BLACK & VEATCH | CANARY CREATIVE

Energy Transition Snapshot 2022

Volatile Momentum

Every year brings unique challenges to the renewable energy sector — but 2022 has been an unusual year even for this industry in terms of its volatility.

Global demand for clean energy is sky-high. A host of powerful drivers are spurring demand. In response to Russia's invasion of Ukraine, for example, the European Union pledged to reduce its purchases of Russian gas by two-thirds by the end of this year. Increasingly worrying impacts of climate change have also accelerated the urgency of efforts to decrease greenhouse gas emissions across sectors and companies.

But as recent grid-instability challenges in Texas highlight, any notion that the energy transition is inevitable and forever accelerating ignores the many challenges decarbonization faces, especially in the near term.

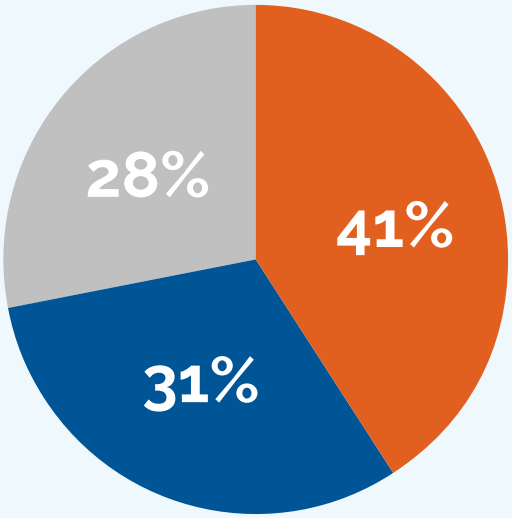
Supply chain problems, global inflation and strong demand for clean energy combined to bring an end to the historical pattern of declining prices for renewables. A report released earlier this year by LevelTen Energy found that the prices in power-purchase agreements for wind and solar had increased by approximately 30 percent over the past year. According to the International Energy Agency, high and volatile energy prices and uncertain supplies have stunted clean energy investments at a time they need to be accelerating, leading to a rebound in spending on coal.

Increasingly worrying impacts of climate change have also helped focus new urgency on driving emissions down

Can we get there?

A recent survey of nearly 200 climate and cleantech professionals conducted by Black & Veatch and Canary Creative gauged perspectives regarding the pace and prospects for decarbonization, as well as the state of specific technologies. It's clear that debates are anything but settled about topics like the growth rates of long-duration energy storage, electric-vehicle adoption, and the likelihood that the United States can meet its most ambitious targets for emissions reductions.

For example, one of the Biden administration's signature climate change strategies is to decarbonize the U.S. power grid by 2035. Yet only 31 percent of survey respondents, which include a cross-section of people in the very industry trying to make that goal a reality, believe it will actually happen, while 28 percent of respondents believe the grid won't be fully decarbonized by 2035, but that it will be close. The survey was taken in spring of 2022, before the U.S. Supreme Court decision limiting the Environmental Protection Agency's ability to regulate emissions, before the solar industry roadblock caused by the Auxin solar tariff investigation and before the passage of the Inflation Reduction act. so the expectations for achieving decarbonization targets may have shifted somewhat given the ups and downs 2022 has delivered.



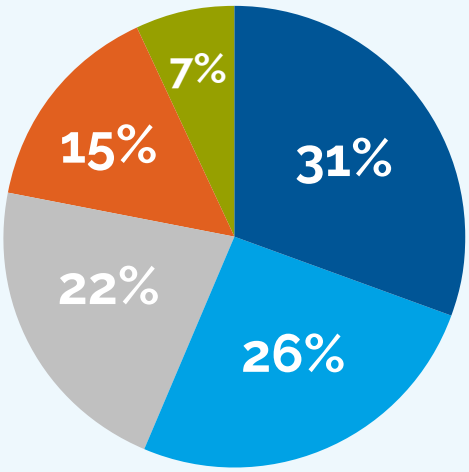
Will the U.S. hit President Biden's target of 100% clean electricity by 2035?

- No
- Yes
- Close, but no

The same mixed views about achieving decarbonization targets extended to individual organizations seeking to chart their strategic paths forward. Nearly 15 percent of organizations surveyed said they set conservative goals and had a clear pathway to meet them. Many others are far more ambitious but acknowledge that a lot remains to be solved.

