ENERGY PRICE STABILITY: THE PERIL OF FOSSIL FUELS AND THE PROMISE OF RENEWABLES

ISSUE BRIEF BY **LAUREN MELODIA AND KRISTINA KARLSSON** | MAY 2022

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After over five years of gasoline prices at less than $3 per gallon, Americans now face soaring gasoline and energy prices that have contributed to the highest inflation in 40 years. The combination of increasing gas prices and rising prices for other basic necessities like food has unleashed a national conversation about inflation—what it is, where it comes from, and who can fix it (quickly). And while the Federal Reserve and the Biden administration have spent the past year attempting to use their existing powers to address rising prices, the extreme price increases of energy commodities and services—more than any other set of items in the Consumer Price Index (CPI)—demonstrate the need for a transformation of our economic systems.

The inherent volatility of fossil fuels and the ways they expose consumers to geopolitical and climate risks drive consumer price volatility at both the gasoline pump and in household utility costs, contributing significantly to overall inflation. But existing monetary policies aimed to curb inflation, such as raising interest rates, are indirect and inadequate approaches to energy price increases. In recent months, executive actions to release strategic reserves of oil provided a small, temporary solution to gasoline price increases; however, the increase in gas prices accompanying Russia's invasion of Ukraine has reminded us of the outsized and determinate role geopolitics and multinational trade play when it comes to energy prices. The current tools to fight inflation will not have a significant and long-lasting impact on the needs of consumers, especially the estimated 90 million Americans who are energy insecure (EIA 2020). Furthermore, in the face of accelerating climate change, energy industry dynamics and price changes will only become more volatile and must be addressed directly and for the long term.

It is important to understand the macroeconomic implications of energy prices in our society, because gasoline and energy price increases in particular have unleashed a conversation about inflation. Inflation has historically been understood as something negative, and its existence (or the fear of it) has been used as an argument to advocate for austerity, to ignore urgent domestic issues (like care infrastructure and cutting carbon pollution), and to suppress the labor movement and wage growth for workers. As we address energy price inflation, we must steer the conversation toward meaningful, systemic solutions and away from austerity and fear.

For the federal government to meet its commitment to achieve price stability . . . it must facilitate a rapid transition away from fossil fuels and toward the renewable sector.

The Federal Reserve and macroeconomic analysts commonly exclude energy price changes from their evaluation of inflation as a macroeconomic phenomenon because energy (along with food) is understood to be inherently volatile and, therefore, can skew or complicate the picture of price stability in the overall economy. However, in this issue brief we argue that energy price volatility has major macroeconomic implications and must be integrated into price stability policy. We demonstrate that energy price volatility is driven by fossil fuels in particular, and that it will only be exacerbated as climate change accelerates. Conversely, we show that renewable energy sources and the electricity sector through which they are distributed have unique qualities that can make them a stabilizing force in the economy. We then highlight the ways in which a renewable energy transition can increase equality by meeting the needs of those most vulnerable to energy price increases. Finally, we argue that in order for the federal government to meet its commitment to achieve price stability—which Congress empowered the Federal Reserve to monitor and manage—it must facilitate a rapid transition away from fossil fuels and toward the renewable sector.

SECTION ONE

ENERGY IS A MACROECONOMIC ISSUE

Energy price changes are excluded from the Federal Reserve's evaluation of macroeconomic price stability because they are volatile. However, because of energy's important role in household subsistence and business operations, and the ways its volatility interacts with the business cycle, it is a macroeconomic issue.

ENERGY INFLATION IS A MAJOR DRIVER OF OVERALL INFLATION

Because of the inherent volatility of oil and gas prices, energy price changes are excluded from the core Consumer Price Index (CPI) and core Personal Consumption Expenditures Price Index (PCE)—metrics often preferred by the Federal Reserve and other analysts to evaluate inflation as a macroeconomic phenomenon. However, energy prices impact the health and stability of the economy as a whole—and especially how the average person experiences the economy. For this reason, consumers, journalists, and policymakers tend to instead discuss "overall inflation," which includes energy and food prices—prices that everyone, regardless of race, gender, or income, pays each month.

As shown in Figure 1 below, energy—defined here as utility fuel and service costs for heat and electricity, as well as gasoline for transportation—is the fourth largest category of expenses for the average US household, after housing, food, and transportation (excluding gasoline).

FIGURE 1. ENERGY IS THE FOURTH LARGEST EXPENSE CATEGORY FOR THE AVERAGE US HOUSEHOLD

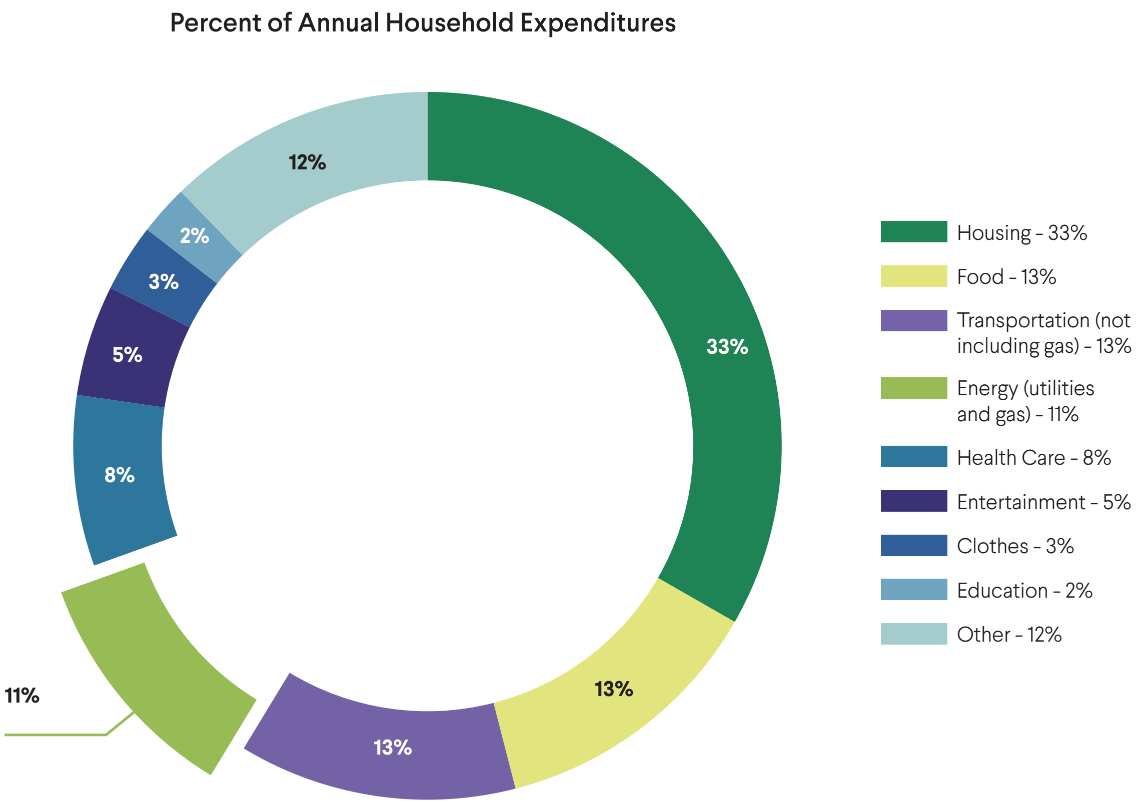

Figure 1 shows the nine major categories of US household consumption as reported in the annual Consumer Expenditure Survey. Energy, including both household utilities and gasoline consumption, comprises the fourth largest category, after housing, food, and transportation (vehicles and public transportation, excluding gasoline). Each category's contribution toward total household expenses was computed as an average of survey results from 2010 to 2020. Source: US Bureau of Labor Statistics (2021a), authors' analysis.

The price change of each item in the CPI is weighted based on how much an average household spends on each item. Utility and gasoline expenditures' relatively large weight in household consumption means that changes in fossil fuel prices make a substantial contribution to changes in overall inflation. Figure 2 demonstrates this impact, showing the weighted contributions of several major energy categories on the overall inflation rate. For example, in March 2022, overall monthly inflation, which measures the change in the inflation rate from one month to the next, was 1.2 percent. However, 63 percent of that month-to-month increase (0.8 percent) was from gasoline price increases in that month alone. In total, energy categories were responsible for 70 percent of monthly inflation that month.

