

## ND Venture Capital: Renewable Energy Industry Thesis

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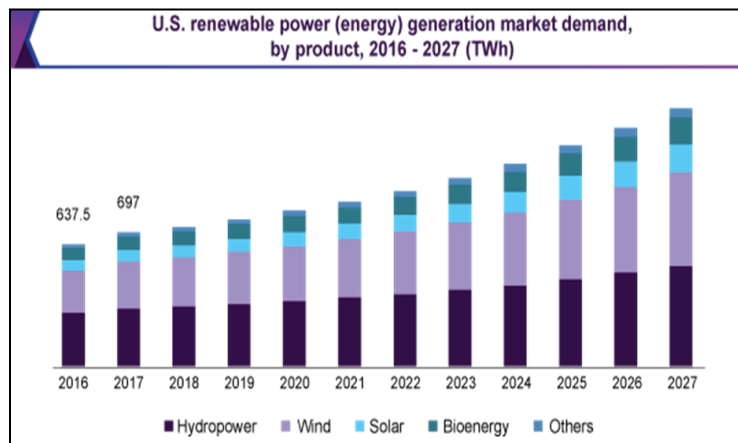
### Executive Summary

Renewable energy encompasses a variety of sectors and touches on various applications. This thesis aims to paint a broad stroke across 1) market dynamics defining the industry, 2) headwinds impeding development, 3) tailwinds driving growth, and 4) opportunities awaiting disruptive innovation. The goal is to expand our knowledge among specific applications and approaches within renewable energy by having this thesis serve as a living document of our shared knowledge throughout the Notre Dame community. Our shared knowledge will help curious students understand the fundamentals of the industry and learn how they can play a part in the next wave of change. This document is not intended to be comprehensive.

### 1. Market Dynamics

Renewable energy is a \$950B industry collectively growing at 8.6% CAGR, meaning it will reach just under \$2T within a decade. Currently just 7-8% of energy consumption and 38% of electricity production is renewable. These figures will only grow as countries strive to hit climate targets (Europe’s target: 40% by 2030. US targets vary by state: 40%-50% by 2030. 100% by 2050 is the common target internationally).

The International Energy Agency has stated that “renewables will account for 95% of power capacity growth over next 5 years”. In 2022, 12.2% of US consumption and 20.1% of US electricity generation is renewable, meaning most states aim to replace around 30% of fossil fuels with renewables by 2030. Growth in the renewable energy industry has been driven by declining production and storage costs due to tech development, which has increased price competitiveness with fossil fuels. On this note, Carbon Tracker predicts 72% of coal-based power will be unprofitable by 2040. Further growing this market are increased subsidies in developed countries to encourage adoption of renewables as well as fines for missing climate targets.



### Energy Sources

The renewable energy market can be separated into 6 different submarkets, including nuclear, hydro, biomass, solar, wind, and geothermal which are listed in order of energy-dense fuels to matter-dense fuels. In the majority of these submarkets, market concentration is relatively low. Wind and solar energy are still the most affordable.

**Nuclear:** Nuclear power is a method of generating electricity by harnessing the energy released from the nuclei of atoms through a process called nuclear fission. Nuclear power plants use heat generated by nuclear fission to produce steam, which then drives turbines to generate electricity. The adoption of nuclear power has grown over the years, with the CAGR of nuclear power capacity increasing by 5.7% globally. As of 2021, there are around 450 nuclear power reactors in operation worldwide, with a total installed capacity of about 390 GW. The world's top nuclear power countries are the United States, France, China, Russia and South Korea.

**Hydro:** Hydro uses the natural flows of water or creates structure to alter the powerful flow of water in order to generate forms of energy such as electricity. Hydro is the world's dominant source of renewable energy, but its CAGR is low at 6.6%. Past dominance was driven by demand for small hydro plants to electrify rural areas of developing economies and infrastructure subsidies in developed countries. 25% of global hydro growth is expected from just three projects: 2 in China, 1 in Ethiopia. PG&E is the largest player with 13.4% of the market share. Tidal Energy is a form of energy that is used a lot around the world. The US department of energy estimates that tidal energy holds around 1400 TWh per year. The US needs 4000TWh to power itself per year. Cons are that the technology is still infantile and expensive. Start-Ups that can demonstrate more efficiency and better metrics would be very profitable for a long term investment.