However, more than a quarter of respondents said their organizations set ambitious goals and don't know how they will reach them. Another 30 percent are pursuing somewhat aggressive goals in the belief that technology advances and cost reductions will get them there.

In terms of your greenhouse gas (GHG) reduction and energy goals, what best characterizes your organization's ability to meet those goals?



- We set somewhat aggressive goals and believe technology advances and cost reductions will help us meet them within our timeframe
- We set aggressive goals and do not yet know exactly how we will meet them
- Not applicable
- We set conservative goals with full knowledge of how we will achieve them
- I don't know

Regulation, regulation, regulation

Clean energy adoption has long relied on supportive policies and regulations to drive customer demand and market uptake. Because many state and federal regulations are today in a state of flux, the adoption of clean energy technologies has been hindered.

For example, high-voltage transmission networks are critical to scale clean energy capacity, but actually getting projects permitted, financed and built is a slow and arduous process – one that requires buy-in from state, local and federal stakeholders. The Biden administration has prioritized transmission-system upgrades and proposed investments of $100 billion as part of reaching its goal of entirely carbon-free electricity.

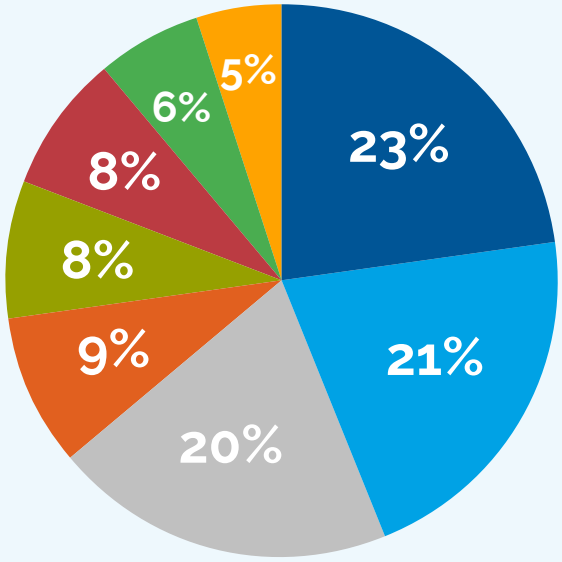
The Federal Energy Regulatory Commission formed a task force with the National Association of Regulatory Utility Commissioners in 2021 to work on aligning state and federal regulators and speeding up transmission-system construction. One of the main hurdles is navigating local opposition to new transmission lines. For example, Maine residents have opposed a 53-mile transmission line extension needed to bring hydroelectric power from Quebec to Massachusetts.

The conflict also highlights a misalignment in the development of clean energy versus the adoption of clean energy. Local opposition to clean energy infrastructure remains strong, even though nearly 70 percent of Americans want to prioritize the development of renewable energy. Some projects have moved beyond that gridlock. In New York, the Smart Path transmission project — upgrading 78 miles of transmission, mostly along existing rights of way to bring renewables from upstate to downstate — is more than two-thirds complete.

It's hardly surprising that survey respondents cited transmission congestion and local opposition as the top two barriers to U.S. renewable growth. Another significant barrier is the lack of regulatory innovation at the state level.

Nowhere is the plodding, conflict-ridden regulatory process more obvious than in California, where efforts to reach consensus on how to value the energy from rooftop solar under its net metering 3.0 proceeding has been contentious and, so far, inconclusive. And even though California's

What is the largest barrier to widescale U.S. renewable growth?



grid operator has allowed distributed energy resources to aggregate into its wholesale market for years, it is still struggling with adjusting those rules to comply with FERC's Order 2222, which requires all grid operators under FERC jurisdiction to figure out how to give DERs access to wholesale energy markets. California is not alone in showcasing these complexities, wide-ranging priorities and gridlock when it comes to valuing DERs in energy markets, but given its relatively long history of working on these issues, it is an instructive example demonstrating how difficult this aspect of the energy transition is.

Local opposition to clean energy infrastructure remains strong, even though nearly 70 percent of Americans want to prioritize the development of renewable energy.

Technology Will Get Us There — or Will It?

