thus compelling her to use more pesticides"); Yates v. U.S. Env't Prot. Agency, 2018 WL 2033290, at *1 (D. Or., Apr. 30, 2018) (objecting to

many rural areas where voters are already suspicious of Democrat-led initiatives, the construction of thousands of large solar and wind farms in predominantly agricultural communities threatens to expand opposition to the clean energy push. Indeed, in an example of the extent to which some Republicans oppose technologies such as wind energy, when Texas Agricultural Commissioner Sid Miller incorrectly identified wind energy as the primary cause of the 2021 Texas blackout (colloquially, "SNOVID"), he referred to wind turbines as "energy-robbing Obama Monuments."[85]

Given that utility-scale renewable farms are typically built by large corporations, a green energy revolution focused too heavily on large-scale energy would also support the increasingly common populist argument that Democrats represent "Wall Street bankers and special interests," not common people.[86] Indeed, although this generalization is inaccurate (corporate donations to Republicans also abound), reliance on "big energy" could potentially give large corporations outsized influence in the energy transition.[87] This detracts

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the impacts of solar farm construction, including, for example, frequent truck traffic; "wire, junk, and large stacks of wooden pallets"; and the use of large equipment for compacting fill dirt); Spence, *supra* note 13 (documenting widespread opposition to renewables by communities and environmental nonprofit organizations); Hannah J. Wiseman, *Taxing Local Energy Externalities*, 96 NOTRE DAME L. REV. 563 (2020) (similarly documenting opposition to large-scale renewable energy); BEDNARIKOVA ET AL., *supra* note 42, at 73–78 (noting some Indiana communities' opposition to wind farms and the movements that coalesced to support local bans and other restrictive ordinances). As explored further in Part IV, there is also opposition to rooftop solar—particularly in historic neighborhoods and communities run by homeowners' association—but the majority of states already have policies that limit this opposition to some degree.

[85] Erin Douglas & Ross Ramsey, *No, Frozen Wind Turbines Aren't the Main Culprit for Texas' Power Outages*, DALLAS MORNING NEWS (Feb. 17, 2021, 5:31 PM), https://www.dallasnews.com/news/weather/2021/02/17/no-frozen-wind-turbines-arent-the-main-culprit-for-texas-power-outages/ (quoting from a Facebook post by Commissioner Miller).

[86] Remarks by President Trump on the Election, Nov. 5, 2020 (on file with author); NextEra energy owns and operates 16% of the wind farms in the United States, and NextEra is the world's largest electric utility. *Renewable Energy*, NEXTERA ENERGY http://www.nexteraenergy.com/sustainability/environment/renewable-energy.html (last visited May 12, 2021); *Our Company*, NEXTERA ENERGY http://www.nexteraenergy.com/company.html (last visited May 12, 2021) (noting that "NextEra Energy is the world's largest utility company"); NEXTERA ENERGY, INVESTING IN AMERICA'S ENERGY INFRASTRUCTURE SUSTAINABLY AND RESPONSIBLY (2017), http://www.nexteraenergy.com/pdf/profile.pdf.

[87] *See, e.g.*, Burke & Stephens, *supra* note 72, at 79 (noting the rise of the "energy democracy" movement, which advocates for "decentralized, democratized, and community-based renewable energy futures" and "calls for reclaiming the energy sector and shifting political power to workers, households, communities, and the public, in opposition to a centralized, corporate, utility-scale renewable energy model"). For examples of corporate donations to Republicans, see, e.g., *Who are the Biggest Organization Donors?*, OPENSECRETS, https://www.opensecrets.org/elections-overview/top-organizations (last visited Apr. 9, 2021) (showing organizations such as Koch Industries and Energy Transfer LP that made millions of dollars in contributions to Republican candidates in 2019–20). Although Republicans, like Democrats, receive large amounts of corporate donations, it is true that the Republican party is now substantially funded by grassroots donations. *See, e.g.*, James Oliphant, Jason Lange, Julia Harte & Tim Reid, *Republication Donations Surge Despite Corporate Boycott After Capitol Riots*, REUTERS (Mar. 9, 2021, 6:46 AM), https://www.reuters.com/article/us-usa-politics-republican-donations-

from the potential for bottom-up, community-driven energy in which residents choose the source of their clean energy and where and how it is produced.[88]

The "capture" theory of the political process posits that well-organized interests with large stakes in the outcome of a policymaking decision can unduly dominate the process that leads to that decision.[89] Even though collectively, the public at large would experience more impacts, individual benefits and costs to each member of the public are smaller than the benefits and costs experienced by smaller, individual, organized interests. And the transaction costs of organizing to lobby are high for the public.[90] There are numerous critiques of this theory, including, for example, the simple empirical observation that many regulations that benefit the diffuse public have been promulgated.[91] Public-interested regulations can emerge because lobbying by wealthy firms can produce political counterweights, including new alignments of interests antithetical to the most powerful interests.[92]

Despite these and other critiques, in some circumstances, it appears that the largest industry players still have the upper hand in the political process depending on their wealth and their long-running connections to decision-makers. Perhaps the starkest example of industry capture in the energy sector comes from the coal mining industry in West Virginia, where large coal companies dominated the state legislature and courts; they used this leverage to

ins/republican-donations-surge-despite-corporate-boycott-after-capitol-riots-idUSKBN2B118K (noting that "Republican fundraising operations supporting Senate and House candidates raked in a combined $15.8 million in January alone on the strength of small-dollar donations").

88 Shalanda Baker explores in depth the potential for energy to be transformative if placed in the hands of people who have historically lacked power over the energy system and have shouldered the bulk of the system's burdens. *See, e.g.*, Baker, *supra* note 11, at 30–33 (exploring the potentially transformative benefits of rooftop solar, net metering, and community energy if access to these resources were expanded to low-income populations).

89 *See* Michael A. Livermore & Richard L. Revesz, *Regulatory Review, Capture, and Agency Inaction*, 101 GEO. L.J. 1337, 1342–43 (2013).

90 *See, e.g.*, *id.* (defining capture).

91 *See, e.g.*, Matthew Wansley, *Virtuous Capture*, 67 ADMIN. L. REV. 419, 422 (2015) (noting many "examples of regulations that do impose costs on the concentrated, wealthy repeat player interest groups and generate benefits to a diffuse public").

92 *See, e.g.*, *id.* at 433. Furthermore, interest groups with power in the political process do not only include traditional corporations. They also encompass powerful national environmental groups that tend to receive more contributions when lobbying by traditional corporations is perceived to overly sway decisionmakers and produce damaging results. *Cf.* DENNIS C. MUELLER, PUBLIC CHOICE III 473 (2003) (describing interest groups as those that "seek to further the objectives of their members as factors of production or producers," as well as those that "seek to influence public policy or public opinion with respect to particular public good-externality issues," including "environmental groups").

influence federal regulation and enforcement of the environmental and safety-based aspects of coal mining.[93]

Large-scale wind and solar industries, like other forms of energy development, involve many large corporations.[94] And while none appear to have exhibited behavior that rises to the level of coal industry influence in West Virginia, they do have powerful political sway. For example, the world's largest utility has the largest market share in both solar and wind capacity in the United States, representing 16% of the U.S. wind market and 11% of the U.S. solar market.[95] This utility, headquartered in Florida, has been a leader on the path to cleaner energy in the United States, but it is also known for having outsized influence with the Florida Legislature and the state's agency that regulates utilities.[96] This utility and three other large utilities in Florida spent $20 million to support a failed ballot initiative that would have constrained distributed solar expansion in Florida.[97]

Large-scale energy, in short, often involves large companies with substantial political sway. Calls for the democratization of energy emphasize that decentralized renewables place power in the hands of individuals and communities rather than large corporations.[98]

### *C. Environmental Justice*

A rapid expansion of large-scale renewable energy and high-voltage transmission lines, some of which could be avoided through small-scale energy, will not only threaten to extend the power of wealthy interests; it will also impact hundreds of communities. Communities hosting new wind and solar farms will benefit from an increased tax base or payments in lieu of taxes, and some job

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93 *See, e.g.*, Hugh M. Caperton v. Massey Coal, 556 U.S. 868, 872–73 (2009) (noting Massey Coal's chairman Don Blankenship's $3 million in contributions to an attorney's political organization and ads and the ultimate victory of that attorney in a West Virginia Supreme Court election, followed by a West Virginia Supreme Court reversal of a $50 million jury verdict against Massey).

94 *See infra* note 95 and accompanying text.

95 *See supra* note 86.

96 The nonpartisan group Integrity Florida reports that Florida Power and Light made nearly $15 million in state-level political contributions in 2016. ALAN STEONCIPHER, BRAD ASHWELL & BEN WILCOX, INTEGRITY FLORIDA: POWER PLAY REDUX: POLITICAL INFLUENCE OF FLORIDA'S TOP ENERGY CORPORATIONS 5 (2018), https://www.integrityflorida.org/wp-content/uploads/2020/06/Power-Play-Redux-final.pdf.

97 Elizabeth Koh, *Political Spending by Utilities Has Jumped, Boosted by Opposition to Rooftop Solar*, MIA. HERALD (May 17, 2018, 3:34 PM) https://www.miamiherald.com/news/politics-government/state-politics/article211235624.html.

