PPHB

Energy Musings

Insights into the Energy Industry

Allen Brooks, Managing Director

Energy Musings *contains articles and analyses dealing with important issues and developments within the energy industry, including historical perspective, with potentially significant implications for executives planning their companies' future. While published every two weeks, events and travel may alter that schedule. I welcome your comments and observations.* Allen Brooks

August 9, 2022

Connecticut Clean Energy Push Hits Oops Moment

Within hours of CT officials hyping a ban on buying diesel buses, an electric one burst into flames. All 12 BEBs in Connecticut were shut down. We look at the economics of BEBs.

READ MORE

Germany's Energy Clock Ticks Toward Zero Hour

Germans, and fellow Europeans, are heading into energy rationing. At the same time, Germany is debating keeping its three nuclear plants running, while renewables fail in delivering power.

READ MORE

Random Energy Topics And Our Thoughts

Energy Performs Better In July On Oil Prices And Earnings

Is The Chinese EV Industry's Nose Under The West's Tent?

Bad News From Gallup About Climate Change

Electric Vehicles Continue To Be In The News

What Will Be The Role Of Nuclear Power In Our Energy Future?

READ MORE

Connecticut Clean Energy Push Hits Oops Moment

One of the worst "Oops" moments a politician could experience happened a couple of weeks ago to the governor of Connecticut. On Friday, July 22, Connecticut Governor Ned Lamont (D) was presiding at a gathering in New Haven of state officials including Department of Transportation Commissioner Joe Giulietti and Department of Energy and Environmental Protection Commissioner Katie Dykes to boast about the passage of the state's recently enacted Clean Air Act that would restrict the purchase of diesel vehicles, increase buying of electric cars in the state, and improve the state's air quality. The legislation is chocked full of incentives and mandates designed to accelerate the switch to electric vehicles and away from gasoline and diesel-powered ones. It was a great day for the clean energy movement.

Unfortunately, at 7:30 am the next morning, the Hamden Fire Department was called to the CTtransit New Haven Operations and Maintenance Facility. A CTtransit electric bus was on fire, something the firefighters could not control. According to the Connecticut State Police, the bus was destroyed, which appears obvious in the picture below.

Exhibit 1. One Of CTtransit Electric Buses Was Destroyed By Fire

Source: ***WFSB Hartford***

Two CTtransit employees suffered from smoke inhalation, and two firefighters dealt with heat exhaustion from the fire, according to the state police. The four people were taken to local hospitals to be treated and were later released. The Hamden Fire Department commented that it

was difficult to extinguish the fire due to the bus's lithium-ion battery. "Lithium-ion battery fires are difficult to extinguish due to the thermal chemical process that produces great heat and continually reignites," the fire department wrote in a Facebook post following the fire. Fighting battery fires is difficult and even the best-trained firefighters struggle to extinguish such fires. There are fire-fighting techniques, but they necessitate using tens of thousands of gallons of water and require hours of time because of the reignition potential. It turns out this was the first battery fire the Hamden Fire Department had confronted.

According to a study by AutoinsuranceEZ, electric vehicle (EV) fires are proportionally less common than internal combustion engine (ICE) vehicle fires. The study examined fire data from the National Transportation Safety Board and vehicle sales data. Battery electric vehicles (BEV) experienced about 25 fires per 100,000 units sold, while ICE vehicles had more than 1,500 fires. Hybrid vehicles suffered from more fires with nearly 3,500 fires per 100,000 vehicles sold.

These conclusions are interesting since some other examiners of the fire issue have noted that reaching firm conclusions about fire risks is uncertain because there is insufficient data about BEVs being more prone to spontaneous fire than ICE vehicles, or more likely to catch fire after an accident. Until there is a larger universe of BEVs with an extended operating experience, we are dealing with very small numbers that can swing wildly from good to bad outcomes.

In that regard, do you remember the February saga of the fire aboard VW's car carrier, the Felicity Ace, carrying almost 4,000 luxury vehicles from Germany to the U.S. Vehicles on board included BEV Porsche Taycans, Audi e-Trons, and VW ID.4s. According to an article in the U.K.'s *Daily Mail*, the ship's captain reported that lithium-ion batteries in the EVs on board caught fire that eventually led to the ship sinking.

Exhibit 2. Felicity Ace Car Carrier With 4,000 VW Autos On Fire Before Sinking

Source: ***MaritimeExecutive.com***

Connecticut's Clean Air Act legislation aims to curtail fossil fuel emissions by banning the state from purchasing diesel-powered buses after January 1, 2024. The law also includes incentives for school districts to transition their buses to zero-emission and away from diesel-powered vehicles.

According to the Connecticut Department of Transportation (CTDOT), the state has about 800 buses that are eventually to be replaced with electric models. CTDOT Commissioner Joseph Giulietti told the Friday press conference that battery electric buses (BEB) "…are quieter, they emit no emissions, and they last longer." He is not the only local politician we have seen discuss how much better it is to be following an electric bus in traffic than a diesel-powered polluting bus.

CTtransit, in consultation with CTDOT, removed its entire 12-vehicle fleet of BEBs from service following the fire. "CTtransit removed the battery electric bus fleet from service out of an abundance of caution," said CTtransit spokesperson Josh Rickman. "We have deployed diesel buses to make sure people get to where they need to be," he said. Redeployment of the electric bus fleet will be based on the conclusions from the ongoing investigation into the bus fire, according to Rickman.

"The bus last operated on July 20 on routes 243 and 265 and was not in service at the time of the incident," Rickman told the media. He went on to say that "Bus fires are rare but can occur similar to cars. This is CTtransit's first fire incident with a battery electric bus. Bus operators, maintenance staff, and others undergo extensive training, and safety protocols are in place."

The CTtransit Hamden garage for the electric buses was not fully outfitted with the fire suppression equipment that is planned according to the CTDOT website description of the state's bus electrification project. Rickman said the work on these improvements is ongoing and is expected to be completed in the fall. That is quite interesting given that the bus destroyed in the fire was delivered last December and entered service this January. So, the fire suppression equipment installation will be completed nearly a year after CTtransit purchased electric buses. Could there be a claim of dereliction of duty against CTtransit for purchasing and putting into service buses that operate from a facility that does not have the required fire suppression equipment installed? The possibility of spontaneous EV battery fires was noted by spokesman Rickman. Who spends $12 million on electric buses without having sufficient safe infrastructure in place? They had no problem getting the proper charging equipment installed to get the buses on the road yet were less concerned about having the proper safety equipment available.

This bus cost $900,000 according to Rickman. At the same time, a diesel bus can be purchased for half that amount. The argument for electric buses is based on a combination of environmental and economic rationales. Environmentally, greenhouse gas emissions from transportation make up slightly more than 37% of Connecticut's emissions, according to the 2018 Connecticut Greenhouse Gas Emissions Inventory report from the Department of Energy and Environmental Protection, the latest official data available. Transportation also accounts for 67% of emissions of nitrogen oxides, a component of smog. The 2018 transportation emissions were flat with those in 1990. They are 20% lower than the 2004 peak.

Exhibit 3. Transportation Is Connecticut's Largest Source Of GHG Emissions

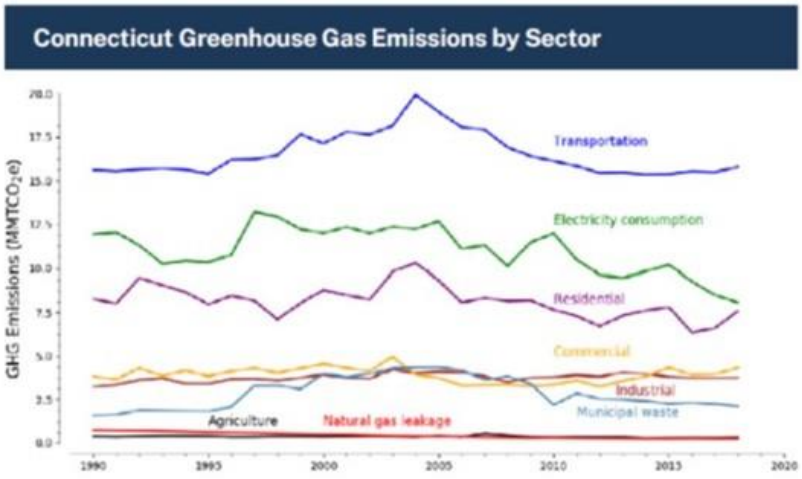


Fig. 2. GHG emissions for CT broken down by economic sector. Transportation, by nearly a factor of two, is the largest emitter followed by electric power and residential consumption of fossil fuel. While emissions from electric consumption and landfill waste fell in 2018, emissions from most other parts of the economy increased with the residential sector experiencing the largest growth.

[2] GHG emissions are reported in terms of CO2e. Carbon dioxide is the primary GHG; and emissions of other gases covered in the inventory are expressed in terms of the equivalent amount of carbon dioxide according to the global warming potential of each gas.