The hydrogen hype

Few energy-transition topics attract as much attention and commentary as green hydrogen. But there's also significant investment and actual development propelling green hydrogen, which uses renewable energy to power electrolyzers that split water molecules to create oxygen and hydrogen, the latter of which can then be used as a fuel.

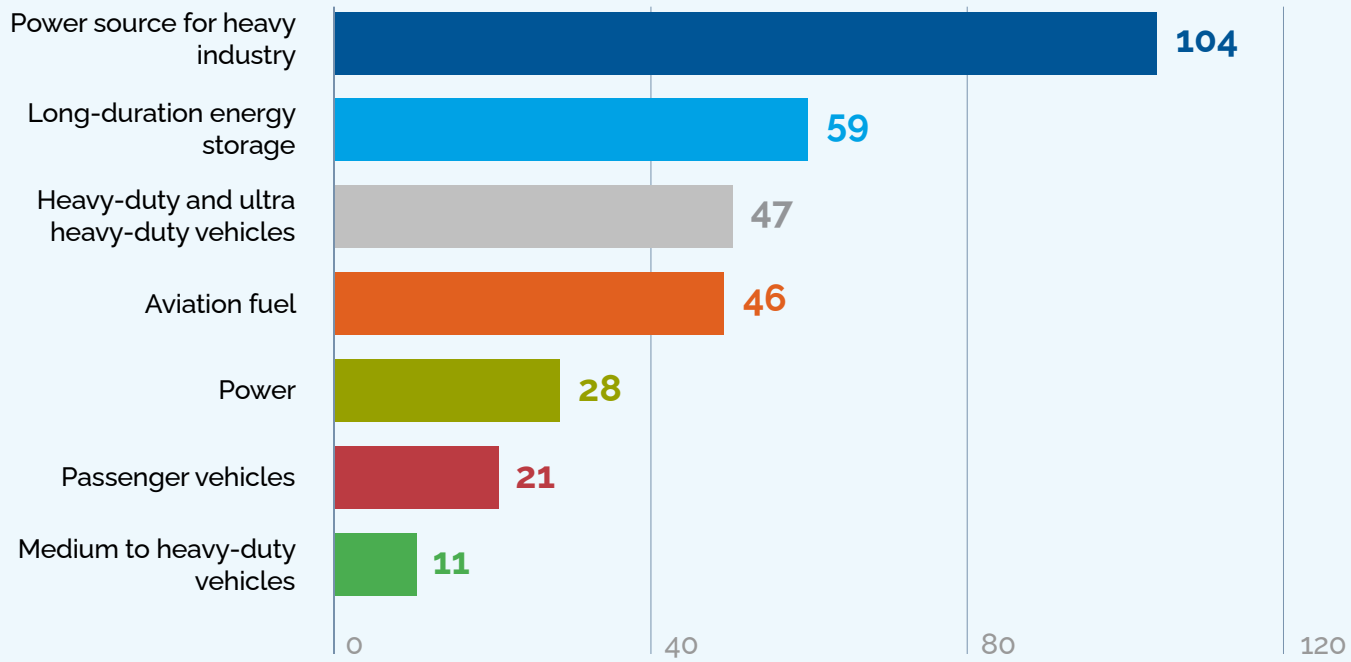
The U.S. Department of Energy recently announced it would use $8 billion in funding from the 2021 bipartisan infrastructure package to support the development of regional hydrogen hubs. The cost to produce green hydrogen is expected to fall quickly as the scale of projects ramp up, driving an increasing number of projects. These market developments are improving the commercial viability of green hydrogen and decreasing the investment risks.

For example, the 220-megawatt ACES Delta project in Utah recently received a $504 million loan guarantee from the DOE. Black & Veatch was selected to be the engineering, procurement and construction provider for the project, which will offer seasonal energy storage as well as a source of hydrogen for power generation and industrial uses. Energy produced by renewables when demand is low can be stored as green hydrogen and then dispatched months later, such as when demand spikes during hot summer days.

Interest in green hydrogen is high because of its many possible applications. The largest number of Black & Veatch survey respondents said hydrogen's "true calling" is as a power source for hard-to-decarbonize industries such as cement or steel manufacturing. Long-duration energy storage was the second most-selected option, followed by fuel for heavy-duty vehicles and then aviation fuel.

