

FEBRUARY 28, 2023

MACRO & MARKET OUTLOOK FOR 2023 AND BEYOND



ISSUE 2

# ENERGY TRANSITION

TRUTHS & IRONIES

The accelerated energy transition is motivated partially by the increasing frequency and severity of climate calamities but, more urgently, by the pursuit of national security amid heightened geopolitical instability.



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# INTRODUCTION

By any measure, the Russian invasion of Ukraine in February 2022 intensified the urgency of the world's transition from fossil fuels to green energy. From price volatility to supply shortages, and security issues to economic uncertainty, the invasion sparked a global energy crisis, its impact and complexity still being appraised today.

In our view, the resulting global energy shift is yet another example of the “[simmer and eruption](#)” dynamic we have observed in other notable secular trends such as deglobalization, declining demographics, and fiscal retreat—all of which will radically reshape the global macroeconomic environment in the coming decade. The accelerated energy transition is motivated partially by the increasing frequency and severity of climate calamities but, more urgently, by the pursuit of national security amid heightened geopolitical instability.

## IN BRIEF

- The 2022 global energy crisis has revealed the true costs of pursuing an environmental agenda single-mindedly without well-rounded economic and social reasoning. An evolved mindset is required for the clean energy transition to ultimately be successful. Specifically, pragmatism needs to prevail over ideology.
- The energy transition movement will be a multi-decade, multi-generational project. The continued production of fossil fuels is an essential foundation which the less mature renewable energy sources can fall back on.
- The unavoidable reliance on crude oil and natural gas, coupled with constrained supply, signals a new bull market for the commodity complex, and correspondingly structurally higher inflation and heightened price volatility.
- The push for widespread adoption of renewables is fundamentally driven by the benefits of energy security. Increasingly, energy security equates to national security, thus becoming a matter of survival.
- The intensifying competition among the world's largest economies in their pursuit for energy resilience requires ongoing green investments of historic scale, subsequently unleashing profound implications for inflation, growth, and financial markets.