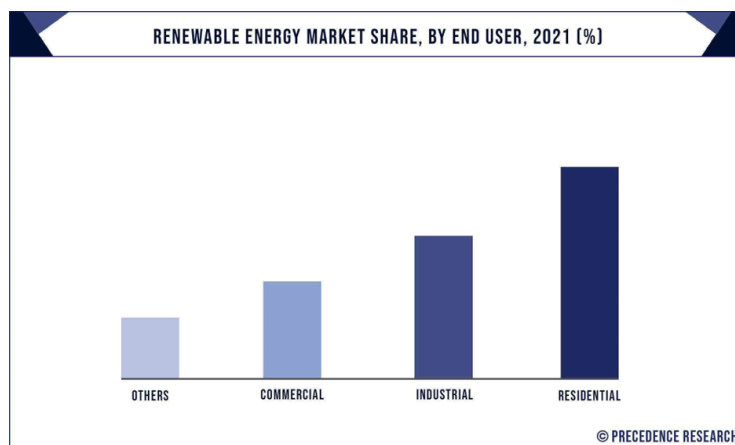
**Biomass:** Biomass is a form of renewable energy where you burn organic materials, such as wood or agricultural waste, to produce forms of energy such as electricity. There are many biomass reserves in the US taking advantage of the urbanization and higher standards of living in a high-consumption country that results in high waste production. In the biomass industry, the largest companies are Progress Energy and Cavanta.

**Geothermal:** Geothermal energy, however, has high market share concentration. The largest firms in the geothermal energy space are Calpine Corp (26.4%), BHE renewables (16.4%), and Ormat technologies (11.5%) (IBISWorld). All of these submarkets have high barriers to entry due to the high production costs of materials and land. For many years, the price of producing renewable energy was in a constant decline, but recently, renewable energy prices have been rising. Geothermal energy capacity will increase 28% to 18 GW by 2024, with Asia responsible for a third of growth. The DOE says geothermal energy will generate 8.5% of US electricity by 2050.

**Solar:** Solar energy has the highest CAGR at 13.5%, with the IEA saying solar will account for 60% of growth in renewables by 2024. While solar technology has become much more mature with standard solar panels lasting up to 25 years before seeing an efficiency drop and IRRs are currently around 12%. Demand is expected from China, India, and other emerging Asian economies, and regions like UAE who are building desert cities. Solar-storage, floating solar PV models, and community solar projects are expected to be growing trends with

Tesla becoming a leading player in battery storage, shipping, and solar installation. While still expensive upfront, solar energy costs fell 85% in the last decade and will fall another 15% to 35% by 2024 (it is currently half the price of onshore wind). In the solar industry, the top players are Nextera Energy, Inc which holds 10.2% of market share and Consolidated Edison which holds 6.1%.

**Wind:** Wind, while widely adopted, will also be a growth area. Capacity has increased 10% annually over the last 3 years. Onshore wind will grow 57% by 2024 to 850 GW, offshore wind will 3x but remain a small percentage of total wind energy production. Several states of the US are targeting onshore wind as their core renewable: 17 states were responsible for 2,166 new turbines in 2019, and the “Biden administration aims to increase offshore wind production from 1 gigawatt to 30 gigawatts by 2030.” In the wind energy segment, Nextera Energy Inc, Avangrid, Duke, and Vestas are a few of the leading players.



### **Customers**

Customers have considerable buying power in the renewable space. There are three types of buyers in this market: residential, commercial, and industrial.

#### **Residential**

Residential buyers are purchasing technology such as solar panels to power their homes. Solar panels are mostly undifferentiated and generate electricity no better than the retail grid. Thus, residential buyers have many substitutes and buying power. The residential sector has forecasted a CAGR of 8.5%. Demand for geothermal energy for heating applications is expected to bring growth. Residential solar will grow to 142GW by 2024 as solar power installations on homes grew 34% in the last year alone. New business models, like panel rental, and mandates to install panels on new homes have spurred growth in some states (e.g. California). The 3 key drivers of consumers' adoption of clean energy are environmental consciousness, technology acceptance, and economic sensitivity.

