



IMPACT OF DECARBONIZATION ON OUR ECONOMY

Around the world, investment and employment have a deeper connection to the energy sector and the industrial process associated with it. Even today, the energy sector and industrial processes primarily depend on fossil fuels, such as oil, coal, etc., which are one of the reasons behind increasing carbon dioxide emissions. Fossil fuel combustion makes up 83% of total carbon dioxide emissions [1]. A study showed that carbon emissions have increased by 90% in the last 50 years, which has raised an uproar to limit fossil fuel use and commit to total decarbonization [2]. Another recent study claims that by 2050, carbon dioxide emissions should be reduced to zero to avoid the extreme effects of climate change [2]. In a recent executive order, President Biden announced his goal to fully decarbonize the energy sector by 2035 [4]. Hence, it is necessary to understand the implications of decarbonization on the job market, investment, and overall economy. A study suggests that the world must spend approximately \$275 trillion, which is around 7.5% of the world's GDP, to ensure a greener economy by 2050 [5]. Energy transition and decarbonization will become the dominant strategy because of climate policies and environmental concerns associated with fossil fuels. However, change in supply without change in demand might not be the best situation.

The main concerns associated with total decarbonization are the possible rise in unemployment, the difference between demand and supply, and the lack of infrastructure and skills among the workers. Several studies have tried to predict job creation rates, build pathways to smooth transitions, and create a sustainable market model over the years. This paper discusses and digs deeper into these researches and draws conclusions about the possibility of radical transitioning in a short period of time.

Different research so far proposed three different pathways of transitioning to greener energy sources. The first scenario proposes an increase in electrification level, while the second scenario encourages a total replacement of fossil fuels and replacing the entire energy sector with renewable sources (e.g., solar, hydrogen, wind, etc.). In the third scenario, bio-hydrogen, e-fuels take the driver seat to ensure a net zero carbon emission [6,7]. All these scenarios are designed to impact the energy market heavily by reducing the demand for fossil fuels dramatically. The shift in demand is supposed to bring down the market share of coal, oil, etc. Also, as fossil fuel production decreases, the internal combustion engine market is also going to shrink, paving the path for electric motors. A recent study agrees with such arguments and predicts that fossil fuel production is going to go down by at least 70%, and EV vehicles are going to make up to 100% of the car market by 2050 [5].

Net Economy-wide Job Growth in the HE/HR Pathway

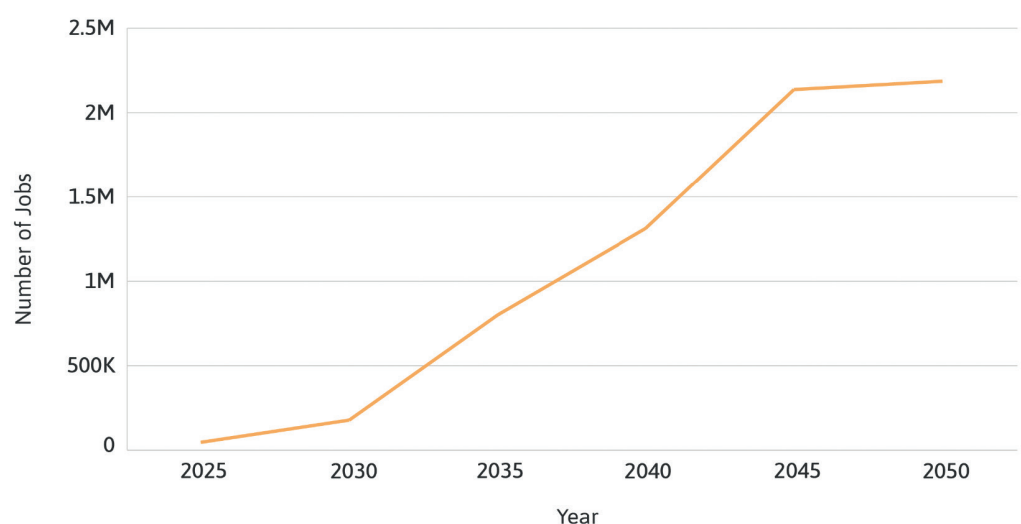


Figure 1: Increase in number of jobs across the years [8]

These three scenarios are closely connected to the job market; according to a study conducted by Ram et al., the higher level of

electrification is bound to lead to increased unemployment in the energy sector as production declines. However, after a short dip,