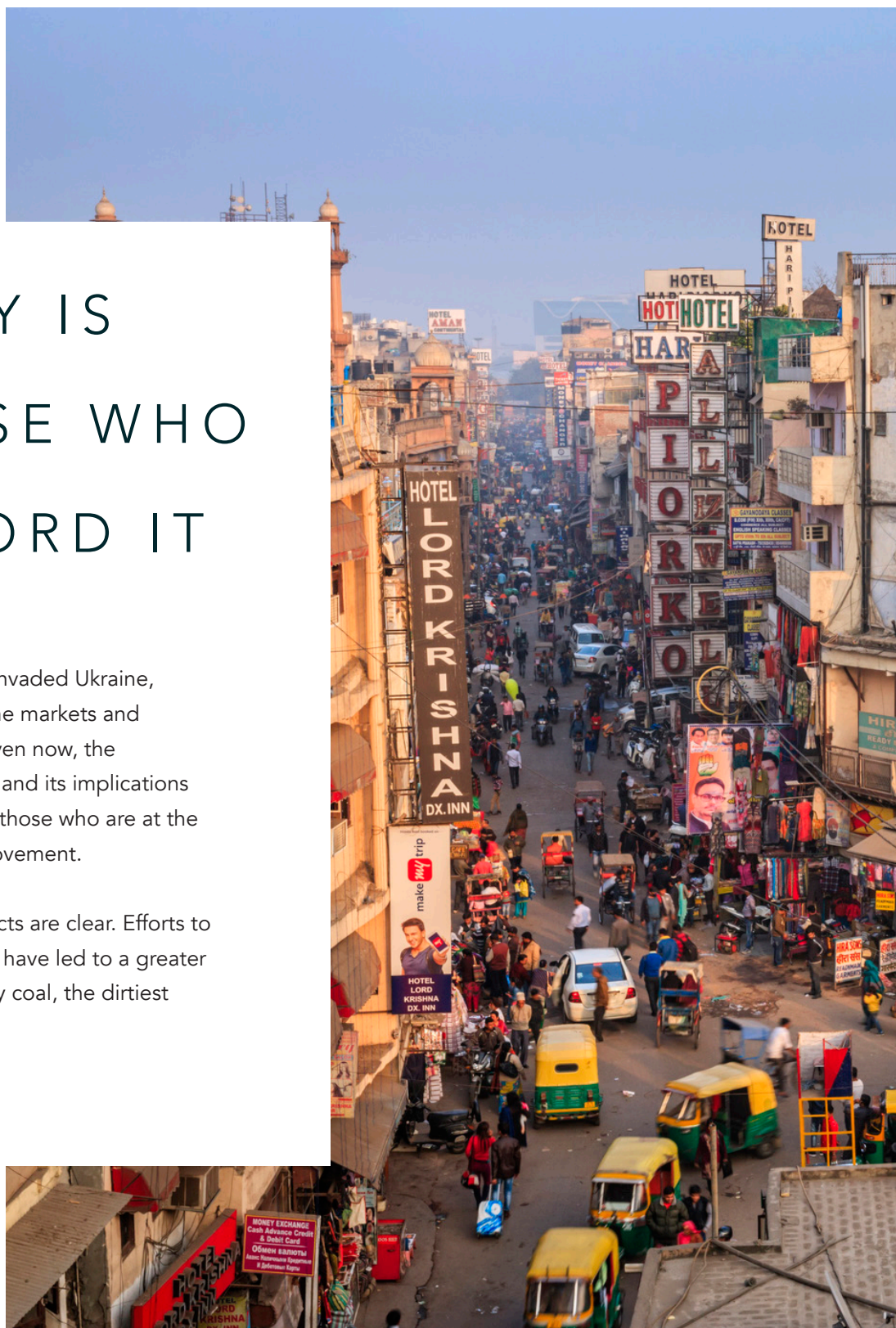


# IDEOLOGY IS FOR THOSE WHO CAN AFFORD IT

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It has been one year since Russia invaded Ukraine, which sent shockwaves through the markets and triggered a global energy crisis. Even now, the interpretations of the energy crisis and its implications seem to vary greatly, even among those who are at the forefront of the climate change movement.

The short-term environmental effects are clear. Efforts to replace Russian natural gas supply have led to a greater reliance on fossil fuels—particularly coal, the dirtiest fossil fuel.



View of the Main Bazar, Paharnanj, New Delhi, India, known for its concentration of hotels, lodges, and shops, catering to both domestic travelers and foreign tourists.



Germany, being heavily dependent on Russian energy, saw a significant upward reversal in coal consumption.

The rapid rise in the prices of “cleaner” fossil fuels has also driven countries in other regions to turn to coal as a cheaper alternative. Global consumption of coal soared in 2022 to an all-time high.

While this is clearly a setback for climate change, the energy crisis has invigorated a push to accelerate the adoption of renewable energy across the globe. European policymakers—widely considered to be leaders on climate actions and policies—have mostly expressed a sense of optimism in the opportunity to decarbonize.

On the other hand, younger climate activists do not share the sentiment. Over the past few months, there has been a rise in protests targeting famous artworks. In October 2022, two activists involved with Britain’s Just Stop Oil organization hurled tomato soup onto one of the world’s most iconic paintings, *Sunflowers* by Vincent van Gogh.

The act was a protest against the “disruption in response to the government’s inaction on both the cost-of-living crisis and the climate crisis.” Since an expansion of oil and gas production would improve energy affordability but would increase carbon emissions, it is unclear whether the two activists were advocating for an increase or a decrease in fossil fuel output.

Commentary by influential climate figures range from deflecting and dismissing to placing blame and blindly demanding justice. In our view, a more appropriate response would have been an honest reflection on the behaviors and decisions that led to the energy crisis, which has clearly escalated into a humanitarian crisis in the past year.

Based on estimates by the International Energy Agency (IEA), since the start of the energy crisis, 70 million people—a majority of whom live in developing countries and only recently gained access to electricity—could no longer afford electricity. Around 100 million people—equivalent to the population of Egypt or Vietnam—could no longer afford natural gas and reverted to using firewood.

## Who is to blame and what should be done?

How did this energy crisis emerge? Ostensibly, after decades of building tension between the West and Russia, the invasion of Ukraine was the spark that ignited the powder keg. However, Putin would not have been able to leverage Russia’s energy dominance as a geopolitical weapon as effectively without Europe’s dependence on Russian natural gas.

In hindsight, it was obvious that Europe’s decision to be unidimensionally dependent on Russia for vital energy resources was strategically reckless. This was partly driven by short-sighted economic motives, as Russian energy was by far the cheapest option.

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The more fundamental reason was the voluntary decision by Europe to pivot away from domestic nuclear and fossil fuel production in the 2010s before developing a resilient alternative energy system.

