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Climate Week

This September (the hottest September on record), the Climate Group in conjunction with the United Nations hosted Climate Week in New York City. We observed that Climate Week captured the attention of New Yorkers and visitors to the summit in a way it had not in years past. The Thursday prior, inspired by Greta Thunberg, children across the world participated in the climate strike. One could not help but be moved by the sight of children holding protest signs advocating for their future.

There were some positive functional outcomes as well. Over seventy-seven countries pledged to reduce greenhouse gas emissions to zero by 2050, including France, UK and Germany. Corporations, no longer willing to wait on legislation for direction, also committed carbon reductions in line with the Paris accord. The shipping industry, a quietly significant polluter, also pledged to operate zero emissions ships on deep sea routes by 2030.

But the progress was significantly overshadowed by the United States' and to a lesser degree Brazil's absence. This allowed other countries like China and India to remain silent as well. While every year without meaningful global progress on climate is critical, the United States' and Brazil's positions on climate change are increasingly isolated outliers which will become difficult to maintain.

During Climate Week, Partner Ted Roosevelt was asked to give the keynote address to the CFA Society about climate science and capital analysis (the full speech can be found [here](#)). It was heartening to see the traditional financial analysts of the Chartered Financial Analyst Society's interest in the potential economic impacts of climate change.

Ted's remarks would have sounded familiar to many readers of our letters. He highlighted that despite climate science's accurate near- and long-term forecast, the market shows an unwillingness to incorporate it into asset prices. His closing comments encouraged institutional investors to consider climate change in their analysis, "Just last month, passively invested funds passed \$4.27 trillion and for the first time they invest more assets than actively managed funds. If you are allocating capital as a fiduciary today, beware of being too heavily reliant on passive investing or divestment strategies. Not unlike the unexpected decline in housing prices in 2008, a paradigm shift that affects all parts of the economy is occurring today. But unlike the housing crisis, there is an accurate forecast provided by some of the world's best scientists and supercomputing. To ignore that forecast and invest as normal, is to bet against the laws of thermodynamics.

Incorporating climate science into an investment model can help investors, not just drive capital to much needed mitigation solutions, but also capture what I believe to be the last major market inefficiency and active alpha opportunity. Put simply, you can help the planet and your investment returns.”

Economic Transitions

Redwood Grove Capital augments a traditional investment process, one honed with over 50 combined years of investing on behalf of large institutional investors, with an analysis of the economic impacts of climate change. These economic impacts will be felt predominately through four main disruptive trends; 1) technological shifts in how we produce and consume energy, 2) increasing physical impacts of a warming planet, 3) changing consumer purchase patterns, and 4) increasing State, Federal and Global regulations on fossil fuel consumption. The four trends will likely happen at different and vacillating speeds, but they should all be long term considerations for a public equity portfolio.

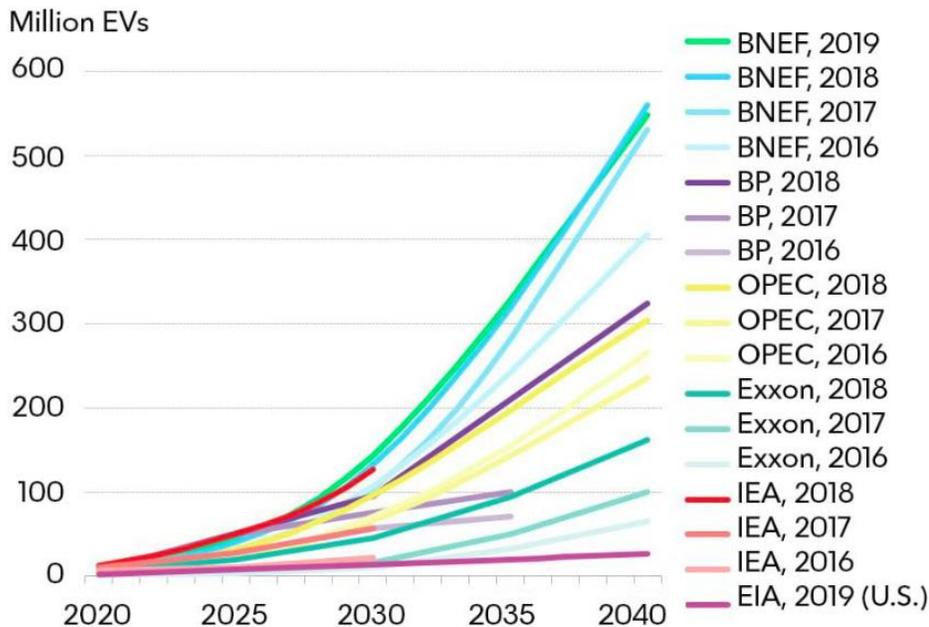
In the last letter we talked about the technological advancements that are de-carbonizing urban areas. In this letter, we dive into the technological shifts that are de-carbonizing transportation. **Transportation alone accounts for about a third of Greenhouse Gas Emissions and consumes about 45% of the annual global oil supply.** Unlike in other sectors, efficiency has not offset increased demand. The first Model T in 1908 got 21 miles to the gallon, the average vehicle today gets 24 mpg. This is a .1% compounded annual growth rate in MPG improvement over the past 110 years. Despite that modest increase in MPGs, auto manufacturers have squeezed about as much as they can from the internal combustion engine (ICE). In a recent interview, GM president Mark Reuss, an engineer and professional racecourse test driver, said electronics are the only way to drive more efficiency, “I don’t know where to spend money anymore” on a combustion engine.