98 *See supra* note 87.

creation, if renewable energy developers hire employees locally.[99] But they will also experience the land use and other harms explored in Part I.A. This raises serious environmental justice concerns, which arise when developers site LULUs in communities where residents lack the money, time, and other resources needed to powerfully lobby for land uses more tailored to community needs.[100] As with other forms of energy development, many of the effects of renewable energy generation and transmission lines are highly localized—indeed, even more so than fossil fuel-fired plants, as renewables do not emit pollution that travels across municipal and state lines.[101] Yet the benefits are widespread. This creates a classic environmental justice problem in which the communities least equipped to effectively fight the siting of renewables are likely to shoulder the burdens of these technologies, with the broader, more distant public reaping the benefits.[102] Indeed, there is a real threat that transmission lines for new large-scale renewable energy generation will be predominantly located in low-income areas because it is cheaper to condemn low-value land.[103]

### *D. Reliability of the Electricity Supply*

A final concern associated with a rapid transition to predominantly large-scale renewables is the reliability of the electricity supply. The challenge for grid

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[99] *See* BEDNARIKOVA ET AL., *supra* note 42 (describing benefits in Indiana); GILBERT MICHAUD, CHRISTELLE KHALAF, MICHAEL ZIMMER, & DAVID JENKINS, UTIL. SCALE SOLAR ENERGY COAL. OHIO, MEASURING THE ECONOMIC IMPACTS OF UTILITY-SCALE SOLAR IN OHIO (2020), https://www.ohio.edu/voinovich-school/sites/ohio.edu.voinovich-school/files/sites/voinovich-school/files/Michaud%20G.%20et%20al.%20(2020).%20Measuring%20the%20Economic%20Impacts%20of%20Utility-Scale%20Solar%20in%20Ohio%20—-%20FINAL%20REPORT%2C%208.31.2020.pdf.

[100] These concerns are primarily distributive, meaning that communities—often low-income communities—tend to shoulder a disproportionate burden of the impacts of energy. But these concerns also involve procedural injustice, which refers to inadequate consideration of communities' needs and concerns, and recognition-based injustice, which describes inadequate knowledge, understanding, and acknowledgement of inequities. For the formation and further description of this tripartite definition of energy injustices, see Kirsten Jenkins, Darren McCauley, Raphael Heffron, Hannes Stephan & Robert Rehner, *Energy Justice: A Conceptual Review*, 11 ENERGY RSCH. & SOC. SCI. 174 (2016).

[101] *Cf.* SAMANTHA GROSS, BROOKINGS INST., RENEWABLES, LAND USE, AND LOCAL OPPOSITION IN THE UNITED STATES 10 (2020), https://www.brookings.edu/wp-content/uploads/2020/01/FP_20200113_renewables_land_use_local_opposition_gross.pdf (noting that "[a] frequent complaint" about large-scale wind energy projects "is that the power produced in these projects is not needed locally and will only benefit people in cities far away" and noting the many localized impacts).

[102] A.M. Levenda, I. Behrsin & F. Disano, *Renewable Energy for Whom? A Global Systemic Review of the Environmental Justice Implications of Renewable Energy Technologies*, 71 ENERGY RSCH. & SOC. SCI. 101837 (2021).

[103] *Cf.* James W. Coleman & Alexandra B. Klass, *Energy and Eminent Domain*, 104 MINN. L. REV. 659, 730-32 (2019) (exploring challenges with the "fair market value" approach to compensating landowners for condemned property and analyzing alternatives involving compensation in excess of fair market value).

operators is that the amount of electricity sent through transmission and distribution lines must nearly exactly match the amount of electricity used by customers on an instantaneous basis.[104] Grid operators accomplish this delicate balancing of supply and load, thus avoiding over- and under-voltages in the wires, by planning for the availability of reserve generation that can quickly come online; engaging demand response tools in which customers pre-commit to reducing electricity use during periods of peak demand; and forecasting the overall supply of electricity needed.[105]

This delicate, complex system can fail spectacularly, as most recently highlighted by the polar vortex event in Texas and neighboring states. Residents in the lower Midwest—particularly Texas—were without power for days, with temperatures inside homes reaching dangerous lows, critical medical support failing, and many water pipes freezing and bursting.[106] The causes of this widespread power outage were numerous and complex. Texas relies on wind power and natural gas to fulfill much of its energy demand.[107] Coal and nuclear energy also provide some electricity in Texas.[108] But during the cold snap, wind generation decreased slightly, in part because some wind turbines froze, and, more importantly, natural gas generation failed dramatically.[109] At the same time, load increased astronomically as residents and businesses turned heating systems to their maximum capacity in an effort to stay warm.[110]As electricity

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104 *See* U.S. DEPT. OF ENERGY, BENEFITS OF DEMAND RESPONSE IN ELECTRICITY MARKETS AND RECOMMENDATIONS FOR ACHIEVING THEM: A REPORT TO THE UNITED STATES CONGRESS PURSUANT TO SECTION 1252 OF THE ENERGY POLICY ACT OF 2005, at x (2006), https://www.energy.gov/sites/prod/files/oeprod/DocumentsandMedia/DOE_Benefits_of_Demand_Response_in_Electricity_Markets_and_Recommendations_for_Achieving_Them_Report_to_Congress.pdf.

105 *Id.* at x–xi.

106 *See* Jack Healey, Richard Fausset & James Dobbins *Cracked Pipes, Frozen Wells, Offline Treatment Plants: A Texan Water Crisis*, NY TIMES (Feb. 20, 2021), https://www.nytimes.com/2021/02/18/us/texas-water-crisis-winter-storm.html.

107 *Texas Profile Analysis*, U.S. ENERGY INFO. ADMIN. (Apr. 15, 2021), https://www.eia.gov/state/analysis.php?sid=TX (Noting that "[n]atural gas-fired power plants supplied more than half of the state's electricity net generation in 2019" and "wind energy provided more than one-sixth of Texas's generation" in the same year).

108 *See* Magness, *supra* note 16, at 4 (describing this balancing).

109 Wind outages were not the primary cause of the problem in Texas. *See, e.g.*, PATRICK MILLIGAN, ICF, WINTER STORMS WREAK HAVOC ON ERCOT GRID 1 (2021), https://go.icf.com/rs/072-WJX-782/images/ICF%20-%20Winter%20Storms%20Wreak%20Havoc%20on%20ERCOT%20Grid.pdf ("Total wind output is slightly below expectations, but the main supply issue is lack of available thermal generation (both gas and coal) due to freezing conditions."); Magness, *supra* note 16, at 14 (showing that natural gas plants had more outages than any other type of generation during the extreme cold event).

110 *See, e.g.*, OFF. OF CYBERSECURITY, ENERGY SECURITY, AND EMERGENCY RESPONSE, U.S. DEPT. OF ENERGY, SITUATION REPORT: EXTREME COLD & WINTER WEATHER UPDATE #1 (2021), https://www.energy.gov/sites/prod/files/2021/02/f82/TLP-WHITE_DOE%20Situation%20Update_Cold%20%20Winter%20Weather_%231.pdf (noting "record winter power demand" in Texas).

outages began, electrified natural gas compressors necessary to push gas through pipelines to power plants stopped working, electric pumps that help to pull natural gas from producing wells and storage also shut down, and components on gas wells and pipelines froze, as did components at the natural gas plants themselves.[111] Some coal and nuclear plants also experienced generation declines.[112]

Politicians were quick to blame wind for the debacle, and they were incorrect to do so; natural gas outages were the predominant cause of the blackout.[113] But it is true that extensive renewable energy penetration in the generation mix can cause reliability challenges if not managed properly. For example, when wind and solar generation dominate the energy mix, other sources of generation such as natural gas serve largely as back-ups, and many developers are hesitant to build back-up generation capacity that will be rarely used.[114] Without enough back-up power, intermittent renewables, which decrease output when the sun goes behind a cloud or the wind stops blowing, can cause reliability problems.[115] Grid operators and generators solve these challenges in a variety of ways. A growing number of solar and wind plants have battery back-up (available only for short periods), and large renewable energy generators must prove that they have the ability to remotely shut down power during periods of over-supply.[116] And for regionally-governed grids that cover large geographic areas, it is likely that the wind is blowing or the sun is shining somewhere in the region during most parts of the day, thus allowing the grid operator to dispatch renewable electricity from different locations at different times.[117] But large, interconnected electricity systems—whether based primarily on renewable or

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[111] *See, e.g.*, T.L. Hamilton, *Texas Gas Well Freeze-Offs, Power Cuts Persist*, ARGUS (Feb. 17, 2021), https://www.argusmedia.com/en/news/2187702-texas-gas-well-freezeoffs-power-cuts-persist.

[112] Erin Douglas, *Texas Relies Largely on Natural Gas for Power. It Wasn't Ready for the Extreme Cold*, TX. TRIBUNE (Feb. 16, 2021, 5:00 PM), https://www.texastribune.org/2021/02/16/natural-gas-power-storm/.