A decade ago, Germany made the fateful decision to phase out its 17 nuclear power plants, which at the time produced nearly a quarter of the country's electricity. Germany has been home to an active, mobilized movement against nuclear energy for decades—even more so than other nuclear-active democracies—including the neighboring country of France. This movement offered considerable political resources to those well situated to leverage it.

The most notable example of this took place in 2011 when the German Green Party, which has historical roots in the anti-nuclear environmentalism movement of the 1970s and 1980s, achieved great electoral success that year. Just 12 days before some of those elections, the untimely Fukushima catastrophe delivered the final nail in the coffin.

The ruling coalition had already been under threat by the Green Party. Chancellor Angela Merkel, a trained scientist and a long-time advocate for Germany's nuclear industry, reluctantly gave in to the decision to pivot the country away from nuclear energy, as she faced mounting political pressure from rising disapproval numbers amid the European sovereign debt crisis.



Onlookers taking in the energy-efficient holiday lighting in the Plaza de Sol in Madrid, Spain.

Although Merkel pledged that the gap left by nuclear would be filled by renewables, that promise was not fulfilled. Fast forward to today, the last three remaining active nuclear reactors are scheduled to retire in April 2023. Ironically, Germany's top power source is coal, which is currently being consumed at the highest pace in the country's history.

In addition, many European countries banned fracking due to environmental and geopolitical concerns. Meanwhile, the U.S. and Canada—both hydraulic fracturing natural gas producers—have weathered the 2022 energy crisis more resiliently.

*Putin's machinations were enabled by Europe's overzealous commitment to green ideologies.*

## Ideology is for those who can afford it

To be clear, we champion Europe's consistent, decade-long efforts towards decarbonization. Thanks to its leadership in the global climate change movement, the world has made great progress on alternative energy—according to the IEA, a key reason climate change's existential risks have dropped meaningfully in recent years, with worst-case scenarios being less likely than before.

The decarbonization efforts by European countries are even more admirable as we consider the fact that their policies are expected to disproportionately benefit developing countries that are the most vulnerable to climate change.

*To quote a well-known contemporary Canadian author and self-described British liberal, "When the aristocracy catches a cold, as it is said, the working class dies of pneumonia."*

Situated in the northern latitudes far from the equator, most European countries will experience less temperature fluctuations and lower exposure to the tangible physical effects of climate change.

*Still, the current energy crisis has revealed the true costs of pursuing an environmental agenda single-mindedly without well-rounded economic and social reasoning.*

As people endeavored to reduce power consumption, stories of how European countries braced for an energy crunch dominated news headlines in November and December of 2022.

Germany encouraged limiting Christmas lights to one illuminated tree per community. Finland asked citizens to spend less time in saunas. European businesses were asked to implement energy-saving measures such as turning off water fountains.

While unaffordable energy has disrupted the economy and lowered people's standards of living in Europe, let us examine how the destabilization imparted by the energy crisis has affected less developed countries.

Bangladesh and Pakistan experienced repeated blackouts. Just a few weeks ago, South Africa declared a national state of disaster over the country's worst-ever spate of rolling blackouts. As power shut off, factories grinded to a halt, crops withered without irrigation, and food spoiled in refrigerators.

To quote a well-known contemporary Canadian author and self-described classical British liberal, "When the aristocracy catches a cold, as it is said, the working class dies of pneumonia."

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## The inconvenient truth

The threat of climate change and its potential adverse effects on the global economy and society are tangible and, to some extent, existential as we look to the future.

Less developed countries, who are also the lowest carbon emitters, will bear the brunt of the negative consequences. Europe's energy missteps diminished the power of key global players at a critical juncture. The demonization of fracking exacerbated the constrained global natural gas supply, resulting in fertilizer and food shortages.

The poor continue to suffer. The latest statistics from the World Food Program (WFP) indicate that a record 350 million people in the world are under the threat of starvation—a startling 20 percent increase from 2021.

*Is it ethical to save the poor in the future (from climate risks) by exposing millions of them in the present to despair, poverty, and starvation? Said differentially, is the present humanitarian crisis the appropriate price to pay to achieve a greener future?*

Some may argue that great achievements are born from sacrifices. In response, we quote a different Canadian author, positioned on the other side of the political aisle from her previously mentioned counterpart. She wrote in her famous futuristic dystopian novel via the voice of the architect of a totalitarian state, "Better never means better for everyone. It always means worse, for some."

