# Burning Questions on the Energy Transition

November 2022

Ecofin focuses on sustainable investing, with one of its primary investment themes surrounding the Energy Transition. This transition has been shifting global priorities toward decarbonization for several years and has only just begun to catch momentum. Keep reading to check out some of our frequently asked questions surrounding this transformation.

**1. The Senate passed the Inflation Reduction Act (IRA) in August 2022. It has several aims, but a major component addresses climate and low-carbon energy. How do you assess this law, and what does it mean for investors?**

The IRA is a large bill; though slimmed down from the Build Back Better bill, **it is the most significant government spending initiative on clean energy ever.** It is a solid, impactful plan that will pack a punch by stimulating the global energy and electrification space. At face value, the objectives of the IRA are to address energy security and climate change; however, the impacts of this bill will stem well beyond such initiatives. The bill is about economics, securing American jobs, and putting the U.S. first regarding innovation and leading the Energy Transition. The IRA offers comprehensive incentives for corporations, homeowners, and utilities.

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We describe this plan in two parts. The first part is logical; it includes sensible extensions and expansions for solar, wind, electric vehicles (EVs), and home electrification. The second part of the plan is about innovation in the form of batteries, green hydrogen, carbon capture, and sequestration. We appreciate the balance and focus on spending, although we must acknowledge it is not perfect. Not only is it smaller than we hoped, but it also lacks attention to transmission infrastructure.

If your goal is to rapidly reverse the impact of climate change, this is not your preferred bill. Conversely, if you want a practical plan that pivots the U.S. in the right direction within the Energy Transition, then you are pleased with this bill.

### Breaking down the Inflation Reduction Act

- $369 billion spending in two major areas. While not as large as Build Back Better, this is the largest government spending initiative on clean energy ever.
- The IRA is logical - sensible extensions of existing spending programs with upgrades in wind, solar, biofuels, and more.
- It is also innovative - spending in areas like electrification, storage, green hydrogen, *CCS/CCUS. The latter two of which are still nascent.
- It is pro-American energy - both electrons and molecules.
- It is both corporate and residential - it addresses solar panels, heat pumps, electric vehicles, energy efficiency, and even hard-to-abate sectors.
- When analyzing U.S. processes, whether it be industrial, manufacturing, or transportation related, we believe they are de-risking as they are decarbonizing. If they are not decarbonizing, expect higher costs and perhaps penalties.
- Finally, we should see a positive feedback loop around renewables. Growth of storage, green hydrogen, *CCS/CCUS, and more upstream manufacturing moving domestic, all provide catalysts to build out renewables. This incentivizes more training & education surrounding renewables, which creates more expertise, drives further investment and R&D.

**CCS is carbon capture and storage. CCUS is carbon capture, utilization and storage*

## 2. Who are the key beneficiaries of the IRA in terms of sectors and stocks?

In the clean electricity generation space, we think the developers and owners of renewable assets will be the key beneficiaries as follows.

**All renewable owners will have the opportunity to enhance the value of existing assets thanks to incentives for batteries and green hydrogen.** This could have a transformational impact on battery storage for companies like Stem and Sunrun, and developers deploying green hydrogen manufacturing assets like electrolyzers. **Furthermore, companies with nuclear generation assets, such as Constellation or Public Enterprise, will also benefit from a better pricing outlook and the ability to contemplate creating more value through pink hydrogen** as a valid option for their electrons.

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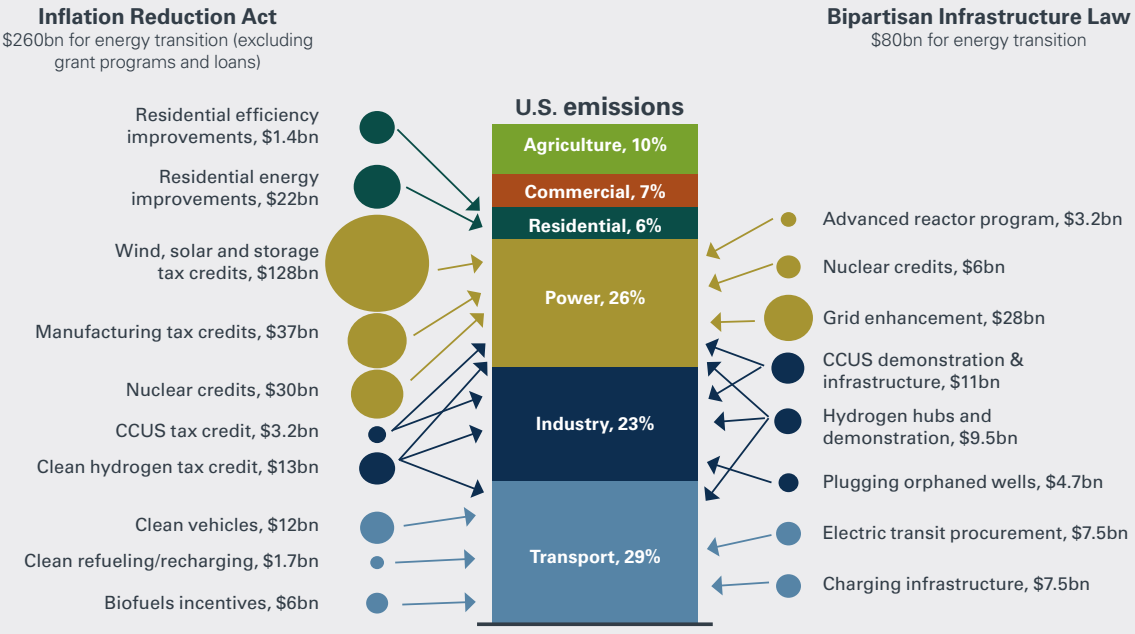
**The IRA will function as an accelerator for solar deployment (rooftop and utility) and electric vehicle penetration** (tier 1 suppliers like Aptiv PLC (APTV), power semiconductor manufacturers like Infineon Technologies AG (IFX), and connectors manufacturers like TE Connectivity Ltd. (TEL)). Finally, there are investment areas that aren't receiving direct support but are enablers of all the above, for example, transmission. There is a need for U.S. transmission development to grow 2x-3x above the current run rate of roughly $20 billion per year for the nation to hit carbon emissions or net zero goals in the next 20-30 years.