[113] *See, e.g.*, Bryan Mena, *Abbott and Other Republicans Blamed Green Energy for Texas's Power Woes. But the State Runs on Fossil Fuels*, TX. TRIBUNE (Feb. 17, 2021, 7:00 PM), https://www.texastribune.org/2021/02/17/abbott-republicans-green-energy/.

[114] THOMAS JENKIN, PHILIP BEITER & ROBERT MARGOLIS, NAT'L RENEWABLE ENERGY LAB. CAPACITY PAYMENTS IN RESTRUCTURED MARKETS UNDER LOW AND HIGH PENETRATION LEVELS OF RENEWABLE ENERGY (2016), https://www.nrel.gov/docs/fy16osti/65491.pdf (noting that variable renewable energy resources can "suppress energy prices while providing relatively little capacity" and that this can "impact compensation and associated incentives for new and existing conventional thermal generation").

[115] *See* L. BIRD, M. MILLIGAN & D. LEW, INTEGRATING VARIABLE RENEWABLE ENERGY: CHALLENGES AND SOLUTIONS 1 (2013), https://www.nrel.gov/docs/fy13osti/60451.pdf (noting that "supply-side variability and uncertainty can pose new challenges for utilities and system operators").

[116] Interconnection for Wind Energy, 70 Fed. Reg. 242 (Fed. Energy Reg. Comm'n Dec. 12, 2005) (codified at 18 C.F.R. pt. 35) (Order 661).

[117] BIRD ET AL., *supra* note 115, at 1.

fossil fuel systems—remain vulnerable, as highlighted by the recent incident in the U.S. South.

Relying more heavily on smaller, more distributed green energy could address many of the challenges here, as explored in Part III. Small energy requires fewer transmission and distribution lines, thus impacting fewer host communities. It enhances reliability by providing for "islanded" microgrids or rooftop systems that can continue operating even in the face of widespread outages.[118] And more rapid, widespread construction of small-scale green energy can directly distribute the benefits of green energy to the communities that have historically experienced lopsided impacts from energy generation and production. Despite these benefits, one might legitimately ask whether a significant expansion of small energy is practical. The following Part explores the factors that have made small-scale energy a more feasible option within a broader green energy revolution.

## II. Factors Supporting a Small Green Revolution

The prospect of supplying a large percentage of U.S. electricity from rooftops, roadways, and parking lots—a scenario deemed possible by the National Renewable Energy Laboratory—likely seems implausible to the casual observer.[119] But a combination of distributed renewables paired with battery storage; energy efficiency measures; and community solar and microgrids could achieve this goal.[120] This is due to the convergence of technological and economic factors that support these small energy forms.

### *A. Technology*

A small-scale clean energy revolution is possible, in part, because the recent technological advances in this area have been nothing short of astounding. Solar panels, wind turbines, and home batteries have become far more efficient and effective in the past several decades.[121]

PV panels now come in a variety of forms, including shingles attached to the roofs of homes and apartment buildings.[122] Between 2018 and 2019, the residential solar industry experienced 15% growth, reaching "its highest

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[118] *See infra* note 195 and accompanying text.

[119] Gagnon et al., *supra* note 19.

[120] *See supra* note 69 and accompanying text.

[121] *See infra* notes 127–38 and accompanying text.

[122] *Solar Shingles: Make Your Roof Solar-Powered (5 Brands)*, SOLAR MAG. (Feb. 21, 2020), https://solarmagazine.com/solar-roofs/solar-shingles/.

installation volumes in history."[123] Indeed, PV technologies are now so readily available (and increasingly affordable) that California recently mandated that most new residential buildings be constructed to include PV technologies.[124] Commercial rooftop solar, too, has burgeoned. For instance, Walmart had 335 renewable energy projects completed or under construction worldwide in 2013.[125]

Beyond the solar panels themselves, in the past five years, batteries to back up distributed renewables have become widely available and are rapidly dropping in price.[126] Industry experts estimate that one-third of residential solar systems will also have battery storage by 2025.[127] Given the recent growth of battery storage, customers with adequate means can, if they wish, wholly disconnect from the power grid, thus imposing no new constraints on local distribution wires. Approximately 180,000 U.S. homeowners have already installed batteries and solar panels and have fully disconnected from the grid.[128]

A full grid disconnect does, however, require some sacrifices of comfort. When operating on their own without input from a PV panel—at night, for example—home batteries cannot typically power all appliances in the home, particularly power-hungry appliances such as air conditioning systems.[129] Homes and businesses with solar panels and batteries can also remain grid connected but rely on their panels and batteries during a blackout, provided they install the proper technologies to cut their system off from the grid during the

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123 Press Release, Solar Energy Indus. Ass'n, Solar Accounts for 40% of U.S. Electric Generating Capacity Additions in 2019, Adds 13.3 GW (Mar. 17, 2020), https://www.seia.org/news/solar-accounts-40-us-electric-generating-capacity-additions-2019-adds-133-gw.

124 24 Cal. Code Regs. 150.1(b)(1); Cal. Energy Commission, Building Energy Efficiency Standards for Residential and Nonresidential Buildings § 10-115 (2019) (allowing community solar installations in lieu of panels on each new rooftop).

125 David Ozment, *Walmart's Commitment to Solar*, WALMART (May 9, 2014), https://corporate.walmart.com/newsroom/sustainability/20140509/walmarts-commitment-to-solar.

126 *See* U.S. ENERGY INFO. ADMIN., BATTERY STORAGE IN THE UNITED STATES: AN UPDATE ON MARKET TRENDS 5, 18 (2020), https://www.eia.gov/analysis/studies/electricity/batterystorage/pdf/battery_storage.pdf (noting that U.S. battery storage capacity doubled between 2015 and 2018, with an average decrease in cost of 61% between 2015 and 2017).

127 SOLAR ENERGY INDUS. ASS'N, SOLAR MARKET INSIGHT REPORT 2020 Q3, https://www.seia.org/research-resources/solar-market-insight-report-2020-q3#:~:text=By%202025%2C%20one%2Dfifth%20of,be%20paired%20with%20energy%20storage.

128 Barry Cinnamon, *The Myth of the Whole-Home Battery Backup*, GREEN TECH MEDIA, https://www.greentechmedia.com/articles/read/the-myth-of-whole-home-battery-backup (Dec. 2, 2019).

129 *Id.* (noting that "battery backup inverters are not powerful enough to start and run many large appliances"). Tesla notes, however, that two Powerwalls can run some air conditioners. *What Does Powerwall Back Up*, TESLA, https://www.tesla.com/support/energy/powerwall/learn/what-does-powerwall-back-up (last visited May 12, 2021).

blackout.[130] Solar will not be the most efficient option in cloudy climates, but in these areas, more energy efficiency measures can be implemented, and a growing suite of small wind technologies also show promise, as do fuel cells powered by green hydrogen.[131]

Beyond rooftop and parking lot solar, options for community solar and wind projects have recently blossomed. Community renewable energy involves mid-scale installations, often in public or quasi-public places such as airports, which typically provide electricity to a group of nearby customers who have subscribed to the project.[132] The technological advances in PV technologies noted above apply equally to the residential and community scales.[133] And for the larger solar photovoltaic panels sometimes installed for community projects, there are now lightweight panels that can be installed primarily with hand labor rather than heavy machines. These have been deployed at former landfills, airports, and similar sites.[134]

Similarly, community-scale microgrids are increasingly feasible, offering local, green options and enhanced reliability during outages. Microgrids are "small-scale, low-voltage distributed generation," which typically power a portion of a neighborhood using "sources such as solar collectors, wind power systems, microturbines, geothermal wells, and fuel cells."[135] In Connecticut, where the state has provided support for microgrids, fuel cell-powered microgrids (relying primarily on natural gas—a non-renewable resource) now supply electricity to critical infrastructure within neighborhoods—particularly

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130 *See, e.g.*, *Will Solar Panels Work During a Power Outage*, SUNRUN, https://www.sunrun.com/go-solar-center/solar-articles/will-solar-panels-work-during-a-power-outage#:~:text=The%20inverter%20runs%20to%20a,so%20will%20your%20solar%20panels.&text=The%20only%20way%20for%20your,blackout%20is%20solar%20battery%20storage (last visited May 12, 2021) (noting that "[t]he only way for your solar panels to continue generating power during a blackout is solar battery storage").

131 *See, e.g.*, U.S. DEPT. OF ENERGY, SMALL WIND GUIDEBOOK, https://windexchange.energy.gov/small-wind-guidebook (last visited May 12, 2021) (describing the range of small wind technologies available to homeowners, businesses, and communities). Green hydrogen is hydrogen fuel produced from renewable energy. Jim Robbins, *Green Hydrogen: Could It Be Key to a Carbon-Free Economy?*, YALE ENV'T 360 (Nov. 5, 2020), https://e360.yale.edu/features/green-hydrogen-could-it-be-key-to-a-carbon-free-economy.

132 *See, e.g.*, *Community Solar Basics*, OFF. ENERGY EFFICIENCY & RENEWABLE ENERGY, U.S. DEPT. OF ENERGY, https://www.energy.gov/eere/solar/community-solar-basics (last visited May 12, 2021) (defining community solar as "any solar project or purchasing program, within a geographic area, in which the benefits of a solar project flow to multiple customers such as individuals, businesses, nonprofits, and other groups").

