The Energy Transition

The Clean Energy Future Is Arriving Faster Than You Think

The United States is pivoting away from fossil fuels and toward wind, solar and other renewable energy, even in areas dominated by the oil and gas industries.

David Gelles reported from Tulsa, Okla.; Brad Plumer and Jim Tankersley from Washington; and Jack Ewing from New York to see how an accelerated energy transition is playing out. Photographs by Mason Trinca.

This is the first article in a three-part series examining the speed, challenges and politics of the American economy moving toward clean energy.

Aug 17, 2023

Delivery vans in Pittsburgh. Buses in Milwaukee. Cranes loading freight at the Port of Los Angeles. Every municipal building in Houston. All are powered by electricity derived from the sun, wind or other sources of clean energy.

Across the country, a profound shift is taking place that is nearly invisible to most Americans. The nation that burned coal, oil and gas for more than a century to become the richest economy on the planet, as well as historically the most polluting, is rapidly shifting away from fossil fuels.

A similar energy transition is already well underway in Europe and elsewhere. But the United States is catching up, and globally, change is happening at a pace that is surprising even the experts who track it closely.

Wind and solar power are breaking records, and renewables are now expected to overtake coal by 2025 as the world's largest source of electricity. Automakers have made electric vehicles central to their business strategies and are openly talking about an expiration date on the internal combustion engine. Heating, cooling, cooking and some manufacturing are going electric.

As the planet registers the highest temperatures on record, rising in some places to levels incompatible with human life, governments around the world are pouring trillions of dollars into clean energy to cut the carbon pollution that is broiling the planet.

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A big shift in the way America produces energy is already underway.

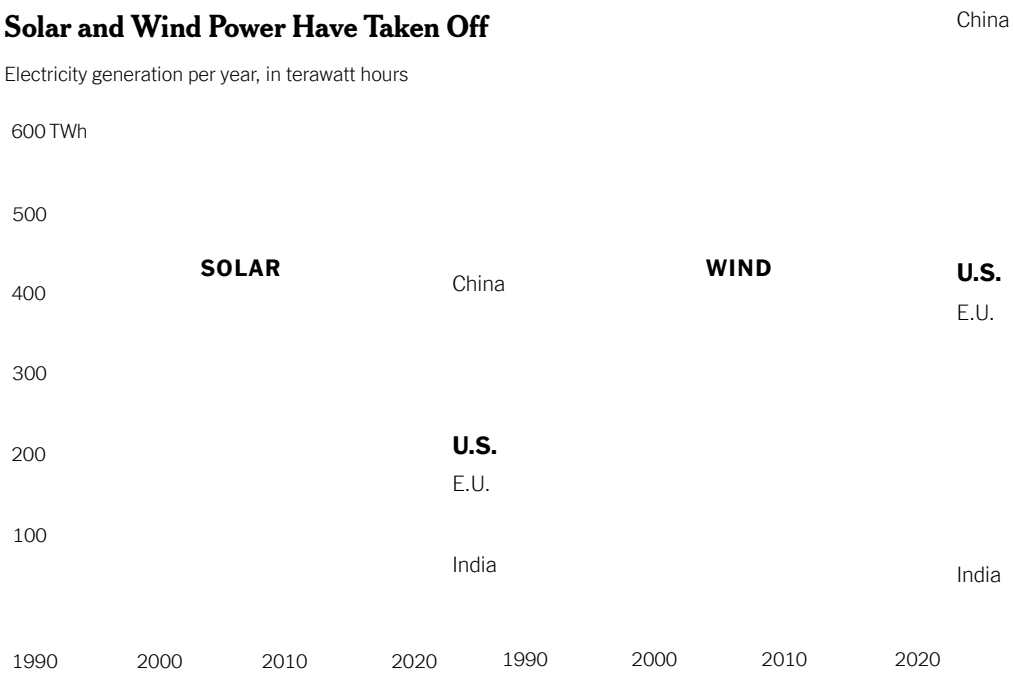
The cost of generating electricity from the sun and wind is falling fast and in many areas is now cheaper than gas, oil or coal. Private investment is flooding into companies that are jockeying for advantage in emerging green industries.

“We look at energy data on a daily basis, and it’s astonishing what’s happening,” said Fatih Birol, the executive director of the International Energy Agency. “Clean energy is moving faster than many people think, and it’s become turbocharged lately.”

More than $1.7 trillion worldwide is expected to be invested in technologies such as wind, solar power, electric vehicles and batteries globally this year, according to the I.E.A., compared with just over $1 trillion in fossil fuels.

That is by far the most ever spent on clean energy in a year.