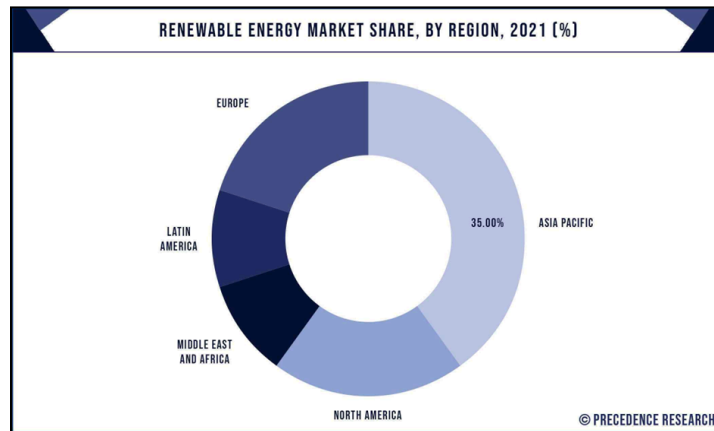
- **Green Customers:** The environmentally aware/"green" energy customer, that shows a high indication of pro-environmental behaviors and a high interest in saving electricity. Customers in this segment choose energy products based on environmental-friendly characteristics, a strong interest in renewable

energy, or their high willingness to pay higher prices for it. This group is motivated by a sense of personal responsibility, moral obligation, and a self perception of benefiting the environment.

- **Early Tech Adopters:** The "modern" and technology-minded customers, who are likely to take on innovations as early adopters and have a high interest in new technologies and preferences for steering, programming, and monitoring services. They are motivated by the novelty of new tech, visual data, self perception, and being innovative. Furthermore, many tend to be influential with an audience that would perceive their actions to be more modern and popular, effectively advertising the adoption of renewables to the everyday consumer.

### ***Industrial and Commercial***

Industrial buyers generally experience lower prices than residential and commercial buyers. Considering renewable energy is often more expensive, notwithstanding government support, industrial users are naturally incentivized away from renewables, another sign of buying power. Additionally, as stated previously, renewables generate electricity no better than the grid, so cost considerations are tantamount for potential buyers. The industrial sector’s CAGR is forecasted at 8.8%. The commercial sector will have the highest CAGR of all sectors due to larger government subsidies, renewable energy requirements, and fines in this segment. Together, industrial and commercial sectors energy use will rise to 377 GW by 2024 (3x residential).



### **International Adoption**

The top 6 countries by renewable energy capacity and electricity generation are China, USA, Brazil, Germany, UK, and Japan. The Asia-Pacific region’s renewable energy industry will grow 9.7% per year and already has 35% market share. China is the world’s largest producer of renewables (3x USA which is in second place). Emerging Asian economies have strong demand for electricity to fuel industrialization and are receiving massive foreign direct investment in the renewable space. North America has 30% market share and highest CAGR, due to strong consumer demand for sustainability, falling renewable energy costs, residential/industrial subsidies, and a supportive presidency. Europe has 30% market share but will grow at an 8.5% CAGR. Consumer demand for

sustainability and EU initiatives are already in place. The European market looks similar to the US one, but slightly more mature. Scandinavian countries are also leading innovators, especially in wind and hydro energy production.

### **Competitive Dynamics**

Within the renewable energy space, market concentration within each subsector is relatively low. There will likely be a trend towards consolidation, most likely through purchases of smaller renewable energy focused companies by big oil and gas companies like BP, Chevron, Exxon, etc. For example, BP purchased the U.S. biogas producer Archaea for \$4.1B last month. Many of them have been shifting their business models to include more renewable energy production in their portfolio. Within the industry there are multiple different sources of renewable energy including hydroelectric, geothermal, biomass, solar, and wind. Solar and wind, especially, are leading the growth in renewable energy capacity due to the drastic drop in their price. A recent report by McKinsey estimated that renewable energy capacity would rise 80% from 2020 to 2026, of which  $\frac{2}{3}$  will be produced by solar and wind. The two key factors to effectively compete within this industry is regulation and the ability to negotiate with regulators.