PAGE 3

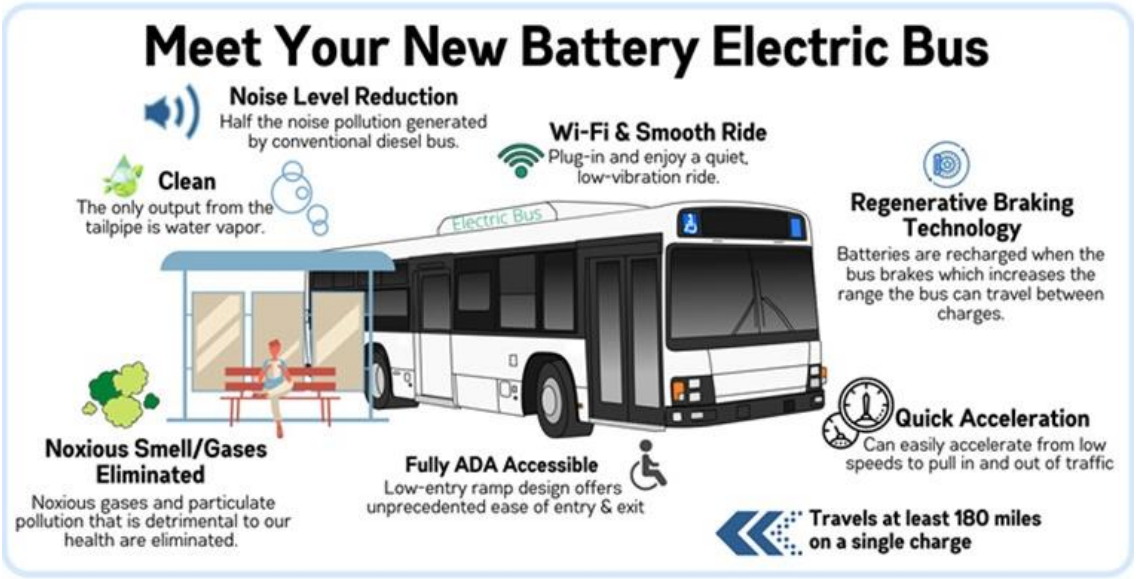
Source: Connecticut Department of Energy and Environment

The CTDOT website lists the following four environmental benefits of switching from petroleum-fueled buses to BEBs.

- 1 Battery electric bus eliminates 1,479 tons of CO2 over its 12-year lifespan.
- 1 Battery electric bus reduces emissions by 30-40% as compared to a petroleum-fueled bus.
- EPA estimates health benefits of replacing one diesel bus with an electric bus in Connecticut saves $370,000 in reduction of respiratory and other diseases over the 12-year lifespan of the electric bus.
- Lifecycle GHG Emissions are -75% than CNG and Diesel buses.

The economic rationale for electric buses is captured in a chart from the CTDOT website outlining the state's Electric Bus Initiative started in 2020. As the agency highlighted: "Electric buses are at an efficiency advantage over diesel buses when stopping because they can recoup kinetic energy losses via regenerative braking. They are also at an advantage when accelerating from a stop because electric motors operate optimally over a wide range of speeds vs. diesel engines that need to operate at higher RPMs."

Exhibit 4. Key Selling Points For Connecticut's Electric Bus Initiative

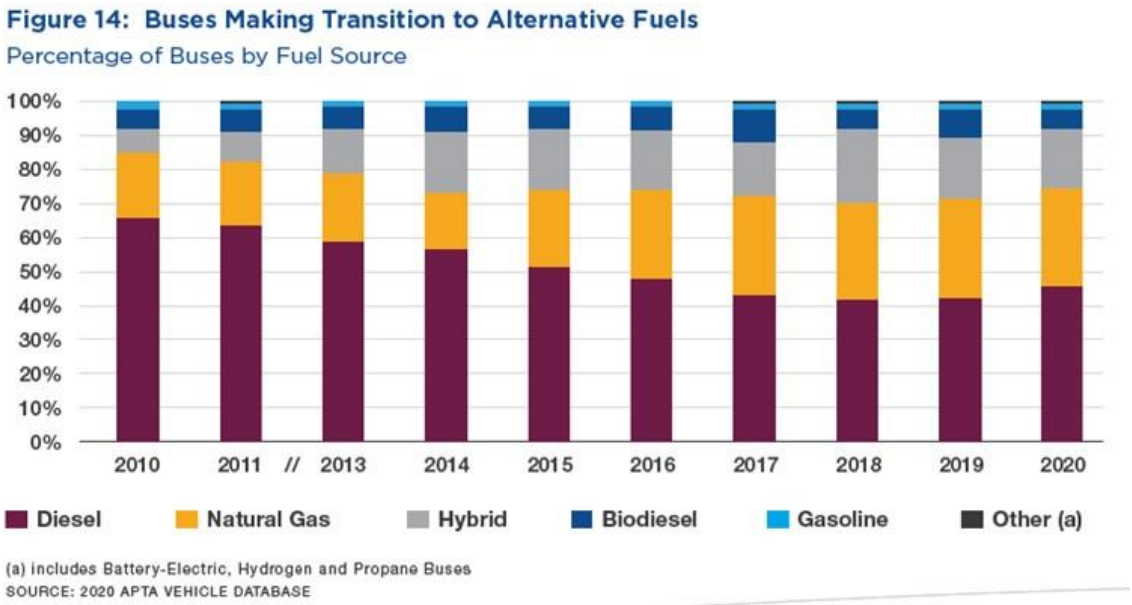


Source: CTDOT

"The first battery electric buses came into service in the fall of 2020," said a spokesman for the CTDOT. "Today, there are 12 electric buses in Connecticut, and approximately 50 planned to be ordered." The existing 12 electric buses represent 1.5% of the 800-bus fleet that the CTDOT is responsible for and that is targeted to be completely replaced in response to the new clean air legislation. We were puzzled by the media articles covering the Hamden bus fire and comments attributed to CTtransit officials about their 12 electric buses. We had earlier read that in the fall of 2020, Greater Bridgeport Transit (GBT) "unveiled the state's first two battery-electric transit buses on September 28."

It turns out that the GBT electric buses were acquired with the assistance of CTDOT, the Connecticut Department of Energy and Environmental Protection, CTtransit, the Center for Transportation and the Environment, and American bus manufacturer Proterra. Thus, while GBT operates in a region downstate from CTtransit's territories, the electric buses are considered part of the latter's fleet. Although it was acknowledged that only 12 electric buses were on Connecticut roads, there was greater attention paid to the prospect of 50 more being purchased for delivery beginning later this year. When those new buses arrive, collectively BEBs will represent about 8% of Connecticut's bus fleet.

Exhibit 5. Electric Buses Do Not Register In U.S. Public Transit Bus Fleet



Source: American Public Transportation Association 2021 Fact Book

The chart above from the American Public Transportation Association's (APTA) 2021 Fact Book shows that electric buses barely register in the American transit bus fleet as of 2020, the latest data available. According to the Fact Book, in 2019 there were 72,665 "revenue" buses, meaning they are involved in transit operations. The data also showed that 2% of the buses were "electric and hybrid." That means roughly 1,450 buses. From the distribution of BEVs and plug-in hybrid electric vehicles, hybrids represent about 35% of the global electric vehicle fleet. Assuming a similar distribution for buses, there would be an estimated 1,000 fully electric buses, equal to about 1.5% of the U.S. bus fleet, with the balance being plug-in hybrid electric buses.

Why are there no more fully electric buses? Is it because they are too new? The German bus manufacturer MAN debuted its first fully electric bus model on the streets of Koblenz in January 1971, over 50 years ago. Maybe the reason there are no more electric buses is that the economics of them are not overwhelming, although they possess a strong environmental case. The CTDOT website for the Electric Bus Initiative made the economic case. It reported the following facts:

- BEBs have 0 dependence on foreign oil.
- Estimated savings of $50,000/year on fuel and maintenance for each electric bus.
- BEBs have the potential to help save money.
    - A typical diesel transit bus uses over 10,000 gallons/diesel/year.
    - Over its 12-year life a BEB can save up to $400,000 in fuel costs.
- Electric buses are 3-4x's more efficient than diesel or natural gas buses.
- Distance traveled per gallon of diesel or diesel-equivalent

- Diesel 4 miles
- Natural gas 4.5 miles
- Diesel hybrid 5 miles
- Electric 17 miles

While the economic facts are impressive, we were surprised there was not a more overwhelming argument made about why BEBs should be employed. It seemed that the quality of the riders' experience was higher in importance than either the environmental and/or economic argument for BEBs. We did find at the bottom of the CTDOT website for the Electric Bus Initiative a link to the report: "Financial Analysis of Battery Electric Transit Buses (2020)," prepared by the National Renewable Energy Laboratory (NREL).

We have copied the Executive Summary and highlighted what we considered some of the key points involved in the analysis.

> Transit buses are well positioned to be the next heavy-duty vehicle market segment to significantly electrify. However, **most fleet managers will only purchase battery electric buses (BEBs) if they are cost-effective when compared to traditional diesel buses over their lifetime**. In this report, this comparison is done through the Vehicle and Infrastructure Cash-Flow Evaluation for BEB (VICE-BEB) model. This model determines the net present value (NPV) and the payback period for investment in BEBs and charging infrastructure.
>
> Numerous economic analyses have been done for specific fleets, but this analysis strives to help all transit bus fleets determine if BEBs would be cost-effective. It does this by establishing a baseline fleet with typical or average values for the parameters of interest and then addressing variations to these parameters in a simplified way that allows specific fleets to place themselves on a spectrum based on key parameters. **The baseline fleet was determined through an extensive literature search and fleet survey**. The baseline scenario invested in four BEBs and four depot chargers, **received a grant of $1,500,000 (or $375,000 per bus with charger)**, and saw an NPV of $785,000 over the 12-year bus life.
>
> When determining if BEB investment would be cost-effective (meaning lower total cost of ownership than diesel bus), fleet managers and grant administrators need to know which fleet parameters to prioritize. **The most important parameters are the ones that are highly influential to NPV and highly volatile**. The relative influence of parameters was determined by independently swinging 33 key VICE-BEB inputs ±50% and recording the corresponding swing in project NPV. The volatility of each parameter was determined by dividing the range of inputs found in a literature search by the baseline value. The most influential and volatile project parameters are represented in Table ES-1.