Those investments are driving explosive growth. China, which already leads the world in the sheer amount of electricity produced by wind and solar power, is expected to double its capacity by 2025, five years ahead of schedule. In Britain, roughly one-third of electricity is generated by wind, solar and hydropower. And in the United States, 23 percent of electricity is expected to come from renewable sources this year, up 10 percentage points from a decade ago.



Source: The Energy Institute's 2023 Statistical Review of World Energy • Note: Data reflects generation within country borders. • By The New York Times

"The nature of these exponential curves sometimes causes us to underestimate how quickly changes occur once they reach these inflection points and begin accelerating," said former Vice President Al Gore, who called attention to what he termed a "planetary crisis" 17 years ago in his film "An Inconvenient Truth." "The trend is definitely in favor of more and more renewable energy and less fossil energy."

Even as the pace of change in the United States is surprising everyone from energy experts to automobile executives, fossil fuels still dominate energy production at home and abroad.

Corporations are building new coal mines, oil rigs and gas pipelines. The government continues to award leases for drilling projects on public lands and in federal waters and still subsidizes the industries. After posting record profits last year, leading oil companies are backing away from recent promises to invest more heavily in renewable energy.

The scale of change required to remake the systems that power the United States — all the infrastructure that needs to be removed, re-engineered and replaced — is mind-boggling. There are major challenges involved in adding large amounts of renewable energy to antiquated electric grids and

mining enough minerals for clean technologies. Some politicians, including most Republicans, want the country to continue burning fossil fuels, even in the face of overwhelming scientific consensus that their use is endangering life on the planet. Dozens of conservative groups organized by the Heritage Foundation have created a policy playbook, should a Republican win the 2024 presidential election, that would reverse course on lowering emissions. It would shred regulations designed to curb greenhouse gases, dismantle nearly every federal clean energy program and boost the production of fossil fuels.

And while energy systems are changing fast, so is the climate. It is far from certain whether the United States and other polluting countries will do what scientists say is required to avert catastrophe: stop adding greenhouse gases to the atmosphere by 2050. All of the investment so far has slowed the pace at which emissions are growing worldwide, but the amount of carbon dioxide pumped into the atmosphere is at record levels.

And yet, from Beijing to London, Tokyo to Washington, Oslo to Dubai, the energy transition is undeniably racing ahead. Change is here, even in oil country.

‘Energy Is Energy’

As the workday begins in Tulsa, Okla., the assembly line at the electric school bus factory rattles to life. Crews fan out across the city to install solar panels on century-old Tudor homes. Teslas and Ford F-150 Lightnings pull up to charging stations powered in part by the country’s second-largest wind farm. And at the University of Tulsa’s School of Petroleum Engineering, faculty are working on ways to use hydrogen as a clean energy source.

Tulsa, a former boomtown once known as the “Oil Capital of the World” where the minor league baseball team is the Drillers, is immersed in a new energy revolution.

At the port, an Italian company, Enel, is building a $1 billion solar panel factory. The bus factory is operated by Navistar, one of the biggest commercial vehicle makers in the world. And the city’s main electric utility, Public Service Company of Oklahoma, now harvests more than 28 percent of its power from wind.

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Even Tulsa, with its strong links to oil and gas, is embracing clean energy.

Clean energy entrepreneurs are flocking to Oklahoma, too. Francis Energy, a fast-growing maker of electric vehicle charging stations, is based in Tulsa. Canoo, an electric vehicle start-up, is building a 100,000-square-foot battery factory at a nearby industrial park and a manufacturing plant for its trucks in Oklahoma City, though there are questions about whether the company will have enough funding to realize its plans. And teams from Solar Power of Oklahoma are busy fastening photovoltaic panels to the roofs of homes and businesses around Tulsa.

The city is embracing its shifting identity.

“We have a tremendous sense of pride in our history,” said Dewey F. Bartlett Jr., the Republican former mayor of Tulsa who was an oil and gas executive but now helps recruit clean energy companies to the region. “But we also understand that energy is energy, whether it is generated by wind, steam or whatever it might be.”

Around the country, clean energy is taking root in unlikely locales.

Houston, home to more than 500 oil and gas companies, also has more than 130 solar- and wind-related companies. Some of the country’s largest wind and solar farms are in the Texas flatlands outside the city, and a huge wind farm has been proposed off the coast of Galveston.

In Arkansas, a planned solar farm — the state’s biggest — is expected to help power a nearby U.S. Steel factory that is undergoing a $3 billion upgrade. When complete, the plant will use electric furnaces to mold scrap steel into new products. That will result in about 80 percent less greenhouse gases, the company says, and set the pace for an industry that has been a major polluter.