**$369 billion allocated for Energy Transition within IRA**




Source: EIA, EPA, Joint Committee on Taxation, BloombergNEF. Note: Chart only captures tax credits and incentives, not grant programs or loans. Bn is billion. CCUS is carbon capture, utilization and storage.

**3. ESG is a politicalized subject. In the U.S., some states are at odds with this subject. Renewables have been lumped into this narrative as well. How do you respond to that?**

The debate on these topics will continue as the market absorbs the meaning behind these buzzwords: ESG, Sustainable, Impact, Socially Responsible, etc. Nonetheless, this is how we have talked about it:

- ESG and sustainability are not the same thing. We have found that after pulling back the curtain and comparing ESG funds and non-ESG funds, the holdings frequently mirror each other.
- ESG is a tool to assess the quality and risk of an investment.
- Sustainable Investing means mobilizing our investments to help tackle global issues.
- Investing in the Sustainable Revolution will drive returns for decades and make an impact.
  - We need a fundamental driver of returns to invest. A sustainable present and future are going to drive alpha.
- Tackling climate change will create enormously successful companies and some high-quality, long-term infrastructure assets. You may be surprised by who wins. For example, a few deeply red U.S. states have plentiful renewable capacity in the form of wind and solar. Other states have quality labor that will construct battery facilities and other technologies across electrification. Further, leaders will include some companies with physical assets and know-how that will win in these growth areas.

For additional context, please read our 5 takeaways on Sustainability piece, linked **here**.

**4. Similarly, the Energy Transition has become a political topic. How do you approach investing in the Energy Transition amidst policy changes?**

The reality is that the Energy Transition is a structural shift that has been happening at pace, regardless of political administration because the structural drivers that drive the transition should not be and are not political. Global decarbonization priorities are being driven by demand for climate action from corporates and consumers. Additionally, demand for renewable energy has reached an inflection point further catalyzing the Energy Transition.

Until recently, the climate change argument on its own was not able to generate sufficient momentum for renewables deployment, then renewables reached an important inflection point in terms of their affordability in producing electricity compared to traditional fossil fuels. The impact on the wallet made renewables more broadly attractive than just the benefit to the planet. Further, the war in Ukraine has delivered a widespread prioritisation of energy supply and security, and renewables' appeal has increased markedly in recent months given the urgent need for greater energy independence, security of supplies, and more predictable energy/electricity prices. We believe these factors, collectively, will massively accelerate demand for renewables and the Energy Transition, regardless of political administration.

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In terms of our investment process, maintaining an in-depth focus on policy in our investment regions is a key focus for us. In terms of investing, we favor investing in sectors and companies with a business case that relies on their competitive advantage and not government handouts and unstable policy decision. During the research process, we spend a lot of time understanding policies around the world because they can create volatility in equity markets. Policies can have incentives (like tax credits and subsidies) and penalties (like penalties for not complying with gCO2/km targets for carmakers.) The best policies, whether incentive or penalty driven, will provide multi-year visibility. For example, we have policy support in the U.S. that will accelerate EV adoption, green hydrogen, and renewable deployment, which will help bring emerging clean technologies into the commercially viable window more rapidly. A predictable operating environment is another significant factor, especially in the case of capital-intensive businesses such as renewables or equipment manufacturing. Ultimately, we assess the fundamental drivers and risks of policy changes for each company and develop a risk-adjusted outlook for each investment.

**5. Are there parts of the Energy Transition that you do not believe in or do not invest in?**

For us, the question is to identify aspects of growth associated with the Energy Transition that may not generate defensible profits. We have seen various aspects of Energy Transition indeed deliver such situations. We are very cautious about green hydrogen-related electrolyzer manufacturing; we see terrific competition emerging here and, despite robust demand, challenges to grow profitably. We are equally hesitant to take much exposure in the mining industry. Numerous factors can upend profits for a miner, including windfall taxes, changes in environmental regulations, and changes in things like battery chemistry preference. We follow the area closely as an input consideration but find investing in this space rather fraught.