Exhibit 6. Key Variables Used In Electric Bus Economic Analysis

Table ES-1. Most Influential and Volatile Project Parameters

Parameter	Influence (NPV Swing)	Volatility Rating
Purchase price of BEB	$3,200,968	Medium
Purchase price of foregone diesel bus	$1,731,602	Low
Grant amount	$1,500,000	Medium
Diesel vehicle maintenance	$1,129,599	Medium
Annual vehicle miles traveled (VMT)	$1,033,894	Medium
Number of BEBs obtained (depot)[a]	$771,923	High
BEB vehicle maintenance costs	$698,440	High
Charger price (fast) [a]	$495,636	High
Number of BEBs obtained (fast) [a]	$429,500	High
Electricity demand charges (fast) [a]	$49,282	High

[a] Parameters with parentheses behind them apply specifically to fast- or depot-charge projects.

Source: NREL

> Many of the parameters vary based upon temporal and geographical factors. **Knowing the trends in variance can help a fleet determine beforehand if a BEB investment is likely to be cost-effective for them**. There are also a number of choices a fleet can make in order to make these parameters more favorable. Choosing between a fast and depot charger is implicated in many of these parameters, and charger power, electricity demand charges, and facility electric load patterns need to be considered when making this decision. BEB range is an intermediary factor that is impacted by important parameters (e.g., battery size, efficiency, duty cycle, temperature) and impacts important parameters (e.g., number of chargers and BEBs).
>
> This report serves as a first screen to determine which fleets may be the most suitable for BEB investment. **Next steps could include fleet-specific modeling with VICE-BEB; route profiling to help determine the real-world BEB efficiency, range, and equipment requirements; and discussions with the electric utility to determine if their rate structure and contract can be conducive to cost-effective BEB projects**.

As the highlighted text shows, the decision to purchase BEBs is highly project specific. Importantly, the decision depends on a financial grant reducing the true cost of the bus, as well as negotiating a cost-effective electricity charging rate structure. In the report's net present value calculations, the financial grant for the BEB, charger, and charger installation has a meaningful impact, thus they are emphasized in the decision process.

Another key point in the report is the impact of the BEB's range. Range is a function of various parameters – battery size, efficiency, auxiliary loads, temperature, driving technique, battery age, and its use. In some cases, BEBs are best utilized on heavily traveled (lucrative) routes and not on low passenger load routes. Mixed transit buses in a system would seem an option.

Some BEB systems have seen electricity consumption rates nearly double during particularly hot months due to air conditioning loads, while others have seen doubling consumption in cold months due to heating demand. These load issues can influence the types of battery chargers needed – standard or fast – and whether chargers are needed along a route because of range issues. The NREL report suggested that route profiles be prepared including geotracking specific

buses and compiling representative duty cycles that also account for temperatures for estimating overall efficiency. Such an analysis, besides helping to determine the type of battery chargers needed, may conclude more BEBs need to be purchased while servicing the same number of passengers, which impacts the revenue and cost estimates.

Besides emphasizing the financial grant for purchasing the BEB, charger, and charger installation, the study's economic analysis assumed an 8% per year cost decline for battery packs. That may have been a reasonable assumption in 2020, but it is questionable today. But again, the most important point of the NREL report was its emphasis on project economics rather than a blanket pro-BEB conclusion. That led us to research other economic analyses of BEBs.

An extensive report, "LIFE CYCLE COST ANALYSIS FOR ELECTRIC VS DIESEL BUS TRANSIT IN AN INDIAN SCENARIO," was prepared by two engineering professors in India. They measured the total cost of ownership, which included estimated benefits from environmental savings, for BEBs versus diesel buses. Their measurement period was 25 years because they claimed that matched the normal life of transportation infrastructure such as pavements in India. Twenty-five years is more than twice the 12-year economics of the NREL study and other reports we found. The shorter period was reflective of the estimated (guaranteed by manufacturers) life of bus batteries.

The paper's conclusion was summarized in the abstract of the article. It stated:

> This paper analyzes the feasibility of this and computes the life cycle cost (LCC) of the procurement and operation of electric as opposed to diesel buses based on a functional unit of one bus driven 100 km per day. The research indicates that the total cost of ownership (TCO) of an electric bus, calculated over a life cycle of 25 years, is 5-10% less compared to a diesel bus.

Once again, like in the NREL report, there was a strong emphasis on the high cost of BEBs and that financial incentives that reduce their cost are key to the TCO of BEBs. The professors also highlighted the savings in operational costs that they found "the most promising part of the electric bus TCO. These savings can be invested to enable phase-wise procurement for the next set of buses." The values for each type of bus were summarized in the table below.

Exhibit 7. BEBs Are Cheaper Alternatives For India's Transit Industry

Table 5 Total cost of ownership for diesel and electric bus mobility

Type of bus	Source of energy	PW of ownership cost (Million INR)	Environmental cost (Million INR)	Total cost of ownership (Million INR)
Diesel	Diesel	39.13	0.83	39.96
Electric	Thermal	36.62	0.84	37.46
Electric	100% renewable	36.62	0	36.62
Electric	50-50% thermal + renewable	36.62	0.42	37.04

Source: ***International Journal of Technology***

The final report we found was prepared by the Center for Transportation and the Environment (CTE), the group actively helping municipalities introduce BEBs into their transit fleets. The report was a series of charts examining "Life Cycle Cost Overview for Different Transit Technologies." We have presented two important charts from the report's conclusion. The report was undated, so we reached out to CTE who informed us via email that it was prepared in 2016 but has never been updated. That is kind of interesting, as one would think being able to show

BEBs are economically better than diesel buses would be a positive fundraising tool. Maybe CTE has reached conclusions like the other studies that emphasize the value decision is project specific. Moreover, the BEB advantage appears highly dependent on subsidies and assumptions about variables such as charging costs, battery cost and life, maintenance expense, distance traveled between charges, temperatures, and revenue-generating routes. That conclusion means broad market studies are less impactful because of all the qualifications. This leads to the primary argument for BEBs being the environmental one, which can be very persuasive.

Exhibit 8. Energy Price For Transportation Systems In Lifecycle Cost Analysis

Fuel Costs

Fuel Type	Efficiency	Fuel Cost	Annual Fuel Costs
Diesel	4.0 mi/gal	$2.60 /gal	$29,250
CNG [2]	3.2 mi/dge	$1.10 /gal	$15,470
Hybrid Diesel Electric	5.5 mi/gal	$2.60 /gal	$21,270
Battery Electric (Off-Peak/No Demand) [1]	2.4 kWh/mi	$0.10 /kWh	$10,800
Battery Electric (Peak w/Demand) [1]	2.4 kWh/mi	$0.20 /kWh	$21,600
Hydrogen Fuel Cell	6.5 mi/kg	$8.60 /kg	$59,540

1. Electricity costs vary by time of use, season, and region
2. Approximate cost, which may vary with the Alternative Fuel Tax Credit

Source: CTE

Exhibit 9. What Various Transportation Lifecycles Cost

Life Cycle Costs

Fuel Type	Base Bus Cost	12-Year Fuel Costs	Lifecycle costs
Diesel	$425,000	$351,000	$776,000
CNG	$475,000	$185,630	$660,630
Hybrid Diesel Electric	$600,000	$255,270	$855,270
Battery Electric (Off-Peak/No Demand)	$750,000	$129,600	$879,600
Battery Electric (Peak w/Demand)	$750,000	$259,200	$1,009,200
Hydrogen Fuel Cell	$1,200,000	$714,460	$1,914,460

1. Excludes Maintenance Costs in all categories
2. Excludes Infrastructure costs: Costs of Charging infrastructure varies significantly depending on charge rate and location
3. Base battery electric bus prices have decreased by 25% over the last five years.

Source: CTE

As the data in the charts suggest, the analysis was conducted a while ago, unlike the other reports. Bus costs and fuel prices have changed materially. The point about the BEB battery prices declining is also no longer true. While the point of the study was to show that BEBs had lower fuel costs the savings did not offset the lifecycle costs of the diesel bus. No environmental benefits/costs were awarded to the respective buses. It also appears that operating and maintenance expenses were not assessed. With those costs included, it is likely the report would have shown BEBs having lower lifecycle costs.

We conclude that BEBs may be cheaper over their lifetimes than diesel buses when all factors are considered. This highlights the point of the NREL report that the BEB decision is more project dependent than universal. It will be interesting to see what happens to the cost of BEBs going forward given the inflation in battery mineral prices and questions about their availability. BEBs will be just as impacted as electric vehicles by higher metal and plastics prices in the cost of their bodies. Will Connecticut's Clean Air Act prove as successful economically and environmentally as Gov. Lamont was claiming at his press conference?

Germany's Energy Clock Ticks Toward Zero Hour

August is typically the month when Europe goes on vacation. We remember being in Paris one August many years ago and struggling to find any open restaurants. The mass abandonment of European cities has lessened over time as more companies find it necessary to staff for 24/7 operations. Increased use of air conditioning has helped, but vacations at this time are still popular. However, this August finds Europeans worried about the upcoming winter and their current bank accounts as they head out to relieve the stress of working. The stress of the energy crisis is not easing their minds despite the longer summer days.