### **Indirect Competitors and Viable Substitutes**

Alternative sources of energy such as natural gas, coal, nuclear electric power, and petroleum all compete with renewables to provide energy for the world. Through government incentives in the U.S. and incentives from other countries, there may be larger renewable energy projects established which will help to compete with external competitors. Although barriers to entry were previously higher, significant government support for renewables and decreasing input costs have lowered them substantially. Ventures in the renewable space have historically required high initial capital and entailed significant input costs. For instance, solar power generation requires an expensive investment in solar panels and channels to disseminate the solar energy. In the US, incentives have included credits, grants, and tax exemptions for startups aiming to disrupt the renewable energy sector. A few important examples are as follows: (1) The Investment Tax Credit (ITC) allows solar operators to write off taxes associated with building plants; (2) the Renewable Portfolio Standard (RPS) requires utility companies to generate energy from renewable sources; (3) the government has enacted extensive property tax exemptions associated with renewables.

### **External Factors**

External factors that affect renewable energy sub sectors include the sufficiency in capital funding for renewable energy technologies and infrastructure, the availability of key inputs for industry operators, the presence of physical assets and infrastructure necessary to support the transition to renewable energy, changing consumer preferences towards renewables, and commitments from the government/society in cutting greenhouse gasses.

Russia's invasion of Ukraine is creating tremendous problems for renewable energy technology companies. This stems from how Russia holds key inputs (copper, nickel, silicon) for renewable energy technologies, and the war is reducing their availability. This is adding tremendous stress to the already overburdened supply chains of these

operators. Additionally, the lack of effective transmission infrastructure for renewable energy, especially offshore wind, is posing a problem. To provide some context, approximately 844 GW of energy (90% of which is renewable) is stuck in transmission. Addressing the capacity problems of transmission infrastructure will require increased funding from both the government and the private sector. Finally, fossil fuels are likely reaching their peak in demand. McKinsey estimates that oil demand could peak in the next two to five years due primarily to the massive uptake in the use of EVs (63% annual increase from 2017-2021).

In August 2022, President Biden signed the Inflation Reduction Act into law. This act spurs investment for clean energy projects across the United States by providing \$369B to producers of clean energy, which may be an opportunity for renewable energy to reach an inflection point. Recently, there have been many state policies to support renewable energy genesis to attract investors to these sectors such as public benefit funds to invest in clean energy projects. These funds are generated by imposing a small charge on customers' electricity bills and other government loans and grants to boost renewable energy consumption. Globally, this has resulted in a rising rate of investment in renewable energy, with global energy investment set to increase by 8% in 2022 to \$2.4T. This has also resulted in an increased adoption of better and more energy efficient technology, along with the development of energy-efficient turbine technology and safer nuclear waste removal. There is a general consensus of welcoming the power transition, with 88% of power sector employees in favor of the energy transition, indicating that transitioning to clean power boosts employee satisfaction and retention. Intrinsically, renewable energy reduces greenhouse gas emissions by approximately 95-98% (compared to coal), has zero fuel utilization, and is generally more available.

## 2. Industry Headwinds

### *Extreme Weather Events*

Since many renewable energy systems depend on the environment and weather conditions, they are vulnerable to weather-related natural disasters. While the destruction is fixable, it takes large amounts of money and resources to build and maintain the clean energy systems. Even the less severe weather-related perils which are not large enough to cause major destruction, still lead to insurance claims. With projects such as wind and solar energy requiring 10 times more land when compared to coal or natural gas-fired plants, it makes renewables more exposed to weather-related risks. In addition, many renewable energy projects require certain weather conditions for proper use, such as wind being necessary for wind turbines. Because of that, the performance of renewables is critically dependent on local weather conditions.

### *Insurance risks*

Due to the fast development of the sector, renewable energy technologies have little historical performance data. That creates difficulties for the insurers to assess their reliability. At the same time, new technologies require insurance for the company to be able to implement and use it. That is why it is important to manage the relationship between insurers and the customers in a way that allows both parties to understand the design and

test the new technologies. Insurers could make use of higher deductibles when first implementing new technologies which will balance out as the technology becomes more widely used over time. Recently, renewable energy technologies have become cost-effective, meaning incentives are becoming less necessary to push growth in this industry as IRRs are naturally attractive. We can expect to see more adoption of state-of-the-art technologies that are cost-effective to both produce and adopt, leaving tailwinds for exciting innovation especially with applications of ML/AI.