133 U.S. DEPT. OF ENERGY, A GUIDE TO COMMUNITY SOLAR: UTILITY, PRIVATE, AND NON-PROFIT PROJECT DEVELOPMENT (2010), https://www.nrel.gov/docs/fy11osti/49930.pdf.

134 *See, e.g.*, *PEG Substructure for Solar Power Plants*, JURCHEN TECH., https://www.jurchen-technology.com/products/pv-substructures/peg/ (last visited May 12, 2021).

135 Sara C. Bronin, *Curbing Energy Sprawl with Microgrids*, 43 CONN. L. REV. 547, 549–50 (2010).

public buildings that can provide refuge and support during storms, including gas stations, grocery stores, schools, senior centers, and health centers.[136]

Finally, with respect to reducing energy demand in buildings through energy efficiency, technologies have also advanced substantially. Smart meters and smart appliances now allow motivated customers to control all aspects of their energy use, provided customers have the means to access these technologies.[137] And recent advances have improved technologies such as window-installed air conditioners, which were previously inefficient.[138] Furthermore, many energy efficiency measures do not require sophisticated technologies. The simple weatherization of homes through caulking of cracks, improved insulation, and similar measures can generate meaningful energy savings.[139]

### *B. Economics*

Beyond technological advances, the economics of small energy have changed dramatically in recent years. Perhaps the most compelling statistic is the price of solar panels that can be installed over parking lots, along roadways, and on roofs. Due in large part to Chinese subsidization of panel production, the cost of panels and associated hardware dropped by 82% between 2010 and 2018.[140]

Indeed, *all* costs of small-scale PV solar have dropped—not just the cost of the panels and associated physical equipment, but also installation labor and soft

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136 Elisa Wood, *Connecticut's Latest Microgrid and Fuel Cell Project Goes Live in Hartford*, MICROGRID KNOWLEDGE (Apr. 25, 2017), https://microgridknowledge.com/microgrid-and-fuel-cell-hartford/. Although these microgrids are primarily powered using natural gas fuel cells, microgrids can also be powered with green hydrogen fuel.

137 *See, e.g.*, *Smart Appliances*, HOME DEPOT, https://www.homedepot.com/b/Smart-Home-Smart-Appliances/N-5yc1vZc7c2 (last visited May 12, 2021).

138 U.S. DEPT. OF ENERGY, BETTER BUILDINGS (2017), https://www.energy.gov/sites/prod/files/2017/07/f35/bbrn_CallSummary_InnovationStation_051817.pdf (describing EcoSnap-AC).

139 *See, e.g.*, OFF. ENERGY EFFICIENCY & RENEWABLE ENERGY, DEPT. OF ENERGY, GETTING IT RIGHT: WEATHERIZATION AND ENERGY EFFICIENCY ARE GOOD INVESTMENTS (2015), https://www.energy.gov/eere/articles/getting-it-right-weatherization-and-energy-efficiency-are-good-investments#:~:text=Savings%20estimates%20from%20the%20E2e,higher%20end%20of%20that%20range.&text=This%20study%20reported%20average%20annual,for%20weatherized%20single%2Dfamily%20homes (noting "10 to 20 percent energy savings from weatherization").

140 RAN FU, DAVID FELDMAN & ROBERT MARGOLIS, NATL. RENEWABLE ENERGY LAB., U.S. SOLAR PHOTOVOLTAIC SYSTEM COST BENCHMARK: Q1 2018, at 21, https://www.nrel.gov/docs/fy19osti/72399.pdf.

costs such as overhead.[141] Labor costs experienced nearly as precipitous a decline as hardware in the same time period—dropping by 77%.[142]

Rooftop solar will not always be the most efficient option: many roofs are not properly oriented for solar access or have physical obstacles to the installation of panels, the roofs that support panels fail over time, and solar panels placed on millions of roofs require maintenance and repair.[143] Community solar projects offer advantages in these areas; they are often sited at airports and other non-rooftop locations within communities, and they are typically maintained by an independent entity, not individual homeowners.[144] The prices for PV for mid-scale applications have similarly declined, thus making commercial- and community-scale solar more feasible and affordable.[145]

Utility-scale systems are still far more efficient on a per-watt basis than smaller-scale systems—particularly residential systems—due to economies of scale in terms of acquiring the project (e.g., getting a customer to agree to a rooftop lease as opposed to permission to use a large property), supply chain issues, and labor.[146] But there are credible arguments that as the effects of climate change intensify, it will be less expensive to rely on distributed renewables than to increase the strength of thousands of miles of transmission lines vulnerable to storm damage and move the large power plants threatened by sea level rise.[147] That said, centralized generation and transmission remain far cheaper than small-scale energy, and recent studies emphasize that the lowest

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141 *Solar Installed System Cost Analysis*, NAT'L RENEWABLE ENERGY LAB., https://www.nrel.gov/analysis/solar-installed-system-cost.html (last visited May 12, 2021).

142 FU ET AL., *supra* note 140, at 21.

143 U.S. DEPT. OF ENERGY, A GUIDE TO COMMUNITY SOLAR: UTILITY, PRIVATE, AND NON-PROFIT PROJECT DEVELOPMENT 2–3 (2010), https://www.nrel.gov/docs/fy11osti/49930.pdf.

144 *See, e.g.*, *Community Solar*, NORWICH SOLAR TECHS., https://norwichsolar.com/solutions/community-solar/ (last visited May 12, 2021) (noting that the community solar company "has created an LLC that is responsible for the operations and maintenance" of its several projects).

145 *Id.*

146 MICHAEL WOODHOUSE ET AL., NAT'L RENEWABLE ENERGY LAB., U.S. DEPT. OF ENERGY, ON THE PATH TO SUNSHOT: THE ROLE OF ADVANCEMENTS IN SOLAR PHOTOVOLTAIC EFFICIENCY, RELIABILITY, AND COSTS 39 (2016), https://www.nrel.gov/docs/fy16osti/65872.pdf; *Lazard's Levelized Cost of Energy Analysis 12.0*, LAZARD (Nov. 8, 2018), https://www.lazard.com/perspective/levelized-cost-of-energy-and-levelized-cost-of-storage-2018/ (showing far higher costs of rooftop solar as compared to utility-scale solar and onshore wind).

147 *See, e.g.*, ELIZABETH B. STEIN & FERIT UCAR, ENV'T DEF. FUND, DRIVING ENVIRONMENTAL OUTCOMES THROUGH UTILITY REFORM: LESSONS FROM NEW YORK REV 15–17 (2018), https://www.edf.org/sites/default/files/documents/driving-environmental-outcomes.pdf (describing a proposal by Con Edison after Superstorm Sandy to recover $1 billion from ratepayers "for the restoration and hardening of system elements" and successful arguments by those opposed to the plan that a system that better integrated distributed resources, managed load (demand), and took other approaches to enhance the flexibility of the grid rather than "harden" the traditional grid would be more effective).

cost way to a zero-carbon grid is likely through large-scale energy and a large-scale expansion of the transmission grid.[148]

The following Part explores how a green energy revolution could place more emphasis on small-scale renewable technologies and reduce the impacts of the many large-scale installations that will still be required to dramatically lower carbon emissions from the U.S. electricity sector.

## III. A BETTER PATH FORWARD: GREEN ENERGY POLICY STRATEGIES AND BENEFITS

Given recent advances in small-scale technologies, a localized green revolution, in concert with numerous other pathways toward a lower carbon future, including utility-scale renewables, is feasible. A green revolution at the federal, state, and local levels that prioritized energy efficiency and smaller-scale renewable generation could empower smaller groups with historic disadvantages in the political process, overcome psychological barriers to climate action, and avoid some of the massive transmission and large-scale generation buildout likely to face strong opposition in rural communities. It could also enhance resiliency and reliability, as discussed here. This Part explores the types of policy changes needed to steer the green energy revolution toward a dual small- and large-scale focus and the benefits of this policy approach.

### *A. Formulating a "Small Energy First" Climate Policy: More Ambitious Mandates for Small-Scale Generation and Energy Efficiency*

To accomplish a smaller-scale green energy revolution, U.S. and state policies, including state clean energy policies and renewable portfolio standards, should mandate larger percentages of clean energy to come from small-scale sources. President Biden's plan calls for 100% carbon-free electricity by 2035; a plan focused on small-scale energy would require some of this change—say, 30%—to be achieved through energy efficiency projects, distributed renewable energy and storage projects, and community renewables and microgrids. President Biden's pledge to build 1.5 million new energy efficient homes is a start, but it pales in comparison to the energy infrastructure that will have to be built to support 100% clean energy.[149]

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[148] Jeff St. John, *MIT Study: Transmission Is Key to a Low-Cost, Decarbonized US Grid*, GREEN TECH MEDIA (Jan. 8, 2021), https://www.greentechmedia.com/articles/read/study-transmission-is-the-key-to-a-low-cost-decarbonized-u.s-grid.

[149] *See* President Joseph R. Biden, Jr., Remarks by President Biden Before Signing Executive Actions on

Many state renewable portfolio standards already have specific "carve-outs" for distributed renewables, but they are quite small.[150] And although twenty-five states have energy efficiency resource standards, many are also inadequately ambitious.[151] Grants and other incentives for clean energy projects should similarly prioritize small-scale infrastructure.

