National
REAL ESTATE ADVISORS

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CLIMATE CHANGE IS GENERATING A TECHNOLOGICAL REVOLUTION


“In the middle of difficulty
lies opportunity.”

INTRODUCTION

The future, as viewed through the prism of projected climate change, looks bleak. The world expects, and is already experiencing, more droughts and floods, deadlier fires, bigger storms, more disease, and rising sea levels. Experts tell us that as climate disasters grow, it will be difficult to maintain existing infrastructure, whether for subways in New York, drinking water in Las Vegas, or flood walls in Miami. Learning to live in a warming world will be difficult and will likely mean the forced restructuring of fundamental aspects of the world economy, including nearly 85%[1] of all energy generation, and rebuilding infrastructure to withstand the environment of the future. This future can feel a bit daunting. But as Albert Einstein is credited with saying, "in the middle of difficulty lies opportunities," and we see opportunity.

While the crisis of climate change worsens, decades of valuable research and innovation have paved the way for fascinating products and solutions capable of sparking massive shifts in market demand while simultaneously resisting climate change's effects. Mass advancements are being made to respond to earth's next great crisis, and there is ample opportunity to invest in them and capitalize on the changes to come. The future sustainable and resilient world economy is just beginning to take shape, but as it expands over the next several decades, it will touch every aspect of the current economy, creating opportunities for those who are prepared to find it and obsolescence for those who do not. Solving problems through innovation will convert the apparent end of the world into simply the end of the world as we know it.

AN EXAMPLE FROM THE PAST

It is difficult to imagine how thoroughly a new technology can change the world before it is widely implemented, so it is useful to look at a past example of how technologies changed our built environment, our economy, and our behavior. Let's examine the technology that underlies refrigeration and air conditioning. At first, this technology appears to have made straightforward impacts on the world. It keeps food fresh and makes hot summer days comfortable, but as the technology became widespread, it changed entirely how and where we live and work.

As refrigeration became feasible for industrial uses in the early 20th century, it enabled fruits and vegetables to be shipped from California across the U.S. thereby allowing year-round consumption of those products for the first time. In the 1950s, as air conditioning was incorporated into nearly all new construction, the population of the sunbelt cities exploded as oppressive heat was now escapable. From 1950 to 2000, the populations of Atlanta, Houston, Miami, and Phoenix grew five-fold while Boston, Chicago, and New York grew by less than 50%. Over the course of the 20th century, refrigeration and air conditioning transformed the U.S. from a country dominated by cities and industries in the northeast and Midwest to one more evenly spread across the continent and trending further and further south.

Beyond migration, air conditioning changed the way we live and work. Before the widespread use of air conditioning, homes, office buildings, and factories all needed to be designed around natural airflow and cooling. Offices in Washington, D.C. and New York all had operable windows and no one's desk could be far from the window line. Home porches were the norm. As air conditioning spread, the design of state-of-the-art office buildings changed, generating skyscrapers with glass curtainwalls and no operable windows, along with large floorplates. In most cases, buildings that were designed pre-air conditioning would become much less desirable or need expensive retrofitting. Of course, prescient real estate investors could have seen the opportunities that lay ahead in the expanding sunbelt or the newly designed skyscrapers.

In addition to changing the built environment, the advent of air conditioning, of course, significantly increased the use of power across the U.S., now accounting for 20% of the energy consumption in buildings and about 6% of total electricity usage in the U.S.[2] making it a significant contributor to, as well as an insulator from, climate change. In addition, air conditioning led to the sealing off of the outside world from most of the spaces we inhabit, leading to a further disconnection of most suburban and urban people's lives from the natural environment around them.

1 U.S. Energy Information Administration (EIA) independent statistics and analysis. (n.d.). Retrieved March 11, 2022, from https://www.eia.gov/international/overview/world

2 Air Conditioning. (n.d.). Retrieved March 11, 2022, from https://www.energy.gov/energysaver/air-conditioning

EXAMPLES OF ADVANCEMENTS FORCED BY CLIMATE CHANGE WITH HUGE INVESTMENT OPPORTUNITIES

We are counting on dozens of technologies—some yet unproven—from electric buses and hydrogen powered aircraft to nuclear fusion and iron ore batteries to help stop climate change. The technologies that become widespread will obviously represent investment opportunities themselves, but they will also change the world around them, creating new and different real estate investment opportunities along the way. Below are several technologies that may become widespread with some thoughts about how they might change the world around them.