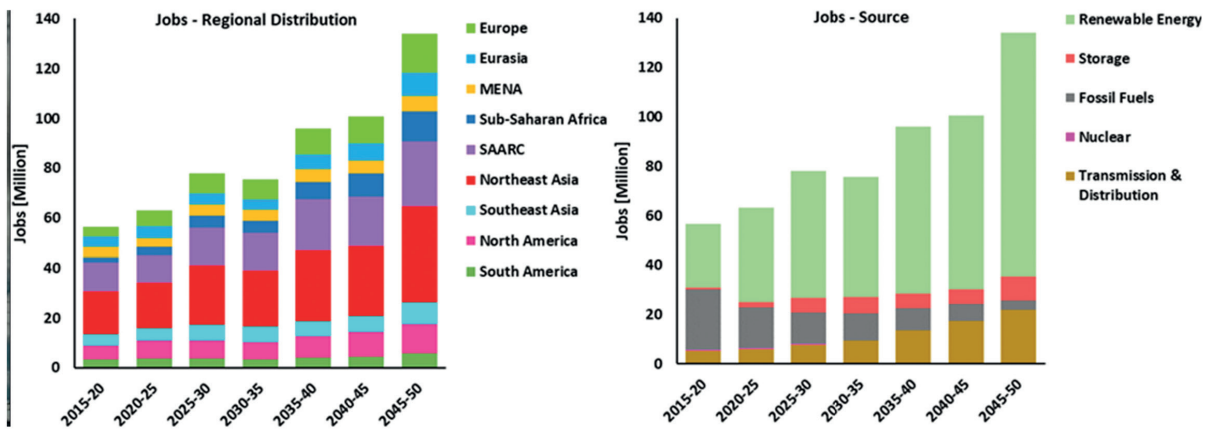


Figure 2: Regional distribution of jobs (left) and distribution of jobs according to the source of energy (right) during the energy transition from 2015 to 2050 globally [7]

Dominant employment by generation: ■ Coal ■ Natural gas ■ Solar ■ Wind
 Drivers: △ Renew ⚙️ Reshape ⚡ Refuel