Similarly, the IEA forecasts that industry will be the greatest source of demand for hydrogen in 2030 under a net-zero emissions scenario. Better coordination between those who see the value of hydrogen across myriad applications would

What is hydrogen's true calling?



aid the price reductions and technology advancements necessary for green hydrogen to achieve its potential.

The near-term future of energy storage

One way to view the progress of the energy transition is through the lens of the individual technologies driving decarbonization. For example, the critical importance of energy storage as the power system integrates larger and larger amounts of variable renewable generation is unquestioned.

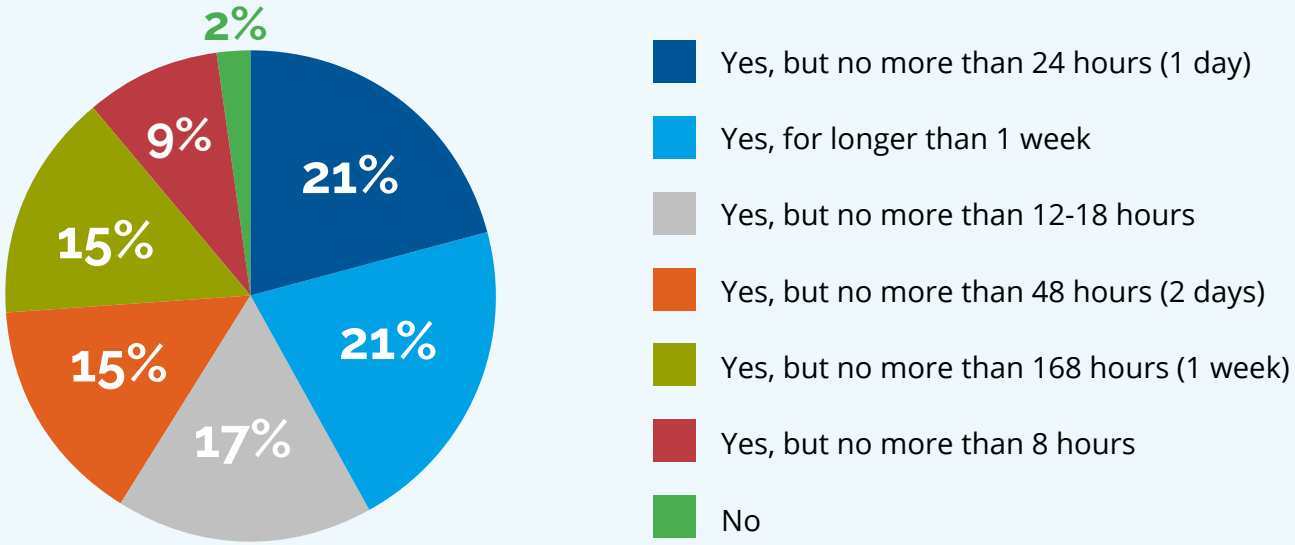
In the near term, however, supply-chain issues and inflation have delayed many projects. In fact, BloombergNEF had to lower its forecast of new storage deployments in the United States by nearly 30 percent between late 2021 and March 2022. Even with temporary setbacks, BNEF expects deployments of storage to grow significantly around the globe in coming years, reaching 58 gigawatts/178 gigawatt-hours each year by 2030. In the immediate term, lithium-ion storage will continue to dominate the market for both electric vehicle (EV) and grid-scale applications. But new battery chemistries are on the cusp of market viability.

In particular, long-duration storage —defined by the U.S. DOE as systems able to store energy for more than 10 hours at a time — is attracting investments and incentives. Form Energy, a startup that claims to be developing a battery technology relying on iron and air that can store electricity for 100 hours, has raised over $360 million from investors.

Not everyone is convinced about either the need for long-duration storage or what the most promising technology is. About 9 percent of Black & Veatch survey respondents didn't believe that any longer-duration storage was even needed, but those who did see a need for it were split on the need for storage for intervals ranging from 12 hours to more than a week.

Survey respondents chose thermal energy storage as the technology most likely to be commercially viable within the next five years. Not far behind were technologies such as mechanical storage, flow batteries, and iron-air storage.

Do you see a need for medium- and long-term storage?



Solar still under siege?