### ***General Political and Regulatory Risks***

The market and revenue for renewables projects is highly regulated by policy or regulatory mechanisms such as government-mandated auction processes. Compared to other power generation systems, regulators and policymakers have power to intervene in the market, distribution of resources, and prices of renewables. This creates policy risks due to potential change in any government policy and regulation. For example, throughout the ongoing political battle over green energy, there have been cases where local and state governments passed bans limiting the expansion of renewable energy. According to the National Renewable Energy Laboratory, the US has enough renewable energy resources to power 80% of the grid, both technically and economically. However, local opposition movements started to limit the supply of land along with entire counties banning expansion of renewables. Irrational fears of nuclear power have also led to oppressive regulation that has prevented further research into making nuclear power safer and cheaper which has slowed down development of this sector.

### ***International Geopolitical Situation***

Triggered by Russia's war in Ukraine, the global energy crisis has caused the energy market to undergo profound and long-lasting changes that have potential to speed up the transition to a more renewable energy system. Remaining highly vulnerable due to unrelenting geopolitical concerns, the current state of energy markets reminds us of how fragile and unsustainable the current system of global energy is. According to the International Energy Agency, the demand for fossil fuels is supposed to be steadily decreasing for the next 30 years. While the prediction sounds promising, the development of new sustainable power systems will require supportive policies both in the leading markets and across the world. The risk associated with the international geopolitical situation comes from the uncertainty of the future events that will be taking place as the Russian war in Ukraine continues. While countries like Germany have been forced back into nuclear and coal with gas lines being shut, this may spur investment in domestic renewables and have lasting effects.

### ***High Development and Installation Costs***

For companies switching from oil and gas to renewables, there is a high level of R&D needed as well as high initial costs for setting up renewable energy plants. This owes to rising costs of electric grids, which makes switching to greener energy more expensive. Furthermore, since renewable energy is relatively new when compared to traditional plants, the technology associated with the sector is less matured and these sources have lower energy efficiencies of only 24-50% when compared to traditional plants. Renewables can also be

intermittent and idle due to cyclicity, which adds to their difficulties in meeting the growing demand for cost effective energy from a swelling global population and increasing rate of industrialization.

### ***Grid Challenges***

There is a rising concern regarding grid capacity. Sometimes electricity coming from solar farms has to be stopped because too much of it gets generated at times leaving the grid susceptible to a blowout. This has led to states being forced to sell their electricity to neighboring states to unload the excess supply of electricity. Grid upgrades are becoming increasingly necessary along with a need for improved interconnection rules.

Unfortunately, the current grid infrastructure has forced many clean power projects into a state of limbo. Being that these projects have to wait several years before they can actually implement their technology to the grid, it is difficult to test their feasibility at a large scale. The US has a challenge where some systems are outdated and very hard to build over or re-do, as it would cause a lot of problems if some systems went down. However, looking at countries in the Middle East like Uzbekistan and Kazakhstan could lead to interesting results. They are innovating faster than other countries through a process called leap frogging which means to build on top of or adopt existing tech from around the world, rather than try and change existing tech to accommodate needs. Both the Asian Development Bank and Green Climate Fund are involved in projects there.

### ***Effects on the Environment and Wildlife***

Renewable energy use has certain limitations in the sense that it could lead to possible landscape distortion, installation errors, and negative effects on biodiversity, which is exactly contrary to the environmental goals it hopes to achieve. Although solar panels and wind turbines both have long product life cycles upwards of 25 years, there is concern and evidence for the harmful effects their waste has on the environment with some experts claiming that their waste is more toxic than nuclear waste. Others worry that after their 25 year life span, solar panels will be shipped to third world countries to be disassembled along with the rest of its electronic waste stream, exposing those people to toxic levels of cadmium, chromium, and lead. Opportunities to recycle the parts and waste from this infrastructure has been largely neglected but is starting to pick up attention from rising innovators. Wildlife advocates also condemn wind turbines for the deaths of multiple endangered bird species and bats. With solar farms demanding large areas of land, wildlife has had to be forcibly removed and relocated threatening their survival, creating tensions in the animal rights world.

### ***Complications with Scaling Solar and Wind***

Electricity from solar rooftops costs twice as much as solar farms. Solar farms and wind farms require a lot of land and transmission line infrastructure. Intermittency of the availability of sun and wind means we get access to their power sources only 10-30% of the time during the year. One solution to the intermittency issue was to convert hydroelectric dams into batteries by pumping water uphill and using it when needed by rolling it over turbines to generate electricity. This still hasn't been done on a useful scale due to geographical restraints and costs. Also, water is getting less reliable and more scarce due to climate change so better uses of it like irrigation has been taking precedent.