FIGURE 2. GASOLINE PRICE VOLATILITY IS A MAJOR DRIVER OF OVERALL INFLATION

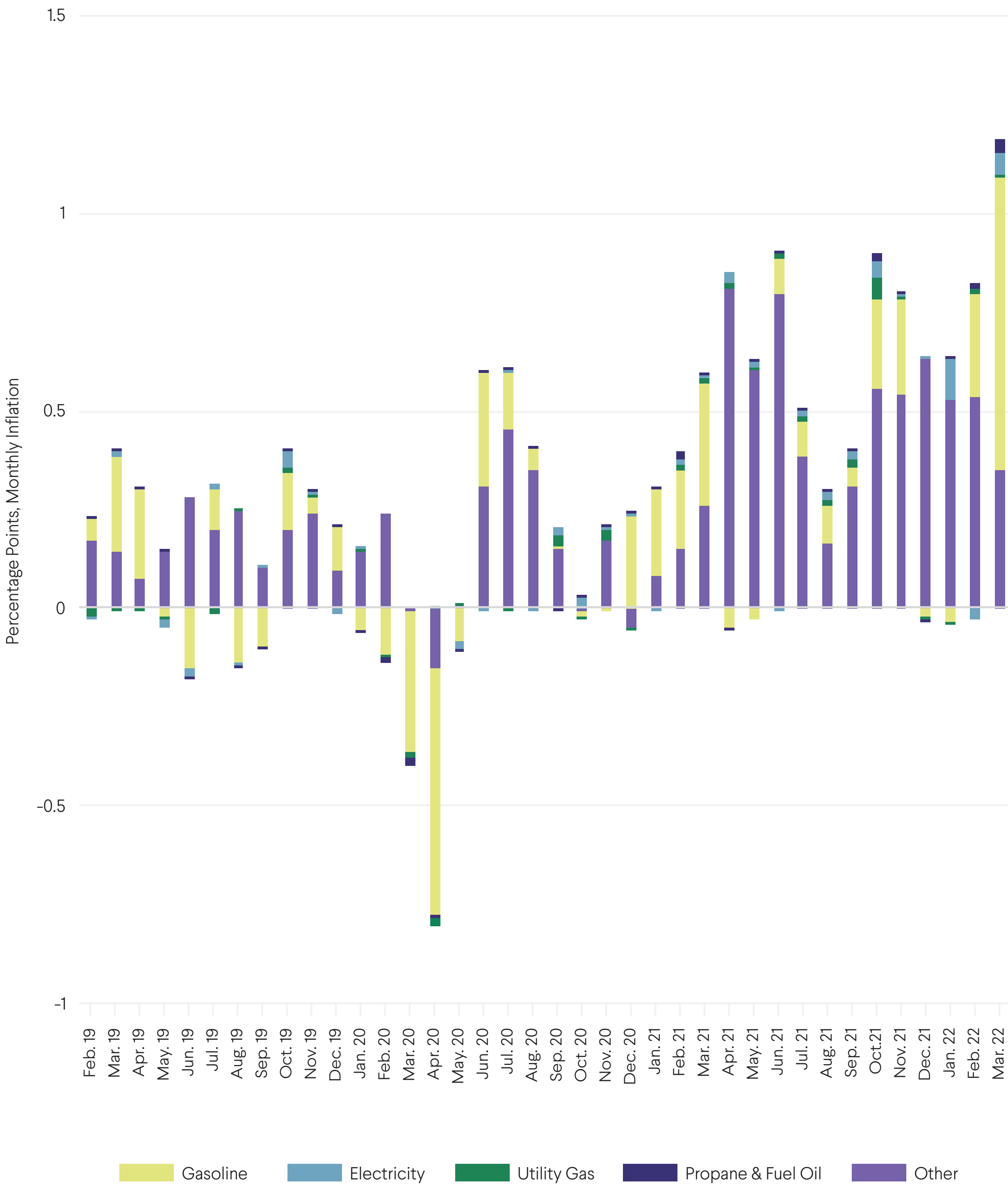

__Figure 2__ shows the monthly overall inflation rate of each month from 2019 to present. Each bar shows the contribution of four major energy goods and services to the monthly rate, as compared to other, non-energy goods and services. The "Other" category is comprised of all other goods and services in the Consumer Price Index. Even before higher-than-anticipated inflation occurred a year into the pandemic, a price change at the gas pump had a major impact on the rate of inflation. Source: US Bureau of Labor Statistics (2021b), authors' analysis.

Gasoline price increases specifically are responsible for 75 percent of energy inflation over the past year.

While energy prices are volatile—regularly increasing and decreasing—recently they have only been increasing. Since the reopening of the economy after the first pandemic shock, energy has greatly contributed to the uptick in inflation and has not yet experienced a significant decline. While as of March 2022 annual inflation was at 8.5 percent, 2.2 percent of that inflation—equivalent to the Federal Reserve's 2 percent overall inflation target—has come from the weighted contribution of energy prices. Gasoline price increases specifically are responsible for 75 percent of energy inflation over the past year.

The impact of energy price changes—and especially gasoline—on overall inflation is not specific only to times of extreme price increases. Before the pandemic, when gasoline prices were relatively low at under $3 per gallon, even a small change in gasoline prices at the pump had a major impact on monthly overall inflation. For example, in March 2019, when average gasoline prices in the US increased from $2.39 to $2.59 per gallon, over half of the 0.4 percent monthly increase in inflation that month was due to this 20-cent gasoline price increase (EIA 2022c).

Much of the growth in inflation during the pandemic—during which time we've seen extreme price fluctuations in a handful of categories—can largely be explained by the pandemic's unique impacts on the economy and a faster-than-expected economic recovery. During this period of higher-than-expected inflation, two-thirds of excess inflation over the past year has come from the weighted contribution of energy and cars alone. Figure 3 below shows the weighted contribution of both energy and new and used cars on annual inflation, which compares prices in any given month to the same month during the previous year. If there had been no price changes for energy and cars over the past year, annual inflation as of March 2022 would have been only 4.4 percent, roughly half of the annual inflation rate.

FIGURE 3. ENERGY AND CAR PRICE CHANGES ARE RESPONSIBLE FOR HALF OF THE PAST YEAR'S INFLATION

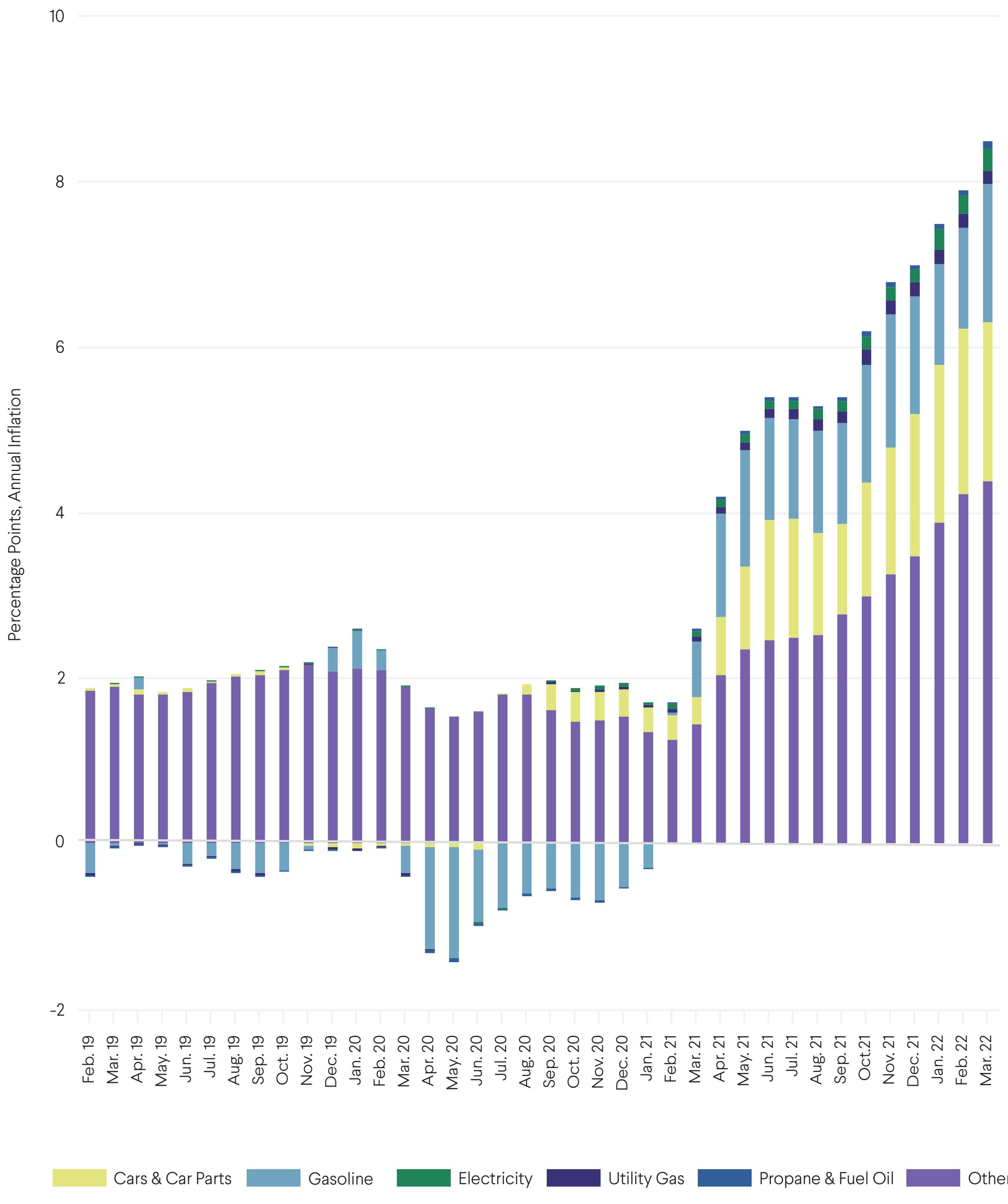

***Figure 3** shows the percentage point contribution of four major energy goods and services, as well as cars and car parts, to overall annual inflation from 2019 to present. The "Other" category is comprised of all other goods and services in the Consumer Price Index. During the pandemic's higher-than-anticipated inflation, two-thirds of excess inflation (or half of all inflation) came from these energy and car categories alone. Source: US Bureau of Labor Statistics (2021b), authors' analysis.*

It is important to note that car price increases over the past year have been driven by supply chain shortages and shifts in consumer demand during the pandemic—not by the energy sector directly. However, both categories represent our society's dependence on a transportation system designed around fossil fuels. Both the transportation and energy industries also have the potential to be transformed in a rapid transition to renewable energy sources. Building out an electrified transportation system that prioritizes both public transit and personal vehicles can greatly diminish the importance of gasoline and cars in our society. Diversifying transportation and its energy sources will shield consumers from future price volatility in these sectors and the impact of these price changes on overall inflation.

