**Headline:** Navigating the Energy Transition: Renewables Abound, but Grid Challenges Loom

**Teaser:** Renewable energy doesn’t matter if we can’t distribute it.

By Erika Schelby

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**[Article Body:]**

2023 stands out as a year in which climate records were set. It also showed us that we have put the cart before the horse regarding renewable energy. Firstly, the National Oceanic and Atmospheric Administration (NOAA) [reported](https://www.noaa.gov/news/2023-was-worlds-warmest-year-on-record-by-far) in January 2024 that in the year prior, the planet experienced its highest temperatures ever recorded since global temperature records began in 1850, surpassing all previous records by a significant margin.

The same month, the International Energy Agency (IEA) [reported](https://www.theguardian.com/environment/2024/jan/11/worlds-renewable-energy-capacity-grew-at-record-pace-in-2023) some good news: Renewable energy expansions surged by 50 percent in 2023, reaching 510 gigawatts and marking the 22nd consecutive year of setting new records for renewable capacity additions.

Almost simultaneously, the IEA [warned](https://www.theverge.com/23920599/electricity-power-grid-report-climate-international-energy-agency) that by 2040, if we are to meet international targets for curtailing carbon emissions, governments and utilities must undertake the monumental task of either adding to or replacing virtually all of the world’s power grids—nearly 50 million miles of infrastructure. This is essential for ensuring reliable access to electricity and mitigating pollution from the power sector.

In June 2024, the IEA released a report, “[COP28: Tripling Renewable Capacity Pledge](https://iea.blob.core.windows.net/assets/ecb74736-41aa-4a55-aacc-d76bdfd7c70e/COP28TriplingRenewableCapacityPledge.pdf),” finding that few of the nearly 150 countries that, in December 2023, agreed to triple renewable energy outputs by 2030 have taken meaningful action to meet that goal. Heymi Bahar, a senior energy analyst at the IEA and co-author of the report, [told the Guardian](https://www.theguardian.com/environment/article/2024/jun/04/world-will-miss-target-of-tripling-renewable-electricity-generation-by-2030-iea) that outdated electricity grids hamper progress, and governments must upgrade these old systems to accept clean energy. “Countries have been allocating lots of support to renewables, but the grid has been forgotten,” Bahar said. “Regulatory action is needed.”

So here we are, knee-deep in contradictions. Having gone through the hottest year on record, with many renewable energy sources available to reduce the use of fossil fuels, we have to face reality: This clean electricity has no place to go. We must wait years for our outdated and inadequate power grids to be accepted by local and regional authorities and installed. As climate journalist Eric Roston [noted](https://www.bloomberg.com/news/articles/2024-02-09/5-climate-lessons-from-the-1-8-trillion-race-to-net-zero?embedded-checkout=true) on Bloomberg News in February 2024, “[A]ll the wind turbines and solar arrays in the world can’t overtake fossil energy if they don’t plug into anything.”

**Heat Records**

Not only was 2023 the hottest year in recorded history, but it also started with extremely high-temperature readings. Climatologist [Maximiliano Herrera](https://www.theguardian.com/environment/2024/feb/17/february-on-course-to-break-unprecedented-number-of-heat-records) watches extreme temperatures around the world. Herrera said that during the first half of February 2024, monthly heat records were broken in 140 countries, primarily during the summer in the southern hemisphere and the global north. Compounding the problem, the current El Niňo event may generate “[record-breaking temperatures from the Amazon to Alaska](https://www.theguardian.com/environment/2024/feb/29/el-nino-forecast-record-heat-2024-climate-crisis)” throughout 2024, Damian Carrington reported in the Guardian.

For example, the American Southwest, known for its desert climate, has been one of the world’s regions plagued by long-lasting and scorching temperatures. According to [NASA’s Earth Observatory](https://earthobservatory.nasa.gov/images/151632/relentless-heat-in-the-southwest), Phoenix, Arizona, trapped under a heat dome, suffered through 27 days of extreme readings of 110 F. And El Paso, Texas, located on the Rio Grande just south of the New Mexico state line, was sizzling for 42 days of hellish highs at or above 100 F.