### *B. Reorienting Large-Scale Renewable Projects*

Although small-scale green energy could cover a meaningful portion of energy load, a federal policy focused predominantly on large-scale renewable projects will still be critical for substantial carbon reductions to occur in the electricity sector.[152] To address environmental impacts and environmental justice concerns associated with the construction of these projects, policies should build from New York's example, where the state's 2020 clean energy policy gives expedited permitting to large renewable energy projects proposed on "an existing or abandoned commercial use" lot.[153] The redevelopment of these types of sites—if done properly and carefully—could benefit communities negatively impacted by past projects due to pollution or longstanding site vacancies, for example.[154]

Many rural areas, however, have few abandoned commercial lots and tend to be dominated by agricultural land. Federal and state green energy policies should therefore expand mandates for the use of marginal lands, such as low-productivity farmlands or abandoned resource extraction sites.[155] New Mexico's

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Tackling Climate Change. Creating Jobs, and Restoring Scientific Integrity (Jan. 27, 2021), https://www.whitehouse.gov/briefing-room/speeches-remarks/2021/01/27/remarks-by-president-biden-before-signing-executive-actions-on-tackling-climate-change-creating-jobs-and-restoring-scientific-integrity/.

[150] NC Clean Energy Technology Center, Renewable Portfolio Standards (RPS) with Solar or Distributed Generation Provisions, DSIRE (Mar. 2015), https://www.dsireusa.org/resources/detailed-summary-maps/rps-carveout-map-3/ (showing requirements that between 0.25 and 4.5% of renewable energy within states come from distributed generation).

[151] DSIRE, NC CLEAN ENERGY TECHNOLOGY CENTER, ENERGY EFFICIENCY RESOURCE STANDARDS (AND GOALS) (2019), https://s3.amazonaws.com/ncsolarcen-prod/wp-content/uploads/2019/07/Energy-Efficiency-Resource-Standards.pdf.

[152] *See supra* note 71 and accompanying text.

[153] S. 7508-B § 94-c 5.f (N.Y. 2020). For a more in-depth exploration of New York's renewable energy siting law, see Michael Gerrard & Edward McTiernan, *New York's State Statute on Siting Renewable Energy Facilities*, N.Y.L.J. (May 14, 2020), https://www.arnoldporter.com/-/media/files/perspectives/publications/2020/05/newyorksenvironmentallaw.pdf?.

[154] For exploration of the benefits of siting utility-scale renewable generation on disturbed sites and other states that encourage such siting, *see, e.g.*, Gerrard, *supra* note 8, at 10602; Amy Morris, Jessica Owley & Emily Capello, *Green Siting for Green Energy*, 5 J. ENERGY & ENV'T. L .17 (2014) .

[155] *But see supra* note 19 for a description of the caution that must be exercised in defining marginalized lands.

Energy Transition Act partially takes this approach.[156] The Act prioritizes renewable energy sites that have the "least environmental impacts" and reduce the cost of reclaiming former coal mine sites in coal power plant communities, presumably by beneficially reusing those sites.[157] Siting new renewable generation near or on the sites of old power plants threatens to perpetuate past environmental justice issues if not done properly—with extensive community engagement. But if the generation can be built in a way that is compatible with the community, it has the added benefit of requiring fewer new transmission resources because it can interconnect with the transmission lines previously used by the coal-fired plant.[158]

Offshore wind also avoids many of the land-based impacts of large-scale renewables. Communities along the shore sometimes vociferously object to the aesthetics, and communities between the generation and load centers still shoulder the burdens of transmission lines.[159] Furthermore, our oceans are not empty spaces; pipelines, transmission lines, shipping routes, fisheries, aquaculture, and a variety of other offshore uses already pose obstacles to additional offshore development; these obstacles are surmountable through planning, however.[160] An additional barrier arises from the high cost of offshore wind as compared to its onshore counterpart.[161] But given the large percentage of the U.S. population that lives along the coast; the relatively open seabed; and the relatively constant, stronger wind offshore, many East Coast states are pursuing offshore wind.[162]

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[156] S.B. 489 § 3 (N.M. 2019).

[157] *Id.*

[158] *See, e.g.*, Karen Uhlenhuth, *Solar Firm Buying Land Rights Nera Coal Plants with Eye Toward Transmission*, ENERGY NEWS NETWORK (Jul. 14, 2020), https://energynews.us/2020/07/14/west/solar-firm-buying-land-rights-near-coal-plants-with-eye-toward-transmission (noting that a large solar company is leasing land near coal plants in hopes of opening up "lucrative transmission connections").

[159] The Cape Wind project, proposed in federal waters near the Massachusetts coast, attracted stiff opposition from wealthy residents near the coast. Although the developer of the proposed project won all of the numerous lawsuits filed in opposition to the project, it abandoned the project after sixteen years of litigation. Katharine Q. Seelye, *After 16 Years, Hopes for Cape Cod Wind Farm Float Away*, N.Y. TIMES (Dec. 19, 2017), https://www.nytimes.com/2017/12/19/us/offshore-cape-wind-farm.html.

[160] *See, e.g.*, LEVITAN & ASSOCIATES, INC., N.J. BD. OF PUB. UTIL., OFFSHORE WIND TRANSMISSION STUDY COMPARISON OF OPTIONS 59, https://www.nj.gov/bpu/pdf/publicnotice/Transmission%20Study%20Report%2029Dec2020%202nd%20FINAL.pdf (describing some of the obstacles to offshore transmission and methods for avoiding these obstacles).

[161] *See* ENERGY INFO. ADMIN., LEVELIZED COST OF NEW GENERATION RESOURCES IN THE ANNUAL ENERGY OUTLOOK 2021 at 7 (2021), https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf (showing a total levelized cost of $115.04 per megawatt hours of new offshore wind as opposed to $31.45 per megawatt hour for onshore wind).

[162] *See* Iulia Gheorghiu, *Biden Administration Sets Target for 30 GW of Offshore Wind by 2030, Plans Offshore Leasing off NY, NJ Coasts*, UTILITY DIVE (Mar. 30, 2021), https://www.utilitydive.com/news/biden-

## C. *Addressing Environmental Justice Concerns*

The bulk of existing industrial projects—many of them power plants—are sited in low-income communities of color, posing a major environmental justice concern.[163] To address past wrongs and provide benefits to these and similar communities, government-mandated or subsidized small-scale energy projects can and should be implemented first in low-income homes and apartments in both rural and urban areas.[164] Beyond prioritizing low-income housing, policymakers should require a percentage of funds for green energy initiatives to specifically reach low-income communities of color.[165] To date, rooftop solar and many energy savings measures have largely been implemented in single family homes, largely in more affluent communities where individuals can afford the high upfront cost of purchasing solar panels or fancy gadgets to reduce

administration-sets-target-for-30-gw-offshore-wind-by-2030-plans/597523/ (describing East Coast states' plans for offshore wind). On the West Coast, waters are deeper closer to shore, thus posing difficulties for traditional offshore wind. Floating wing turbines, if commercialized, could solve this problem.

[163] Minority communities suffer a disproportionate number of LULUs and their associated impacts. There are disputes about whether these LULUs were sited in these communities when they were already predominantly populated by low-income, minority residents or whether these residents "moved to the nuisance" due to an ability to find affordable housing only in neighborhoods with LULUs. Regardless of the timing, it remains undisputed that these communities host the bulk of undesirable land development and that the pollution and other impacts from this development substantially and negatively affect their health. For discussion of the "moving to the nuisance" question, see Been, *supra* note 28, at 1388–92. For discussion of the low-income, minority communities suffering the bulk of polluting land uses, see Bradford C. Mank, *Environmental Justice and Discriminatory Siting: Risk-Based Representation*, 56 OHIO ST. L.J. 329, 335 (1995) (observing that "minorities and poor people disproportionately live closer to polluting industries than do nonminorities" and listing and analyzing sources). For discussion of the importance of rooftop solar for low-income communities, in particular, see, e.g., Outka, *supra* note 72, at 810 (exploring how energy costs make up a disproportionate amount of low-income residents' expenditures and arguing for equitable access to rooftop solar, which has predominantly been installed in wealthier communities to date); Shelley Welton, *Clean Electrification*, 88 U. COLO. L. REV. 571, 580 (2017) (arguing for a "participatory grid" in which all consumers have access to policies and technologies that help to lower electricity consumption).

[164] For a summary of some of the existing programs that have supported small-scale energy in low-income housing, see STEFEN SAMARRIPAS & DAN YORK, AM. COUNCIL FOR AN ENERGY-EFFICIENT ECON., OUR POWERS COMBINED: ENERGY EFFICIENCY AND SOLAR IN AFFORDABLE MULTIFAMILY BUILDINGS, at iv (2018), https://www.aceee.org/research-report/u1804. For the importance of small-scale energy in rural communities, see, e.g., BEN A. WENDER, NAT'L ACADS. SCIS., ENG'G, & MED. ELECTRICITY USE IN RURAL AND ISLANDED COMMUNITIES: SUMMARY OF A WORKSHOP 5 (2016), http://www.nap.edu/23539 (noting that "rural communities contain a greater proportion of low-to-moderate-income individuals with greater difficulty accessing credit or capital necessary to invest in home improvements").