As 2022 unfolded, the fears of Russia using its exports of oil, natural gas, and coal as a weapon against Europe have grown. The confrontation between Russia and Europe shifted from the latter instituting sanctions on the use of Russian fossil fuel supplies to now adopting voluntary measures to cut gas usage by 15% from November through next March. If the cuts fail to materialize, the measures will become mandatory, although the details of how that will be accomplished are unclear. Moreover, to secure agreement among all 27 members of the European Union (EU), exemptions were allowed for island nations and other countries with limited alternative supplies readily available. The entire issue has become contentious.

In April, with European power prices soaring, EU Commissioner Margrethe Vestager told people to take shorter showers to stand up to Russian President Vladimir Putin whose invasion of Ukraine was the catalyst for the escalating electricity prices. Now, the advice from European government officials is to save energy, both to lower current use and costs, and enable the power sector to stockpile gas supplies for the coldest times in the upcoming winter.

To get an understanding of what the market is saying about future power prices, the chart below shows pricing expectations for prices in 1Q 2023. The chart shows the price expectations for Germany and two export points in Norway. Germany's price expectation began rising noticeably in December 2021, just as geopolitical tensions over a possible war between Russia and Ukraine escalated and physical supplies of fossil fuels appeared limited at year-end. Price expectations fell back and remained steady until they spiked at the end of February 2022 when Russia did invade Ukraine. Prices remained volatile for a while as the outcome of the conflict was uncertain. As it became clear that Russia would not easily defeat Ukraine, prices remained relatively stable awaiting further developments.

Power price expectations slowly climbed during late spring and in the summer. When the EU began discussing cutting back natural gas use, and the Nord Stream 1 pipeline's gas supplies were suddenly restricted by compressor problems, prices began rising. When the 10-day mandatory pipeline maintenance period was over and the repaired compressor was shipped back to Germany, the resumption of gas supplies took some of the price pressure off. Then, the compressor was delayed in being sent to Russia for reinstallation, and Gazprom, operator of the Nord Stream 1 pipeline said it would limit capacity of the restarted pipeline to only 20% of its maximum output. The alarm bells began ringing in European capitals and the possibility that all Russian gas flows to Europe might be cut off, which would create a serious energy crisis, became a reality. That reality sparked the voluntary cutoff measure.

Exhibit 10. Power Market Expectations Are Predicting An Energy Crisis This Winter

Source: Insight by Volue

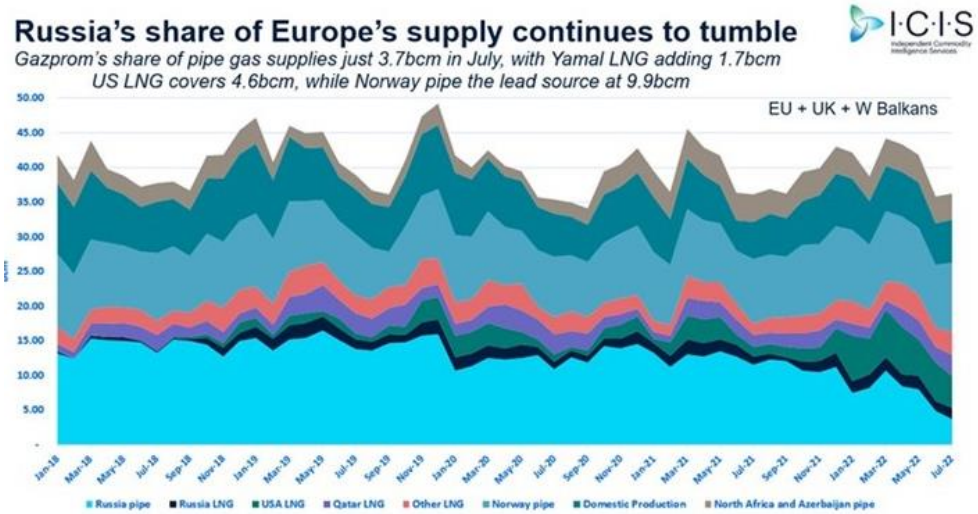
Power price expectations for next March have reached €470 per megawatt-hour (MWh), over 1,000% above the €41.1 per MWh average for 2010-2020. [With one euro equal to 1.01 dollars, both prices are equivalent.] Current power prices are not only crushing citizens, but they are also delivering a devastating blow to Germany's industry, forcing companies to cut back operations and even close plants completely, costing workers their jobs.

As the chart shows, prices in Norway are climbing too, as Europe demands more power exports from the Nordic country. The prices for NO2 (southwest Norway) are €70/MWh higher than the Nordic average of €370/MWh. Reports are that the forward prices for the Western and Eastern parts of Norway are at price levels of €350/MWh through the first quarter of 2023. The higher export price will encourage continued exports of Norwegian power, suggesting that Norway's prices may go higher before export volumes are reduced. Limiting exports just became a reality because of the reduced winter snowpack that is limiting Norway's hydropower output.

Power prices in France have the highest market expectations in Europe at €920/MWh, double those of Germany. This is due to the shutdown of most of France's nuclear power plants for repairs and forced reduction in output from some of the operating plants as river waters that supply reactor cooling water warm to levels too high for reactor safe operations.

The chart below shows just how much Russian gas from its pipelines is down as well as limits to its LNG supplies. U.S. LNG and Norwegian gas supplies have expanded to offset the reduced Russian volumes.

Exhibit 11. Most Of Lost Russian Natural Gas Imports To Europe Have Been Replaced



Source: ICIS

When Germany's Commerzbank reported its second-quarter profits last week, CEO Manfred Knof told employees in a written memo that "The months ahead will continue to be challenging. There is reason to believe that things will become even more difficult economically." He echoed these sentiments and went further on his call with investors and analysts. Knof spoke of "bright spots and clouds" when he discussed the problems Germany and all of Europe face over its high dependency on Russian energy supplies and the threat of a 100% cutoff. The impact on economies will be reflected in financial pain in all sectors, and banks are likely to suffer loan losses hurting their earnings. "The most difficult and pressing question is about natural gas supply and GDP development," he said.

In Germany, there is a raging debate about extending the operations of the last three operating nuclear power plants that are scheduled to shut down at year-end according to the nation's energy plan for shifting to 100% renewable power that was put in place in 2011 by then Chancellor Angela Merkle following the Fukushima nuclear accident in Japan. Potentially delaying the shutdowns surfaced in Chancellor Olaf Scholz's response to the Russian invasion of Ukraine at the end of February. He proposed extending the plants' operations that supplied 6% of the nation's electricity in the first quarter of 2022. We were told that companies had let employees leave who would be needed to run the plants. Also, several plants lacked fuel or could not acquire additional fuel as quickly as needed. That was the news in early March. A few weeks ago, we learned that government officials had misled the public in their comments about the ability of these plants to continue operating. That was because the economy minister is a leader of the Greens party, one of the three partners in the current coalition government, which is opposed to nuclear power.

German Finance Minister Christian Lindner called for Economy Minister Robert Habeck to stop the use of natural gas to generate electricity and keep the nuclear plants operating. Habeck said it would accomplish little in keeping the plants operating because they only supplied 6% of the electricity, while natural gas supplied 13%. In his view, natural gas is not that important in the generation of electricity. He believes it is a bigger issue in fueling the industrial sector and providing heating throughout the economy.

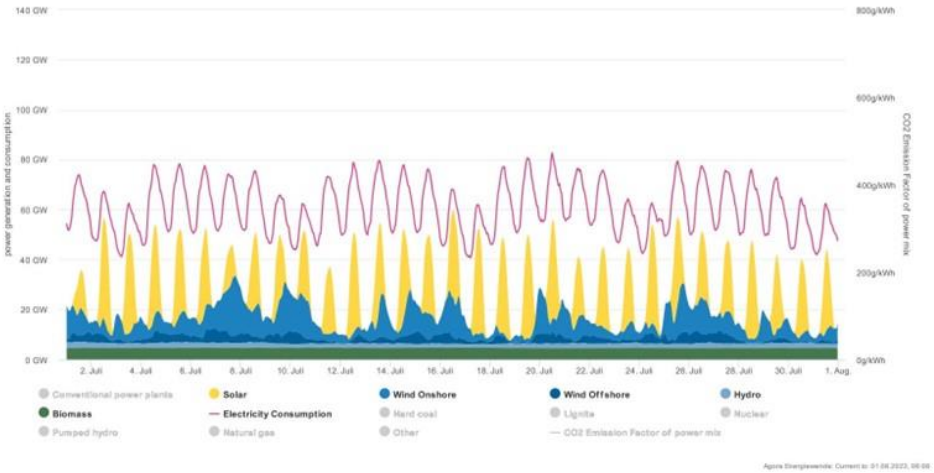
"We have a heating problem or an industry problem, but not an electricity problem – at least not generally throughout the country," said Habeck in early July. Some Greens have indicated in recent days that they are open to allowing one or more reactors to keep running for a short period with their existing fuel rods if the country faces a power supply emergency, but not to a longer extension. In their view, it would require a change in the existing law because it would be "a lifetime extension."

Opposition political leaders are calling on the government to order new fuel rods immediately. They also believe lifetime extensions for another five years are appropriate. Chancellor Scholz is awaiting a new "stress test" that will assess the outcome of a more severe energy supply situation than was used in an earlier test in May.