After years of consistent growth, solar has had a particularly bumpy year. The combination of supply-chain woes, inflation, policy uncertainty and the tariff investigation triggered by panel manufacturer Auxin Solar have led to higher equipment prices and delayed and canceled projects — all at a time when solar installations need to grow exponentially to meet forecasted customer demand and support clean power targets across the commercial and industrial sectors. The result: first-quarter solar installations in the United States fell 24 percent compared to the same period in 2021.

In early June, the Biden administration announced that no new tariffs would be levied on solar imports from the four Asian countries targeted in the Auxin petition for two years. U.S. solar companies hailed the move, and forecasts for the 2022 domestic market were

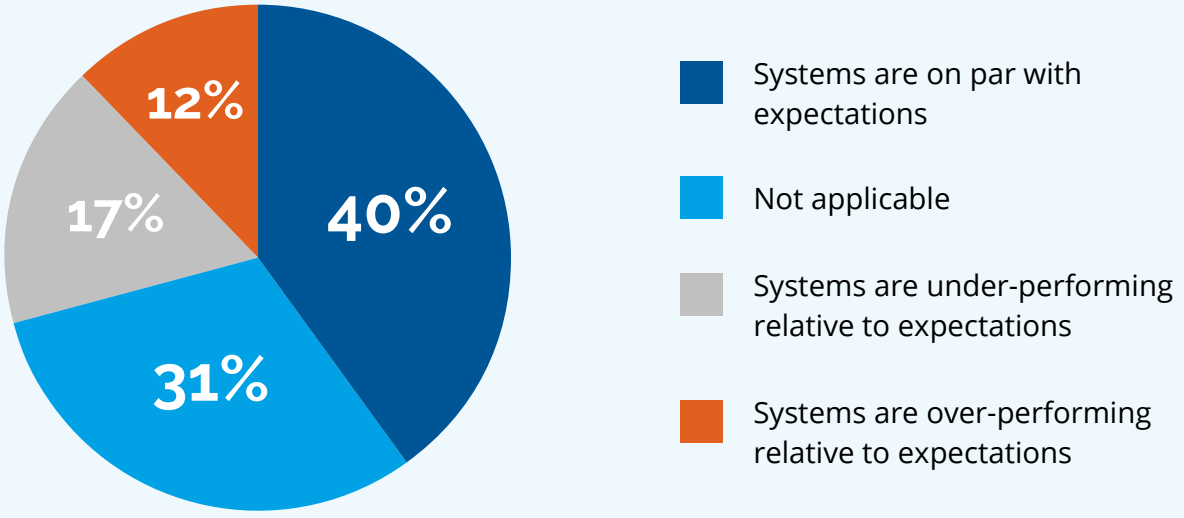
upgraded by as much as 3 gigawatts.

The tariff pause doesn't remove market uncertainty, but it does help. The U.S. Department of Commerce, which is responsible for investigating Auxin Solar's claims, must release a preliminary ruling by late August. More importantly, the passage of the Inflation Reduction Act of 2022 will direct nearly $370 billion over 10 years toward clean energy, electric vehicles, pollution reduction and energy security, making it the largest single federal investment to fight climate change.

The Solar Energy Industries Association released analysis before the passage of the IRA showing how much the outcomes of federal policy matter to the industry's growth over the next five years. If the tariff investigation ends and favorable clean energy policies are enacted, the result could be an additional 55 gigawatts of utility-scale installations between 2022 and 2027.

One factor influencing solar's future growth is how well systems perform once they're installed — and that picture is mixed. According to the Black & Veatch survey, just over half of respondents said the solar systems their organizations built or invested in either have performed as expected or were overperforming. More than 16 percent of respondents said their installations were underperforming, though feedback in other venues indicates that the percentage of systems not performing as expected is higher, with higher operations and maintenance costs and overly aggressive financial models cited as the most common reasons for missed expectations.

How would you rate the performance of solar installations your organization has built or invested in relative to expectations?



Offshore wind is on its way

Offshore wind has long been seen as an important tool to achieve reduced carbon emissions the United States, but very few projects are operational — yet.