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We are also cautious about developing new nuclear plants (as a structural business) and nascent technologies around nuclear. While we believe new nuclear plants and technologies will happen, the risk/reward of such activities inside public equity are quite challenging, as costs tend to escalate over time, while renewable electricity costs remain structurally advantaged.

Lastly, we do not invest in carbon credits or emission-based value; we tend to focus explicitly on the inherent technology costs. The caprice of government policy around these emission frameworks makes it challenging to develop high degrees of confidence (particularly outside the European Union), while the ability to securitize these cash flows is minimal. As such, we treat them as cash inputs/outputs rather than repeatable cash flows.

**6. Electricity consumption has seen over a decade of no growth. You have mentioned that the growth profile will change substantially. How do you see that profile changing?**

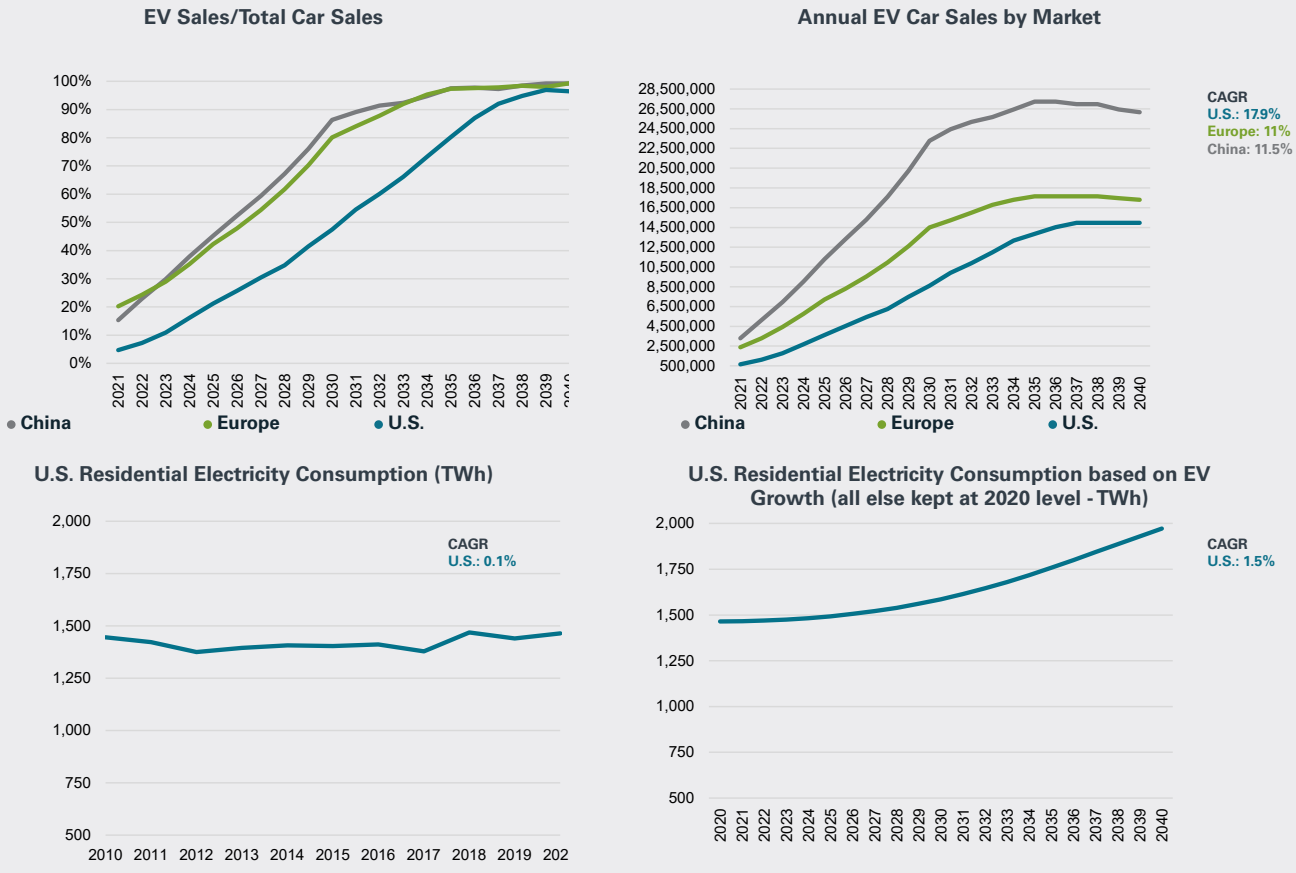
In the past decade, electricity consumption has been stagnant due to increased efficiencies offsetting the underlying demand growth driven by population growth and the proliferation of electric appliances and devices. For instance, the impact on consumption was sizeable with the substitution of light bulbs with light emitting diode (LED), say replacing a 50-Watt light bulb with a 5-Watt bulb. As such, we believe that the impact of efficiency might be reduced in the future.

For example, electric vehicles are replacing petrol cars, and governments are setting phase-out dates for petrol cars.