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TRANSPORTATION

Electric Cars, Trucks, and Buses

STATUS:

Electric cars and trucks are on the verge of becoming the dominant transportation method around the world. In the first half of 2021, electric cars made up less than 5% of sales in the U.S. and less than 15% in China and Europe.[3] The trend is rising fast, with annual growth of 50% worldwide over the past five years. As owning and charging vehicles becomes ever easier and governments keep subsidizing and mandating sales, this growth is expected to continue. In the U.S., the Biden administration has a goal of electric cars making up 50% of new car sales by 2030 by subsidizing sales and building charging stations throughout the country. Meanwhile, China has mandated 40% of all sales be electric by 2030 and the EU plans to mandate 100% emission-free new car sales by 2035. As soon as electric vehicles make up a significant portion of sales, it seems likely that given economies of scale and the inherent advantages electric motors have with their powerful acceleration and low maintenance requirements, they will come to dominate the market worldwide over the next few decades. The volatility of oil prices and the relative steadiness of electricity prices, as well as the security that comes from the domestic generation of electricity almost all of which is generated with domestic resources, will also propel the adoption of electric vehicles.

THE IMPACTS:

Air pollution: Millions of people suffer and die from asthma, emphysema, and other respiratory illnesses caused or exacerbated from pollution worldwide. A recent study concluded that pollution contributed to one in five deaths worldwide in 2018.[4] Although transportation is not responsible for all pollution, it is a major source of pollution and smog in and around cities, with some estimates suggesting that diesel cars and trucks are responsible for as many as 20% of pollution related deaths. With electric vehicles, cities would have cleaner, healthier air making them significantly more desirable places to live and work.

Noise Pollution: Imagine living in a city without the noise of thousands of trucks, busses, and car engines at all hours of the day and night. Reduced noise will further make cities more desirable.

New and Evolving Industries: There will be enormous pressure to domestically mine minerals associated with green technologies, particularly lithium, and to produce lithium hydroxide domestically to ensure energy security, leading to new industrial facilities in the U.S. Recently , there have been exciting innovations in geothermal lithium extraction[5].

3 US lags in electric vehicle sales despite Biden administration's push. (2021, December 03). Retrieved March 11, 2022, from https://www.theguardian.com/us-news/2021/dec/03/us-electric-vehicle-car-sales-biden

4 Leah Burrows | Press contact. (2021, February 09). Deaths from fossil fuel emissions higher than previously thought. Retrieved March 11, 2022, from https://www.seas.harvard.edu/news/2021/02/deaths-fossil-fuel-emissions-higher-previously-thought

5 https://www.prnewswire.com/news-releases/es-minerals-scales-deployment-of-iliad-lithium-extraction-platforms-in-the-us-promotes-sustainably-sourced-lithium-and-domestic-supply-chain-for-ev-industry-301435221.html

Electric Helicopters

STATUS:

The battery and electric revolution will lead to more than just cars, trucks, and buses. Several companies, in particular, Joby Aviation, are exploring electric planes and helicopters for use in cities. Joby is currently seeking an FAA license to transport passengers in its prototype aircraft that can fly over 150 miles on a single charge while only making as much noise as the normal background noise in urban areas. It expects to carry its first passengers in 2024 and is exploring sites in the U.S. and Europe.[6] The potential for clean and safe helicopter technology that is quiet enough to fly in urban and suburban neighborhoods could change the urban landscape.

IMPACTS:

Quiet electric helicopters may not quite democratize commuting by helicopter, but they will remove much of the negative impact on other city residents. To accommodate flying commuters, rooftops in dense neighborhoods will need to be equipped with heliports, including power supplies to rapidly charge refueling aircraft. Additionally, the current infrastructure on rooftops such as HVAC and mechanical penthouses will need to be moved. It's possible the new buildings or neighborhoods that can accommodate helicopters will be at an advantage as it becomes a more commonplace way to commute or spend a night out in the city.