We believe the primary intention of Europe's environmental and energy policies was, and still is, to do good. However, the inconvenient truth is that actions have consequences, which do not always respect borders.

It is tempting to blame such "oversight" on a lack of awareness of the potential consequences or the emergence of external factors, such as geopolitical shocks; we have not had such severe energy security issues since the 1970s.

But the reality is that developed countries have generally been sheltered from the risks of their actions. In this instance, the impact of the global energy crisis will likely be felt for years to come and, as ever, the less fortunate will bear the brunt.

Following the global energy crisis and its many negative consequences, developed countries—in particular, the more advanced European countries—have been hard-pressed to reassess their definitions of morality and, for the very first time, confront their internal hypocrisy, however unintentional.

## Pragmatism prevails... eventually

Regardless of how passionate one's pursuit of a greener planet is, policymakers and other people in power in developed countries will hopefully come to the realization that the world's increasing adoption of renewable energy over the past two decades was contingent on an unchanging standard of living.

The continued production of fossil fuels has acted as a reliable foundation which the less mature green energy technologies can fall back on.

By recklessly rushing the timeline of the transition away from fossil fuels and indiscriminately repressing drilling, fracking, or pipeline construction, policymakers invariably expose societies to greater vulnerability against external factors, such as those that we have recently experienced.





A lighted hydraulic fracturing or “fracking” rig at dusk in the Permian Basin of West Texas.

In the wake of the Russian invasion of Ukraine, the idea of defending energy sovereignty with domestic shale gas production has been brought back into the spotlight.


Clearly, fracking is not consistent with net-zero objectives. It is also unlikely to provide effective short-term energy relief to Europe, not to mention the lack of public support in influential energy-importing countries.

Nonetheless, the revitalization of the debate over domestic shale gas production signals a changing attitude toward energy transition, especially among developed countries where environmental policies are the most advanced. This is far more significant than the fracking debate itself; it signals an evolved mindset.

The most important lesson of the global energy crisis is that pragmatism trumps ideology. This is a dynamic that has historically produced more positive than negative outcomes for humanity. A convenient validation would be the indisputable economic divergence between capitalist and communist nations with similar history, culture, and resources through the post-WWII decades.

*With a more mature and pragmatic approach forward, the global movement to address climate change may finally have a real chance of widespread success.*





# THE PROBLEM MAY BE THE SOLUTION

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In 2008, Al Gore ambitiously claimed that completely repowering the supply of electricity in the U.S. in a single decade would be “achievable, affordable, and transformative.”

In hindsight, the resulting disappointments were not surprising. In the last two hundred years, major global energy transitions—from wood to coal, and coal to oil—each took place over more than half a century.

*Aerial view of a petrochemical complex at dusk in Thailand.*

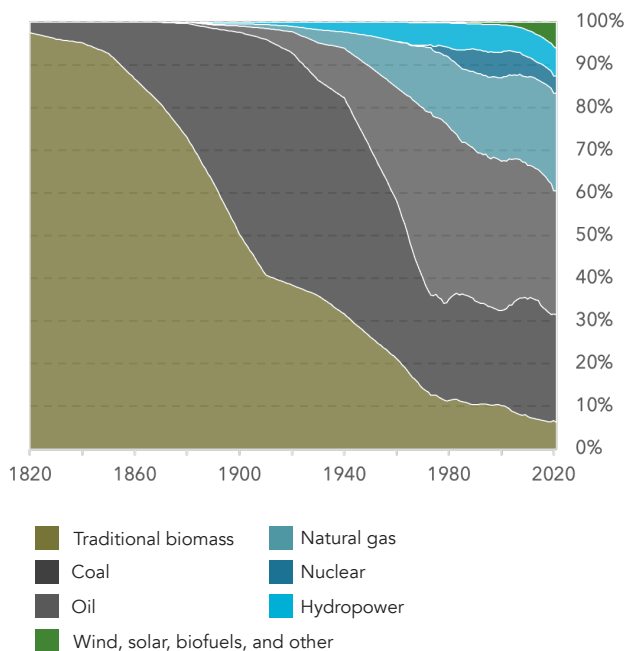
## Here for the long haul

Contrary to popular belief, the era of rapid industrialization in the early 19th century was fueled not by coal, but by wood and charcoal. It was not until around the turn of the 20th century that the amount of energy supplied by coal finally exceeded 50% of global demand. Likewise, the early 20th century ran not on oil, but on coal.