CRUDE OIL PRICE SPIKES HAVE HISTORICALLY TRIGGERED RECESSIONS

Of the past 12 economic recessions that have taken place in the post-war United States, 10 were preceded by large oil price increases

In addition to their impact on inflation data, energy price spikes or shocks can have a negative effect on the economy as a whole. This strong correlation occurs because energy is a necessary input for the daily subsistence of households and most business operations—energy consumption cannot be easily substituted or delayed until prices go back down. Therefore, consumers and businesses have no choice but to pay higher energy prices, which impacts their spending in other sectors. The relationship between energy prices and recessions is most clearly demonstrated by price spikes for crude oil, which is used to make gasoline. Figure 4 shows the interaction between crude oil prices and economic recessions. Of the past 12 economic recessions that have taken place in the post-war United States, 10 were preceded by large oil price increases (and all but three post-war oil price shocks have been followed by an economic recession) (Hamilton 2011). These oil price shocks were typically the result of geopolitical conflicts or global supply shortages—from the 1956 Suez crisis to OPEC's decision to cut production at the start of the pandemic (and many instances in between). Notably, the 2020 recession caused by the COVID-19 outbreak is one of only two recessions in post-war US history that was not preceded by an oil price spike.

FIGURE 4. US RECESSIONS ARE PRECEDED BY OIL PRICE SPIKES

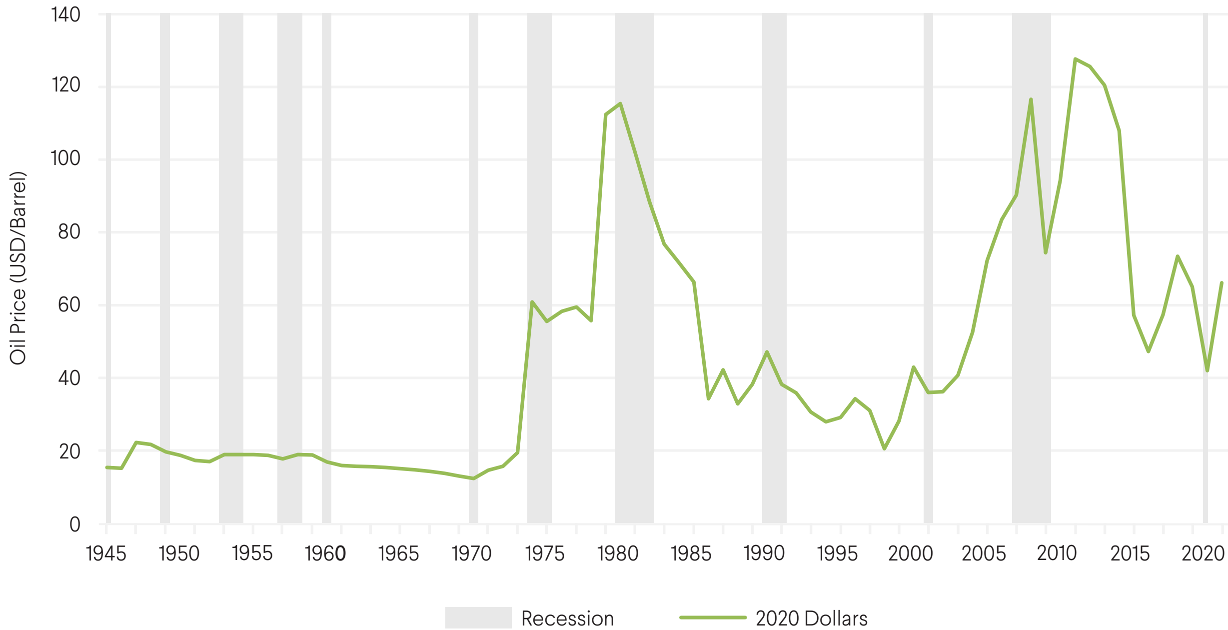

Figure 4 shows the price of crude oil from 1945 to the present in terms of the value of the dollar in 2020. With the exception of the 1960 and 2020 recessions, each US recession since 1945 has been preceded by an increase in oil and gasoline prices. Sources: BP (2021); NBER (2022); authors' analysis.

On the demand side, when gasoline prices spike, consumers continue to maintain their purchases of gasoline and other energy, which results in households having less money to spend on other goods and services in the economy. This reduced consumer spending depresses aggregate output in the economy and can be the tipping point toward a recession (Edelstein and Kilian 2009).

On the supply side, many business operations rely on gasoline and energy as factors in the production and distribution of goods and services. Increased fuel costs across the economy reduce business revenue and profits, which could otherwise be reinvested in productive capacity. Moreover, energy price increases have a powerful multiplying effect in production and consumption—that is, energy price increases (directly and those passed on to consumers by businesses) impact consumer preferences and spending on other items, especially items that are energy intensive. This can result in significant changes in demand in other sectors of the economy and economic growth overall. For example, some industries directly tied to the consumption of gasoline, such as automobile manufacturing, can experience a negative demand shock following a gasoline price increase. An analysis of recessions following five historical oil price shocks since the 1970s demonstrates that a decline in auto manufacturing made a significant contribution to those recessions. In fact, during the five quarters of recession following the 1979 and 1990 oil price shocks, real GDP would have actually increased rather than decreased had automobile manufacturing also not seen a decline during those periods (Hamilton 2011). The recession caused by the COVID-19 pandemic is actually an aberration from this historical trend: Instead of increased gasoline prices triggering a decline in automobile manufacturing, pandemic-related supply chain disruptions over the past two years have stymied automobile manufacturing alongside increased demand for cars. Even so, despite the specifics of the COVID-19 pandemic, history demonstrates that crude oil price volatility can have significant impacts on the economy as a whole.

SECTION TWO

FOSSIL FUEL SOURCES ARE VOLATILE

As we demonstrated in the previous section, energy costs make up a significant portion of household budgets, and fossil fuels make up the majority of energy inputs, exposing consumers to fossil fuel price fluctuations in different ways. Consumers experience the volatility most acutely at the gasoline pump, where prices are largely determined by the price of crude oil. However, fossil fuels are also the main fuel source for heating American homes—whether it is propane, fuel oil, or natural gas. Even 61 percent of power generation for electricity service in the United States comes from natural gas and coal (EIA 2022e). In all of these sectors of the energy industry—though in some more than others—fossil fuels have unique qualities that result in considerable price volatility.

The issue of energy price inflation is particularly difficult to resolve so long as our reliance on fossil fuels remains paramount to the functioning of our economy. Effectively managing energy price inflation while retaining a fossil fuel-based economy is nearly impossible, especially as energy commodity markets are getting more, not less, volatile. The Federal Reserve already has limited ability to mitigate inflation that results from supply-side bottlenecks or shortages in domestic production, and even less ability to tame the price volatility resulting from a turbulent international hydrocarbon market. The fact that fossil fuel prices are omitted from the Federal Reserve's measure of core inflation signals that we've accepted the constant volatility of fossil fuel prices as the backdrop of our economy, rather than as an alarming indicator of the precarity of our energy dependence.

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Some fossil fuel price volatility comes from the nature of fossil fuels as finite resources buried deep underground, and the associated significant extraction and production costs. In the case of traditional drilling, in which an oil or gas reservoir is drained entirely over time, operating costs are high at first but become quite low once a well is established and remain low until a new well must be created, giving rise to long cycles in fossil fuel costs that contribute to some price volatility. However, now that fracking in the US has become the leading global supplier of crude oil and natural gas, the cost cycles have changed. Hydraulic fracking requires shooting large quantities of water, sand, and chemicals into "tight" rock formations to crack them open and release trapped gas (Denchak 2019). Fracking requires higher initial production costs and has a higher depletion rate, so it can be necessary to repeat the costly fracking process to keep up with demand (Taylor 2021). This can lead to more frequent cost spikes and greater potential for price volatility.

A second source of fossil fuel price volatility is that countries and regions with a high supply of fossil fuels amass significant geopolitical power. The Middle East, Russia, and now the US lead in global oil production (IEA 2020) and compete in global markets that not only hang in delicate balance but are vulnerable to international conflict. Fossil fuel prices have been both implicated and used as a tool for international conflict. When supply and demand are tight, the leaders of fossil fuel-producing countries like Russia and Saudi Arabia can become more aggressive, knowing that their fossil fuel exports give them a shield against Western sanctions (Sahay 2022). In other instances, fossil fuel-rich countries manipulate the price of oil intentionally to further their geopolitical positions, as was the case in 1973 when the Arab members of OPEC imposed an oil embargo on countries perceived to be in support of Israel (Hamilton 2011). There are many other instances of geopolitical conflicts that coincide with the oil price spikes and ensuing recessions highlighted in Figure 4.

BOOSTING DOMESTIC PRODUCTION CANNOT GUARANTEE LOW OR STABLE PRICES

Even in moments of elevated domestic demand, the profit incentive to transport domestic oil and natural gas abroad continues to take precedence over the affordability and stability of energy prices.

Because of the international nature of fossil fuel markets, increasing US domestic production of fossil fuels does not yield the relief in energy prices that some politicians claim it can. Oil prices are determined at the international level through OPEC, and increases in domestic oil production, even if intended to be consumed in the US, will impact the global aggregate supply and price. As a result, conflict among fossil fuel-rich countries or shifts in global supply and demand bear huge weight on the prices that people pay at the gas pump or to heat their homes, but changes in US production have a diluted effect on domestic prices. This is a crucial aspect of the fossil fuel supply chain that is different from other drivers of inflation, for which ironing out supply blockages can be effective in taming inflation.