However, on the demand side, we believe that we will see increased electrification of the economy as electricity replaces other forms of energy. For example, electric vehicles are replacing petrol cars, and governments are setting phase-out dates for petrol cars. Similarly, we anticipate a transition from gas boilers to heat pumps. This pattern will continue when green hydrogen starts to ramp up. The sector that is seen as ex-growth and defensive is migrating towards structural growth, which is typically powerful for equities. **We expect the substitution away from fossil fuels toward electricity and decarbonized electricity to drive a multidecade power demand trend.** Nextera Energy, a leading utility company in the country, has been a leader in embracing that change and has demonstrated that a utility can deliver consistent and predictable high growth. It has been one of the top performers in the S&P 500 over the past five years.

Check out our recent White Paper, It's Electrifying to find out more about the structural growth opportunities for renewables in the past five years.

## EV penetration and impact on U.S. electricity consumption




Source: EIA

**7. How does fossil fuel-generated electricity from sources such as natural gas play a role in the Energy Transition?**

In the U.S., natural gas has the largest share of electricity generation at 38%. Natural gas will remain an important contributor throughout the transition, especially if we see growth in electricity consumption on the back of the electrification of the economy.

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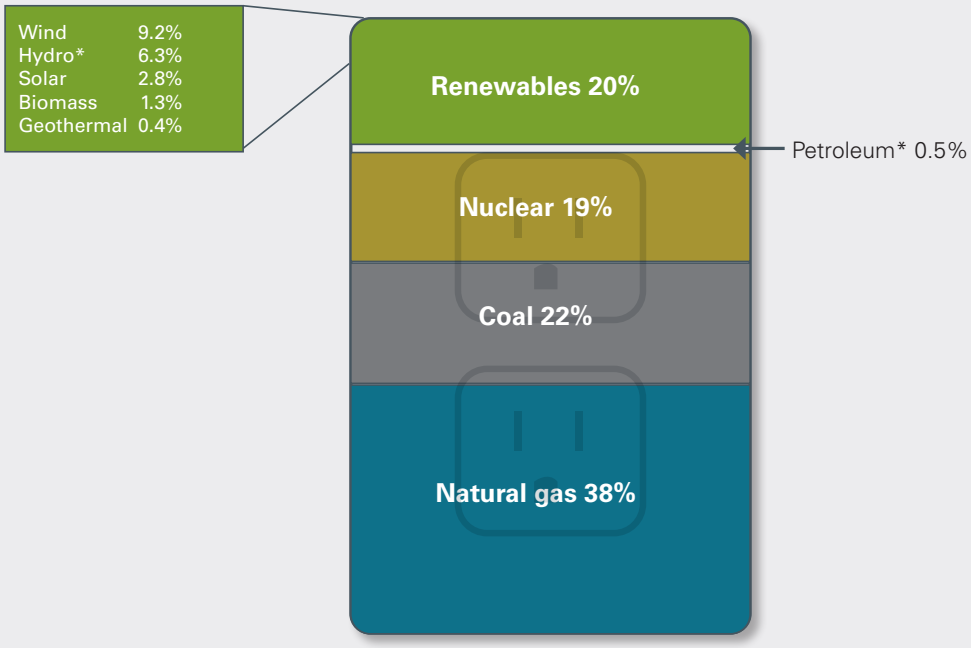
NextEra Energy announced at its June analyst meeting that it will be Real Zero by 2045, i.e., the company will not use any coal or natural gas by 2045. This is a game changer: NextEra skipped a net zero target and instead set a real zero target, confident it will not need any coal or gas generation by 2045. We should see a shift within the industry as other participants will be forced to follow suit to avoid being left behind.

That is quite a statement by one of the leaders in the industry. Nonetheless, natural gas will not disappear overnight. It will, however, move meaningfully lower as we move to the middle of the century.

## Sources of U.S. electricity generation




Source: U.S, Energy Information Administration (EIA). Data is for 2021. Total = 4.12 trillion killowatthours

## 8. What role does electricity play in decarbonizing within the Energy Transition?

There are two major trends occurring right now:

1. Corporates and consumers will continue to decarbonize their supply chains and footprints by replacing fossil fuel heavy energy sources with renewable electricity, such as replacing traditional internal combustion engines with renewable electricity powered EVs.

2. The grid will natively decarbonize over time as renewables and natural gas replace emission-heavy coal, demonstrating a clear trend toward more electricity demand. Everything using grid-based electricity is also gradually decarbonizing. These are tectonic shifts happening in the absence of the IRA. The related question that is often asked is, since EVs are pulling energy from the power grid, which is typically fossil fuel based, how do we achieve the environmental benefit? The above native decarbonization trends are the answer. Further, see question 13 for more color.