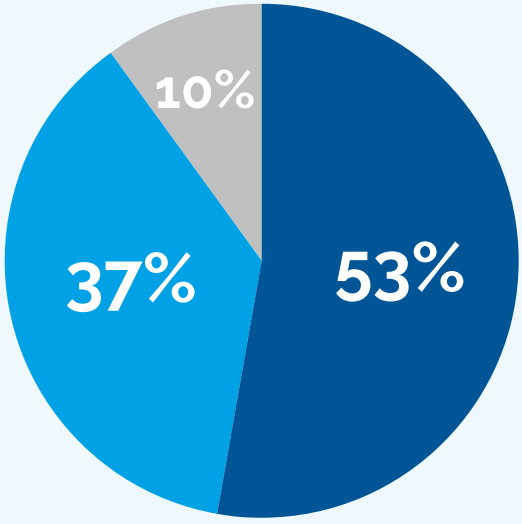
Policy support, improved coordination between the federal government and states, and better economics appear poised to change that. For example, the Biden administration wants 30 gigawatts of new offshore wind capacity to be installed in U.S. waters by 2030. As part of that effort, the administration has brought together multiple federal agencies, including the departments of Energy, Interior, Commerce, and Transportation, to speed up the lease and permitting process and build the complex supply chains and infrastructure necessary to build and service massive wind farms.

States also have ambitious targets for offshore wind. Maryland and Connecticut seek to install 1.2 and 2 gigawatts by 2030, respectively, while New Jersey and New York aim to have a total of 16.5 gigawatts in operation by 2035. New Jersey recently signed an agreement leasing a state-financed port to developer Orsted to build the components for the 1.1-gigawatt Ocean Wind 1 project.

Nevertheless, plenty of skepticism about offshore wind's prospects remains. In the Black & Veatch survey, more than 60 percent of respondents said they were not optimistic that large-scale projects would be operational by 2030. As noted, community opposition — even for farms located far offshore — has hampered some projects.

Given the infancy of the U.S. offshore wind industry, projects are just much slower to materialize. Equinor, for example, was the winning bidder for the right to build a wind farm across nearly 80,000 acres off the coast of New York back in 2016 when the company was still named Statoil, and yet that project is not expected to be operational until late 2026.

Will large-scale U.S. offshore wind be operational by 2030?



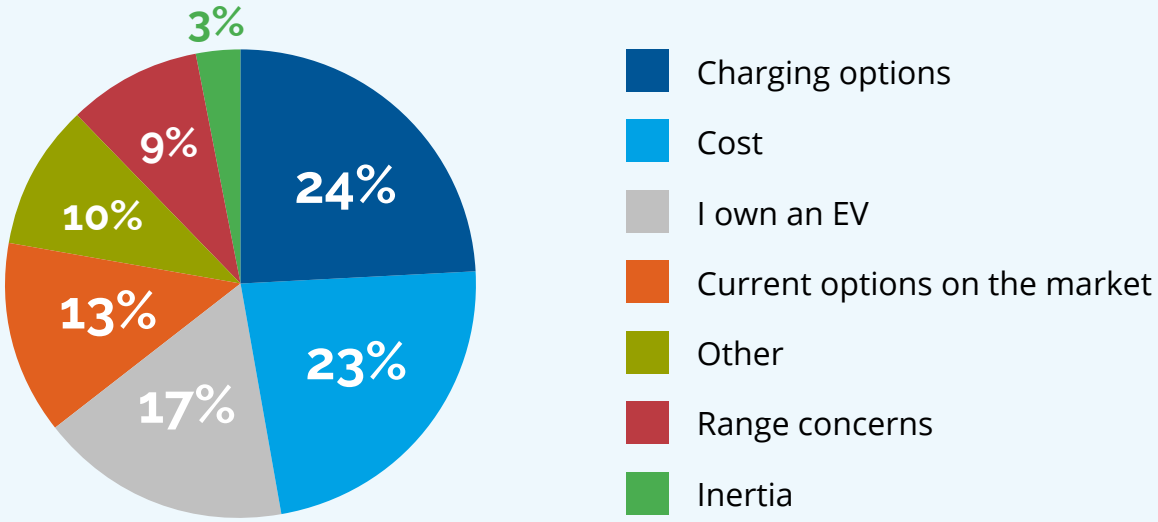
Evolving EVs

In 2021, global EV sales doubled compared to 2020. By 2025, passenger EVs could account for 23 percent of all vehicle sales.