It is therefore no surprise that significant investments in domestic production of both oil and natural gas over the past decade have borne comparatively little weight in stabilizing domestic fossil fuel prices. In addition to the intricacies of geopolitics, this is also due to the powerful and enduring profit incentive for selling domestic fossil fuel abroad.

The recent Liquified Natural Gas (LNG) export boom in the US provides an example. Natural gas fracking initially led to lower domestic prices because the gas could not be transported overseas and so prices were shielded from the dynamics of an international market. The advent of LNG—cooling natural gas to a liquid state—made it possible to transport it overseas, beyond the reach of pipelines. This enabled US producers of LNG to enter a lucrative, global market, in which they can earn high profits by exporting abroad. In the 2010s, the US started investing significant resources into producing and transporting LNG. In 2016, the US began exporting LNG, and as of April 2022, has become the largest LNG exporter in the world (Chapa 2022). This LNG boom has led to skyrocketing domestic gas production, but not to US energy independence.

In fact, LNG exports have grown faster than domestic natural gas production, which means that inventories are drawing down to meet international demand and domestic prices are increasingly impacted by higher global benchmark prices. In October 2021, the EIA predicted that "lower US inventories could contribute to more natural gas price volatility, particularly if any area in the United States experiences a severe cold snap" (EIA 2021). The winter of 2021/2022 showed this prediction to be true: LNG exports kept apace, while severe weather in the US led to pipeline infrastructure disruptions and soaring prices (Chapa and Maglione 2022).

A similar trend can be observed in domestic oil production, which also increased during the fracking boom of the 2010s. After the termination of the crude oil export ban in 2015, annual exports rose from just under 170 million barrels in 2015 to 1.7 billion in 2020 (EIA 2022d). The US now exports 4 million barrels of crude oil and gasoline every day, making it the fourth largest oil and gasoline exporter in the world.

FOSSIL FUEL PRICE VOLATILITY IS FURTHER EXACERBATED BY SPECULATION

While the unique supply and demand forces of international fossil fuel markets account for structural volatility in fossil fuel prices, speculation by financial institutions further amplifies price fluctuations. Speculators thrive on and promote volatility, as every price change is a profit opportunity. Wall Street and private trading desk speculation plays a role in raising prices in many industries—including nascent clean energy markets—but is particularly inflationary in fossil fuel markets due to the inherent volatility of oil and gas prices, which provides ample opportunity for speculators to profit. Unsurprisingly, during times of elevated demand—for example, following severe winter storms during which energy supply is compromised and energy companies can be expected to raise prices for their own profit gain—speculators betting on price increases cash in while consumers are shouldered with drastically inflated energy bills. This was the case during the Texas winter storm of 2021, during which wholesale power costs rose by 400 times the normal amount and consumers faced energy bills in the thousands of dollars, some reaching over $15,000 (Nieto del Rio et al. 2021).[1]

Deregulation in commodity futures markets, beginning with the Commodity Futures Modernization Act of 2000, opened the floodgates for energy trading and price speculation (Stout 2011), effectively undermining the oversight authority of the Commodity Futures Trading Commission (CFTC) and its ability to prevent financial institutions from inflating energy prices ultimately paid by consumers. The passage of the Dodd-Frank Wall Street Reform and Consumer Protection Act in 2010 provided some relief by compelling commodity trading to move from the unregulated, dark markets (known as over-the-counter, or OTC) into exchanges fully subject to CFTC oversight and by requiring these regulated trades to post margin, which eliminated the ability of speculators to make big leveraged bets. Dodd-Frank's most explicit safeguard against speculation was mandatory position limits, but these were not actually implemented until 2020 (CFTC 2021).

Though these new safeguards were a step in the right direction, oil and gas traders formerly housed by major banks opened private commodity trading houses in Europe and Asia like Vitol, Mercuria Energy Group, Trafigura Group, and Gunvor Group, making the industry's largest speculators more difficult to regulate. These fossil fuel commodity traders made significant profits in 2021 during the significant oil and gas volatility that followed the COVID-19 lockdown, and they are still building their capacity in anticipation of continued volatility in the market (Hampton 2022). Vitol reported $4 billion in net profits in 2021 compared to $3.2 billion in 2020 (Vitol 2022), Mercuria Group reported $1.255 billion in 2021 compared to $728 million in 2020 (Farchy and Hunter 2022), and Trafigura reported $3.1 billion, nearly doubling 2020 earnings (Trafigura 2021). Future volatility in oil and gas prices will continue to be exploited by trading desks like these so long as our reliance on fossil fuels continues, contributing to further overall inflation.

[1] The Electric Reliability Council of Texas (ERCOT) power market is designed to rely upon scarcity pricing to provide generators with excess revenue during scarcity events, such as winter storm Uri in 2021, to incentivize them to operate year-round. As a result, the market model incentivizes failure during scarcity events and leads to extreme price fluctuations, making the market vulnerable to speculation.

FOSSIL FUEL DEPENDENCE CONTRIBUTES TO CLIMATE CHANGE, SEEDING FUTURE PRICE INSTABILITY

Continuing to burn fossil fuels further intensifies climate change, which is responsible for increased extreme weather events that damage and disrupt both local energy infrastructure and the global supply chain that delivers fuel to this infrastructure. There are numerous examples that illustrate how vulnerable fossil fuel infrastructure is to climate disaster, and the impact of such disasters on production and prices.

For example, Texas winter storm Uri in February 2021 (discussed above) caused Gulf Coast production and refining capacity to decrease by one-third (Hasemyer 2021). On the other side of the country, the Trans-Alaska Pipeline System is currently suffering from thawing permafrost that will jeopardize the supports holding up elevated portions of one of the world's largest pipelines (Hasemyer 2021). Fossil fuel infrastructure across the globe is similarly vulnerable to a variety of climate impacts and disasters. In 2021, Russian environmental minister, Alexander Kozlov reported that permafrost degradation led to roughly 23 percent of technical failures and 29 percent of losses in fossil fuel extraction (Lee 2021; Moscow Times 2021). Wildfires also pose a threat to fossil fuel infrastructure; for example, in 2016, wildfires in Alberta threatened oil-sands mining complexes, causing a 40 percent reduction in Canadian daily oil production—or over 1 million barrels a day (Lee 2021).

The solution to inflation driven by fossil fuel prices therefore cannot be to produce, export, and burn more fossil fuels—a policy choice that attempts to address short-term inflation by increasing the supply of fossil fuels, but subjects consumers and the economy as a whole to growing price instability as well as to the ever increasing and unpredictable costs of climate disaster. The dynamics of the industry—geopolitical precarity, export incentives and international pricing, speculation, and climate risk—make it clear that the costs to the stability of the economy and the planet will outweigh any short-lived relief that may come from increased fuel production. Instead, we need a long-term solution that can only be found through a proactive, government-led transition to a renewable energy economy (Beachy 2022).

SECTION THREE

TRANSITIONING TO ELECTRIFIED, RENEWABLE ENERGY WILL SIGNIFICANTLY INCREASE PRICE STABILITY

Transitioning away from the volatility of the unregulated, global fossil fuel industry toward renewable energy produced and distributed through the electricity industry will significantly improve price stability. The most well-established plan for a rapid transition away from fossil fuels and toward renewable energy sources requires the electrification of energy usage—such as switching from gas-powered vehicles to electric buses and cars and from gas- or oil-powered furnaces to electric home heating sources. This plan would facilitate significant energy price stability due to the stable qualities of both electricity and renewable energy sources.

THE ELECTRICITY SECTOR HAS HISTORICALLY PRODUCED STABLE PRICES

Historically, electricity prices have had a lower average annual inflation rate and smaller range of price changes than gasoline and piped utility gas service, used for heating and fueled by natural gas. Figures 5 and 6, and Table 1, below, show these dynamics through examining price data of these three major energy categories from 1968 to the present (all of the years that the BLS has collected consumer price data on these three energy sources). Figure 5 shows the annual rate of inflation as it changes from 1968 to the present, while Figure 6 plots the frequency of all of the annual inflation rates of these three energy sources during this time period. Table 1 reports some of the values from this distribution analysis.

Both figures and Table 1 illustrate that electricity has a much lower average annual rate of inflation and price volatility compared to gasoline and utility gas. Moreover, electricity also has a smaller standard deviation—or, difference between its inflation rate during any given time and its average inflation rate—compared to the other two energy sources. This analysis shows that gasoline is almost four times more volatile than electricity. Natural gas is more than twice as volatile as electricity.