In response to the power situation, the government has given the green light for utility companies to fire up 10 dormant coal-fired power plants and six oil-fueled ones. It has also opened the possibility for dormant lignite-fired plants to be reactivated and another 11 coal-fired plants scheduled to be closed in November to be allowed to continue operating. Given all the fossil fuel plants that are being revived or allowed to continue operating, Germany's CO_2 emissions are rising. For the long-term, the Scholz government has reiterated its view that doubling down on renewable power is still the answer to Germany's future energy structure.

The problem is that renewable energy still is failing to deliver the power necessary to operate the German economy. The chart below shows Germany's electricity demand in red and all forms of renewable energy supplies – solar, onshore and offshore wind, hydropower, and biomass daily for July. On no single day does renewable energy meet demand. The total installed renewable capacity in Germany is 138 gigawatts (GW) and it supplied between 9 and 65 GW. Total electricity demand never fell below 41 GW nor rose above 82 GW.

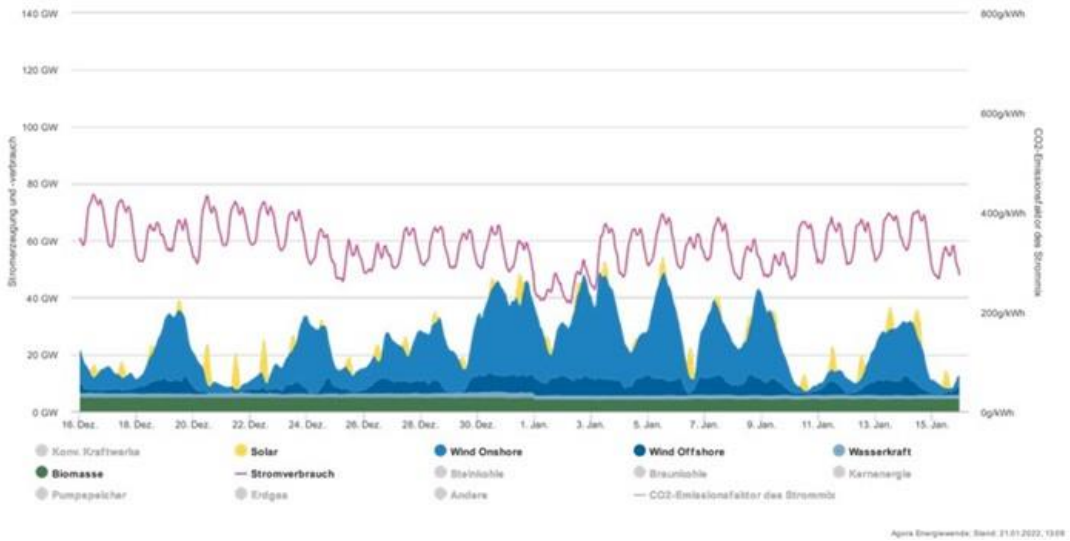
Exhibit 12. Germany's Renewable Energy Supplies Cannot Meet Power Demand



Source: Agora Energiewende

An interesting comparison is to examine renewable power from mid-December 2021 to mid-January 2022. The performance of Germany's renewable energy sector was much worse than in July even though electricity consumption is lower. During this period, electricity consumption reached a low of 41 GW over the New Year's holiday, and it peaked in mid-December at 78 GW. Only during the year-end holiday period did renewable power come close to meeting the nation's energy demand, but that reflects a period of low industrial and commercial activity.

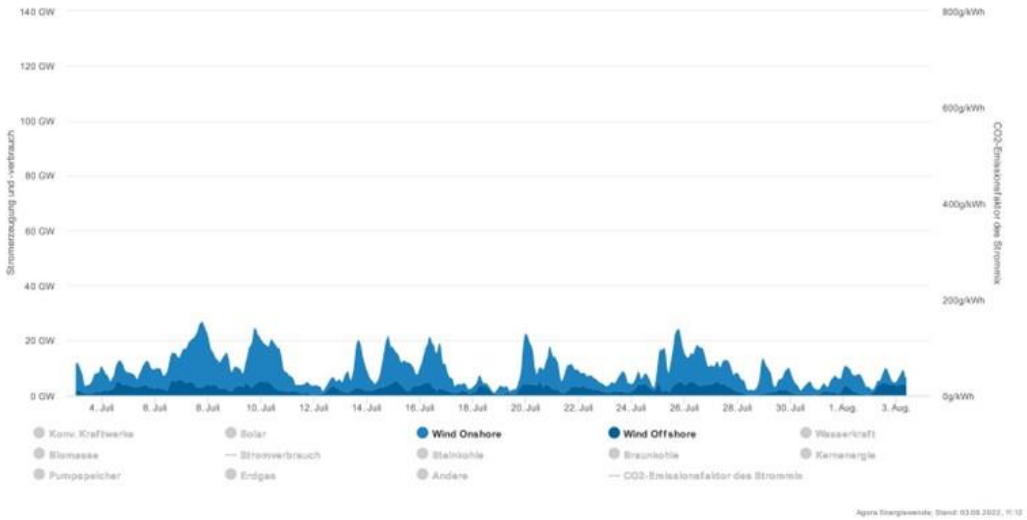
Exhibit 13. German Renewable Energy Supplies Were Worse Last Winter



Source: Agora Energiewende

If we look only at wind power generation in Germany during July 2022, we have the chart below. Wind power supplied between 1 and 27 GW depending on wind conditions. However, the total installed wind generation capacity is 64 GW. That is a utilization range of 1.6% to 42.3%.

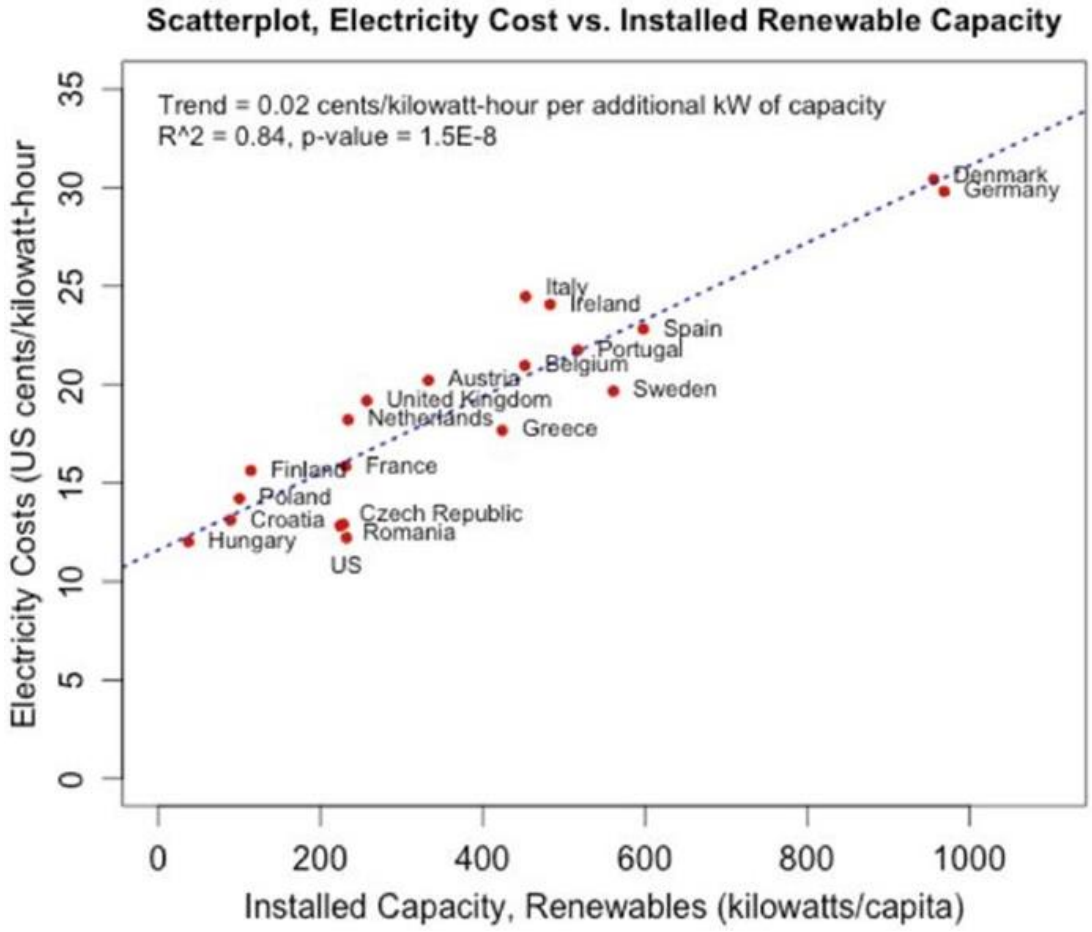
Exhibit 14. Wind Power's Contribution To Germany's Demand In July



Source: Agora Energiewende

The most fascinating chart is the one below showing a scatter plot of European country-installed renewable energy generation per capita against the cost of power per kilowatt. What the relationship shows is that the price of power increases by 2 cents per kilowatt-hour for every kilowatt per capita added. As can be seen, Germany and Denmark have the highest installed renewable energy capacity among the European countries and, also, the highest electricity prices on the continent. The cost of electricity in these two countries is twice the 15 cents per kilowatt-hour (kWh) average price of electricity in the United States in May 2022.

Exhibit 15. Countries With Highest Renewable Share Have Highest Electricity Prices



Source: ***Watts Up With That?***

When we examine individual U.S. state wind and solar power shares against their average electricity prices and the annual increase, we find interesting conclusions. Some of the states with the most renewable power share have small populations such that the relationships are unclear. That includes states such as North Dakota, Oklahoma, Kansas, South Dakota, Vermont, and Iowa. However, California, a leading state in installing renewable power (52%) has among the highest power price at 27 cents/kWh in May 2022, which increased 18.8% in the past year.