About two-thirds of the new investment in clean energy is in Republican-controlled states, where policymakers have historically resisted renewables. But with each passing month, the politics seem to matter less than the economics.

“We’re the reddest state in the country, and we’re an oil and gas state,” said J.W. Peters, president of Solar Power of Oklahoma. “So it took a lot of time to convince people that this wasn’t snake oil.”

Mr. Peters was broke six years ago, with less than $400 in his checking account after his contracting business slowed down. Then he responded to a help-wanted ad looking for workers to install solar panels, which were becoming more popular in Tulsa. He now employs 61 workers and has $18 million in annual sales. “The environmental benefits are nice,” he said, “but most people are doing this for the financial opportunity.”

‘Something Very Dramatic’

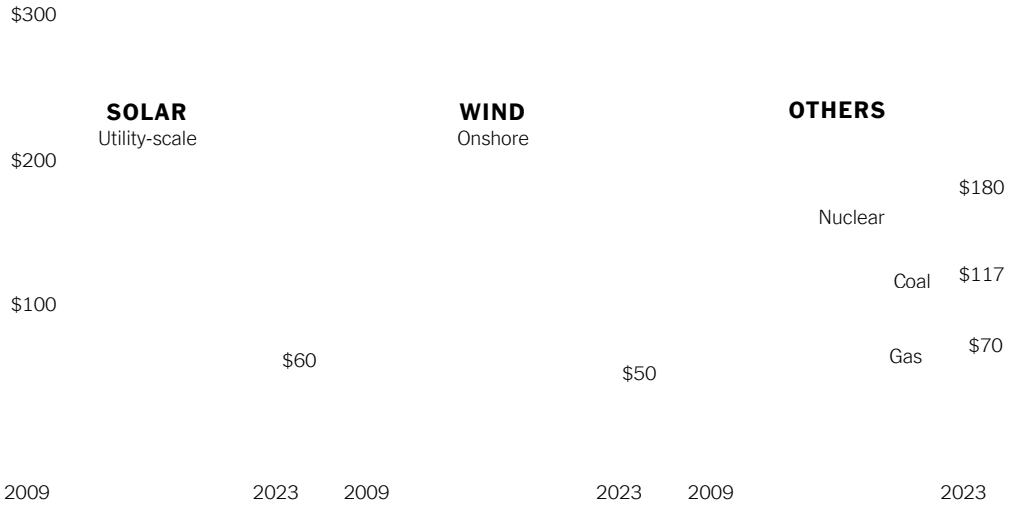
Fifteen years ago, solar panels, wind turbines and battery-powered vehicles were widely viewed as niche technologies, too expensive and unreliable for mainstream use.

But clean energy became cheap far faster than anyone expected. Since 2009, the cost of solar power has plunged by 83 percent, while the cost of producing wind power has fallen by more than half. The price of lithium-ion battery cells fell 97 percent over the past three decades.

Today, solar and wind power are the least expensive new sources of electricity in many markets, generating 12 percent of global electricity and rising. This year, for the first time, global investors are expected to pour more money into solar power — some $380 billion — than into drilling for oil.

The Cost of Renewable Energy Has Plummeted

Cost of building and running new power plants, in dollars per megawatt hour



Source: Lazard • Notes: Charts reflect the mean levelized cost of energy, which captures the price of building and running new power plants but excludes other electrical system costs. Lazard did not release data for 2022. In 2023, costs rose because of supply-chain problems, inflation and other issues. • By The New York Times

The rapid drop in costs for solar energy, wind power and batteries can be traced to early government investment and steady improvements over time by hundreds of researchers, engineers and entrepreneurs around the world.

“The world has produced nearly three billion solar panels at this point, and every one of those has been an opportunity for people to try to improve the process,” said Gregory Nemet, a solar power expert at the University of Wisconsin-Madison. “And all of those incremental improvements add up to something very dramatic.”

An equally potent force, along with the technological advances, has been an influx of money — in particular, a gusher since 2020 of government subsidies.

In the United States, President Biden signed a trio of laws during his first two years in office that allocated unprecedented funds for clean energy: A $1 trillion bipartisan infrastructure law provided money to enhance the power grid, buy electric buses for schools and build a national network of electric vehicle chargers. The bipartisan CHIPS and Science Act set aside billions of dollars for semiconductors vital to car manufacturing. And the Inflation Reduction Act, which marks its first anniversary on Aug. 16, is by far the most ambitious attempt to fight climate change in American history.