Fortunately, the transportation industry is experiencing not one but three simultaneous revolutions that will reduce its carbon footprint: electrification, shared mobility and autonomous driving. Each revolution alone will be highly disruptive. Especially in an industry that has used the same core technology, since 1876 when Nikolaus Otto created the first commercially viable internal combustion engine.

The end of the ICE age

The end of the internal combustion engine is happening faster than market predictions. If one were to go back just 4 years and look up estimates for EV sales, one would find conventional wisdom anticipated a few hundred thousand EV cars would be sold sometime in the early 2020’s. In 2018, 1.45 million electric vehicles were sold. Not surprising, forward looking estimates have increased as EV sales have accelerated, but they have continued to be consistently and systematically lower than actual results. The below, somewhat confusing, chart illustrates the changing predictions for electric vehicle adoption by five different organizations for the years 2016, 2017 and 2018. **The main take away is that all the organizations, OPEC, Exxon Mobile, British Petroleum, International Energy Agency and Bloomberg New Economy Finance have all revised their forward-looking estimates *up every subsequent year.***

EV Outlooks then and now



Source: BloombergNEF, organization websites. Note: BNEF's 2019 outlook includes passenger and commercial EVs. Some values for other outlooks are BNEF estimates based on organization charts, reports and/or data (estimates assume linear growth between known data points). Outlook assumptions and methodologies vary. See organization publications for more.

Today, Morgan Stanley, in line with its peers, believes that by 2030 EV's will see a 14% penetration rate in the United States and approximately 30% penetration rate in the rest of the world. EV's are not a one for one proxy for autonomous cars (AV's), but AV's will be built on EV platforms so we know that mass AV adoption will likely follow EV adoption.

Not included in these models is any future legislation that might incentivize a faster acceleration to EVs. It is worth noting that current forecasts for EV adoption do not meet the requirements for the globe to stay below a 2 C degree warming target. The transition may be driven exclusively by market forces, which is a reasonable expectation. But, while we are mindful of the current political environment in the U.S., we believe, that global adoption will likely see more aggressive regulatory incentives over the next decade.

The predilection to underestimate a disruptive technology's adoption rate, like that of electric vehicles, is not unique. Market experts are often blindsided by the speed of disruptive change. Famously, the company that invented digital photography, Eastman Kodak, went out of business because they failed to anticipate the speed of the shift from silver halide film to digital photography. And outside experts like the ones represented in the above chart are no better at anticipating paradigm shifts. Tony Seba, a Stanford professor across the street from us, tells a story of when AT&T hired McKinsey in the 1980s to model out cell phone adoption by 2000. The best minds at McKinsey estimated that over the next 20 years 900,000 cell phones would be used in the United States. The actual number was 102 million. As a result of that poor prediction, instead of developing that business internally AT&T had to buy their way into the wireless business. AT&T

acquired Cellular One, a company that did not exist a decade earlier, for \$11 billion in what at the time was the second largest merger in U.S. history. That new AT&T wireless business was spun out as its own company, only to acquire the original AT&T business seven years later.