[165] These types of requirements—viewed as affirmative action programs by courts—can run afoul of the Equal Protection Clause. *See, e.g.*, City of Richmond v. Croson, 488 U.S. 469, 505 (1989) (invalidating a local program favoring minority-owned businesses under strict scrutiny review). But with adequate evidence regarding the necessity of the relief and the narrow tailoring of a program to achieve those needs, among other measures, these programs can survive these challenges. *See, e.g.*, Adarand Constructors v. Slater, 228 F.3d 1147, 1177–87 (10th Cir. 2000) (analyzing these factors and affirming the validity of a federal highway grant program that favored "minority enterprises").

energy use.[166] And as wealthy individuals have reduced their consumption of electricity—and therefore their payments through utility bills—the remaining customers who lack these technologies shoulder more of the burden of paying for distribution wires and other aspects of the shared electricity system.[167]

The federal government and some states have already taken steps toward subsidizing clean energy for low-income communities.[168] President Biden has pledged that 40% of the $2 trillion that he plans to invest in clean energy will go to disadvantaged communities, although this is yet to be solidified within policy.[169] New York similarly requires 40% of clean energy investments to go to disadvantaged communities, with much of the investment focused on energy efficiency, including "clean heating and cooling."[170] California, too, offers several programs for low-income residents, including upfront rebates for rooftop solar, and discounts for customers who lack the ability to install rooftop panels (those in multi-family housing, for example) but who wish to purchase green energy or invest in a community solar project.[171] Colorado, New York, and Oregon also mandate support for low-income residents' participation in community solar projects.[172]

U.S. energy policy could go much further in terms of specifically empowering underrepresented groups and targeting the types of clean energy development that are most likely to benefit these communities. With particularly careful design, grants and mandates could even encourage the formation of "boundary organizations"—a political science term that describes the creation of stakeholder groups that cross the lines that typically divide sectors.[173] For

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166 Welton, *supra* note 163 at 574; Shelley Welton & Joel Eisen, *Clean Energy Justice: Charting an Emerging Agenda*, 43 HARV. ENV'T. L. REV. 307, 326 (2019).

167 Welton, *supra* note 163, at 574; Welton & Eisen, *supra* note 166, at 326–27; *see also* Troy A. Rule, *Solar Energy, Utilities, and Fairness*, 6 SAN DIEGO J. CLIMATE & ENERGY L. 115, 136 (2014) (noting this regressivity concern and that solar leasing has helped to "expand the accessibility of distributed solar energy to some customers with lesser means," but that even leasing requires customers to have "solid credit histories and stable incomes").

168 *See supra* note 164; *infra* notes 169–70.

169 *The Biden Plan to Secure Environmental Justice and Equitable Economic Opportunity*, JOEBIDEN.COM, https://joebiden.com/environmental-justice-plan/.

170 *Governor Cuomo Announces Clean Energy Investments to Benefit Over 350,000 Low-to-Moderate Income Households*, NEW YORK STATE (Jul. 27, 2020), https://www.governor.ny.gov/news/governor-cuomo-announces-clean-energy-investments-benefit-over-350000-low-moderate-income.

171 *Low-Income Solar Policy Guide*: *California*, https://www.lowincomesolar.org/best-practices/single-family-california/ (updated Feb. 2018); *Green Tariffs/Shared Renewables Program (GTSR)*, CAL. PUB. UTIL. COMM'N, https://www.cpuc.ca.gov/GTSR/ (last visited May 21, 2021).

172 *Low- and Moderate-Income Solar Policy Basics,* NATL. RENEWABLE ENERGY LAB., https://www.nrel.gov/state-local-tribal/lmi-solar.html.

173 *See* Stephanie Lenhart, Natalie Nelson-Marsh, Elizabeth J. Wilson & David Solan, *Electricity*

example, some government grants could be reserved for programs that pair community college and technical school clean energy training programs with equipment suppliers and community groups representing the consumers who could benefit from these installations.

Another method that could shake up traditional interest group dynamics and empower underrepresented groups is to channel more subsidies for energy efficiency and small-scale renewables directly to end-users. Governments already do this through instruments such as tax credits for customers' clean energy installations.[174] But tax credits are a luxury that often benefit only the wealthier segments of society. They do not cover the full cost of installation, and they are an ex-post payment. Direct grants to consumers, with clear limits on the expenditure of funds, could empower broader segments of communities.[175]

This approach would, of course, also attract larger groups who benefit from end-user grants, rebates, or credits, such as associations of contractors. Indeed, although rooftop solar is small in scale, several large companies are key players in this field, as with centralized renewables. Sunrun, now owned by Tesla, has the largest market share—just over 9%—in the rooftop solar industry.[176] But the very prospect of large amounts of funds being funneled to a smaller scale—appliances within homes and solar panels on rooftops, parking lots, and along roadways, might tend to attract a more diverse array of interests, in terms of size and power, to the decision-making table.

Programs that prioritize small-scale, low-carbon energy measures in low-income communities must carefully address the needs and desires of these communities before plowing forward with implementation. Community-engaged programs are essential. Many communities will be rightfully skeptical of programs that tell them how and why they should change their living spaces

*Governance and the Western Energy Imbalance Market in the United States: The Necessity of Interorganizational Collaboration*, 19 ENERGY RSCH. & SOC. SCI. 94, 95 (2016) (describing boundary organizations).

[174] Dan Quinley, *More Power to the Wealthy: Renewable Energy Tax Programs, Market Distortions, and the Ramifications on the Cost of Electricity*, ENVIRONS: ENV'T L. & POL'Y J. 185, 189–90 (2017) (describing the Residential Renewable Energy Tax Credit).

[175] *Cf.* Felix Mormann, *Clean Energy Equity*, 2019 UTAH L. REV. 335, 347 (2019) (observing, in the context of large-scale energy development, that when the American Recovery and Reinvestment Act temporarily transformed a tax credit for wind energy into a "direct cash subsidy," "the pool of direct economic beneficiaries increased dramatically beyond" beyond the few "highly profitable" corporations and handful of banks that previously benefited).

[176] Bryan White, S*unrun Holds Its Ground at the Top of US Residential Solar Rankings*, GREENTECH MEDIA (Mar. 31, 2020), https://www.greentechmedia.com/articles/read/sunrun-holds-its-ground-at-1-in-us-residential-solar-rankings.

to support a green revolution.[177] There is a growing consensus in the literature that perceptions of large-scale renewable energy projects largely flow from perceptions of the fairness of the project development process.[178] There are many ways to improve this process. Educational campaigns can give residents the data that they need to raise strong arguments for the mitigation of impacts from clean energy land uses.[179] Developers or governments can also appoint an ombudsman—an individual whose sole job is to answer citizens' questions about a governmental process and to help those citizens engage with the process.[180] Environmental review statutes, which approximately fifteen states have, require agencies approving new developments to first seriously consider the environmental and social impacts of these developments and explain why they selected a particular location and scale of development.[181] If implemented properly, these statutes can help ensure that communities have adequate input in the siting process. Additional tools include encouraging or requiring renewable energy developers to enter into community benefits agreements with host communities, as New York does.[182] These agreements can include monetary donations and in lieu contributions such as the construction of parks and schools by developers, and they can also list detailed mitigation measures that will reduce the impacts of development.[183] They must be carefully designed, however, to constitute a real investment in a community rather than a buy-out.

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[177] *Cf.* U.S. DEPT. OF ENERGY, ENERGY EFFICIENCY & RENEWABLE ENERGY, SUMMARY OF GAPS AND BARRIERS FOR IMPLEMENTING RESIDENTIAL BUILDING ENERGY EFFICIENCY STRATEGIES 10 (2010), https://www.nrel.gov/docs/fy10osti/49162.pdf (noting that "[s]aving energy may be low on the list of priorities when a homeowner decides to make changes to his/her home (usually comes after financial, comfort and other values").

[178] *See, e.g.*, Hoen, *supra* note 49; Anahita A.N. Jami & Philip R. Walsh, *The Role of Public Participation in Identifying Stakeholder Synergies in Wind Power Project Development: The Case Study of Ontario, Canada*, 68 RENEWABLE ENERGY 194, 194 (2014); Stewart Fast et al., *Lessons Learned from Ontario Wind Energy Disputes*, 1 NAT. ENERGY 1 (2016); Theresea M. Groth & Christine Vogt, *Residents' Perceptions of Wind Turbines: An Analysis of Two Townships in Michigan*, 65 ENERGY POL'Y. 251 (2014).

[179] *See, e.g.*, Sean Nolon, *Negotiating the Wind: A Framework to Engage Citizens in Siting Wind Turbines*, 12 CARDOZO J. CONFLICT RESOL. 327, 345 (2011).

[180] Hannah Wiseman, Note, *Searching for Balance in the Aftermath of the 2006 Takings Initiatives*, 116 YALE L.J. 1518, 1560 (2007).