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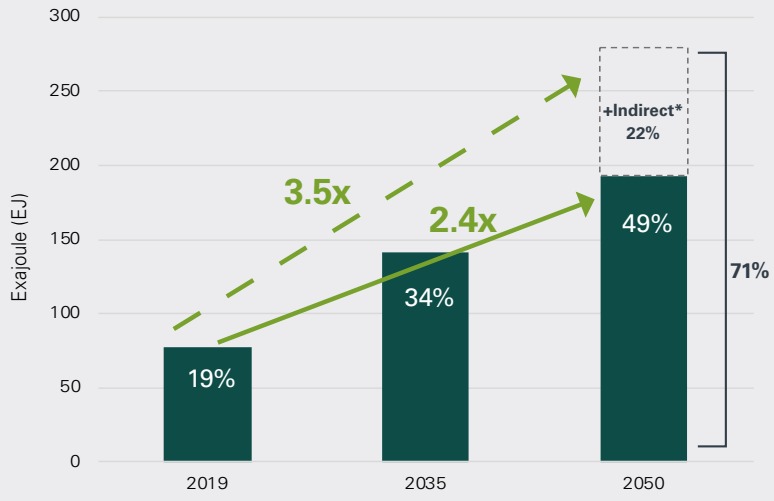
### Electricity gains market share

**Electricity consumption is growing as a % of total final energy consumption**




**Electrification**
% of final energy consumption


*Indirect electricity consumption refers to electricity used in hydrogen production.
Source: BNEF 2021 New Energy Outlook. This page contains projections, there is no guarantee these projections will be met.

**9. The cost curve for renewables has declined substantially in the last decade, but the perception is that time and costs are still prohibitive in meeting market demand. Is this an accurate portrayal and will the IRA be a catalyst for change?**

We believe it is a misconception that costs are prohibitive. Renewable electricity has reached an inflection point in terms of its relative affordability in producing electricity compared to traditional fossil fuel technologies. Renewables are the electricity technology with the lowest cost in most places around the world. The spread between fossil fuel power generation costs (high) and renewable power generation costs (low) has never been wider. Not only that, once installed, there is no variability in renewables production costs. There is value in that visibility, and the IRA was an important catalyst for this because it provides long-term visibility, which is essential for large capital investments.

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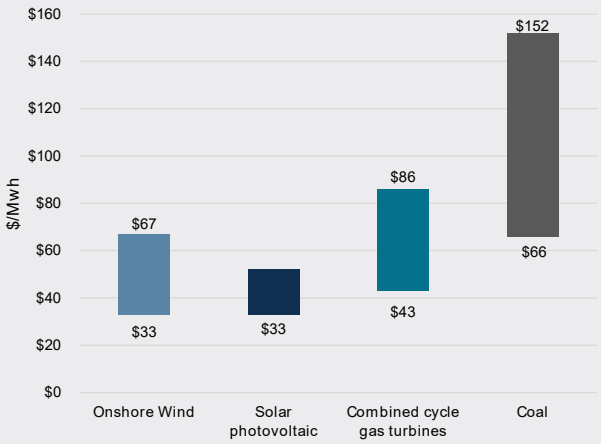
Also, because the IRA addresses the entire value chain of the Energy Transition, we believe this will create strong momentum and an eco-system that has been lacking thus far. The emergence of domestic champions should help innovation and costs down the road. There is ample evidence to support this, and we see companies we invest in capable of replacing existing plants with renewables, which positively impacts consumer bills. As another confirmation, we can see that countries that previously incentivized renewables have removed these incentives as they are no longer necessary, for instance, in China and Europe. The main issue is not the cost of generation; it is getting renewables around the clock. Like transmission interconnectivity, we believe storage will play a crucial role in improving reliability.

### Technology advancements lower costs

- Wind and solar levelized cost is now cheaper than fossil fuels in most regions on an unsubsidized basis and even more so in regions with subsidies, such as tax credits in the U.S.
- Technological advancements in renewable generation technologies should drive further declines in renewable levelized generation costs, while fossil fuel generation costs are likely to increase due to more stringent regulatory requirements and higher carbon prices
- Declining battery costs should increase the penetration of storage alongside renewable generation, increasing the total market share of renewables within total electricity consumption

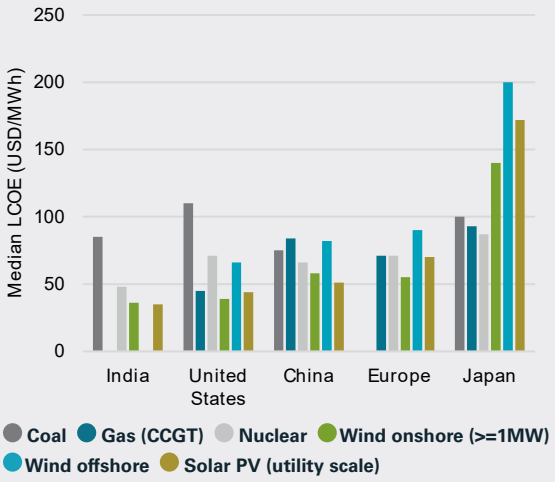
**Unsubsidized levelized cost of electricity in the U.S., first half of 2022**




Source: BNEF Levelized Cost of Electricity 1H 2022

### Cost advantages

- The cost to generate clean electricity is more attractive and stable versus most fossil fuel incumbents
- Electricity is a meaningfully cheaper fuel to operate light-duty vehicles, delivering more than 50% cost savings per mile vs petrol




Source: IEA.