Technology companies like Alphabet, Apple and over a dozen venture-backed start-ups are looking to disrupt transportation. They approach the transportation sector with the “as a service” model (TaaS). This approach both changes and expands the market opportunity. Traditional auto manufacturers think of their total addressable market (TAM) as units sold (approximately 80 mm cars worldwide) times average cost of vehicle (approximately \$19k) for a TAM of \$1.5 trillion. Technology companies think of TaaS. This expands their TAM calculation to total miles driven (approximately 10 trillion a year) times cost per mile (approximately \$1) creating a market opportunity of \$10 trillion a year. (Uber’s average cost per mile is approximately \$2.) In addition, if you are driving people autonomously you are containing people and their attention for periods of time which can also expand the market opportunities. In other words, the three disruptive forces, electrification, self-driving vehicles and shared mobility may drive unit sales down, but the total addressable transportation market will go up.

In addition to thinking about growth opportunities brought on by a transition to a low carbon economy, we are mindful of potential value traps. Auto part manufacturers and distributors have attractive valuations, but we believe remain on the wrong side of this disruptive trend. Internal combustion engines have over 2000 moving parts, many of which rub and bump into each other causing wear and tear. Electric vehicles have 20 moving parts, and because of electromagnetics many of them never touch each other. So, while we see a growing market opportunity in transportation, and significant future investment in the space, we also see negative secular trends that we believe are best avoided despite low valuations. It is an example of where our climate analysis helps us avoid what we believe to be a value trap.

Redwood Grove does not claim to be the only investor anticipating these new technologies. They have been written about by most Wall Street analysts. But the acceleration of damages caused by a warmer planet (which we’ve discussed in detail in our prior letters), is creating an increased urgency to reduce global GHG emissions. This will drive shifts in consumer behavior and regulation, both accelerating the speed of the transition faster than currently anticipated by the broader markets. In addition, though not discussed in detail here, we believe advances in these technologies, including batteries, and costs reductions are just hitting inflection points that will meaningful steepen their adoption “S-curves.”

Technology and Automobiles

There are two companies that we think have core business advantages and technology leads for this transition: Alphabet and counter intuitively General Motors. We think they are both well positioned, but the speed of the transition will likely play a determining role in which company fares better over the next 3 to 5 years. Alphabet is the clear technology leader with Waymo and is very well capitalized. General Motors is the leader among traditional automobile manufacturers, and by virtue of its legacy business has the capability to mass manufacture the vehicle of the future. Though that same advantage, mass manufacturing, will be a disadvantage if mass adoption of autonomous and electric vehicles happens over an even shorter time period. As we will discuss later, repositioning their manufacturing capabilities and work force will be difficult.

We've talked a bit about General Motors in the past, and we've seen some investors of ours raise their eyebrows at this investment. The company is an excellent case study for sustainable investing, because it illustrates the dynamism of these transitions and the very real challenges investors face when assessing climate trends. It is easy for us to focus on our clean energy and efficiency investments in our investor letters, but we think it is more helpful to our investors to discuss how we analyze the more difficult parts of our economy. We are willing to invest in companies we believe are attractively valued and by virtue of their strategic pivot are well positioned to grow due to the transition to a low carbon economy. Even if their current business is increasingly a relic of our old economy.

Mary Barra talks about General Motors as a technology company that happens to sell cars. This description reflects her three goals: zero crashes, zero emissions and zero congestion. In order to accomplish those goals, General Motors needs to lead the three disruptions taking place in the transportation industry. Compared to their original equipment manufacturing peers, we believe they are leading this transition.

In 2016, GM bought Cruise a leading autonomous vehicle technology company, which along with Waymo had been one of the first to plan a roll out of an autonomous taxi service. Cruise has seen recent stand-alone valuations at \$19 billion, or the equivalent of 37% of GM's \$51 billion market cap. GM also owns approximately 10% of Lyft (worth another \$1 billion) and has rolled out a car sharing platform in Maven Gig.

GM is using a significant amount of their \$6 billion of free cash flow to aggressively move into the EV, AV and shared mobility markets. If investors want to see where a company is trying to go, they can start by looking at that company's capital investments. In this quarter's earnings call Mary Barra said over the next five years she expects to spend more on R+D for electric vehicles than on the internal combustion engine. GM already leads traditional automotive manufacturers in the electric vehicle space. They were first to market (beating Tesla) with an affordable, long range EV in the Chevy Bolt and are the second auto manufacturer behind Tesla to pass 200,000 all-electric cars sold in the United States. They are looking to expand that effort and focus on the luxury market by turning Cadillac into an electric brand.