In fact, crude oil did not become the world's biggest energy source until the 1960s. More recently, the rise of natural gas—despite it being abundant, comparatively cleaner, and generally more affordable—has occurred at an even slower pace relative to the prior two energy transitions. The world's consumption of natural gas has merely doubled in the past six decades. Natural gas' share of global demand has only grown to 20 percent today from 10 percent in the 1960s.

### Global primary energy consumption by source<sup>1</sup>

As a percentage of total energy consumption



1. Our World in Data and BP Statistical Review of World Energy. Data from 1820 to 2021.

It is tempting to say, “this time is different.” The circumstances today are unique in the sense that the survival of humanity is more clearly at stake. In the context of climate change, the world is faced with two major challenges.

On one hand, elevated carbon emissions remaining elevated have resulted in physical risks from the tangible effects of climate change: more frequent and severe heat waves, storms, and other extreme weather events. On the other hand, the nonlinear process of transitioning towards a lower carbon economy carries substantial transition risks, from policy mistakes to underdeveloped supply chains.

*The past year has highlighted the negative consequences when physical risks and transition risks collide. The vulnerability of renewable energy systems is magnified by climate change hazards.*

Europe recently endured an unusually hot, dry summer. In France, elevated water temperatures threatened to reduce already unusually low nuclear output, as the water could not sufficiently cool the reactors.

In Germany, low water levels on the Rhine—the country's main shipping artery—limited the volume of coal supplies that could be transported to powerplants, which were recently reactivated to combat the challenges from dwindling Russian gas supplies.

*If history is any guide, wide adoption of renewable energy will likely take many decades.*



Policy actions could hasten the rise of renewables. Realistically, however, accelerating the energy transition is unlikely to bear fruit in the short term in the form of reducing the physical risks of climate change. Meanwhile, aggressive actions to speed up the process may lead to more disorderly transitions, thus creating new risks and additional costs along the way.

In our view, the attempt to balance physical risks and transition risks will ultimately constrain the pace at which the energy transition may progress. As circumstances vary by country, policy makers will likely act accordingly with prioritizing the mitigation of one risk (e.g., sea wall defenses against rising sea levels) while being more exposed to an alternative risk (e.g., greater economic uncertainty driven by policy shifts).

*There is no easy way around it. The energy transition movement will be a multi-decade, multi-generational project.*

## The world needs an offramp

It will take decades for the world to transition its energy supply to renewables by a meaningful degree. In the interim, the world needs an offramp, but none has been offered.

So, when the Russia invaded Ukraine in February 2022, exposing global oil and natural gas supplies to extraordinary risks and causing energy prices to skyrocket to historic levels, the responsibility of creating a solution was imposed on the market.

Independent of this one-time windfall, oil and gas producers have emerged as major beneficiaries of the energy transition movement, with extraordinary staying power. Ironic, isn't it?

Many would not have predicted a triumphant return of the fossil fuel industry, especially after public and private sector support for greener energy had begun to take hold, thus raising existential questions for the oil and gas industry.

In fact, this is an outcome that has been years in the making, orchestrated by major oil producers—notably the U.S. and Saudi Arabia—and executed in the form of consistent underinvestment.

Remarkably, global investments towards expanding exploration and production have fallen by two thirds since their peak in 2014.

Currently, oil and natural gas are the world's dominant energy sources, collectively accounting for more than half of global energy consumption. When demand remains stable or continues to rise and supply is severely constrained, the cost goes up.

*From the perspective of the oil and gas industry, if the world intends to ultimately shift away from fossil fuels, there is no incentive to ease the transition. The oil and gas industry will not go quietly into the night.*

From a business perspective, it is entirely logical to restrict supply in order to keep the costs of fossil fuel as high as possible and generate as much profit for as long as possible.

Following a year of record earnings and cash flows, Chevron (the second largest oil company headquartered in the U.S.) announced in its 2022 earnings report that it would launch a substantial share buyback program, representing 20 percent of the company's shares outstanding at the time of the statement.

Gone are the days when strong earnings were followed by even stronger investments. After significant consolidation in the aftermath of the 2014-2016 oil price decline, U.S. oil producers today are no longer incentivized to chase after earnings growth via aggressive expansion. Instead, they have adapted their business models to focus on near-term profitability, steady cash flows, and strong balance sheets.