**10. Wind and solar are intermittent, so battery storage is vital. What is the current state of storage, and how does the IRA impact it?**

Storage is a broader issue than just batteries. Given the intermittent and seasonal characteristics of wind and solar, we increasingly see developers offer combined technologies with different generation patterns to deliver quasi-continuous 24/7 electricity to help combat the issue. There are also 24/7 solutions that are considered renewables, such as geothermal and biomass, which are more developed outside of the U.S.; however, they could see renewed interest in the U.S. as well.

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We believe battery storage is going to be one of the major technologies to drive an increase in the overall penetration of decarbonized electricity consumption. The first example is time shifting the power generation timing of utility-scale renewables from the point of maximum generation to the point of maximum demand. Often, this is in the form of 4-hour time shifts.

The second example is increasing the consumption of self-generated power, which is part of the trend towards greater decentralized power generation. We are seeing more and more of this in rooftop solar with battery storage. Instead of selling unused power at the time of generation back to the grid (at wholesale power prices), you can store the power and use it later in the day. This will also work in conjunction with using your EV as a storage device in the future.

We believe the IRA will drive an acceleration of storage because of the standalone storage Investment Tax Credit (ITC). The ITC provides tax credits for storage facilities regardless of whether they are attached to power generation sites; it will also trigger the retrofit of storage facilities adjacent to renewable generation. The best location for battery storage is often not at the point of power generation but rather closer to the consumer and closer to grid bottlenecks, so the standalone storage ITC also aims to improve grid efficiency.

**11. Looking at Europe, what is the impact, both short and long-term, of the energy crisis? If renewables are the path forward, how long will it take to build enough capacity to replace Russian imports?**

For context, in the past, about 35% of Europe's gas supply came from Russian pipelines. During 2022, however, this dropped significantly, down by almost 50%. In terms of electricity generation, less than 15% relies on gas; therefore, Russian gas can be replaced with electricity production.

The updated European plan to decarbonize the economy, called RePowerEU, calls for renewables to represent 45% of the European energy stack vs. 22% today. That is more than a doubling of renewables, with the bulk coming from the decarbonization of electricity generation. This will not happen overnight. Renewable project rollouts vary. It usually takes less than 12 months for solar, 18 months for onshore wind, and 2-3 years for offshore wind. Europe will also offset gas via biomethane and green hydrogen. In the near term, there are few alternatives to natural gas for heating. Europe is focused on diversifying its procurement of gas, including imports of liquified natural gas (LNG).

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**12. What is the role of nuclear in the Energy Transition? What are the takeaways from Germany's approach to phasing out nuclear?**

We believe nuclear is essential to generating carbon-free electricity and to do so as a baseload, i.e., not intermittently. It will be one of the key bridges to a world without fossil fuel power plants, and existing nuclear plants are likely to see their lives extended, as we have seen in several countries, including the U.S. Nuclear also has a role to play in producing low-cost hydrogen. This is far more compelling than building new nuclear power plants, which are costly and take several years to construct.

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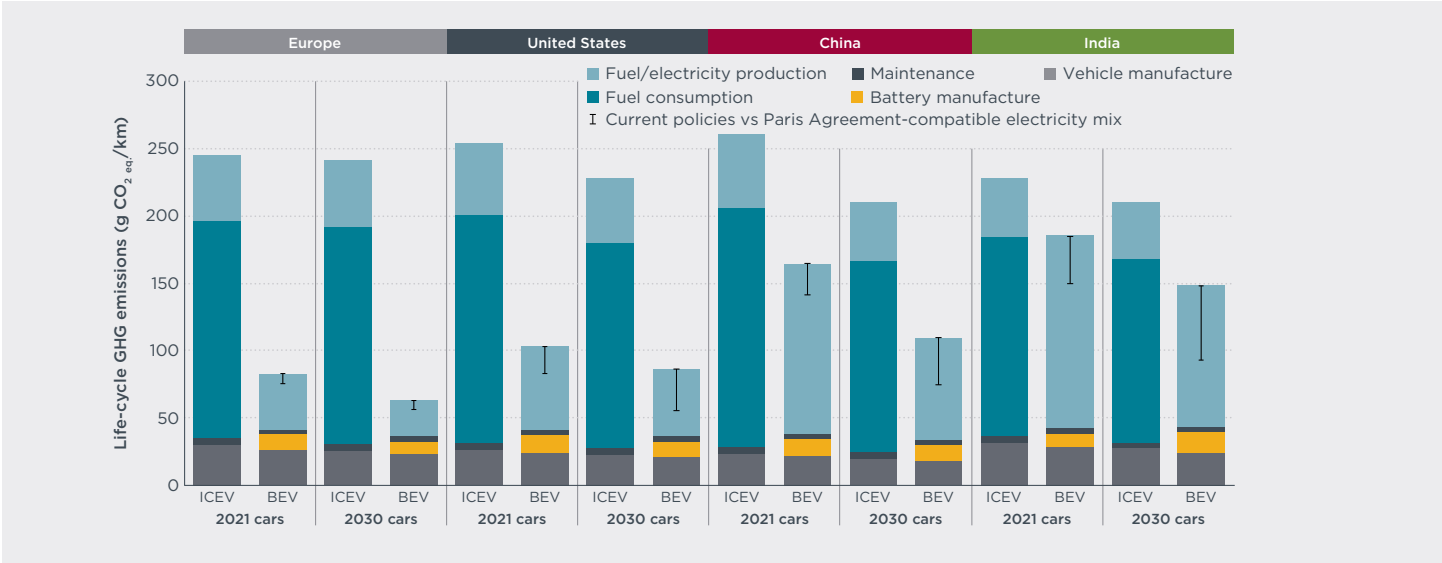
In Germany, it was less of a pro-renewables approach; instead, a major miscalculation regarding the political stability with Russia and an over-reliance on Russian gas. Their aggressive approach has shown that no country or region can have a unilateral and single technology approach to electricity and energy security. We need to be cognizant that this effort requires an understanding of energy management and more than just money. Switching technologies will require planning on permitting issues, grid availability, technology testing, and more, when deciding to alter the energy mix.