Once you have languished for weeks trapped under such a heat dome, you understand perfectly well that heat stress is hazardous. Heat stroke, respiratory and cardiac emergencies, and chronic disease complications lead to spikes in hospitalizations and can be fatal. Even if serious problems are avoided, extreme heat will rob even the healthiest individuals of strength and initiative.

[Heatwaves are regarded as “silent killers](https://climatecommunication.yale.edu/publications/worry-about-extreme-heat/).” In the U.S., they claim more lives than other climate-related disasters. Europe lost an estimated 61,000 people to extreme temperatures in 2022, and Spain’s [Seville became the first city in the world to name a](https://www.miragenews.com/time-to-name-silent-killer-heatwaves-1176334/) heatwave, calling it ‘Cerberus.’ Elsewhere, [Australia’s Climate Council](https://www.climatecouncil.org.au/resources/time-to-name-the-silent-killer-heatwaves/) proposed that heatwaves should have names “similar to tropical cyclones, as a way of helping to avoid more deaths.”

Not surprisingly, extreme weather events have amplified people’s anxiety and feelings of exhaustion around the world. But humans aren’t the only ones negatively affected by the increased temperatures. Wildlife is also being impacted, with some species being pushed toward extinction.

“We often think that climate change may cause a mass mortality event in the future, but this study tells us that the change in climate that has already occurred is too hot, and in certain areas, [nonhuman] animals can’t tolerate the warming and drying that has already occurred,” [said](https://e360.yale.edu/features/with-temperatures-rising-can-animals-survive-the-heat-stress) Eric Riddell, a physiological ecologist at the University of California at Berkeley and lead author of a 2020 [study](https://www.pnas.org/doi/10.1073/pnas.1908791116) that found that climate change-related warming is behind the collapse of bird populations in the Mojave Desert over the past century.

**Heat Pumps: One Solution—at Least for Humans**

Amid these worrisome developments, the [IEA found that](https://www.iea.org/reports/co2-emissions-in-2022) “global growth in emissions was lower than feared, despite gas-to-coal switching in many countries. Increased deployment of clean energy technologies such as renewables, electric vehicles, and heat pumps helped prevent an additional 550 Mt in CO2 emissions.”

Heat pumps are viewed as one solution to heat waves. Global sales of heat pumps increased by 13 percent in 2020-2021, and between 70 and 80 percent of energy delivered by this technology is renewable.

“Heat pumps offer an energy-efficient alternative to furnaces and air conditioners for all climates,” according to the [U.S. Department of Energy](https://www.energy.gov/energysaver/heat-pump-systems). “Heat pumps move heat from the cool outdoors into your warm[er] house during the heating season. During the cooling season, heat pumps move heat from your house into the outdoors. Because they transfer heat rather than generate heat, heat pumps can efficiently provide comfortable temperatures for your home.”

This technology still heats the indoors even when outdoor temperatures dip to minus 15 F.

Humans began experimenting with [cooling systems in ancient China, India, Egypt, and Iran](https://www.library.pima.gov/content/evaporative-coolers/) early. Initially, enslaved people or servants were used to fan the air over water jars for many hours daily. Leonardo da Vinci also tinkered with a cooling system. At the same time, the Spaniards used grass or cactus fibers wrapped over water jars to better cope with the hot season in America’s Southwest. Native Americans built thick-walled adobe (mud brick) pueblo homes that stayed relatively cool in summer and warmer in winter. They worked with shade whenever possible.

Gradually, things evolved. Oscar Palmer of Phoenix, Arizona, constructed the first evaporative cooler in 1908. By 1936, Phoenix had become the major producer of these coolers, and people in the arid states of the American West relied on them. They used water, pads, and motorized fans to cool the indoor air by up to 20 degrees Fahrenheit. However, with global warming, temperatures are rising, and these devices fail when heat readings are in the upper 90s and above. Combine high humidity during the monsoon season with excessive heat, and evaporative coolers will become useless.

Switching to residential air conditioning, however, has a high carbon footprint. The newer technology of electric heat pumps offers far more efficient solutions, both for new and older—existing homes. Heat pumps use electricity only as an addition to natural sources found in the air, ground, or water—which means they produce more heat (and cooling) than they consume. This makes them highly energy efficient.