FIGURE 5. ELECTRICITY PRICES ARE LESS VOLATILE THAN GASOLINE AND UTILITY GAS

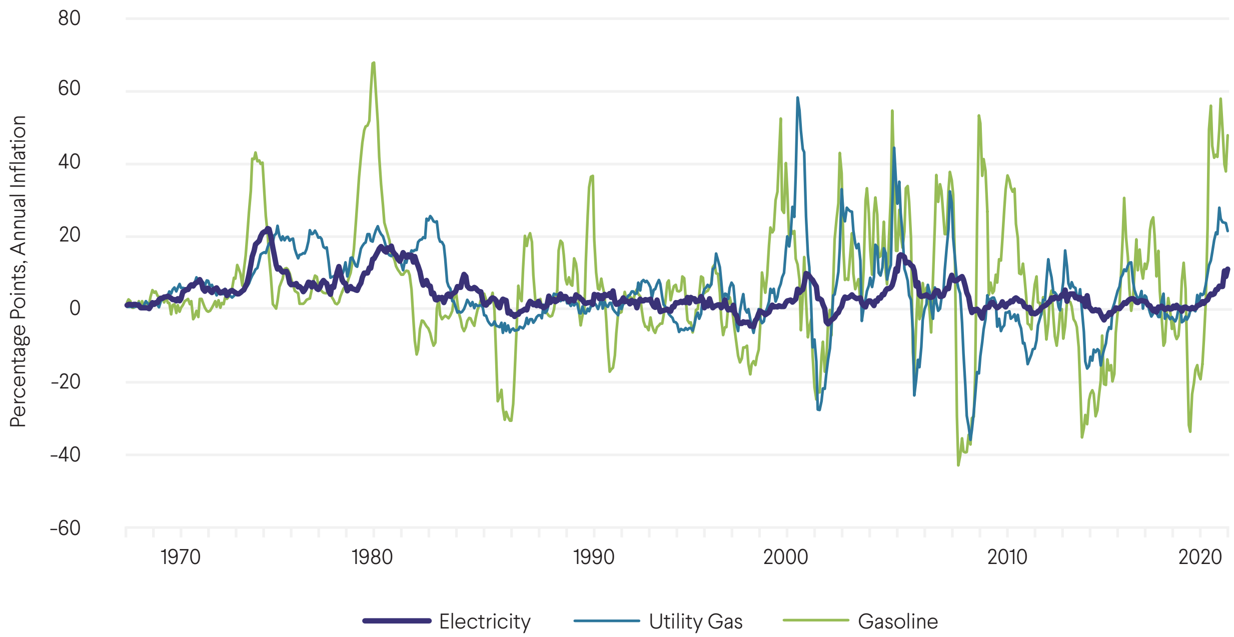


Figure 5 shows the annual rate of inflation of three major consumer energy items (gasoline, utility gas, and electricity service) from 1968 to the present. Gasoline (and utility gas to a lesser extent) prices historically experience large increases and decreases, while electricity service has never had such extreme price volatility. Source: US Bureau of Labor Statistics (2021b), authors' analysis.

FIGURE 6. ELECTRICITY HAS A LOWER AVERAGE INFLATION RATE AND SMALLER VARIATION IN PRICES THAN GASOLINE AND UTILITY GAS

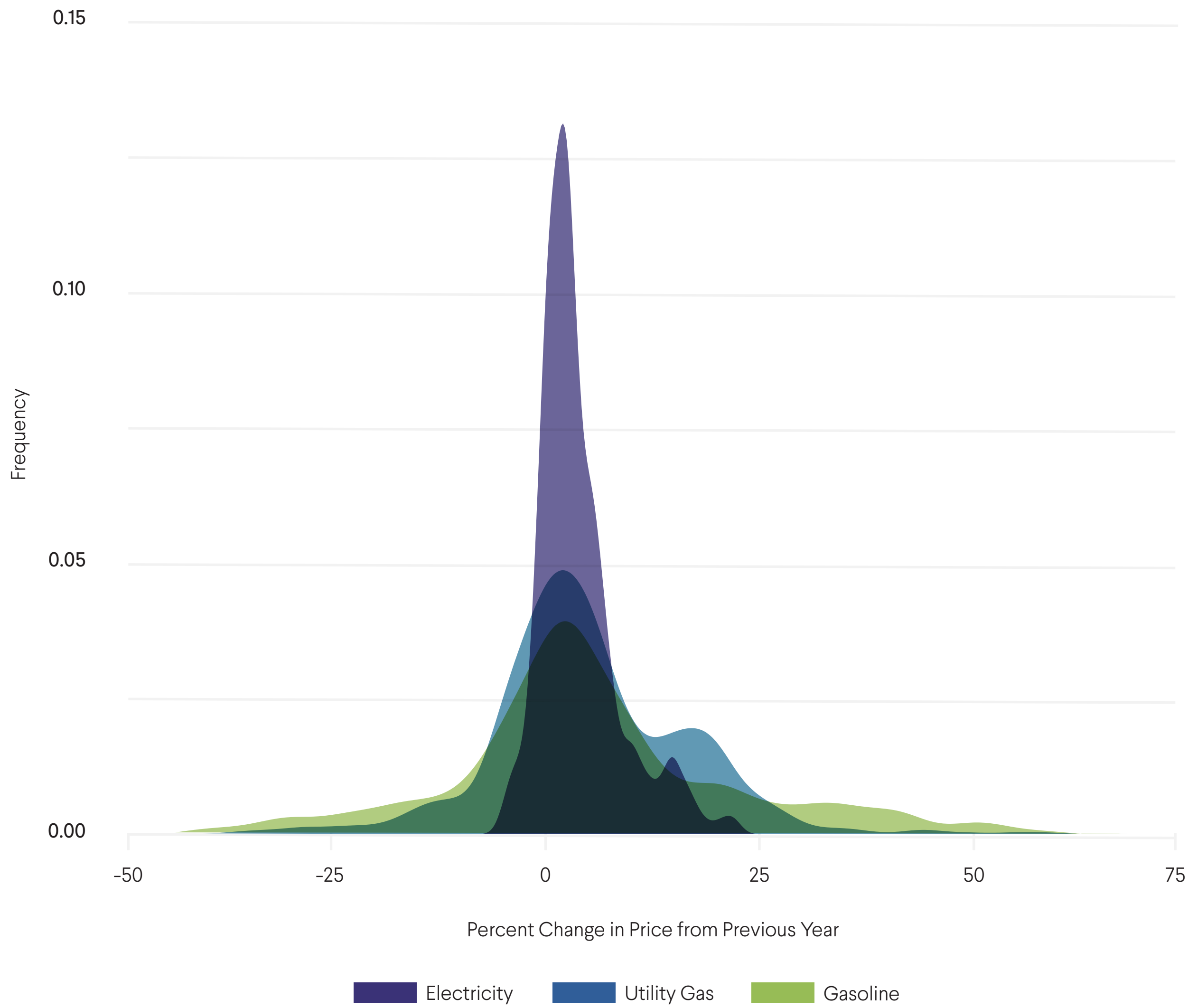


__Figure 6__ shows the frequency of the distribution of the annual rate of inflation of three major consumer energy items (gasoline, utility gas, and electricity service) from 1968 to the present. The tails of each line represent the lowest and highest extreme rates of inflation for each item. The frequency of each inflation rate is represented by the height of the line at a given rate. Electricity's distribution plot has a lower average annual rate of inflation and less extreme price volatility. The shape of electricity's trend line shows that most electricity inflation is clustered in a very narrow range. Gasoline's trend line is the opposite extreme: Its long tails represent annual inflation rates at -40 percent to 70 percent. The height of its distribution plot is overall shorter than the other two, demonstrating that gasoline inflation spans a broad range and that it is far more volatile. Source: US Bureau of Labor Statistics (2021b), authors' analysis.

TABLE 1. ELECTRICITY HAS A LOWER AVERAGE AND SMALLER VARIATION IN INFLATION THAN GASOLINE AND UTILITY GAS

	Average Annual Inflation (percentage points)	Standard Deviation (percentage points)
Electricity	3.9	4.7
Utility Gas	5.3	11.5
Gasoline	6.0	17.9

__Table 1__ reports some of the values represented in Figure 6 for the distribution of the annual rate of inflation of three major consumer energy items (gasoline, utility gas, and electricity service). Column 1, "Average Annual Inflation," is the average of all annual rates of inflation for each specific item from 1968 to the present. Column 2, "Standard Deviation," is the amount of variability among the annual inflation rates of each item. It calculates the typical distance of a data point from the average. Electricity's low standard deviation means its prices are clustered around the average. On the other extreme, gasoline's large standard deviation—almost four times the size of electricity's standard deviation—means the annual rate of inflation is much more spread out, or more volatile. Source: US Bureau of Labor Statistics (2021b), authors' analysis.

Electricity prices have consistently remained stable for two main reasons. First, things that run on electricity draw power from the electricity grid, which utilizes a variety of sources. This is the opposite of gasoline-powered cars, which have primarily been designed to run on gasoline, or gas-powered furnaces, which are manufactured to run on a specific fossil fuel gas or oil. The electricity grid, on the other hand, was designed to utilize power generated from a wide variety of sources, such as hydropower, fossil fuels like petroleum and natural gas, nuclear, wind, and solar. It is structured to manage the complexities of balancing supply from multiple sources alongside consumers' expectation for electricity on demand. Even in a fossil fuel-reliant economy, the electricity sector has been able to circumvent some of the volatility of fossil fuels by diversifying its sources. In doing so, it can relieve the inflationary pressure on consumers in a way that businesses and public providers in other energy goods and services cannot. It is, therefore, also best equipped to incorporate renewable energy sources into its production and balance intermittent generation as storage capacity advances.

Second, the regulation of the electricity industry enables a much greater degree of price stability compared to natural gas and crude oil. Electricity is the most regulated sector of the US energy industry. The 1935 Federal Power Act (FPA) mandated that all electricity service rates be "just and reasonable" and that all retail electricity prices be determined by the cost of service plus a reasonable, regulated profit (Slocum 2007). Prior to the

1990s, most electricity was delivered to consumers via vertically integrated monopolies[2] subject to full cost-of-service regulation by state utility commissions. When some states[3] began restructuring in the late 1990s (prompted by federal legislation in 1992 compelling utilities to provide open access to their transmission lines), wholesale power prices were increasingly determined by competition subject to the FPA's "just and reasonable" standard rather than via cost-of-service regulation. While many consumer advocates have concerns about whether wholesale market competition provides households with consistent access to fairly priced energy, the continued diversity of energy supply combined with a modicum of federal and state oversight of rates continues to subject electricity to a higher standard of regulatory oversight in comparison with other energy commodities.[4] A renewable transition that delivers stable energy prices will, therefore, also require improved regulation and oversight of deregulated energy markets.