**13. When you factor emissions from battery manufacturing and mining, are electric vehicles more environmentally friendly than traditional internal combustion engines?**

Determining the answer here requires a holistic view of the vehicle's life cycle, from extraction of raw materials, to manufacturing, to recycling, or disposal. In a comprehensive, global life-cycle assessment (LCA), results suggest that battery electric vehicles (BEVs) produce lower emissions on average than comparable internal combustion engine vehicles (ICEVs), even when considering emissions embedded within battery production. In fact, for BEVs projected to be registered in 2030, the life-cycle emissions are projected to be 30%–63% lower than the life-cycle emissions of ICEVs.




Source: International Council on Clean Transportation

Further, emissions produced in battery manufacturing can be reduced in a few key ways, helping to lower the emissions profile of the end-product BEVs:

- Second-life usage – although the cycle life of batteries is somewhat uncertain, experiments suggest that batteries may outlast the average BEV's lifetime mileage, meaning they could be used in second-life applications. Thus, only a portion of emissions from battery production would need to be attributed to the vehicle in the LCA.
- Recycled batteries – using recycled raw material in battery production is estimated to lower emissions (although not considered in the study above due to regulatory uncertainty).

Finally, continued decarbonization of the power grid will further accelerate emissions reductions of BEVs compared to ICEVs. Along the same token, BEVs will also boost renewables demand as owners of BEVs naturally will want to supply electricity from renewable sources.

**14. Energy Transition requires a significant amount of minerals and metals. Our current capacity is not enough to meet future demand. What can change in mining and manufacturing to support the growing demand?**

Raw materials are not a particular bottleneck for wind and solar based on the current global capacity. However, trade restrictions and ESG concerns could create temporary issues. Within the IRA, advanced manufacturing production credits offer incentives to various parts of clean energy supply chains that should accelerate the build-out of domestic manufacturing capacity.

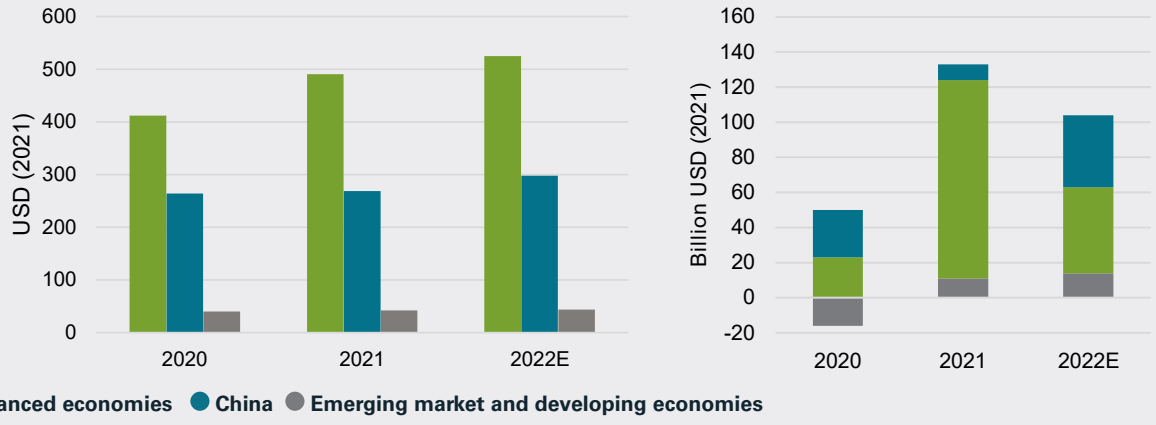
The electric vehicle supply chain could have a greater risk of raw material bottlenecks, in particular for cobalt, high-grade nickel, and, to a lesser extent, lithium. Cobalt content per battery is steadily declining, and new production processes are commercialized to process lower-grade nickel into battery grade. Lithium is fairly abundant; the challenge is building mining capacity in time. The IRA has an additional stipulation on electric vehicle credits. In order to be eligible, an electric vehicle supply chain must have a significant percentage of the critical mineral in the vehicle's battery which is recycled in North America, or extracted or processed in the United States, or in a country with a free trade agreement with the United States. Currently, the U.S. supply chain in this regard is almost non-existent for most (apart from Tesla), and it will take years to build out. In the interim, few electric vehicles will qualify for the full $7,500 credit. The Department of Energy has launched a separate investment program to accelerate onshore U.S. EV supply chain build-out.