### 3. Industry Tailwinds

#### *Excitement around next-generation clean energy technologies*

The renewables industry, which has traditionally been focused on wind and solar, is moving towards alternatives such as green hydrogen and advanced batteries. A bipartisan \$9.5B bill for clean hydrogen projects and proposed regional clean hydrogen hubs to expand hydrogen infrastructure shows the government's commitment to these emerging technologies. This confidence is also shown in the US Department of Energy's (DOE) *Earthshots Initiative*, which aims to reduce the costs of green hydrogen and long-duration energy storage by up to 90% by 2030. This is already happening on a smaller scale in different states and metropolitan areas. For example, the city of Los Angeles is attempting to drive down the green hydrogen cost premium over natural gas. Their goal is to get to \$1.50/kg by 2030 (currently ranging from \$3/kg - \$6/kg). The DOE is also experimenting with long-duration energy storage to try to integrate renewables into the electricity grid. One company to watch in this space is Form Energy. Recently, they revealed that iron-air batteries can provide over 100 hours of energy at a cost of \$20/kWh (10% of the cost of lithium-ion batteries). In October, TPG led their \$450M Series E round at a post-money valuation of \$1.95B. Energy Vault, led by ND founder Robert Piconi, is also a notable player in this space.

#### *Companies setting net-zero targets at record-high rates*

Companies have been working with the Science-Based Target initiative (SBTi) to reduce their emissions. The SBTi set a framework for corporate net-zero target-setting in October 2021. Since then, an increasing number of companies are getting on board (over 1,000 worldwide). Shareholder pressure to implement ESG initiatives has also caused the number of companies setting these goals to rapidly increase. Additionally, there seems to be an unspoken competition among organizations to be the first in their industry to reach 100% renewable energy or net-zero carbon emissions. An increasing number of consumers are driving this further by voting with their wallets and actively choosing companies with sustainable energy goals.

#### *Electric Vehicles*

Electric vehicles are approaching 8% of all car sales in the US and 18% of all sales in California. As competitors move into this space and infrastructure continues to be built out in support for EVs, consumer sentiment is increasing in favor of electric vehicles over gas-powered vehicles. However, consumer sentiment is growing faster than ever before with gas prices skyrocketing and electric vehicles becoming cost-effective leading to a supply problem for EVs rather than a demand problem. Notable car brands aiming for all-electric fleets include GM, Lexus, Honda, Bentley, Audi, Volkswagen, and Volvo. This switch will require much more electricity and boost the demand for renewable energy. Commercially, companies are starting to consider electrifying their Class 8 vehicle fleets as startups offer ways to reduce carbon emissions and costs through hybridized retrofitting approaches (Hyllion) or simple electric add-on technologies (SixWheel). There tends to be a battle between battery electric vehicles, hybrid electric vehicles, and plug-in hybrid electric vehicles. While the infrastructure for these battery-dependent technologies is getting built out, the question remains how to address the limited lithium available to produce these batteries and meet consumer demand on a sustainable level. In the short term,

indirect emissions from factories that manufacture these EVs contradict the sustainable motivations behind adoption. Solutions such as ethanol-mixed gasoline technologies have proven to be more effective in reducing carbon emissions compared to burning conventional pure gasoline and are cheaper to adopt than taking on the upfront costs of an electric vehicle.

#### **4. Investable Opportunities**

##### ***Energy Storage Technologies***

Batteries and energy storage technologies are where the majority of funding currently goes with \$650M of investment poured into these startups in August 2021 alone. However, this has only brought about incremental improvements in storage amounts and densities, meaning larger batteries or more batteries are necessary for longer distances which don't currently scale. Solid state batteries, for example, or others stand to disrupt this problem area. Another important area to address is long-duration energy storage for renewable energy which is key to solving the intermittency issues of solar and wind, making these sources more reliable and easing grid congestion. As of today, we have little technology out there in terms of battery storage but key players like Energy Vault have shed light on the importance of this sector. However, finding ways to address the shortage of lithium without harming the environment to produce these technologies is crucial. Lithium mining today is still toxic to the environment and is in need of sustainable transformation. An additional issue is the disposal of these large batteries at the end of their life span.