While there is much room for the Federal Energy Regulatory Commission (FERC) to increase its effectiveness at regulating deregulated markets—which can improve price stability and affordability further—the level of regulatory oversight of electricity is still far greater than other energy commodities. Natural gas and petroleum industries do not have comprehensive regulatory oversight, and comparing electricity to these unregulated industries demonstrates how regulation mandating that electricity service providers keep prices in line with the rates that utility regulatory commissions set adds a significant level of stability absent in other energy sectors. Regulation of electricity prices by the federal government is a necessary way to keep pricing in line with the cost of production, and it will only become more important as uptake of renewable energy increases.

RENEWABLE ENERGY SOURCES SHOW STABLE PRICE TRENDS

Renewable energy sources have qualities that make them a more stable source of energy than petroleum and natural gas, which can in turn have a positive impact

[2] The significant capital investment in infrastructure necessary to deliver utilities, like electricity generated at a power plant, to all households and businesses creates a barrier to entry and prohibits competition (Regulatory Assistance Project 2011). For these reasons, utilities are often referred to as natural monopolies. Recognizing this natural tendency toward monopolization, many countries have prohibited private firms from participating in the utility sector, and the government instead directly provisions electricity and other utilities.

[3] To date, 16 states and the District of Columbia have deregulated their electricity markets: California, Connecticut, Delaware, Illinois, Massachusetts, Maryland, Maine, Michigan, Montana, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, and Texas (American Public Power Association 2021).

[4] Niko Lusiani's forthcoming issue brief, "Power Struggle: How Shareholder Primacy in the Electrical Utility Sector Is Holding Back an Affordable and Just Energy Transition," provides additional detail on the topic of regulation in the electricity sector.

on overall price stability. While there are a wide variety of renewable energy sources, we focus in this section on solar and wind energy production because of recent technological advancements, their popularity in current policy proposals, and their potential to curb carbon emissions. First, while petroleum must constantly be discovered and extracted, renewable energy is, by definition, naturally replenishing—the sun shines and the wind blows every day. Once capital is invested in the infrastructure to capture renewable energy and convert it to electricity or heat, there are no fuel costs—that is, no specific volume of gasoline manufactured elsewhere that must be input into the system in order to generate power. Without fuel costs, the most volatile component of fossil fuel prices, renewable energy production can have long-term fixed price contracts—something that is not possible in fossil fuel production. This translates to near-zero marginal costs, particularly for large-scale wind farms, consistently driving prices down and resulting in significant consumer savings.

Second, universal and widespread access to sun and wind limits the possibility that building out renewable energy production would mimic the geopolitics of the fossil fuel industry—the cause of much fossil fuel production and price volatility. While some countries have more wind or sun relative to others, each country has access to some renewable energy sources and can customize its own sourcing plan based on the qualities of its environment. As a result, compared to the extraction of fossil fuels—which incentivize oil-producing countries to maximize profits through global trade at the expense of local demand—renewable energy production incentivizes domestic production and consumption. Of course, the viability of solar and wind power depends on battery storage technologies that utilize rare earth metals and other components concentrated in certain regions of the globe. However, with equitable distribution of these necessary components for the upfront costs of renewable energy technology, renewable energy production can be relatively free of the geopolitical dynamics that cause much of the volatility of fossil fuels.

Lastly, a rapid transition to renewable energy will slow and minimize further warming of the climate. Fewer climate disasters translates to fewer energy system disruptions that result in price volatility due to a mismatch between supply and demand or speculation. Furthermore, because wind and solar energy production do not require fuel inputs, any climate-related disruptions to the energy system would be much more localized. Linking renewable energy facilities to disparate load centers through expanded transmission can amplify renewable energy's benefits by ensuring that excess zero-emission generation can feed demand.

SECTION FOUR

RENEWABLE ENERGY IS BECOMING MORE AFFORDABLE

Numerous studies conducted in recent years to ascertain wind- and solar-generated electricity price trends have found evidence that the overall cost of renewable energy production is declining[5] and will continue to decline, and that it has already contributed to a reduction in consumer electricity prices—despite its marginal use today. This is another important and unique feature of renewable energy's potential: While price stability is important for the overall health of the economy, a meaningful reduction in energy price levels would further benefit consumers and the economy.

The cost of producing renewable energy is rapidly declining due to technological advances and increases in economies of scale. A global review of cost and auction price data from 2010 to 2020 found that the global weighted-average levelized cost of energy[6] for utility-scale solar-generated electricity decreased 85 percent. Similarly, the global weighted-average cost of electricity from onshore and offshore wind projects fell 56 and 48 percent respectively during the same 10-year period (IRENA 2021).

Drawing on these recent trends in renewable energy production costs, several researchers have modeled and forecasted the long-term impact of a rapid transition to renewable energy. Given that investing in wind and solar is already cheaper than investing in existing gas plants, researchers at Carbon Tracker project the levelized costs for solar and wind technologies will fall to 60 percent and 70 percent, respectively, below the long-run marginal cost for natural gas by 2030 (Carbon Tracker 2021). Figure 7 illustrates these trends. The cost of producing electricity with solar and wind energy is currently cheaper and trending downward over the next 10 years. On the other hand, the long-run marginal cost of producing electricity with natural gas is currently more expensive and trending upward.

[5] We discuss production costs here instead of prices because neither the BLS nor the EIA collect price data for renewables specifically. The trends in production costs, however, are an appropriate proxy for trends we anticipate in prices of renewables.

[6] Because fuel sources (natural gas, nuclear, renewables, etc.) feature radically different capital, operation, and maintenance costs, analysts commonly use the levelized cost of energy to effectively compare costs across different energy systems. The levelized cost measures the present value of building and operating power generation facilities during their projected lifetime.

FIGURE 7. RENEWABLE ENERGY IS CHEAPER THAN NATURAL GAS POWER GENERATION

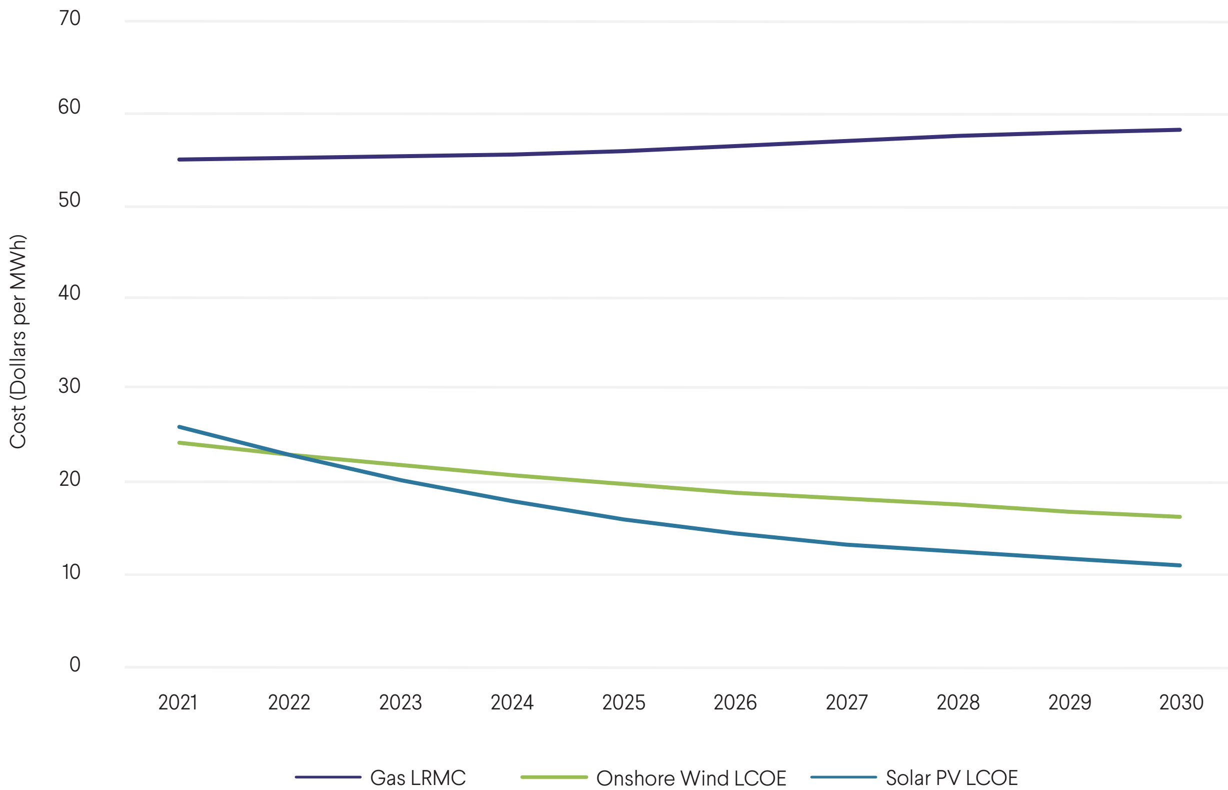


Figure 7 shows the projected cost per megawatt hour (MWh) to produce energy generated by natural gas, onshore wind, and solar from 2021 to 2030. Due to the complexities in distilling the costs of these three very different energy production methods, analysts compare the long-run marginal cost (fixed operating and maintenance costs to produce an additional MWh) of natural gas to the levelized cost of energy (LCOE) of onshore wind and solar, which measures the present value of building and operating power generation facilities during their projected lifetimes. Renewable energy production is on a trend toward lower costs, while natural gas production costs are increasing over time. Source: Carbon Tracker Initiative (Sims et al. 2021).