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The United States is ramping up its capacity to produce electric vehicles, batteries, solar panels and wind turbines.

That landmark law provided tax breaks related to electric vehicles, heat pumps and energy efficiency upgrades, solar panel and wind turbine manufacturing and clean hydrogen production. The government is also investing in efforts to capture carbon emissions and store them before they can reach the atmosphere, as well as technology that can remove them directly from the air.

Originally estimated to cost roughly $391 billion between 2022 and 2031, the tax breaks are proving so popular with manufacturers and consumers that estimates now put the cost as high as $1.2 trillion over the next decade.

Combined, the three laws have prompted companies to announce at least $230 billion in manufacturing investments so far. In Georgia, a Korean solar manufacturer, Qcells, is building a $2.5 billion plant. In Nevada, Tesla is building a new $3.6 billion electric truck factory. And in Oklahoma, the Enel and Canoo facilities are primed to benefit from the Inflation Reduction Act, as is a new $4.4 billion battery factory being considered by Panasonic, the Japanese conglomerate.

“There’s a lot of appetite to invest in the United States thanks to that law,” said Giovanni Bertolino, an executive at Enel, adding that the plant his company is building in Tulsa would not exist without the Inflation Reduction Act.

Regulations are also hastening the energy transition. Mr. Biden has proposed tough new federal pollution limits on tailpipes and smokestacks, but several states are acting on their own. California, with market muscle that influences the entire auto industry, plans to halt sales of new gas-powered cars by 2035 and new diesel-powered trucks by 2036 — and a

handful of states are following suit. In May, New York became the first state to ban gas hookups in most new buildings, requiring all-electric heating and cooking starting in 2026. Several cities, including New York and San Francisco, have similar prohibitions, although some Republican-controlled states have blocked their municipalities from banning gas.

Heavy investment by the United States has spurred a spirited reaction from other wealthy nations. Countries that initially complained that the United States was unfairly subsidizing clean energy manufacturers have since engaged in a sort of friendly subsidy race.

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Clean energy investments are generating thousands of new jobs.

Canada, South Korea and others have pushed for their companies to have better access to the American incentives, while offering similar subsidies to their domestic manufacturers. After Russia invaded Ukraine last year, the European Union moved to lessen its dependence on Russian oil and gas. In May, for the first time ever, wind and solar power in the E.U. generated more electricity than fossil fuels.

And in China, which is currently both the world's top polluter and the global leader for renewable power, the government continues to invest in every stage of clean energy production, from solar cells to batteries, wind turbines and more. Like the United States, China provides subsidies to buyers of electric vehicles. Last year it spent $546 billion on clean energy, far more than any other country in the world.

With costs falling fast, manufacturing has picked up and installations of solar and wind projects have increased. The U.S. solar industry installed a record 6.1 gigawatts of capacity in the first quarter of 2023, a 47 percent increase over the same period last year.

And those low costs have led many of the United States' biggest corporations, such as Alphabet, Amazon and General Motors, to purchase large amounts of wind and solar power, because it burnishes their reputations and because it makes good economic sense.

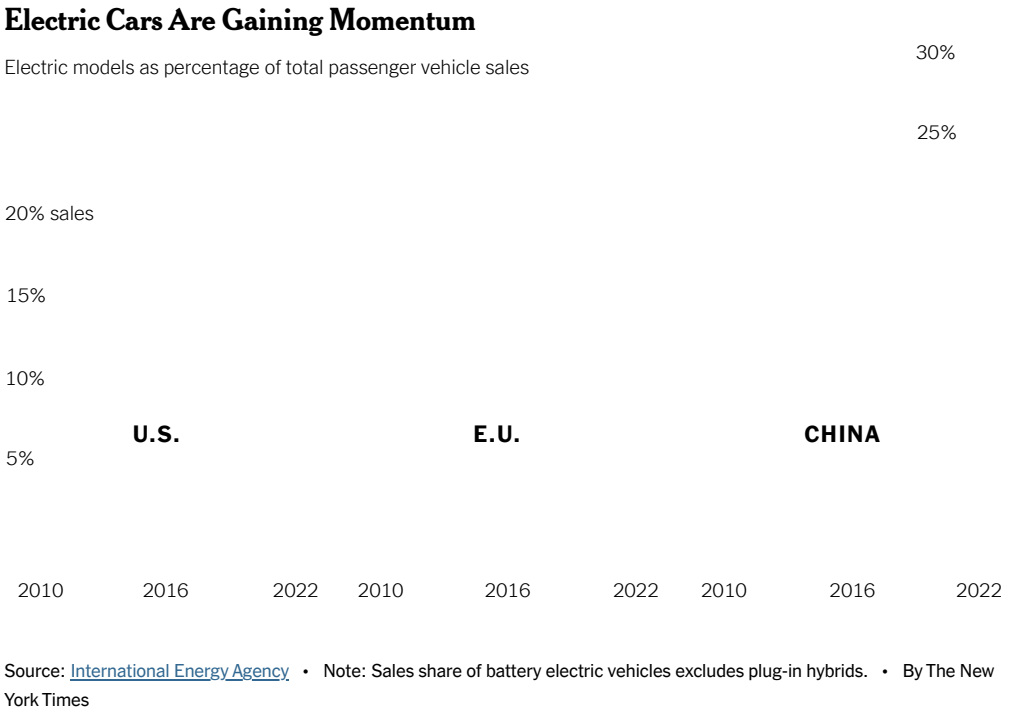
"We're seeing the nonlinear change happen before us," said Jon Creyts, chief executive of RMI, a nonprofit organization that promotes the energy transition. "And that's important, because we're facing a climate crisis right now."