##### ***Carbon Capture***

Carbon capture has started picking up steam, through both technical and non-technical methods. VC investment in this area has reached an all time high of ~\$882M this year after the Inflation Reduction Act significantly increased the tax credits carbon capture companies can earn and made it easier for smaller startups to enter the space. Carbon markets are picking up steam as corporations search for alternative ways to offset carbon emissions, and creative opportunities are emerging to “capture” the available carbon. JPM Morgan spent \$500M on a 250k acre forest to initiate their entry into the carbon offset market, allowing them to effectively sell the carbon stored in the trees to corporations at a markup. For startups looking to enter the space, decarbonizing the transportation sector which contributes to a third of all carbon emissions is one of the best areas to pursue. The biggest questions here lie around finding efficient ways to decarbonize hard-to-disrupt sectors such as long haul trucking, aviation, locomotives, and shipping. A partnership with the US Department of Defense is a huge target customer as the DoD is the largest producer of emissions in the US and is already investing their time into partnerships with startups, corporations, and the National Renewable Energy Lab.

##### ***Nuclear Power***

As compared to solar, nuclear power is much more reliable, generating consistent power with no intermittency throughout the year. The Intergovernmental Panel on Climate Change reported that nuclear power produces four times less carbon emissions than solar farms and that nuclear power provides twice as much electricity for

half the price. 450 times more land is also needed for solar to generate the same amount of power as nuclear. The uranium used in nuclear power is extremely energy dense as a tennis-ball sized piece of uranium can power all the energy the average human uses in a lifetime. In terms of environmental impact, nuclear waste is the only waste from energy production that is safely contained and internalized. Every other method emits the waste as pollution or material waste and solar panels need 17 times more materials than nuclear plants do in the form of glass, cement, steel, and concrete. According to British medical journal Lancet, nuclear power is the overall safest compared to coal, petroleum, biomass, and natural gas in terms of air pollution. Nuclear power does come through the process of nuclear fission which produces radioactive waste that must be safely stored for potentially hundreds of years, but the recent nuclear fusion breakthrough by Lawrence Livermore National Lab that proved to generate more energy than was used to start the process shows some early promise as the waste from fusion is less radioactive and decays much more quickly.

On a global scale, France gets twice as much electricity from clean energy sources than Germany but pays half as much because 75% of their electricity is generated by nuclear power. The South Korean citizen's council recently decided to vote on expanding nuclear power and the same thing just happened in Arizona. Germany is about to follow suit. The US should consider nuclear power and reevaluate its potential for clean energy generation although the saliency bias of nuclear disasters being widely known and publicized threatens public confidence in this transition since many citizens don't want to live in close proximity to a nuclear power plant.

### ***Regional Sourcing Potential***

There is a vast untapped generation potential. For example, for hydropower developers, Alaska is the ideal place to venture into new hydropower projects because of its unmatched natural resources and supporting state policies – nearly 200 possible sites exist for hydropower generation but the technology needs to be developed enough to withstand the harsh turbulent conditions of Alaskan rivers. Similarly for solar, the world's sunniest places have the least amount of solar infrastructure or support due to geopolitical headwinds and economic instability. The same applies for wind power - the world's windiest places have the least support or infrastructure for harnessing wind energy. Providing access to these regions of the world could take the growth in solar/wind to the next level. The main question lies in how the infrastructure can be built in these regions so the generated energy can reliably be transported to its destination.

### ***Green Hydrogen***

Green hydrogen refers to hydrogen that is produced using renewable energy sources or low-carbon power, resulting in significantly lower carbon emissions compared to gray hydrogen. Gray hydrogen is predominantly derived from natural gas through steam reforming, and is currently the primary source of hydrogen in the market. Green hydrogen is an excellent technology for startups to continue to explore and a driver behind its growth has been the decreasing costs of renewable energy. 90% of the hydrogen currently produced is used for industrial processes, so as the industrial sector attempts to decarbonize, green hydrogen will be the natural power source to utilize. KPMG estimates that demand for hydrogen in the ammonia industry will increase 11% by

2030. Additionally, the underlying technology, electrolyzation, is expected to be optimized substantially through capacity increases.

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