[181] *See* Tara K. Righetti, *The Incidental Environmental Agency*, 2020 UTAH L. REV. 685, 709 (2020) (describing state NEPAs).

[182] S. 7508-B, § 94-c 5.f (N.Y. 2020) (mandating that "[t]he final siting permit [for a renewable energy installation] shall include a provision requiring the permittee to provide a host community benefit"); Wiseman, *supra* note 84, at 605–06 (advocating for a requirement for developer negotiation of benefits agreements with communities).

[183] *See, e.g.*, Kristen Van de Biezenbos, *Contracted Fracking*, 92 TUL. L. REV. 587, 614–16 (2018) (describing CBAs); *see also* Wiseman, *supra* note 84 at 606.

Beyond considering the incorporation of these types of process-enhancing measures, green energy policies should build from programs such as the New York State Healthy Homes Value-Based Payment Pilot, which pairs in-home energy efficiency and weatherization work with home visits from nurses and community health workers to reduce asthma and other respiratory risks.[184] Similar programs that engage families in health efforts and connect these efforts to energy efficiency programs have also met with success in cities such as Seattle.[185] Weatherization of homes controls moisture infiltration and pests, which, in turn, cuts down on asthma triggers such as mold and in-home pesticides.[186] Furthermore, installing efficient air conditioning units and heat pumps in the many apartments and homes that currently lack any cooling or adequate heating can protect residents from temperature extremes and improve air filtration.[187]

Focusing the green energy revolution on low-income and BIPOC communities first—and doing so through an engaged process—could have a variety of benefits, including reducing energy burdens for those who face the highest burdens, empowering groups who typically have a weaker voice in energy decision-making processes, and improving health outcomes within these communities, as shown by the Seattle and New York programs.

### *D. Mitigating Impacts on Rural Communities and the Environment*

Beyond their ability to empower and benefit groups who tend to be under-represented in the political process, energy efficiency and small-scale energy measures can benefit rural communities—many of which are predominantly low-income—and avoid some of the large renewable generation and transmission infrastructure slated to be built in these communities.[188] A reduction in the need for large-scale energy infrastructure can also have major environmental benefits, among other types of benefits.

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[184] Author Conversation with Mishel Filisha, New York State Energy Rsch. and Dev. Auth. (Feb. 5, 2020) (notes on file with author).

[185] Jill Breysee et al., *supra* note 25, at 63 (concluding that the program "substantially improved asthma" and improved homes).

[186] *Id.*

[187] *See, e.g.*, Nate Seltenrich, *Between Extremes: Health Effects of Heat and Cold*, 123 ENV'T HEALTH PERSP. A275, A279 (2015).

[188] Ale Bishaw & Kirby G. Posey, *Incomes and Poverty Higher in Urban Areas*, U.S. CENSUS BUREAU (Nov. 30, 2017), https://www.census.gov/library/stories/2017/11/income-poverty-rural-america.html (noting that "[h]ouseholds in rural areas have lower incomes than those in urban areas but they are less likely to live in poverty than their urban counterparts"). *But see* Iryna Kyzyma, *Rural-Urban Disparity in Poverty Persistence*, 34 INST. FOR RSCH. ON POVERTY FOCUS 13, 13 (2018) (concluding that "[e]xtensive evidence shows that poverty is more prevalent in rural compared to urban areas").

### 1. *Enhancing Distinct Rural Benefits and Political Consensus*

Small-scale renewable energy measures populate an unusual policy area that attracts voters from extreme ends of the political spectrum. Distributed solar, in particular, enjoys support from rural, libertarian voters who want energy independence and a more reliable electricity supply and from liberal, urban voters who are concerned about climate change.[189] The subsidies and mandates that drive the revolution—if rolled out as aggressively as many policymakers intend—will benefit all of these voters.

Rural residents will also benefit from small-scale energy in important, distinctive ways that could potentially enhance their support for green energy policies. Many rural residents are low-income residents who face high energy burdens, in part because it requires more energy to heat or cool substandard residential spaces. Take the example of the area served by the Roanoke Electric Cooperative, where there are "more than twice the number of mobile homes compared to national benchmarks" and "[m]ore than 30 percent of the community members report having an average electricity bill in excess of $250 per month."[190] An energy efficiency program implemented by the electricity cooperative in this area resulted in average bills declining to $60 monthly, "with the balance kept as savings by the customer."[191]

Beyond the income status of residents, the distribution of electricity to rural homes is disproportionately expensive simply because these homes tend to be located farther from generation centers. Furthermore, rural homes are sometimes the last to regain power after an outage, as utilities tend to focus on more populated areas first. As explored further below, small-scale green energy in the form of distributed solar and microgrids can enhance the reliability of power, thus allowing some rural consumers (and others) to avoid outages to begin with or to maintain at least some amount of power despite a widespread outage. And small-scale projects will alleviate the need for some of the massive generation projects and transmission lines that would be predominantly sited in rural communities.[192]

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[189] *See, e.g.*, Payne et al., *supra* note 18, at 17 (describing how rural and urban customers in the otherwise-divided Pedernales Electric Cooperative in Texas, which includes electricity users in the Austin metro area and highly rural areas, support rooftop solar).

[190] Wender, *supra* note 164, at 6.

[191] *Id.* at 7.

[192] *See, e.g.*, ENV'T PROT. AGENCY, *Assessing the Electricity System Benefits of Energy Efficiency and Renewable Energy*, *in* QUANTIFYING THE MULTIPLE BENEFITS OF ENERGY EFFICIENCY AND RENEWABLE ENERGY: A GUIDE FOR STATE AND LOCAL GOVERNMENTS, 3–5 (2018), https://www.epa.gov/sites/production/files/2018-07/documents/mbg_2-3_electricitysystembenefits.pdf (describing the generation and transmission

### 2. *Addressing Psychological Barriers to Climate Initiatives*

As explored in Part I, all humans, whether progressive or conservative, rural or urban, struggle with climate policies for a variety of psychological reasons—in large part because the costs of addressing climate change now are concrete and clear, whereas the benefits are disbursed globally and accrue in the future. In rural areas, the conservative tendency to oppose Democrat-led climate initiatives compounds the existing psychological barriers to these initiatives.[193] Smaller-scale energy projects can, however, produce visible, concrete, and *current* benefits for energy consumers, thus potentially combatting this psychological barrier. The hefty reduction in energy bills wrought by energy efficiency and net metered solar—solar energy sold back to utilities when homes or businesses produce more electricity than they consume—could enhance support for low-carbon energy initiatives.

## *E. Enhancing Grid Reliability and Resilience*

Another major benefit of smaller green energy is its ability to enhance grid reliability—the constant supply of electricity in the quantities in which it is demanded—and resiliency, which is the ability of electric generation and the grid to bounce back quickly after an emergency such as a computer hack or a storm. Small-scale energy in the form of microgrids—self-contained energy systems on university campuses, for example—and distributed solar can be "islanded," meaning they can be temporarily disconnected from the broader grid.[194] Indeed, after massive electricity outages in New York City as a result of Superstorm Sandy, several microgrids never lost power.[195] Relying on small-scale generation rather than "hardening" extensive transmission networks to weather increasingly severe storms can be cost-effective and can produce better results with respect to reliability and resilience.

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and distribution costs avoided by energy efficiency and renewables).

[193] McCright AM, Marquart-Pyatt ST, Shwom RL, Brechin SR & Allen S., *Ideology, Capitalism, and Climate: Explaining Public Views About Climate Change in the United States*, 21 ENERGY RES. SOC. SCI. 180, 184–86 (2016).

[194] William C. Edwards, Scott Manson & Jakov Vico, *Microgrid Islanding and Grid Restoration with Off-the-Shelf Utility Protection Equipment*, 2017 IEEE CANADA INTERNATIONAL HUMANITARIAN TECHNOLOGY CONFERENCE, https://ieeexplore.ieee.org/document/8058185.

[195] Urban Green Council, *Round Table Recap—Sandy Success Stories Revealed*, URBAN GREEN COUNCIL (Aug. 21, 2013), https://www.urbangreencouncil.org/content/news/roundtable-recap-sandy-successes-revealed; Jiancheng Yu, Chris Marnay, Ming Jin, Cheng Yao, Xu Liu & Wei Feng, *Review of Microgrid Development in the United States and China and Lessons Learned from China*, 145 ENERGY PROCEDIA 217, 218 (2018) (describing the resilience attributes of microgrids).

If small-scale energy development is first prioritized in low-income neighborhoods, this will also improve the overall resilience of these neighborhoods to climate emergencies such as increasingly severe storms. Residents in these communities are at a disadvantage during these types of emergencies because they often lack adequate transportation and other resources that would allow them to escape or otherwise combat the effects of the storm.[196] In contrast with wealthier residents who can drive to a distant hotel or friend's house until the lights come back on, lower-income residents often must stay in place, experiencing uncomfortable and sometimes life-threatening conditions while waiting out the storm and resulting power outage.