‘A National Phenomenon’

Steve Uerling’s Tulsa home is a model of energy efficiency. He replaced all his incandescent light bulbs with LEDs. He installed a heat pump and rooftop solar panels this year. And he drives a plug-in hybrid Ford Fusion and a Tesla Model 3.

Mr. Uerling, a mechanical engineer, said he wanted to see renewable power take off in Oklahoma and was trying to do his part. But he was also driven by his wallet.

“My fuel cost is equivalent to getting 200 miles a gallon on gasoline,” he said. “We charge at night, when we get a much cheaper rate on our electricity.”



Millions of people around the country are making similar calculations. Electric vehicles are by far the fastest-growing segment of the auto industry, with record sales of 300,000 in the second quarter of 2023, a 48 percent increase from a year earlier. Teslas are now among the best-selling cars in the country, and Ford has expanded its production of the F-150 Lightning, the electric version of its popular pickup truck, after a surge of initial demand created a waiting list.

Concerns among consumers about the availability of charging stations as well as the cost of some models have helped to cool sales somewhat, leading some automakers to slash prices. Still, federal tax credits of up to $7,500 have made the least expensive electric vehicles competitive with gas-powered cars. And about two dozen states offer additional tax credits, rebates or reduced fees, further pushing down their cost.

Government action is also helping heavier vehicles go electric. Sales of electric school buses are soaring, largely because of $5 billion in federal grants that can cover 100 percent of the cost for low-income communities.

The Postal Service plans to spend nearly $10 billion to purchase 66,000 electric mail trucks — roughly 30 percent of its fleet — over the next five years.

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Electric vehicles sales are growing quickly, but consumers are still concerned about high upfront costs and charging availability.

In the private sector, Amazon has ordered 100,000 electric delivery trucks from Rivian. Tesla has an electric semitruck, as do several other manufacturers, including Peterbilt.

Companies that provide charging stations are springing up to meet the demand. Francis Energy has more than 400 chargers across Oklahoma and is expanding nationwide. EVgo, which has one of the largest fast-charging networks in the United States, plans to more than double the 3,000 charging stalls it operates.

“It is not a red-state, blue-state thing,” said Cathy Zoi, EVgo’s chief executive. “It is a national phenomenon.”

In an unusual move, seven carmakers — BMW Group, General Motors, Honda, Hyundai, Kia, Mercedes-Benz Group and Stellantis — are spending $1 billion in a joint venture to build 30,000 charging ports on major highways and other locations in the United States and Canada.

The shift is happening so quickly that some of America’s most iconic automakers are preparing for a world beyond gasoline-powered cars and trucks.

General Motors, which has the largest market share of any carmaker in the United States, has committed to selling only zero-emissions vehicles by 2035. It’s a “once-in-a-generation inflection point” for the 114-year-old automaker, according to Mary Barra, G.M.’s chief executive.

In an interview, Ms. Barra said her company began to consider an all-electric future in 2020. “We started to see this happening with the consumer research we did,” said Ms. Barra, who has subsequently bet billions on G.M.’s efforts to reorient its engineering, overhaul its manufacturing facilities and processes and build new battery plants.

As the cost of batteries comes down, and the number of charging stations nationwide goes up, Ms. Barra expects exponential growth. “I think it’s going to be definitely an upward trajectory,” she said. “It’ll be a little bumpy, but bumpy growing.”

The clean energy future is ...

① Arriving Faster Than You Think

② Roiling Both Friends and Foes

③ A Battle for Hearts and Minds

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