Ductless Mini-Split Heat Pumps, for example, are a good choice for existing ductless homes. They provide flexibility and can cool just one room if you are on a budget: this can be your protective oasis during heat waves and avoid the expense and negative environmental impact of cooling an entire house. During the winter months, these pumps also provide heating. Once expertly installed, they are simple to handle and maintain.

Heat pumps require an investment, so doing one’s homework is a strategy to save money and prevent missteps. The [Energy Star website](about:blank) is a good place to start. It details the [2022 Inflation Reduction Act](https://www.energy.gov/lpo/inflation-reduction-act-2022#:~:text=The%20President's%20Inflation%20Reduction%20Act,energy%20manufacturing%2C%20and%20putting%20the)*,* which allows homeowners to receive federal tax credits up to $3,200 per year and project (until 2032) future costs, thereby lowering the cost of purchasing and installing an energy-efficient device by 30 percent. The site helps you to [find the right products](https://www.energystar.gov/products/air_source_heat_pumps), educates you about different types and sizes of heat pumps, and does much more.

Once installed, heat pumps should be serviced once per year to ensure no refrigerant leaks. This technology uses low-GWP (global warming potential) refrigerants, which are alternatives to hydrofluorocarbons (HFCs)—greenhouse gasses that are much more potent than CO2—but are still harmful to the environment. Yet, compared to the impact of traditional electric and gas equipment, heat [pumps cut emissions by 45 to 70 percent.](https://www.nrdc.org/bio/pierre-delforge/dont-let-refrigerants-slow-heating-decarbonization) Most importantly, at the end of a heat pump’s lifespan, homeowners should work with installers and service providers who will [recover the refrigerant as required by federal law](https://www.epa.gov/section608/stationary-refrigeration-refrigerant-reclamation-requirements).

**No Longer the Greatest Machine in the World: The Grid**

In North America, the power grid of the 20th century was once called the world’s greatest machine. However, the grid has grown weak and is increasingly unfit to handle the clean electricity required to advance the energy transition. Primarily [constructed in the 1960s and 1970s](https://www.energy.gov/gdo/articles/what-does-it-take-modernize-us-electric-grid#:~:text=Much%20of%20the%20U.S.%20electric,growing%20building%20and%20transportation%20electrification.), its vast network of several hundred thousand miles of power lines connects to households, businesses, and industry. That’s almost taken for granted. Very little is said about it until power outages occur. They happen more and more often, triggered by extreme weather and other events.

According to a Bloomberg NEF [analysis by Lars Paulsson and Naureen S. Malik](https://www.washingtonpost.com/business/energy/2023/10/20/why-bigger-better-power-grids-are-needed-to-achieve-climate-goals/310190c0-6fc2-11ee-b01a-f593caa04363_story.html) published in the Washington Post, “Power capacity will need to grow to 39.7 terawatts by 2050 from 8.5 terawatts in 2022, with the proportion of that energy derived from wind and solar rising to 70 percent from 25 percent.”

Despite relatively optimistic projections, grid bottlenecks are now a global issue, with continents, regions, and countries all confronted by specific political, economic, environmental, and social challenges.

In the United States, progress is made at the state level, where [efforts are underway to modernize the local electric transmission infrastructure](https://www.whitehouse.gov/briefing-room/statements-releases/2022/11/18/fact-sheet-the-biden-harris-administration-advances-transmission-buildout-to-deliver-affordable-clean-electricity/), integrate renewable resources, and facilitate the integration of renewable energy into the distribution grid.

Altogether, on the global and local level, this task requires massive funding, vast amounts of scarce metals and minerals, and land and ocean space for solar and wind installations. Paradoxically, this must be undertaken with a changed attitude that accepts limits. Why? Because the false promise of ever-growing abundance is gone. Resources are finite; therefore, demand can no longer be infinite. A balance must be found. We must relearn how to be more modest, value what we have left, and be careful about extracting and using assets from the Earth.