## Key drivers of the Energy Transition

### Energy security and independence

- Energy independence becomes an urgent policy objective. Renewable asset development increases domestic energy production and expands the role of electricity in overall energy supply (taking market share from fossil fuels)
- Technology innovation using renewable electricity further widens its addressable market opportunity

**Per-capita clean energy investment (left) and annual change in clean energy investment (right) by region, 2020-2022E**




Source: IEA.

**15. In the U.S., there are states banning the sale of new gasoline-powered vehicles starting in 2035 and restricting natural gas in homes and businesses. Meanwhile, we are also increasing the overall demand for electricity in other ways. Can the electricity grid sustain the demand load in the next 10-15 years?**

Electricity is increasing its market share of total energy consumption, and within that, electrification of vehicles is a major component. If all cars converted to EVs, it would likely add c. 20-25% incremental electricity demand per annum. This U.S. automotive car park transition is likely to take over 20 years. As a result, the incremental electricity demand is not a major hurdle, but how cars will charge and generate power will require extensive grid upgrades. Electricity demand is going from a decade of decline to multi-decade structural demand growth. As increasing amounts of renewable power generation are added to the grid, this often requires more transmission spending due to some of the large wind and solar sites being further from the point of consumption relative to fossil fuel power generation sites. In addition, the intermittency of some renewables will also drive investments in grid storage capacity to improve the utility of decarbonized power. The other area for grid investment will be at the distribution level within communities to strengthen the grid resilience and ability for simultaneous medium and high-speed EV charging systems such as breakers, transformers, and substations. Rooftop solar and storage, with an ability to self-use locally generated power, will also play an important role, and partially alleviate stress on the grid.

Electricity demand is going from a decade of decline to multi-decade structural demand growth.

California has an issue of lack of available power during demand peaks which are now hitting new records. California is a leader in terms of renewable penetration, with 25% of the power coming from wind and solar in 2021 vs. 12% for the U.S. There are two key issues that have occurred. The first is that heat waves have resulted in record demand peaks. At 5 pm on September 6, 2022, California's peak demand hit a new record of 52.1 gigawatt (GW), handily above the previous 50.3 GW set in 2006. This record exceeds California's Independent System Operator (CAISO's) forecasted 2022 summer peak of 45.9 GW by 14%. The second is that the state has shut down baseload fossil fuel (gas in particular) too quickly without ensuring adequate reserve capacity. This is a planning and execution issue in the transition to a decarbonized grid. Finally, solutions are grid storage, more renewables for peak demand, demand response, and increasing levels of decentralized power generation such as rooftop solar.

Texas is a different story. It has an abundance of power but a lack of grid interconnectivity, which is the main issue. They have developed what is known as "competitive renewable energy zones" to build a transmission that connects some of the state's best wind resources to population centers that need it. As a result, Texas has become one of the world's most significant sources of wind and power globally. If it were a country, the state would have the world's fifth most extensive fleet of wind farms. The benefit has been lower power prices relative to many other regions. In addition, Texas has no links to power networks in other states, meaning it cannot export electricity when generation exceeds demand or import from other places with different wind and solar resources. Greater interconnectivity and storage can alleviate this.

### 16. What could be the magnitude of the IRA with respect to the U.S.'s Energy Transition?

To start, we need to examine the IRA's objectives.

First, it is clear the Act responded to U.S. required support, extensions, and future visibility. Visibility matters to corporations, utilities, and homeowners making capital allocation decisions.

Second, the Act's transformative areas, such as battery storage and green hydrogen, are integral to decisively address climate change.

Third, the Act will help the U.S. be a top contender within the global Energy Transition.

Knowing these objectives, we can begin to evaluate the IRA's effectiveness by answering a range of questions over the course of time:

- Does this enable the U.S. to boost its competitiveness, create champion companies, create a new form of energy independence, encourage investment into the U.S., and have a smooth transition from fossil fuels? Does it boost production and lower costs?
- Does the IRA and its long-term visibility trigger an influx of capital deployment? The commitment to Net Zero on behalf of companies, countries, regulators, and individuals is at substantial levels. Is the IRA a green light?
- If the U.S.'s goal is to reduce emissions to combat climate change and achieve energy security, and knowing the goal is to reduce 2030 net GHG emissions by 50% relative to 2005 levels, does the IRA provide the spark to achieve it?

Across the board, we strongly believe the IRA will be a game changer for the Energy Transition at large. The IRA gives support to certain technologies that will be catalysts for substantial decarbonization initiatives. For instance, the biggest gem in the IRA, and perhaps its legacy, could be what it does for battery storage. It was added to the Investment Tax Credit and the incentive level was increased. Due to the acts' incentives, we will now see greater use of co-location of renewables + batteries, which is a meaningful one-two punch. That alone could make the most considerable dent in emissions.

We look forward to following the IRA's transformational impacts within the Energy Transition and endeavour to keep our readers abreast of such exciting updates.