Interestingly, when campaigning for the presidency in 2008 in San Francisco, President Barack Obama told donors at a fundraiser that the cost of the renewable energy transition would “cause electricity prices to skyrocket” because the cost will be passed on to ordinary consumers. His

reality is happening, and it is being driven today by the Biden administration, which is populated by many former Obama administration officials.

Because Europe rushed to embrace renewable energy, it allowed itself to ignore its historical dependency on Russian fossil fuels. Germany was most exposed because of its cultural desire to avoid a geopolitical confrontation with Russia given its historical experience, so it decided that by building strong economic ties with Russia political clashes would be minimized. That is a geopolitical and economic philosophy that needs an in-depth examination.

In the meantime, energy rationing is coming for Europe. The first move was formalized in Spain last Monday when the government enacted the following policy: Offices, stores, and hotels will no longer be allowed to set thermostats below 27C (81F) degrees in summer and heating cannot exceed 19C (66F) this winter. Stores must turn off their lights by 10 p.m. Spain's prime minister also recommended office workers shed their neckties to cool off rather than turning on the air conditioning. The mandates in Spain go into effect this week and will last until November 2023. There may be exceptions for periods of extremely hot weather.

Italy's government is also recommending limits on heating and cooling in public buildings. And in the Netherlands, a campaign dubbed "Flip the Switch" is urging showers no longer than five minutes in length, using sunshades and fans instead of air conditioning, and air-drying laundry. Saunas in Munich's municipal swimming pools are closing, and the pools have chillier water, too. Only cold showers will be allowed in public pools in Hannover. In other cities in Germany where there is community heating, warnings have been issued of planned reductions in temperatures for heating in homes and hot water restrictions. Some apartments have been told that radiators will run at reduced levels during the night. The Bavarian city of Augsburg, for example, has turned off its fountains, dimmed the facades of public buildings at night, and is debating switching off some under-used traffic lights.

In France, mayors are waging wars against energy waste. For example, fines are being levied on air-conditioned or heated stores that leave their front doors open. In cities across Europe, officials are shutting off the lights after closing to visitors and keeping them dark through the night.

In Aureilhan, a town of 8,000 residents in the foothills of the Pyrenees in southwestern France, streetlights are turned off from 11 p.m. to 6 a.m. The mayor said he would rather spend the electricity money on other maintenance. Turning off the lights will help keep the €84,000 annual bill in 2021 from tripling in 2023 as currently projected. Mayor Yannick Boubée told a reporter that "there's no reason to keep the lights on at night." He said, "It is shaking up our way of thinking." His next task is to convince residents to agree to reduced heating in classrooms when schools reopen. "We're going to ask parents to put a pullover on their children, all measures that don't cost anything," Boubée said. "We have no choice, unfortunately."

These energy conservation measures are in keeping with the claims in the International Energy Agency's (IEA) Net Zero Emissions by 2050 plan. The IEA said that behavior changes "will reduce 250 metric tons (Mt) of CO_2 in 2030, reflecting changes in temperature settings for space heating or reducing excessive hot water temperatures." When Europe's energy crisis ends, will peoples' behaviors be altered permanently, or will they revert to pre-crisis patterns? An interesting question to ponder.

Random Energy Topics And Our Thoughts

Energy Performs Better In July On Oil Prices And Earnings

After a dismal June performance for the Energy sector, it regained its momentum and finished third among the 11 S&P 500 sectors in July, even though it was hurt early by oil prices dropping sharply. For the month, oil prices fell by $10 a barrel to $98. Significantly, the price rallied during the last five trading days of the month from $94 to $98, although it traded intraday at over $100 a barrel on the final trading day. The chart below shows the monthly performance for the sectors and the overall S&P 500 Index for the first seven months of 2022.

Exhibit 16. Monthly S&P 500 Sector Performance During 2022

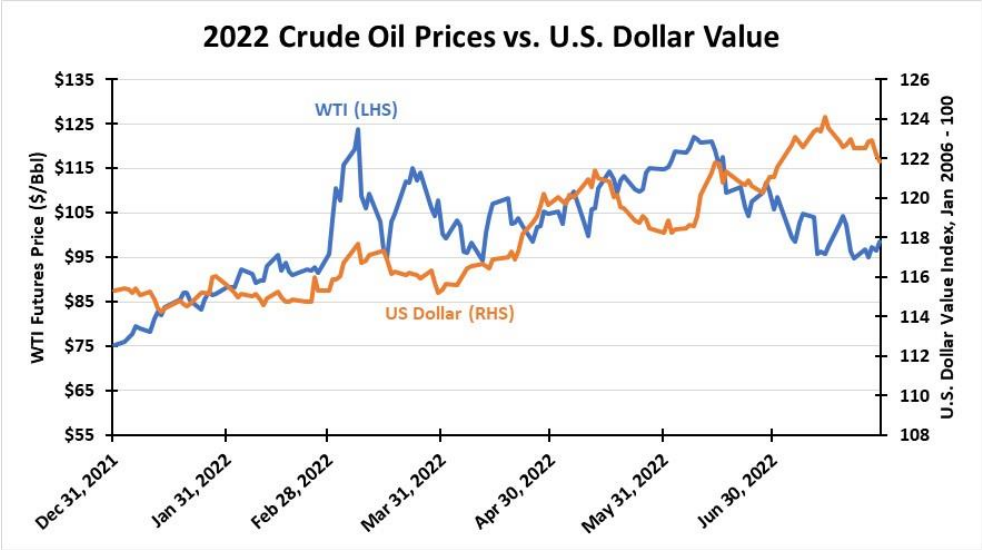
Jan - 22	ENRS 19.1%	FINL 0.1%	CONS -1.4%	UTIL -3.3%	INDU -4.7%	S&P 500 -5.2%	TELS -6.2%	HLTH -6.8%	MATR -6.8%	INFT -6.9%	REAL -8.5%	COND -9.7%
Feb - 22	ENRS 7.1%	INDU -0.9%	HLTH -1.0%	MATR -1.2%	FINL -1.4%	CONS -1.4%	UTIL -1.9%	S&P 500 -3.0%	COND -4.0%	INFT -4.9%	REAL -4.9%	TELS -7.0%
Mar - 22	UTIL 10.4%	ENRS 9.0%	REAL 7.8%	MATR 6.1%	HLTH 5.6%	COND 4.9%	S&P 500 3.7%	INFT 3.5%	INDU 3.4%	CONS 1.8%	TELS 1.0%	FINL -0.2%
Apr - 22	CONS 2.6%	ENRS -1.5	MATR -3.5%	REAL -3.6%	UTIL -4.3%	HLTH -4.7%	INDU -7.5%	S&P 500 -8.7%	FINL -9.9%	INFT -11.3%	COND -13.0%	TELS -15.6%
May - 22	ENRS 15.8%	UTIL 4.3%	FINL 2.7%	TELS 1.8%	HLTH 1.4%	MATR 1.1%	S&P 500 0.2%	INDU -0.5%	INFT -0.9%	CONS -4.6%	COND -4.8%	REAL -5.0%
Jun - 22	CONS -2.5%	HLTH -2.7%	UTIL -5.0%	REAL -6.9%	INDU -7.4%	TELS -7.7%	S&P 500 -8.3%	INFT -9.3%	COND -10.8%	FINL -10.9%	MATR -13.8%	ENRS -16.8%
Jul-22	COND 18.9%	INFT 13.7%	ENRS 9.7%	INDU 9.5%	S&P 500 9.2%	REAL 8.5%	FINL 7.2%	MATR 6.1%	UTIL 5.5%	TELS 3.7%	HLTH 3.3%	CONS 3.3%

Source: S&P, PPHB

For the record, Energy has finished first three times, second twice, last once, and now third during the first seven months. According to S&P, year-to-date, Energy along with Utilities are the only two sectors with positive market performance. Energy is up 44.7%, with Utilities up 4.9%. These performances came while the S&P 500 fell 12.6%, which was a recovery in July from the index's -20% decline for the six months through June.

The market has been impacted by the surge in commodity prices that has sparked rapid inflation throughout the economy. The fears of recession, which is based on the typical definition of two consecutive quarters of real GDP declines, and geopolitical tensions have further contributed to the market's downturn. Although some government economists are stating the GDP declines are not reflective of a recession, we would point to the fact that every one of the last ten times there have been at least two consecutive quarters of GDP declines it was deemed a recession. For the global economy, and especially commodities, a major troubling issue has been the strength of the U.S. dollar against foreign currencies. The chart below shows how the value of the dollar and oil prices have moved this year.

Exhibit 17. How The Value Of The Dollar Has Impacted Oil Prices This Year



Source: EIA, FRED, PPHB

The chart shows the dollar's value essentially flat for the first quarter while oil prices performed similarly other than during the outbreak and early days of the Russia-Ukraine war. From late March to early May, the dollar strengthened, as did oil prices. This was unusual as a stronger dollar is traditionally negative for commodity prices. When oil prices peaked at the end of May and began falling, the dollar was strengthening, a performance in line with the traditional pattern. Lately, the value of the dollar has declined, and oil prices are rebounding back to the $100 a barrel level, but subsequently fell below $90. We suggest investors and petroleum industry participants should watch the dollar/oil price relationship over the next few months, as well as OPEC and geopolitical developments. We fully expect Energy will continue to outperform the market as we are in a long-term positive cycle for oil and gas fundamentals and prices.