During a follow-up discussion to the United Nations COP 28 climate summit hosted in 2023 by the IEA, Sultan Al Jaber of the United Arab Emirates, president of the conference and a powerful fossil fuel industry executive, said that we can no longer look only at the supply side of the [energy transition but must include the demand side](https://www.theguardian.com/environment/2024/feb/20/energy-turmoil-looms-unless-demand-is-checked-says-cop28-president-sultan-al-jaber)—otherwise the world could sink in to “energy turmoil.” Does this mean, for instance, that a buyer must consider responsibly if they need to purchase another gas-guzzling SUV? In 2022, [6 million of these cars were sold](https://www.goodcarbadcar.net/2022-us-suv-sales-figures-by-model/) in the U.S.—an increase of 15 percent over 2021 sales.

**The Search for Answers**

There are numerous ideas on how to overcome big challenges. Visionaries hope for a global grid network that avoids unresolved storage issues and multiple other problems by transmitting clean electric energy from continent to continent and from remote surplus locations to urban regions where it is needed, for example, from summer climate conditions to winter environments and vice versa. But given the current geopolitical instability, the human inclination for war, plus covert acts of destroying other countries’ energy supply lines (like the [Nord Stream pipeline](https://theintercept.com/2023/09/27/intercepted-podcast-nord-stream-bombing/)), such goals appear to be utopian.

More realistic decision-makers will have to start with the fact that the U.S. has the [only major power grid without a plan](https://rmi.org/the-united-states-has-the-only-major-power-grid-without-a-plan/). In its place, it has three grids: the Eastern, Western, and the ERCOT (Texas). These systems don’t talk to each other. They remain fragmented. They evolved in such a way, and perhaps now the three parts can be seen as silo systems.

That leaves room for microgrids, local and regional solutions, energy generation from rooftop solar panels, and a minimal degree of independence from the woes of the big power grids. In October 2023, the Biden administration announced a [$3.46 billion investment in the electric grid](https://www.theverge.com/2023/10/18/23922336/biden-doe-power-grid-investment-electricity-renewable-energy). These funds will support 58 projects in 44 states, including microgrids.

In Reuter’s Special Report, Tim McLaughlin outlines that “infrastructure investments are… controlled by a Byzantine web of local, state, and regional regulators.” Navigating this labyrinth of obstacles requires outstanding diplomatic skills and robust perseverance. Fortunately, some problem-solvers with these qualifications are working in many locations.

Lawrence Berkeley National Laboratory (Berkeley Lab) research shows that [grid connection requests have grown by 40 percent in 2022](https://emp.lbl.gov/news/grid-connection-requests-grow-40-2022). An April 2023 Berkeley Lab study headed by Joseph Rand recorded [more than 10,000 projects in the interconnection queues](https://www.switzernetwork.org/fellow-stories/rand-finds-long-waits-and-low-completion-rates-projects-seeking-join-electric-grid) in the United States, a list of renewable projects waiting to be accepted on the electric grid. In 2022, the average wait time in the U.S. was five years, and success rates were reduced by high fees and surprise costs that the developers could not afford. As a result, many of the projects were never built.

According to the Financial Times, [Joseph Rand at Berkeley Labs is convinced that the momentum](https://www.ft.com/content/a3be0c1a-15df-4970-810a-8b958608ca0f) has taken hold. Despite all the setbacks, detours, and stress tests, he sees a vibrant willingness to transform the energy system. And the public is not too far behind him. People [worldwide](https://grist.org/international/study-climate-anxiety-spreading-all-over-the-planet-india-china/) are anxious about climate breakdown, prompting Dr. Stephanie Collier in Havard Health to [write](https://www.health.harvard.edu/blog/is-climate-change-keeping-you-up-at-night-you-may-have-climate-anxiety-202206132761), “As uncertainty and loss of control characterize climate anxiety, the best treatment is to take action.”

The first global study of climate anxiety among the young, published in 2021 by [Lancet](https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(21)00278-3/fulltext), reported that “83 percent said that they think people have failed to take care of the planet. Respondents rated governmental responses negatively.”

Fast-forward: If many of these young individuals translate anxiety into action, this could initiate a great global fossil-hunting stampede, triggering a rough rocking motion for the fossilized apparatus of governments still beholden to fossil fuel dependencies and obsolete grids minus a plan.