Thanks to the continued capex discipline of their U.S. competitors, OPEC (Organization of the Petroleum Exporting Countries), led by Saudi Arabia, has also drastically pivoted its production strategy from the 2010s era of competing for wallet share by flooding the market with a low-cost supply of energy to low capex, low spare capacity, and low inventory.

Despite the commitment to raise baseline production in 2018, OPEC-10 consistently missed their target in the years that followed. This was, at the very least, a partially intentional move by the core OPEC members who can easily increase capacity if they so desired.

But why inject flexibility into a market when they stand to benefit from intensified supply tightness? To put it into context, at the time of Russia's invasion of Ukraine, the shortfall in OPEC-10's daily supply was nearly half of Russia's total daily oil production.

In recent years, OPEC's marginal supply adjustments appear to have largely been designed, especially in an already supply-constrained environment, to starve the market just enough to maximize unit prices without triggering material demand erosion.

In our view, the significance of such oil and gas supply dynamics presents a double-edged sword. Indeed, a prolonged period of supply constraints coupled with low inventories, elevated costs, and heightened price volatility should provide an incentive to shift away from

fossil fuel consumption. The effects are comparable to carbon taxes. We caution that the efficacy of such incentives may be limited, especially in the near term, when the bottleneck to a widespread adoption of renewable energy is not willingness, but capability.

In addition, higher energy costs disproportionately weigh on less advanced countries, thus potentially reducing their financial ability to invest in energy transition efforts.

## The problem may be the solution

If we allow pragmatism to trump ideology for a moment, it may be apparent that the problem can also be the solution. It's essential to differentiate fossil fuels from each other; they are not all antagonists in the efforts towards carbon emission reduction.

For example, in countries such as the U.S. where land is abundant and natural gas is generally affordable, the potential for natural gas to serve as a lower-carbon, intermittent solution to renewables—thus providing a reliable hedge against the variance in supply and demand—is significant, particularly if presented as an alternative to coal-powered electrification.

*The unavoidable reliance on fossil fuels, coupled with restrained supply during the multi-year transition process signals a new bull market for the commodity complex, thus leading to structurally higher inflation and heightened price volatility.*



# ENERGY SECURITY

## IN THE SPOTLIGHT

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In September 2022, the International Monetary Fund (IMF) published a paper in September 2022 titled “Climate Change and Energy Security: The Dilemma or Opportunity of the Century?” The paper presented empirical evidence of cases in Europe where the increasing share of alternative energy production not only reduced carbon emissions but also resulted in the additional benefits of improving a country’s energy security.

If the paper’s primary intent is to promote greater adoption of renewable energy sources to individuals who (1) are not already climate activists (naturally) and (2) are in a position to influence policy actions, it is not making a very strong case by referring to energy security as an “additional” benefit—implicitly, a “nice to have.”

## A matter of survival

Indeed, the amount of evidence supporting the physical effects of climate change has been rising imperceptibly quarter to quarter. Clearly, carbon emissions, if not brought under control, pose urgent and catastrophic threats to humanity as a whole.

The reality, however, is that the leaders of the most influential countries in the world are far more motivated by improving energy security than addressing climate concerns.



*An open pit rare earth element mine in Western Australia*

In some sense, Vladimir Putin—an authoritarian leader accused of war crimes—may have done more for the future of the global climate movement than Greta Thunberg, the outspoken Swedish climate youth activist.

Following the energy crisis, the interest in renewables has risen sharply around the globe. This has little to do with ideology, or even science. It is motivated nearly entirely by survival—a seemingly remote concept for most people in developed countries—that is, until the exorbitant costs of electricity and heating erode one’s standard of living.

Elected politicians in democratic societies are motivated by the interests of their voters. Dictators in repressive, authoritarian regimes are constantly paranoid about the threat of widespread anger and dissent.





At the end of the day, the calculation by countries' leaders and decision makers comes down to just how much longer they can manage to hold on to power until the revolution is at the gates. Nothing is more effective at winning the people's hearts than defending national security when it is at risk.

Fundamentally, the current push for widespread adoption of renewables is driven by the benefits of energy security.

By moving away from coal, oil, and natural gas, energy-importing countries will be less captive to energy-exporting countries—friends or foes—and become more resilient against global price hikes and disruptions to supply chains.