General Motors will produce 20 new all-electric vehicles by 2023 by virtue of an all-new electric vehicle architecture which is most easily thought of as an ice tray. By storing cell modules (batteries) in the tray they can configure them to best meet a multitude of design needs. This new architecture plus a focus on the luxury market makes them optimistic they can sell EVs profitably in the next few years. Finally, they have deals with EVgo, ChargePoint and Greenlots to establish the largest EV charging network in the United States. The combination of all these strategic initiatives, puts them meaningfully ahead of their peers in their readiness for the adoption of EV and AVs.

We are, of course, value investors which is what makes GM particularly appealing to us. Shares trade at a discount to peers, GM's historical valuation and their future growth prospects. At 5.5x P/E and 10% free cash flow yield, GM looks particularly undervalued even mindful of a potential economic downturn. Plus, at current valuations, GM has an "unpriced" or "free" technology company in their autonomous, ride sharing and EV businesses.

Like many companies trying to *pivot* for a low carbon economy, we find they are rarely perfect and our assessment of their efforts evolve with the company's actions. As we finished writing this letter, it was announced that GM has joined the Trump administration in suing to end California's CAFE standards waiver. We are engaged with GM on this issue. They have told us that this position reflects their desire to have a single regulatory body setting the standards and is not reflective of a desire to lower CAFE standards. While that may be true, they have certainly not taken a leadership stance on CAFE standards and their recent lobbying efforts have raised real concerns for us.

Companies pivoting their businesses to prepare for a lower carbon economy will face the headwinds of their core businesses' innate inertia. This is illustrated by the UAW's recent strike at GM. If you had followed this story in the news, you would have seen headlines focused on issues of profit sharing and ability for temporary workers to become full time employees. However, fundamentally at issue was General Motors' transition to electric vehicles. Forty two percent of GM's plants make internal combustion engines or their parts. Many need to be closed with a few becoming lower paying battery plants. Those that remain open will require thirty percent fewer workers due to the fewer parts required to assemble an EV. The very real and stated concern for the UAW was preventing plants like the one in Lordstown, OH which made the Chevy Cruise from being converted into a battery plant. It's worth remembering that this march to electric vehicles, while much needed to save the planet, comes with a much more immediate real economic cost to many families.

Alphabet is the highest valuation company in our portfolio, though we bought shares when they were trading with more modest earnings multiples. We've talked to many industry experts about autonomous vehicle technology and there is a near consensus that Waymo is leading the pack. This assessment is evidenced in Phoenix where they have started offering fully automated rides without "drivers" in the vehicle to a few hundred early users of their robo-taxi service. The early days have gone so well they are already expanding the program. Alphabet is also testing autonomous technology on Peterbilt trucks with plans to expand in trucking and commercial delivery applications. Management is looking at licensing or selling the technology to car manufacturers who want to offer automated driving as a feature either under the Waymo or manufacturer's brand. Alphabet does not have the legacy auto manufacturing business of General Motors, so the focus is on technology, not hardware.

Portfolio Construction

A quick closing thought on portfolio construction. Readers of our quarterly letter know that Redwood Grove's investment process focuses on the economic cost of climate change, specifically in the public equity market. Climate change's costs and opportunities will manifest in three main areas. First, costs and opportunities related to the adaptation to the physical impacts of climate change. Second, costs and opportunities to mitigate climate change by transitioning away from Greenhouse Gas emissions. And third, costs associated with damage for which we do not have adaptive solutions. Without adaptive solutions, the loss may be associated with an economic loss, or a qualitative loss for which there is no economic assessment. When a hurricane in Florida comes ashore, destroying a coral reef and a large hotel, the economic "damage" assesses the hotel and not the coral reef. The losses from the direct impact of climate change that are not being captured far exceed the damage estimates.

At Redwood Grove, we categorize the companies in our portfolio as mitigation solutions, adaptation solutions or corporate leaders. Corporate leaders are companies that do not have significant climate risk or opportunities due to the nature of their business, but where the management has been outspoken about climate change and is managing the business, mindful of the climate challenge. Our portfolio is currently constructed with 68% of our investments in mitigation strategies like Clearway Energy, Qualcomm and Pattern Energy, 15% adaptation strategies like United Rentals which we discussed in our 2018 2nd quarter letter found [here](#) and 17% corporate leaders like Bank of America. If we ignored all other macro-economic conditions, we might lean even more heavily toward mitigation strategies, but that would create several economic factor risks, like rate risk, that we are uncomfortable holding over shorter periods of time.

As always, we thank you for your continued trust in us. If you have any further questions, please do not hesitate to reach out to any of us.

Best,

A handwritten signature in black ink, appearing to read "Red Gray". The signature is written in a cursive, flowing style.