## IV. OVERCOMING LEGAL BARRIERS TO SMALL ENERGY

Distributed green energy in the form of rooftop and parking lot solar panels, community solar, and energy efficiency measures face legal hurdles that, although real, can be overcome. The literature has thoroughly explored these barriers, but they merit brief reexamination due to rapidly changing laws in this area. The legal hurdles arise in several policy spheres. In the land use area, rooftop solar installers often face vague or anti-solar zoning laws or servitudes, physical impediments on buildings within older neighborhoods, and shading issues.[197] The ways in which land is owned or leased also pose both barriers and opportunities to local energy. For example, under current legal structures, tenants often have very different incentives from landlords and typically cannot individually reap the benefits of green energy measures.[198]

### *A. Land Use: Zoning, Covenants, and Easements*

A primary obstacle to distributed and community renewable energy projects arises in the form of municipal and county zoning laws, which sometimes ban these types of energy, but more often fail to address them at all.[199] The omission of renewable energy from many zoning laws creates uncertainties for

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[196] Alice Kaswan, *Domestic Climate Change Adaptation and Equity*, 42 ENV'T L. REP. NEWS & ANALYSIS 11125, 11126 (2012).

[197] Wiseman & Bronin, *supra* note 18.

[198] MICHAEL CARLINER, JOINT CTR. FOR HOUS. STUD. OF HARV. UNIV., REDUCING ENERGY COSTS IN RENTAL HOUSING: THE NEED AND THE POTENTIAL 8 (2013), https://www.jchs.harvard.edu/sites/jchs.harvard.edu/files/carliner_research_brief_0.pdf.

[199] *See* Hannah J. Wiseman, Lyndsay Grisamer & E. Nichole Saunders, *Formulating a Law of Sustainable Energy: The Renewables Component*, 28 PACE ENV'T L. REV. 827, 872 (2011) (similarly describing ordinances that omit mention of renewables). Many states have prohibited local governments from banning rooftop solar. *See* Evan J. Rosenthal, *Letting the Sunshine In*, 40 FLA. ST. UNIV. L. REV. 995, 998 (2013) (surveying state solar access laws).

developers, who must persuade local legislative bodies to amend the zoning code to accommodate their projects. A growing number of zoning laws, however, address rooftop solar, often allowing it as an "accessory use" to a home.[200]

Mid-level community solar projects—placed in parks or other common areas, for example—often remain unaddressed by zoning codes, thus requiring somewhat onerous efforts by developers to work with local governments. Some zoning codes limit the percentage of on-site energy consumption that renewable energy may cover—thus largely constraining projects to a rooftop size.[201] But some municipalities and counties have amended or proposed to amend these limits and have specifically allowed community renewables in certain zones, such as agricultural zones.[202]

As with local zoning, covenants, conditions, and restrictions in communities governed by homeowners' or condominium owners' associations can pose obstacles to small-scale renewables. While many states also prohibit outright bans on renewables within these communities, they do allow for reasonable restrictions, such as covenants that ban front-yard renewable installations.[203] This can slow down renewable products or make them somewhat less productive, although restrictions that substantially reduce the productivity of solar or wind installations are often defined as unreasonable under state laws.[204]

Another common issue for distributed solar, in particular, is the presence of buildings and trees on neighboring properties that shade solar panels and make them less productive. Many states recognize solar easements, in which landowners can mutually agree to avoid shading. Others prevent the shading to begin with. For example, California prohibits trees or other structures from shading solar panels that existed prior to the growth of trees or the building of new structures.[205] Still other states allow solar panel owners to force neighbors to agree to a solar easement that will avoid shading if a local public board

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[200] Wiseman & Bronin, *supra* note 18.

[201] *See, e.g.*, MONTGOMERY CNTY., MD., MONTGOMERY CNTY. ZONING ORDINANCE, ch. 59, § 3.7.2 (2021), https://www.montgomerycountymd.gov/COUNCIL/Resources/Files/zta/2021/20210223_19-14.pdf (noting that Montgomery County, Maryland, limits the amount of solar capacity to 120% of the energy that is produced onsite, meaning that a large number of panels cannot be installed to sell electricity back to the grid).

[202] *See id.*; *Increase Community Solar Access in Montgomery County*, SOLAR UNITED NEIGHBORS, https://www.solarunitedneighbors.org/maryland/take-action/ensure-community-solar-supports-the-community/ (last visited May 12, 2021) (noting a proposed amendment to allow community solar projects in agricultural zones).

[203] Rosenthal, *supra* note 199 at 1006; Tesoro del Valle Master Homeowners Ass'n v. Griffin, 200 Cal. App. 4th 619 (Cal. Ct. App. 2011).

[204] *See, e.g.*, CAL. CIV. CODE § 714 (2015).

[205] CAL. PUB. RES. CODE § 25980.

approves the easement and if the solar owner pays a government-established amount of money to the homeowner burdened by the easement.[206]

### *B. Ownership Forms*

Different forms of individual ownership and community governance also affect the feasibility of small energy projects. Subdivisions governed by homeowners' associations may be particularly good candidates for community solar projects because the homeowners' association can enter into a contract to build a small solar farm on the community golf course, for example, or place rooftop panels over the clubhouse and pool.[207] Additionally, for newly constructed communities, laying out neighborhoods and homes in a manner that is conducive to rooftop solar and community renewables is far easier than in older neighborhoods. This is why some states and local governments now have "solar ready subdivision" requirements, which specify lot orientations and the location of vents and chimneys on roofs to support future solar development.[208]

The renter-owner divide is another exceedingly important barrier to energy policy measures. Most energy efficiency programs have focused on homes, yet multi-family structures, which tend to house more low-income people and often involve sub-standard living conditions, would benefit the most from energy efficiency measures.[209] Furthermore, renters typically cannot install rooftop solar panels because their landlords own the roofs. Nor can tenants reap the monetary benefits of rooftop solar, such as net metering (selling excess electricity back to the utility). Similarly, renters in apartments without sub-metered energy bills cannot benefit from energy efficiency measures. Very few states allow landlords to submeter electricity, in which landlords would act like a utility and individually charge and credit tenants for their electricity use.[210] A well-managed submetering program could fix this problem, as could government distributed solar and energy efficiency programs that primarily targeted landlords of multi-family buildings.

A final limitation on small-scale energy arises in the form of state laws that prohibit third-party ownership of rooftop solar. Third-party solar is one of the most affordable options for many homeowners, as a company pays for the up-front cost of solar installation and then sells the electricity from the solar panels

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[206] *See, e.g.*, IOWA CODE ANN. § 564A.3 (2020).
[207] Wiseman & Bronin, *supra* note 18, at 180.
[208] *Id.* at 188–89.
[209] CARLINER, *supra* note 198, at 8.
[210] Wiseman & Bronin, *supra* note 18, at 190–91.

to the resident at a fixed, long-term price.[211] But only a handful of states directly prohibit this practice, and the prospect of widespread small-scale development (and an associated inflow of cash) could perhaps persuade state legislatures to amend this statutory barrier in those states.[212]

## CONCLUSION

As wildfires consume the western United States, coastal areas experience more flooding, and entire communities begin to relocate due to climate change, the urgency of moving to 100% zero-carbon energy is clear.[213] The current federal administration and many states are committed to achieving this goal, and in rapid fashion. As plans to roll out massive amounts of clean energy quickly unfold, now is the time to get this energy revolution right. We can and must avoid enhancing volatile political divisions, deep-seated environmental justice issues, and negative infrastructural path dependence by prioritizing small-scale energy alongside the utility-scale energy that will be necessary for a zero-carbon future.

In some political circles, the green energy revolution is viewed as a win-win—less pollution, more jobs, and economic growth for communities. In other circles, it represents a disastrous move, transforming hundreds of agricultural communities, building thousands of miles of aesthetically displeasing and environmentally damaging transmission lines, and raising electricity bills. A an energy revolution focused on both small and large projects could chart a delicate course between these two views. Energy efficiency measures result in well-established cost savings and have relatively quick payback periods, and they help residents in ways unrelated to climate benefits, including improving health and the comfort of homes. Some libertarians and religious groups, and many liberals, also tend to support small-scale solar for varied yet equally valid reasons, such as the independence that it provides and its environmental benefits. And community solar projects allow residents, including renters, to participate collectively in energy development.

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[211] *Understanding Third-Party Ownership Financing Structures for Renewable Energy*, ENV'T PROT. AGENCY (Oct. 14, 2020), https://www.epa.gov/repowertoolbox/understanding-third-party-ownership-financing-structures-renewable-energy.

[212] DSIRE, NC CLEAN ENERGY TECHNOLOGY CENTER, 3RD PARTY SOLAR PV POWER PURCHASE AGREEMENT (PPA) (2015), http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2015/01/3rd-Party-PPA_0302015.pdf (showing five states as disallowing this financing arrangement).

[213] *See, e.g.*, *Relocating Kivalina*, U.S. CLIMATE RESILIENCE TOOLKIT, https://toolkit.climate.gov/case-studies/relocating-kivalina (last visited May 12, 2021).

With a meaningful focus on small-scale zero-carbon resources in addition to large-scale generation, it is possible to rapidly transform U.S. energy infrastructure with fewer negative effects. Taking advantage of recent technological, economic, and policy changes, we can harness the benefits of small energy and avoid repeating the mistakes of past industrial transitions. And given the gravity of these mistakes, the imperative to "get it right" is a strong one.