## The clean energy arms race

The rivalry between the U.S. and China will continue and intensify in the coming decade and beyond. Although a complete decoupling is unlikely, the two countries have already been at war on economic and technological fronts.

With the geopolitical nature of energy security in the spotlight, the U.S. and China have inevitably entered a new race centered around energy independence.

In the past, collaboration between the two countries had been crucial to global action on climate. A bilateral deal between the U.S. and China paved the way for the breakthrough 2015 Paris Agreement. Since then, diplomatic relations have seriously soured. In some sense, this may be a blessing in disguise.

*The competition between the world's two largest economies and top carbon emitters may just supercharge the shift to clean energy.*

The U.S. appears committed to surpass China's role as the world's top supplier of clean technology and components with the Inflation Reduction Act backed by nearly \$400 billion in investment funding.

China's stance on climate change has long been a paradox. It generates the largest share of global carbon emissions, primarily due to its heavy reliance on coal.

Yet, the country also has the world's largest installed capacity of hydro, solar, and wind powers and is the global leader in clean energy production and deployment: from electric vehicles and batteries to new renewable energy infrastructure.

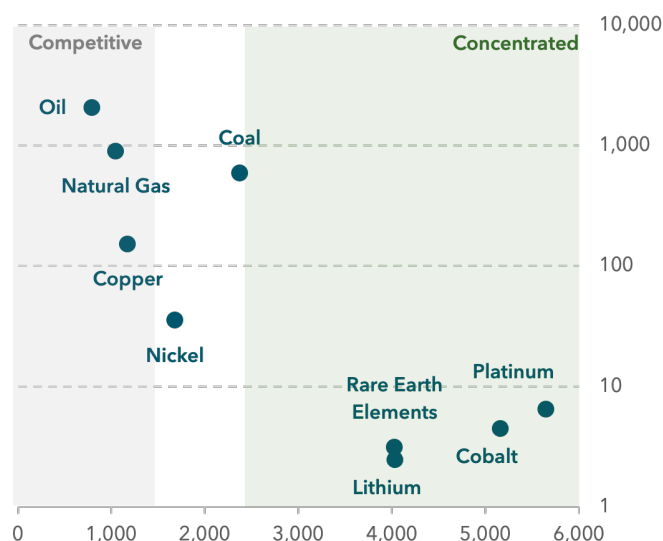
The clean energy arms race between the U.S. and China has opened a new era in geopolitics. Global dominance may be fought via the buildout of advanced green industries and measured by a country's influence over clean energy supply chains and ownerships of sensitive, cutting-edge technologies.

Right now, China appears to be winning. Its trump card is its raw material strategy that was years in the making. Copper, lithium, nickel, cobalt, and rare earth elements are crucial to the transformation of the global energy sector.

Not only is China among the few countries where the raw production of lithium, cobalt and rare earth elements is geographically concentrated, it has a near-monopoly on refining operations through its 2013 Belt and Road Initiative (BRI) in Africa and substantial investments in assets in Australia, Chile, and Indonesia.

## Market size and geographical concentration level for selected commodities<sup>2</sup>

Unit in billions of dollars, Herfindahl-Hirschman index<sup>3</sup>



2. Source: International Energy Agency, "World Energy Outlook 2021" published October 2021.

3. Note: the Herfindahl-Hirschman index (HHI) is a measure of market concentration. An HHI of 1500 or lower is considered to be a competitive market and an HHI of 2500 or higher to be a highly concentrated market.

To put it simply, the U.S. cannot advance its domestic production of electric cars and batteries without relying on Chinese sources for essential materials. The demand for these strategically important minerals will intensify significantly over the coming decades.

*If the U.S. wishes to win the clean energy arms race, it must develop leverage. The most obvious answer is chokehold technologies.*

The intensifying competition between the U.S. and China in their pursuit for energy security calls for ongoing green investments of historic scale. With escalating decoupling between the U.S. and China, energy advantages have become a matter of survival. Predictably, no countries at war—at least those with a will to win—have held back from military spending.

From a geopolitical perspective, the clean energy arms race between the U.S. and China are of concerns to other major powers.

Europe has long been hailed as the world leader in climate actions. Based on headlines out of Davos 2023, European leaders are clearly alarmed by the bloc's potential loss of its competitive advantages in green industries and have called for an increase in funding.

India, the world's the third largest carbon emitter, the second largest coal consumer, and soon, the most populous country, stands to play a crucial role in shaping global energy dynamics.