In the U.S., the federal tax credit of up to $7,500 to incentivize drivers to purchase EVs has helped drive sales. But ultimately, consumer demand is what matters. A Morning Consult survey in late 2021 found that 51 percent of U.S. adults would consider purchasing an EV over the next decade. Automakers have responded by releasing dozens of new EVs, and demand from fleet operators is also strong. Companies such as Amazon and FedEx, along with big cities including New York and Los Angeles, are in the process of electrifying their large vehicle fleets.

But real barriers to mainstreaming EVs remain. In the Black & Veatch survey of clean energy professionals — certainly a group that could be presumed to be early adopters — fewer than 20 percent of respondents said they own an EV. Their primary hurdles: charging options and the cost of EVs.

What is your biggest personal hurdle to owning an EV?



Building a charging network able to reliably serve EV drivers is a challenge, whether that's at home or on the road. One big obstacle is making charging accessible in low-income communities and to those who live in apartments and condos. The Biden administration plans to deploy 500,000 EV chargers by 2030 and has dedicated $7.5 billion from the infrastructure bill to accomplish the task. The National Electric Vehicle Infrastructure Formula Program will oversee $5 billion in funding and is focused

on adding public charging stations in underserved communities and highways.

Coordination between communities, utilities, policymakers, regulators, charging companies and other stakeholders is needed to build an equitable and accessible nationwide charging network. The same collaboration will also be needed to accelerate fleet electrification. In the Black & Veatch survey, respondents shared many lessons learned from their experiences setting up charging infrastructures to serve their organizations. Among the insights: the costs of installing charging infrastructure are high enough to limit deployments; costs vary significantly from location to location and between equipment providers; and recent public-private partnerships are proving to be an effective cost-sharing tool.

Despite the challenges for both individual drivers and fleets to go electric, the momentum is there. An analysis by Bloomberg recently found the U.S. is at a tipping point of EV adoption. Currently, about 5 percent of new car sales are EVs, the point where the technology goes from early adopter to mainstream, with massive acceleration likely in the coming years.

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The Need for Coordination

Toward the end of 2021, there was reason to believe that a major inflection point in the energy transition had been reached.

The bipartisan infrastructure law already had been passed, and many expected inflation and supply-chain issues to be transitory.

But the reality of 2022 has been quite different.

The Consumer Price Index was up more than 9 percent from 2021 to 2022, the largest one-year jump in the past 40 years. Given the protracted war in Ukraine, energy is leading the surge in prices. Supply-chain issues are affecting many industries, and the U.S. clean energy sector faces challenges, including critical minerals and technologies that are largely sourced from other regions of the world.

Other issues, such as long interconnection queues and lack of new transmission, are also holding back progress when there is an urgent need to accelerate adoption of clean energy technologies. Fortunately, the decarbonization commitments of many cities and states, and a large and growing number of corporations, are moving forward.

What is needed are new processes and partnerships that move away from traditional, project-focused energy development plans to more systemwide and collaborative approaches that can rapidly drive greater scale. Even as another abnormally hot summer highlighted the fragility of the U.S. electric grid, hope is still alive. The passage of the Inflation Reduction Act represented a striking turnaround for Democrats' prospects of passing major energy legislation before the midterm elections in November.

For example, the New York Independent System Operator recently issued a report that acknowledged the need for a more

holistic, integrated approach to planning and interconnection as a way to better navigate the complexities of offshore wind and other clean energy projects. Similarly, Federal Energy Regulatory Commission proposed a host of major regulatory changes in June designed to unclog interconnection bottlenecks.

These more comprehensive approaches to solving these systemwide problems must be applied to regulatory innovation and throughout the technology ecosystem if we are truly going to unleash clean energy in this decisive decade of combating climate change.

The passage of the Inflation Reduction Act of 2022 will direct nearly $370 billion over 10 years toward clean energy, electric vehicles, pollution reduction and energy security, making it the largest single federal investment to fight climate change.

As the impacts of climate change, corporate and governmental decarbonization pledges and the increasing complexity of the grid collide, more holistic approaches to solving system-wide problems must be applied to the regulatory and technology ecosystems. Black & Veatch, and our thousands of employee-owners, are working with stakeholders across the energy value chain to accelerate this more holistic approach to technology and integrated lifecycle planning and unleash the power of clean energy.

For more information, contact us at www.bv.com.

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