Is The Chinese EV Industry's Nose Under The West's Tent?

A technology newsletter we follow posted the following item in its latest edition.

> **Chinese electric trucks**. A Chinese medium-weight electric truck was certified for sale in the EU. I think this may have been the first approval of such a vehicle. We cannot know whether this may be the start of the rapid growth of Chinese exports of freight trucks into the EU, but it is a further indication that the electrification of transport will include larger commercial vehicles. Chinese suppliers of EVs and electric trucks, now with superior scale, will be well positioned to address Western markets if geopolitics allows.

Unstated but significant is it marks another move by China in its strategy to dominate the "green" energy industry. Remember how Germany dominated the technology of solar panels early in their use? Then the United States came into the game, but when China arrived, its low-cost labor and cheap energy enabled it to capture the market in a matter of a few years.

Solar panels were followed by wind turbines. Recent data from Bloomberg New Energy Finance (NMEF) points to Chinese wind turbine manufacturers accounting for 63% of offshore wind

installations globally and 59% of those onshore. We recently reported that Europe's wind farm developer Ørstad was holding discussions with a Chinese wind company to provide both turbines and installation services for a new project in Europe.

Another data point was the announcement last fall by Chinese wind turbine manufacturer Ming Yang Smart Energy Group Ltd. that it was planning to set up a major manufacturing facility in Germany in a bid to capture a chunk of Europe's fast-growing renewable power market. At the time, it was reported that the Ming Yang facility would be the first major wind equipment and manufacturing hub built by a Chinese company in Europe, although rivals Xinjiang Goldwind Science & Technology Co. has a majority stake in German turbine manufacturer Vensys Energy AG, and Envision Energy Co. has a research center in Bristol, U.K.

With the recent re-commitment to renewable energy by the European Union, the cheerleading of the International Energy Agency (IEA), and the new Inflation Reduction Act with its increased renewable energy subsidies that is working its way through Congress, the global renewable energy business will be growing quickly. This is an ideal time for the Chinese renewable energy equipment and services companies to make a push to get into these markets. Will these moves follow the pattern of China's entry and eventual domination of the solar panel and now the wind turbine businesses?

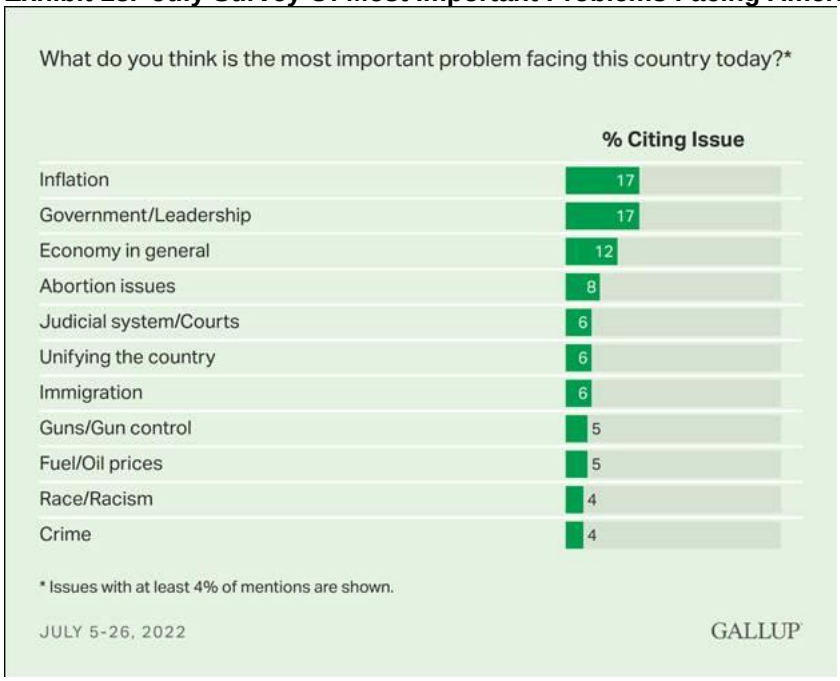
Bad News From Gallup About Climate Change

Every month, survey company Gallup asks Americans what they consider to be "the most important problem facing the U.S." Gallup has been asking this question in 1935. It was asked intermittently in the decades through the 1990s. Since March 2001, the question has been asked every month.

The results from the July survey in some ways were surprising but in other ways not so much. The latter conclusion was the headline of Gallup's press release: "Abortion Moves Up on 'Most Important Problem' List." Gallup pointed out that abortion registered at the top of American concerns among 8% of respondents. This was the highest such percentage since Gallup began tracking mentions of abortion in 1984 but given the Supreme Court's decision in the Dobbs case, overturning Rowe v. Wade at the beginning of July, abortion moved centerstage for politicians, the media, and Americans. Gallup suggested that another 6% of Americans named problems with the nation's judicial system and courts as issues, which it assumed was related to the abortion case. We think Americans may be more concerned about the courts handling of crime.

Here is what Gallup reported Americans listed as their most important problem facing the U.S.

Exhibit 18. July Survey Of Most Important Problems Facing Americans

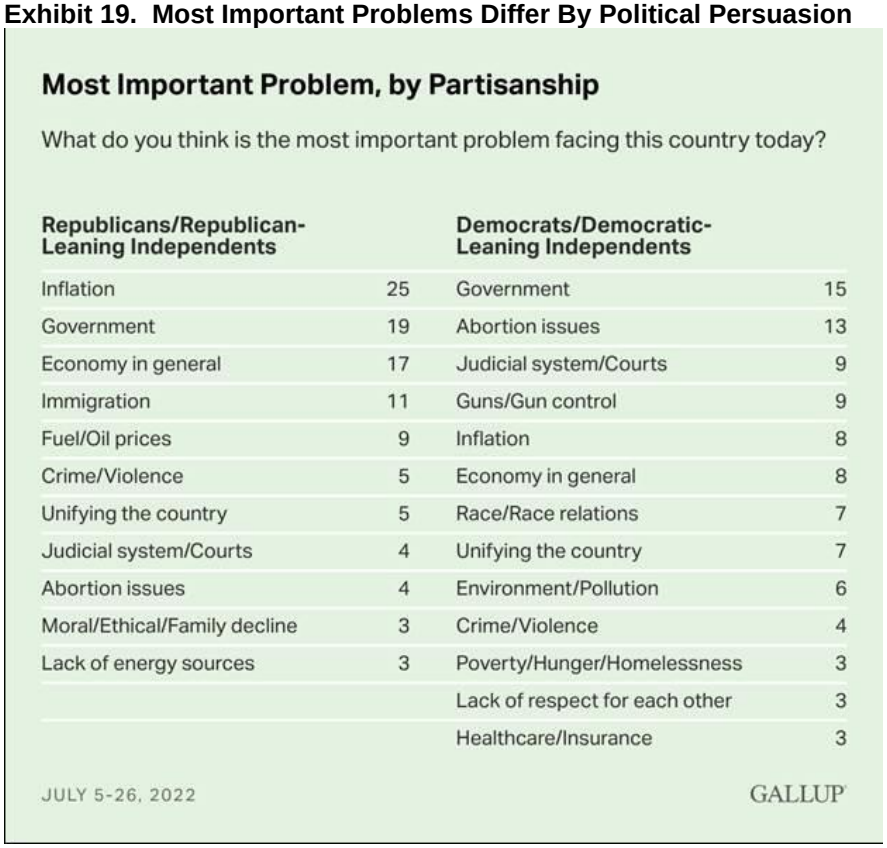


Source: Gallup

Notice that climate failed to make the top 11 topics that registered mentions of 4% or more. According to Gallup, despite regions of the country experiencing record heat and others record flooding, only 3% of Americans mentioned the weather, the environment, or climate change as the nation's top problem.

Another significant trend regarding climate is who is more concerned. The following chart shows how climate registers in the concerns of Democrats/Democratic-leaning Independents at 6%.

Exhibit 19. Most Important Problems Differ By Political Persuasion



Most Important Problem, by Partisanship

What do you think is the most important problem facing this country today?

Republicans/Republican-Leaning Independents		Democrats/Democratic-Leaning Independents	
Inflation	25	Government	15
Government	19	Abortion issues	13
Economy in general	17	Judicial system/Courts	9
Immigration	11	Guns/Gun control	9
Fuel/Oil prices	9	Inflation	8
Crime/Violence	5	Economy in general	8
Unifying the country	5	Race/Race relations	7
Judicial system/Courts	4	Unifying the country	7
Abortion issues	4	Environment/Pollution	6
Moral/Ethical/Family decline	3	Crime/Violence	4
Lack of energy sources	3	Poverty/Hunger/Homelessness	3
		Lack of respect for each other	3
		Healthcare/Insurance	3

JULY 5-26, 2022 GALLUP

Source: Gallup

The Gallup press release discussed the historical significance of its "most important problem facing Americans" question. But equally important, Gallup noted that asking its "open-ended" question provides valuable information about the concerns of Americans without prior prompting. We have always argued this is a more telling way of determining what issues Americans are most concerned about. However, Gallup had to cover for climate activists who failed to make the list of the most important issues concerning Americans. It wrote the following paragraph at the end of its press release.

> The "most important problem" question asks about problems "today," and thus doesn't measure Americans' concerns about issues that may be important in the future. Research, for example, shows that climate change rises to the top of the list when Americans are asked about the most important problems that will face the world in the future if nothing is done to stop them.