India has clear incentives to pursue an aggressive energy transition strategy, given its current heavy reliance on imported fossil fuels and its rapid economic and political rise as a democratic counterweight to China in the region.

Although by all measures the world is likely going to miss the totemic 1.5°C climate threshold, most countries, in particular the largest economies and carbon emitters, are working actively to seize the economic and political advantages of being ahead in the race to tackle climate issues and achieve energy security.

## Capex, capex, capex

No one can build for a future they can't imagine and history has given us a glimpse of what lies ahead. The world needs to fully appreciate the expansive costs and numerous setbacks that are inevitable for advances to take place.

Every energy source—including renewables—has risks, which may be mitigated to some extent but never fully eliminated. Technological breakthroughs will emerge at an increasingly faster pace; meanwhile, complications and risks will also evolve.

This mindset is crucial because it is the prerequisite to maintain momentum, unleashing large-scale innovation, and boosting massive public and private investments that are essential for achieving a more resilient global energy system.

As the International Energy Agency (IEA) made clear at Davos 2023, “The magic word is investment.”

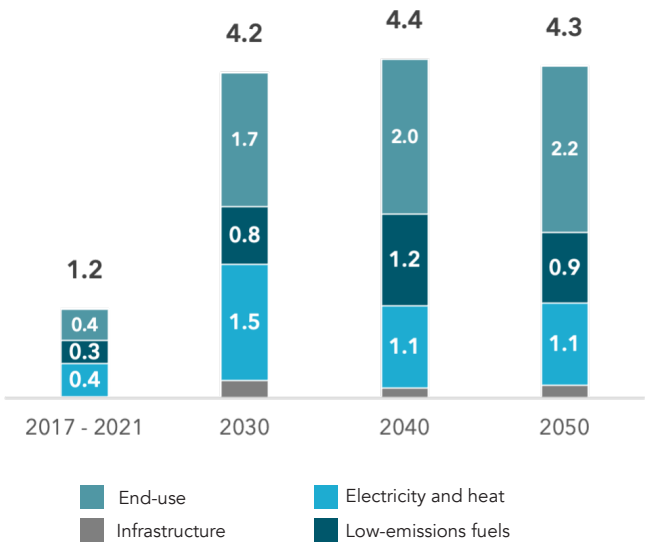
Indeed, the shift to a greener economy calls for significant investment into decarbonization technologies such as clean hydrogen. Widespread adoption of renewable energy—even the most accessible sources such as wind and solar—require a fundamental reshaping of our modern energy infrastructure.

Mass electrification, the cornerstone of the climate change movement, is highly levered to the commodity complex, especially mineral markets where structural demand increasingly outpaces supply.

If policy makers follow through in enacting policies to facilitate a net-zero transition, the sheer amount of capital and time necessary are extremely large, requiring a near-doubling of current investment levels almost immediately, and an additional doubling of annual investment levels by 2030, not to mention continuing investments in the subsequent decades. The implications for inflation, growth, and financial markets should not be underestimated.

### Global annual energy investment by sector in the net-zero emissions scenario<sup>3</sup>

Unit in trillions of dollars



3. Source: International Energy Agency, “World Energy Outlook 2022” published October 2022.



# MACROECONOMIC IMPLICATIONS

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- The need for significant investment to support the widespread adoption of renewable energy, as well as solutions for climate change-related physical and transitional risks, will unleash significant structural inflationary pressure around the globe.
- A massive influx of capital into the development of clean energy production and deployment will also generate a growth boom in those sectors levered to an energy transition.
- The rise of disruptive technologies in the past two decades has created a meaningful deflationary force driven by rising productivity. Looking ahead, while we continue to expect new advances in green science and technology, we believe that a potential price impact may be overshadowed by the world's insatiable need for supply-constrained commodities - from continuing reliance on fossil fuels during the multi-decade transition to increasing demand for raw materials. The rise of commodities is ironic in the race to shift towards renewable energy sources. Through this dynamic, we expect not only higher inflation but also higher inflation volatility over the medium-term.

## THE BOTTOM LINE

- Long inflation
  - Long commodities
  - Significant growth potential from disruptive technologies in the sectors levered to the energy transition.
- (See our latest Rockefeller Insights Portfolio Opportunities report, [Hydrogen's path to cleaner energy](#).)



Wind turbines and transmission lines in the Atacama desert in Chile.

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