A rapid transition to wind and solar energy production today, followed by more technological advancements in subsequent years, will save consumers $26 trillion in energy costs in the coming decades.

Based on historical data on annual system costs and prices of all current sources of energy production, Way et al. (2020) find that a rapid transition to wind and solar energy production today, followed by more technological advancements in subsequent years, will save consumers $26 trillion in energy costs in the coming decades. This is a huge value, exceeding the entire US economy's $24 trillion annual output. This cost saving is due to the fact that renewable energy production costs are already lower than many competing sources of electricity generation and are expected to continue to decline over the long term, while fossil fuel production costs are expected to rise in the long run. While significant investment is needed to make the transition, Kingsmill Bond, Senior Principal at the Rocky Mountain Institute, estimates that by moving to renewable energy, "We save about two trillion dollars a year on fossil-fuel rents. Forever." (McKibben 2022).

Finally, while solar and wind comprised less than 13 percent of sources of energy in the US in 2021, they are already contributing to a decline in overall wholesale electricity prices (EIA 2022b). Researchers at the Lawrence Berkeley National Laboratory found that the growth in use of solar and wind for electricity generation from 2008 to 2017 reduced annual wholesale electricity prices by about $3/MWh (Mills et al. 2020). For each 1 percent increase in use of solar and wind as an energy source, they estimate a $0.14/MWh decrease in wholesale prices. They argue that the introduction of more solar and wind energy production, especially in ways that compete with peaker plant usage, will result in continued downward pressure on electricity prices.

RENEWABLE ENERGY POLICY CAN BE EQUITY POLICY

A rapid transition to electrified, renewable energy sources will not only improve price stability and affordability but could also reduce the disproportionate burden of energy prices on low-income and other vulnerable households and the likelihood that these households will face energy insecurity. However, given how inaccessible renewable energy sources and options are to low-income and other vulnerable households currently, new policies must be implemented to ensure an equitable, rapid transition to renewable energy.

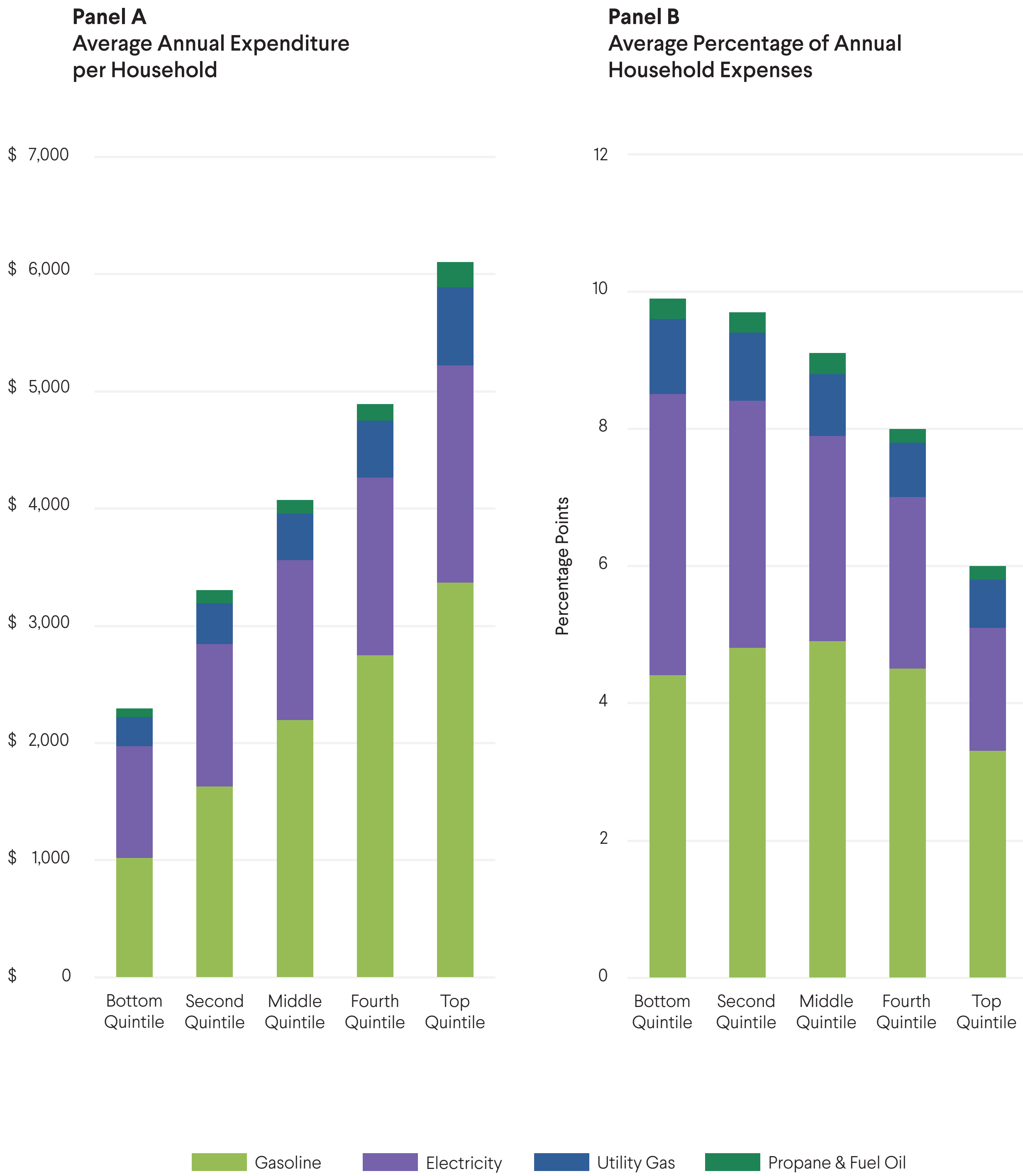
ENERGY PRICE VOLATILITY INCREASES ENERGY INSECURITY

Energy price changes disproportionately burden low-income and other vulnerable households. Although higher-income households consume more of all types of energy sources, energy comprises a bigger portion of low-income households' budgets, simply because energy is a necessity and low-income households have less money.

Panel A of Figure 8 shows the average consumption level for each energy good or service in the Consumer Expenditure Survey (CEX)[7] by income quintile. Panel B shows the percentage of annual expenses a household spent on each energy good or service by income quintile.

[7] The BLS surveys households annually about their consumption habits, and the CEX survey is used to compile the weights applied to each item in the CPI.

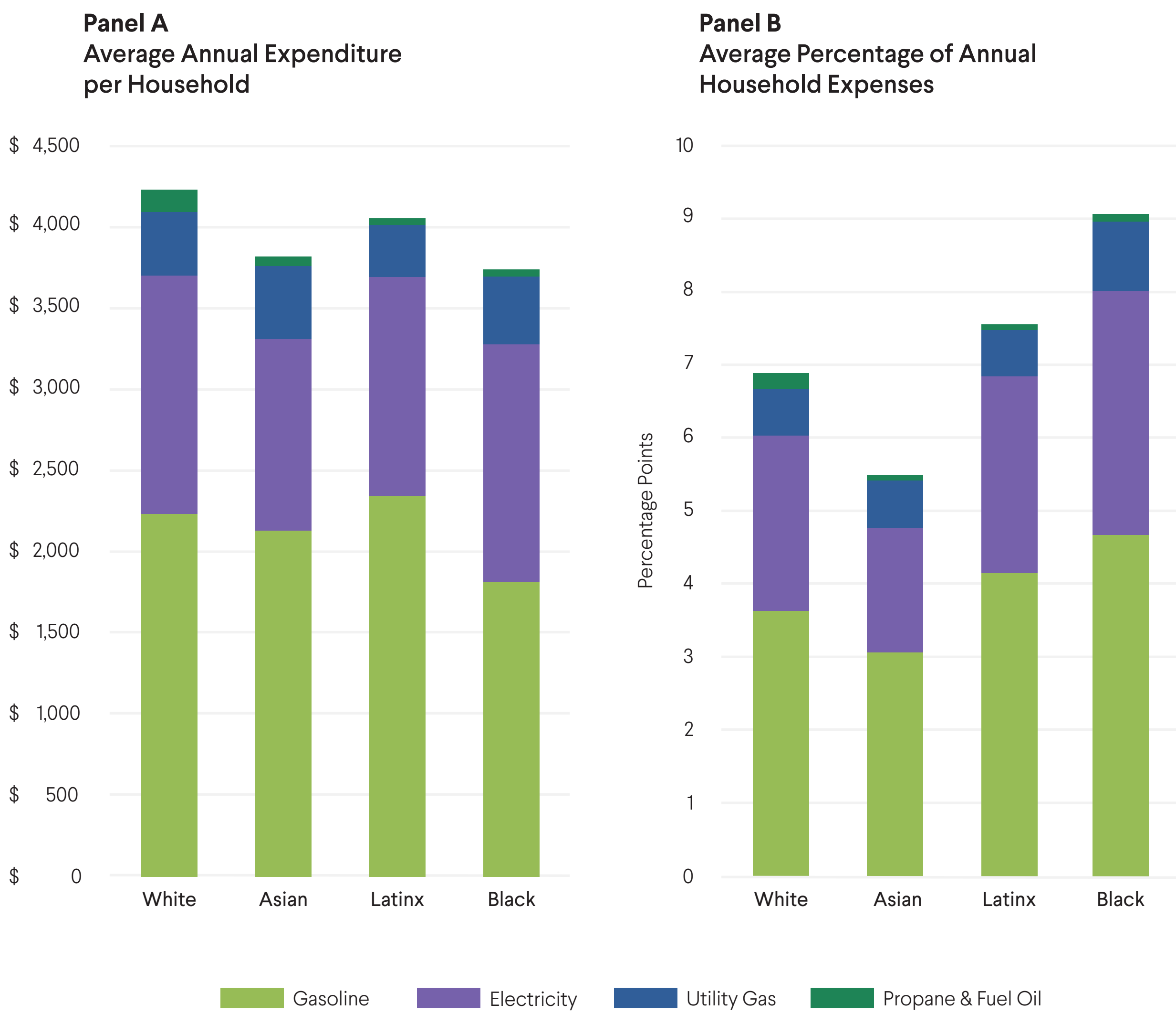
FIGURE 8. HIGHER-INCOME HOUSEHOLDS SPEND MORE ON ENERGY, BUT LOWER-INCOME HOUSEHOLDS ARE MORE BURDENED BY ENERGY COSTS