City Infrastructure: By 2050, thriving cities will be separated from their lesser brethren by the adoption of advanced mobility and clean energy source types. Cities that do not prioritize electric vehicle-related investments will be left behind. Now is a critical time for governments to electrify public transit fleets, provide enhanced access to smart charging tech, and incentivize citizens and private sector businesses to make complimentary moves.

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Power Generation: Nuclear Fusion

STATUS:

Viable fusion technology has felt just out of reach for decades, but there is new momentum. In September 2021, MIT's fusion project successfully tested the most powerful magnet field yet created on Earth of 20 tesla, a crucial step towards building a fusion power plant that produces more power than it consumes.[7] Soon thereafter, on December 21, 2021, the Joint European Torus fusion reactor near Oxford, England, produced the highest level of sustained energy ever from atom fusion, more than double what it managed before. Additionally, substantial private funding is flowing into the sector for the first time, which is always a clear sign that a government-funded technology is promising enough to move to the private sector and practical commercial applications. Several venture capital-funded companies now exist in both the U.S. and Europe with several, like Commonwealth Fusion Systems (CFS) in Cambridge MA, Helion Energy in Everett, WA[8], General Fusion in British Columbia racing to become the first entity to demonstrate a prototype powerplant that can be replicated and attached to the grid. CMS, in collaboration with MIT's Plasma Science and Fusion Center, projects they will have a working demonstration reactor completed in 2025 opening up the world to the new technology.[9]

THE IMPACT:

Nuclear fusion has the potential to provide essentially unlimited, cheap, carbon-free power anywhere in the world.

Carbon Capture and Green Hydrogen: Some industrial processes, like making cement and flying jet aircraft, will be difficult or impossible to decarbonize or electrify. Nuclear fusion has the potential to drastically reduce the cost of taking carbon out of the atmosphere or producing liquid hydrogen which could replace jet fuel and other fossil fuels. The development of these technologies will mean we can keep using many of the energy intensive industrial processes without having to decarbonize or electrify every last piece of the world. It will also mean the additional development of new pipelines and industrial centers to process, move, and distribute the hydrogen or captured carbon.

Industrial uses: Industrial uses like the production of aluminum and data centers often have been concentrated in places like upstate New York and Iceland where cheap hydropower is plentiful. When power is universally affordable, these uses will not be constrained by location and can spread wherever is most convenient.

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6 Joby. (n.d.). Joby begins journey to becoming First Evtol Airline. Retrieved March 11, 2022, from https://www.jobyaviation.com/news/joby-begins-journey-become-first-evtol-airline/

7 David Chandler | MIT News Office. (n.d.). MIT-designed project achieves major advance toward Fusion Energy. Retrieved March 11, 2022, from https://news.mit.edu/2021/MIT-CFS-major-advance-toward-fusion-energy-0908

8 Hiller, J. (2021, December 01). WSJ News Exclusive | Nuclear-fusion startup lands $1.8 billion as investors Chase Star Power. Retrieved March 11, 2022, from https://www.wsj.com/articles/nuclear-fusion-startup-lands-1-8-billion-as-investors-chase-star-power-11638334801

9 Technology. (n.d.). Retrieved March 11, 2022, from https://cfs.energy/technology#sparc-fusion-energy-demonstration

Other Power-Hungry Uses: Countries that already have cheap and plentiful power have entertainment venues unthinkable in the rest of world. Iceland has massive outdoor heated pools at the arctic circle; the UAE has indoor ski slopes in the desert. What else will people's creativity unleash when they are unconstrained by the cost or impact of power consumption?

Far in the future: Fusion power could allow rocket propulsion with far less fuel than today's rockets use, which could allow for much longer missions travelling faster than ever before. It's possible that far in the future, fusion power could allow people to routinely travel to other planets and even out of the solar system.

Power Generation: Geothermal

STATUS:

Commercial geothermal energy production is currently limited to special volcanic and seismically active locations around the world. These locations are special because the heat generated in the core of the Earth is much closer to the surface than in other locations. New drilling technology, however, has the potential to open upopen large- scale geothermal energy production to any location on Eearth. Quaise Energy, a startup spun out of MIT, is currently working on demonstrating new drilling technology to allow cost- effective geothermal wells to be drilled 12 miles into the Earth, deep enough to reach large reservoirs of heat anywhere on the planet. The new technology uses millimeter wave radiation to vaporize rock and pumping it to the surface, creating a hole, rather than cutting rock with traditional mechanical drill bits. Quaise Energy plans to demonstrate the technology by 2024 and have operational projects by 2028[10].