We find this paragraph extremely disingenuous. If people were experiencing record heat waves and record flooding, then how come climate/weather/environment was not top of their minds? Heat waves and flooding, the outcomes of climate change according to scientists, happening now should be both a "today" and "future" concern. If it does not make the list, then it is hard to accept that it is the top concern that climate activists want you to believe. Maybe the people have figured out that adaptation efforts need to be stepped up, which goes to their concern about "government/leadership" which was tied for first place with 17% of Americans rating it the most important concern.

The results of the Gallup poll were supported by a *New York Times*/Siena College poll that found only 1% of voters named climate change as the most important issue facing the country. More significant was that among voters under 30, that portion of society thought to be the most energized by climate change, only 4% thought it was important. It seems everyone believes the economy and inflation are our most important issues – everything else can wait.

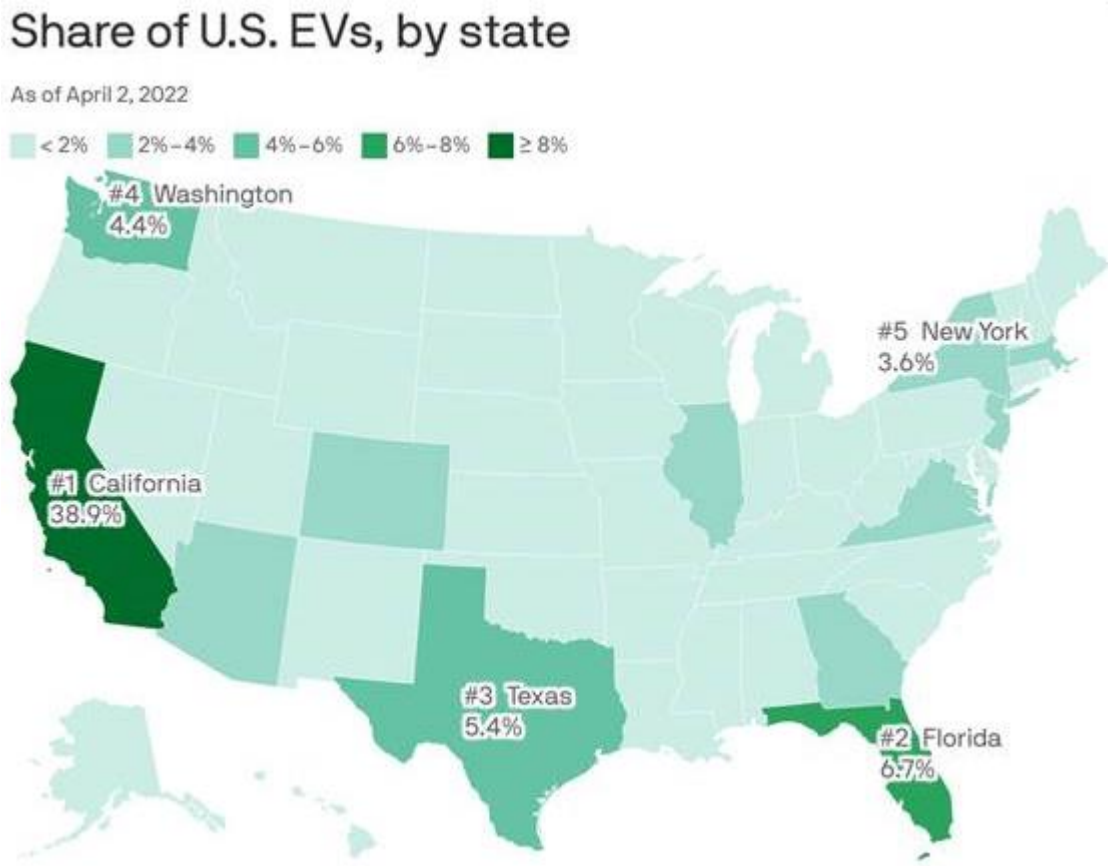
The view of Gallup respondents toward government and climate change was reflected in comments from Anusha Narayanan, climate director for Greenpeace USA, quoted in the *New York Times* article. "People are exhausted by the pandemic, they're terribly disillusioned by the government," she said. We would add that maybe people are frustrated with the incompetence of government, which is becoming more evident every day. Narayanan added, "People see climate as a tomorrow problem. We have to make them see it's not a tomorrow problem." Good luck, as the article pointed out: Greenpeace is struggling to mobilize supporters.

Electric Vehicles Continue To Be In The News

We were intrigued with a *Wall Street Journal* article detailing the business model of electric vehicle (EV) startup Vingroup JSC from Vietnam. The company plans to build a $2 billion EV manufacturing plant in North Carolina. It opened its first store in California in July, with plans for another two dozen stores in the state before expanding elsewhere. Customers can order from two EV sport utility vehicle (SUV) models. They are priced at $40,700 and $55,500, but you also must contract monthly for the battery. The leases range from $35 to $160 a month depending on the amount of driving the owner desires. The monthly fee includes battery maintenance and replacement when the charging capacity drops below 70% of original capacity. The company says the battery lease arrangement reduces the vehicles' prices by $15,000 to $20,000.

This is an interesting business model. If the Inflation Reduction Act becomes law, which extends the $7,500 EV tax credit and turns it into a point-of-sale price reduction and coupled with California's Clean Vehicle Rebate Project (CVRP), the EVs much more affordable, assuming the buyer can qualify within the income and vehicle cost caps of the various subsidies. A problem for EV buyers in California is the $2,000 EV subsidy of the CVRP is competitive, limited in funds, and often has required waits that find the buyer's EV purchase price has been raised and wipes out the subsidy's value. If a buyer (lower income person) receives the full amounts of the subsidies, it lowers purchase prices of Vingroup's EVs by 17%-23% from the suggested list prices making them much more affordable.

Exhibit 20. States Where Electric Vehicles Have A Significant Presence



Source: ***Axios***

A recent story by *Axios* about the EV market made the following points:

- California leads the U.S. in electric vehicle ownership, accounting for 39% of all EVs registered nationwide.
- But EVs represent less than 2% of all vehicles on the road in the Golden State.
- Reality check: We're a long way from a "tipping point" for electric vehicles. The EV revolution has barely begun in the U.S. And it's playing out in super slow-mo.
- 4.6% of the new vehicles registered in the U.S. in May were electric, according to the research firm's (S&P Global Mobility) most recent data.
- EVs account for 0.6% of all registered vehicles in the U.S.

Obviously, *Axios* was countering the recent EV "tipping point" article from *Bloomberg* we commented on in our last *Energy Musings*. Yes. The revolution is beginning but it will take decades to reshape our vehicle fleet. One liberal/environmental group agrees.

What Will Be The Role Of Nuclear Power In Our Energy Future?

At the end of July, the Nuclear Regulatory Commission (NRC) announced it would be issuing a certification for a new nuclear reactor design, making it just the seventh to be approved for use in the U.S. The approval process began in 2016.

The design from NuScale is a small modular reactor that can be constructed in a factory and then moved to the site in a single unit or in several modules assembled on the site where it will be operated. The design received a final safety evaluation in 2020, which set it on the road to this final approval. The reactor is shown in the picture below.

Exhibit 21. NuScale's Small Nuclear Reactor To Receive NRC Approval Soon

Source: ***Ars Technica***

Small nuclear reactors are promoted because they appear to avoid the problems that have made large nuclear plants extremely expensive to build. Georgia Power, a subsidiary of Southern Company, is building units 3 and 4 at its existing Vogtle nuclear plant. These are the first new nuclear reactors built in the U.S. in over three decades. It uses the Westinghouse AP1000 advanced pressurized water reactor technology. Construction challenges, coupled with the impact of Covid, have caused the project to fall well behind its projected construction schedule and well over its budget. The project was initially estimated to cost $14 billion, but the latest estimate is over $30 billion.

Vogtle 2 is targeted for service between 4Q 2022 and 1Q 2023. Fuel is scheduled to be loaded sometime in October, pushed back from August. The fourth unit is planned to go live between 2023's 3Q and 4Q, with its fuel loading scheduled for July/August 2023, delayed from an earlier April target date.

Small nuclear reactor designs involve different technologies from traditional reactors, such as using molten uranium salts as the reactor fuel. The NuScale design is more traditional by having fuel and control rods and the energy transported through boiling water.

While there are many skeptics of the economics of small nuclear reactors, besides questioning the ability to scale them up by linking multiple units together to deliver more power from one installation, developing the technology continues to progress. The NuScale reactor is planned to be used in a test of linking multiple reactors together that would allow them to be activated or deactivated to create a demand-following dispatchable power supply. This test effort, to be managed by a government research laboratory, needs private capital to undertake. For various reasons, utilities have been hesitant about committing to the project, with some who have signed up now worrying about the fate of the experiment. We will be following this project and the evolution of small nuclear reactor technology. The International Energy Agency (IEA) issued a report on the nuclear energy industry in which it advocated for increased development of small nuclear reactors as key to the future of the industry. Nuclear is a power source the IEA considers critical for the world's ability to meet its Net Zero Emissions by 2050 goal.

Contact PPHB:
1885 St. James Place, Suite 900
Houston, Texas 77056
Main Tel: (713) 621-8100
Main Fax: (713) 621-8166
www.pphb.com

Leveraging deep industry knowledge and experience, since its formation in 2003, PPHB has advised on more than 150 transactions exceeding $10 Billion in total value. PPHB advises in mergers & acquisitions, both sell-side and buy-side, raises institutional private equity and debt and offers debt and restructuring advisory services. The firm provides clients with proven investment banking partners, committed to the industry, and committed to success.