__Panel A__ shows the average energy expenditures for each income quintile. __Panel B__ shows the average percentage of annual household expenses spent on energy sources for each income quintile. Each income quintile represents 20 percent of the total population by annual household income. Low-income households are disproportionately burdened by energy expenses, despite consuming less energy. This data is sourced from the Consumer Expenditure Survey from 2004 to 2020. Source: US Bureau of Labor Statistics (2021a), authors' analysis.

Figure 9 shows the average consumption level and percentage of annual expenses for each energy good or service by race and ethnicity. While income level is not the sole determinant of people's consumer choices and preferences, it is important to note that Black and Latinx households have lower average household incomes in the United States and, therefore, their energy consumption follows similar trends: For the most part, Black and Latinx households consume less energy, but energy consumption comprises a larger share of their annual expenses.

FIGURE 9. WHITE HOUSEHOLDS SPEND THE MOST ON ENERGY, BUT BLACK AND LATINX HOUSEHOLDS ARE MORE BURDENED BY ENERGY COSTS



__Panel A__ shows the average energy expenditures for four race and/or ethnic groups surveyed by the Bureau of Labor Statistics. __Panel B__ shows the average percentage of annual household expenses for those groups. Black and Latinx households are disproportionately burdened by energy expenses, despite consuming less energy than white households. This data is sourced from the Consumer Expenditure Survey from 2012 to 2020. Source: US Bureau of Labor Statistics 2021a, authors' analysis.

As a result, when energy prices rise, low-income, Black, and Latinx households with less disposable income are more likely to become energy insecure. Energy insecurity occurs when a household faces challenges meeting its energy needs and must choose between keeping the home at an unsafe or unhealthy temperature, forgoing other basic necessities to pay an energy bill, or not paying an energy bill (which may result in extra fees, debt, or energy disconnection). In 2020, 27 percent of all households surveyed by the EIA reported experiencing energy insecurity. By comparison, 52 percent of Black households surveyed in 2020 reported experiencing energy insecurity (EIA 2020).

Because energy consumption cannot be delayed or easily switched to another source or provider, energy inflation can be the tipping point into energy insecurity for many low-income, Black, and Latinx households who face a higher energy burden and have limited disposable income. Electrifying the grid and transitioning to renewable energy sources will deliver more stable and affordable energy prices in the long term, reducing the energy burden for all households in addition to decreasing the disproportionate impact on low-income, Black, and Latinx households and minimizing their risk of energy insecurity due to fossil fuel volatility.

Because energy consumption cannot be delayed or easily switched to another source or provider, energy inflation can be the tipping point into energy insecurity for many low-income, Black, and Latinx households who face a higher energy burden and have limited disposable income.

PUBLIC INVESTMENT IS NECESSARY FOR AN EQUITABLE ENERGY TRANSITION

While some states, municipalities, and companies are choosing to invest in solar and wind energy production or electrical vehicle charging stations, existing renewable energy policy at the consumer level is largely limited to tax credits for households and businesses who want to—and can afford to—make the upfront investment in weatherization, home solar panel installation, or electric vehicles. These policies are not easily accessible to the low-income, Black, and Latinx consumers who are disproportionately burdened by energy price volatility. Thus, the benefits of stable and affordable electrified renewable energy are currently only available to consumers with the disposable income to make these capital-intensive direct purchases. In order for a rapid transition to renewable energy to occur and for consumers to broadly experience the accompanying price stability and affordability, renewable energy policy must be designed more equitably.

One clear illustration of the limits of current renewable energy policy is that it excludes the 37 percent of Americans who rent their homes (US Bureau of Labor Statistics 2021a). Most renters have short-term leases and so investing in home solar panels or a home electric vehicle charging station makes little sense. Additionally, installing most renewable energy infrastructure requires up-front capital investments, most often paid for with existing wealth or by leveraging assets—most notably housing. Installing renewable energy infrastructure is therefore not possible for most people who do not own their own homes and do not have mortgage debt to leverage—a population that is disproportionately made up of low-income families and people of color due to the history of racist and exclusionary housing policy and the racial wealth gap in America.

Furthermore, within the existing renewable energy policy framework, landlords and property developers lack the financial incentive to make upfront capital investments. Landlords are typically responsible for the energy services in their buildings, but they often do not pay the utility bills. Increasing the energy efficiency of current homes and home appliances or installing newer technologies that directly utilize renewable sources, such as on-site solar panels or geothermal heat pumps, greatly reduces monthly energy costs for renters, but is often only experienced as a cost by landlords.

Given the burdens faced by low-income, Black, and Latinx households and the hurdles faced by renters, existing renewable energy policies are not sufficient to facilitate the rapid transition to renewable energy production needed to achieve net-zero greenhouse gas emissions by 2050 and the price stability and affordability this transition will pass on to consumers. Regulation mandating the build out of utility-scale wind and solar energy production and public electric vehicle charging stations will be necessary for a rapid transition to electrified, renewable energy. Direct public spending on and credit creation for this infrastructure will also be critical, as will new incentives and requirements for landlords to facilitate building upgrades to utilize electrified, renewable energy for heating and home appliances that currently require utility gas inputs. Without fiscal policy and public investment, renewable energy policy will fail to deliver price stability to groups who are most at risk of energy insecurity.

SECTION SIX

A WHOLE-OF-GOVERNMENT ENERGY TRANSITION

Electrified, renewable energy can provide the stability our society needs and is a crucial step in the green transition necessary to slow the progress of climate disaster. The faster we transform our energy infrastructure, the quicker we will be able to experience the relief that price stability of renewable energy sources can provide. However, this transition cannot be left to individual consumers' and business owners' choices, especially for the transition to be rapid and equitable. Investing in this new system requires a government-led approach.

Policymakers cannot wait until fossil fuel-driven inflation comes back down. As we have shown in this issue brief, energy price volatility is a long-standing phenomenon that will continue so long as our economy relies on fossil fuels, and current fossil fuel-driven inflation should not discourage crucial federal spending on a renewable transition. Instead, the inflation we are experiencing is an urgent signal that public investment is necessary, and should be a strong motivating force to dramatically reduce our reliance on fossil fuels and secure long-term energy price stability.

Congress must provide sufficient fiscal spending for the capital-intensive build out of wind and solar utility infrastructure as well as public and personal electric vehicle infrastructure in order to achieve net-zero greenhouse gas emissions by 2050. Congress must also pass legislation that mandates and commits building owners to increase energy efficiency and electrify building infrastructure. Federal spending toward a renewable transition must ensure that 40 percent of overall benefits flow to disadvantaged communities in line with Biden's Justice40 initiative (Daly 2022). In launching a green transition, the federal government has the opportunity to not only reduce price pressures on low-income, Black, and Latinx households, but to proactively reinvest in communities that have historically faced the worst of climate change and of white supremacist policy. It is crucial that an electrified, renewable energy-based economy not reproduce the structures of inequality we are fighting to dismantle.

The Federal Reserve cannot rely on traditional monetary policy to reduce price volatility from fossil fuels, as raising interest rates will not relieve inflationary pressure from gasoline and natural gas prices. To manage an orderly transition away from fossil fuels, the Fed must adopt a precautionary approach to climate-related risk as part of its mandate to foster economic conditions that achieve stable prices and ensure the safety and soundness of the financial system (Arkush and Karlsson 2021).

Together, urgent adoption of these policies can transform energy's role in our economy—from precarity and volatility to stability.

CONCLUSION

Our reliance on fossil fuels makes energy inflation particularly difficult to resolve. The Federal Reserve has minimal ability to tame inflation resulting from volatile fossil fuel markets, and consumers end up paying the price. Price stability in our economy requires a stable energy sector, which can be achieved through transitioning to electrified, renewable energy. But over the past century, the US government has worked closely with the fossil fuel industry to design our current fossil fuel-dependent energy and transportation sectors. These systems have catastrophic environmental and social costs, well beyond the financial burdens created by an uptick in gasoline prices in a given month. Global inflation, largely driven by fossil fuels and cars, and existential climate disaster are both indications that it is time for the government to invest in a new energy system.

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