IMPACTS:

The initial use could be to drill for geothermal energy on the sites of existing fossil fuel plants that have operating steam-driven turbines. These turbines could be converted to use geothermal steam, eliminating their carbon emissions and, hopefully, lowering production costs. Beyond converting existing power generation to geothermal, this new technology could have a similar impact as fusion technology, allowing abundant, cheap energy production anywhere on earth.

Alternative Power Storage: Iron-Air Batteries, Solid State Batteries, Hydrogen

STATUS:

Hydrogen-powered cars and trucks are on the road around the world, but they have not been truly mass-produced or widely adopted. Europe and Japan are both investing in widespread hydrogen processing and distribution networks that they expect will help hydrogen-powered cars, trucks, trains, and planes compete with electric and petroleum-powered vehicles, but adoption is still in its infancy.

Solid-state batteries are still in the development phase. Several companies have created promising prototypes, but none have successfully mass-produced solid-state batteries that could be used in electric vehicles.[11] Solid state batteries provide higher energy density, a longer lifespan, increased safety, and much faster charging speeds.

Iron-air batteries are still in the very early research stages. Iron-air batteries are batteries where power is stored in the form of iron pellets and released as the pellets rust. The advantage of these batteries is they can release power over a longer period of time (think days rather than hours) than conventional chemical batteries. They also have the potential to be cheaper, made from more common materials than the current state-of-the-art lithium-ion batteries. Iron-air batteries would likely be large and heavy, making them impractical for transportation but useful for storing energy from power sources like wind and solar and releasing it on the grid when it is most needed rather than when the wind is blowing, or the sun is shining.[12]

IMPACTS:

Perhaps the most important impact of these technologies will be to allow the current infrastructure to keep operating.

Hydrogen has the potential to use much of the existing natural gas infrastructure to allow trucks, trains, and jet airplanes to keep flying and keep the modern transportation system intact and therefore the way we currently live, work and travel intact.

Solid-state batteries could propel the use of electric vehicles, and they will allow clean vehicles to use the road, street, and highway infrastructure that already exist.

Iron air batteries have the potential to keep the grid as we know it stable and allow the last gas and coal plants that provide baseline energy to come offline. These may also allow the replacement of expensive and polluting generators as a backup power source for critical infrastructure.

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10 Alter, L. (2022, February 23). You can have geothermal power everywhere if you drill deep enough. Treehugger. Retrieved June 23, 2022, from https://www.treehugger.com/geothermal-drilling-technology-quaise-energy-5219924

11 Vousden, M., GlobalData, Team, T., Vousden, M., Retrieved March 11, 2022, from https://www.just-auto.com/features/how-far-away-are-mass-market-solid-state-ev-batteries/

12 Gold, R. (2021, July 22). WSJ News Exclusive | Startup claims breakthrough in long-duration batteries. Retrieved March 11, 2022, from https://www.wsj.com/articles/startup-claims-breakthrough-in-long-duration-batteries-11626946330

Carbon Capture

STATUS:

Carbon capture technology involves the capture of carbon dioxide produced by the burning of fossil fuels and sequestering it or converting it to other substances. Carbon capturing is rapidly dropping in price. Recently, there has also been an influx of private capital entering the space as companies raised over $2 billion in funding for sequestration projects. This funding has come as many major corporations committed to paying to sequester carbon linked to their operations.[13] Currently, there are small operational plants in British Columbia and Iceland, where cheap carbon-free power already exists. For example, Climeworks, a leading carbon capture company, has plants that run on clean energy and sequester the carbon in rock formations. The plants use a huge amount of energy primarily to operate at high temperatures leading to prices of about $600/ton of sequestered carbon.[14] As these plants expand and become more efficient, the price is likely to drop. If prices drop closer to $100/ton, carbon capture would likely be viable within the European cap and trade system and compete with other carbon offset technology.[15]

IMPACT:

Like energy storage solutions, carbon capture could allow our current energy systems to continue to operate as is. Researchers at Oxford have recently announced breakthroughs allowing for a more efficient method of manufacturing jet fuel with captured carbon that would provide another market for the technology and allow for carbon-neutral air travel without substantial changes in technology.[16]

Carbon capture could have the best chance of stopping or even reversing the rise in CO2 going forward. This could help avert the worst climate disasters and protect the current real estate that is at risk from rising seas, severe storms, and wildfires.

Huge new infrastructure investments will be required. From new power plants and power infrastructure, to pipelines to transport carbon to be sequestered, or fuel to be moved from power plants into the existing networks.

Lab Grown Meat and Dairy

STATUS:

Dozens of companies around the world are working to create meat grown in a lab using cells harvested from live animals. The goal of this work will be ground beef, chicken breasts, steaks, milk, fish, and pork chops that are indistinguishable from products made from animals. Starting in 2020, Eat Just, a San Francisco based company, began selling chicken nuggets at restaurants in Singapore and aims to have them more widespread and in grocery stores in 2022. Another company, SuperMeat, has a factory and test kitchen in Tel Aviv serving fried chicken sandwiches to the public. Additional companies are working to gain approval to produce similar chicken products and hamburgers in the EU and U.S. over the next several years. Given the inherent efficiency of growing meat without the rest of the animal, cultured meat should be able to be produced more cheaply and cleanly than traditional meat leading to the eventual displacement of legacy meat products.

THE IMPACT:

Approximately 77% of farmland worldwide is devoted to livestock production.[17] This represents almost 27% of all the land in the world. Imagine a world where 27% of land worldwide becomes available for new economic uses or reversion to a natural state. This agricultural land could be converted to the production of biodiesel, allow for the expansion of urban development, or simply allowed to return to rainforest and natural prairie.

Financial Engineering

The only way many of these technologies will become initially viable is if financial incentives are created to encourage their proof of concept. Thereafter, with economies of scale and proof of success, they will become widespread. Although a major new program like a carbon tax or cap and trade system seems like a remote possibility in the U.S. today, it is instructive to keep in mind that there are a variety of ways of creating incentives to drive the change we need to mitigate the impacts of climate change. In the past, government incentives enticed settlers westward with free land and helped create the large middle class with subsidized college, mortgages, and retirement. It has also successfully used a cap-and-trade system to reduce power plant pollutants and acid rain.[18] Today, the U.S. is already fighting climate change by controlling auto emissions with CAFE standards, subsidizing electric vehicles, subsidizing rooftop solar and wind farms, and incentivizing power companies to adopt greener technologies. Implementing the broadest financial incentives to reduce carbon emission or to recapture it would set loose the creative energies of the private sector resulting in technologies that we have not even thought of yet.

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13 Ramkumar, A. & Ballard, E. (2022, June 9). Carbon-removal industry draws billions to fight climate change. The Wall Street Journal. Retrieved June 23, 2022, from https://www.wsj.com/articles/carbon-removal-industry-draws-billions-to-fight-climate-change-11654640329

14 https://climeworks.com/

15 https://www.bloomberg.com/news/articles/2021-08-15/cost-to-bury-carbon-near-tipping-point-as-emissions-price-soar

16 https://www.forbes.com/sites/davidrvetter/2021/01/05/these-oxford-scientists-just-created-carbon-neutral-jet-fuel-from-co2/?sh=69f0adcd42ca

17 https://www.onegreenplanet.org/news/chart-shows-worlds-land-used/

18 https://www.smithsonianmag.com/science-nature/the-political-history-of-cap-and-trade-34711212/

CONCLUSION:

Collectively, these technologies will require a substantial reorganization of the economic capacity of our society. That reorganization can be intimidating and will have an impact on countless lives, but it will also be a huge opportunity. In addition to all the indirect impacts on real estate, such as cheaper power, cleaner air in cities, and altered transportation infrastructure, each of these technologies themselves will require enormous direct investment in infrastructure and real estate such as new power plants, new or updated transmission lines and pipelines, and new industrial and manufacturing centers. Rather than imagining a world ravaged by climate change, dare to imagine a world magnificently transformed by the technologies that are created to fight climate change. We believe that is our future.

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MANAGER PROFILE

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