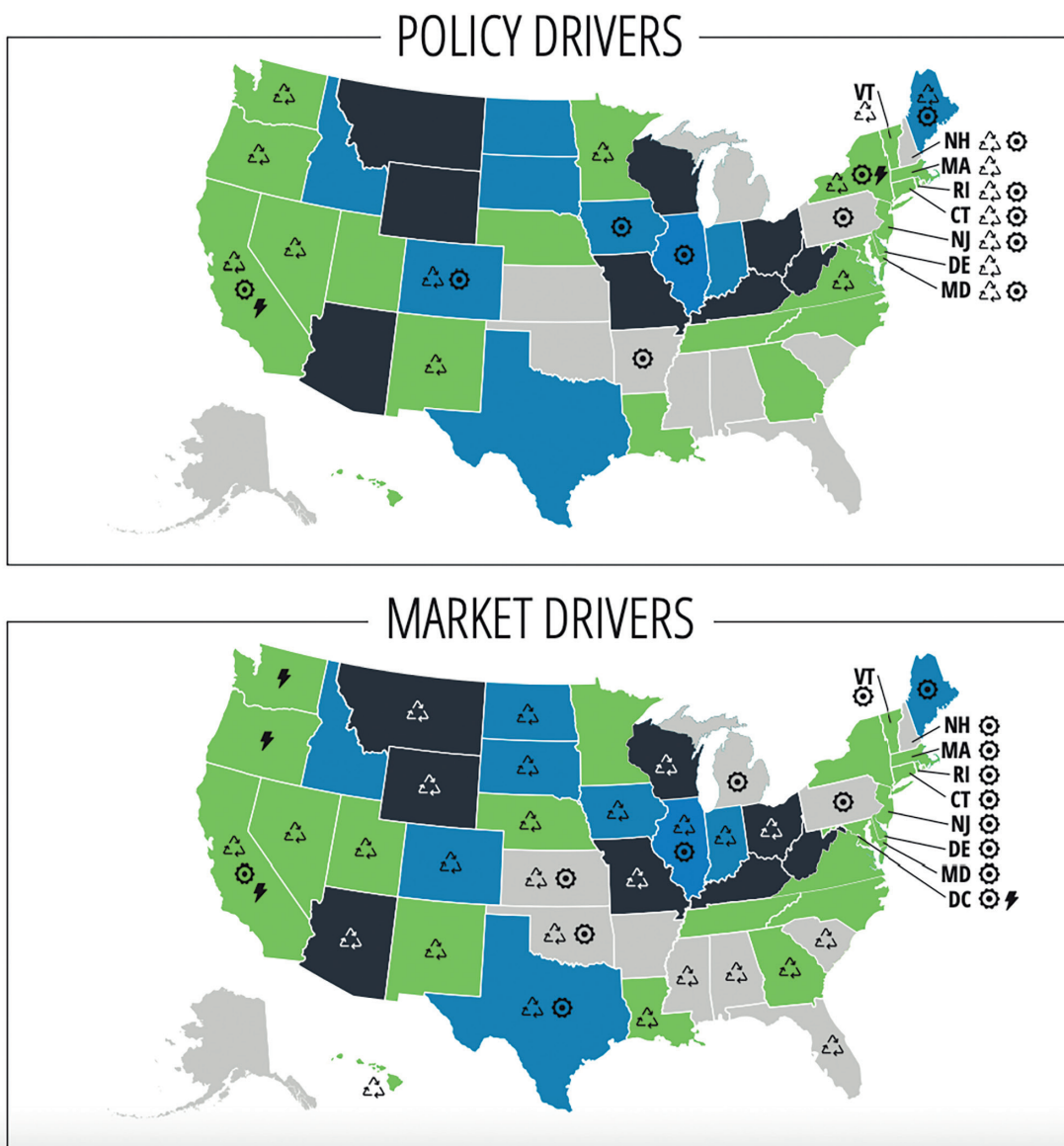


Figure 3: The United States Energy Market Drivers [11]

the job market is predicted to soar as the job transition begins and the demand for employees increases in the green energy sector [7,9,10]. Figure 1 shows that total transition is going to add approximately more than 134 million direct jobs to the economy by 2050 [8].

Before pushing the world toward decarbonization, it is important to investigate the possibility of replicating scenarios created by and for the first world countries. For many parts of the world, keeping unemployment lower is the main goal of the government to avoid any political unrest. In those parts of the world, building new infrastructure, training a skilled workforce, and increasing the cost of energy production might be a recipe for disaster. A study shows that in the early stages of decarbonization, Eurasian countries are most likely to face a major decline of 8% in the energy job market, and since most of the countries are oil exporters, countries' overall economies are going to take hits. As the transition happens and e-fuel gets introduced to the energy sector, 9 million new jobs will be added to their economies. The southeast Asian countries are going to experience an 8% decline by 2050; however, the African countries are going to experience an economic boom, as the job growth

reaches 500% by 2050 [7]. It will be possible because of the increased need for manpower to produce and distribute e-fuels throughout the country, and also the storage and maintenance sector will need skilled workers [7].

To facilitate job growth and ensure economic stability, it is important to understand the current market and prepare it for the upcoming change. One study divided the market into several parts and developed three strategies to meet the demand. Markets where there are green tariffs, carbon pricing, and already established renewable infrastructure available are known as renew states. If a market has mandatory energy efficiency standards, retail net metering, and third-party solar power agreement, it is known as a reshape state. If a market provides incentives for electric vehicles (EV), and hydrogen targets, then this market is known as a refuel state. Taking the United States as an example, states like California and Colorado would be considered renew states, while Illinois, Pennsylvania, and New Jersey, would be called reshape states [11].

Figure 3 illustrates that although the policymakers believe that specific policies will work best for certain markets, markets sometimes behave differently. Therefore, it is important to take consumer behaviors into account before venturing out into a greener energy market. This data proves that to make a smooth transition happen, organizations need to adopt strategies according to how the market behaves. Power companies will be required to train their workforce based on these drivers to better prepare for what is to come. In most cases, data-related skill sets will be highly sought after, along with some other engineering and technology-related skills [11].

While studying the potential of decarbonization, it is crucial to investigate the possible production and market price of a unit of energy and how to handle the new energy pricing. A study reported that energy prices are bound to go up by at least 3-4% due to the increased production cost [12]. The increased energy price will affect not only common people but also industries that heavily rely on energy, such as steel, cement, etc. Most of these industries use pieces of machinery that are compatible with current energy sources. In the near future, companies will have to replace current equipment with something more compatible with renewable energy sources. These replacements will cost these companies a considerable amount of capital, which will lead to increased prices of various goods and services. A study found that production costs after transitioning could rise by up to 45% [5]. However, such increases in production costs are short-term, considering as the dust settles, there will not be additional production costs by 2050; they will drop more than 60%, bringing back the market stability (Figure 4).

The increased cost of energy leads to a decrease in purchasing power for ordinary people. Most modern houses use electricity to accomplish a multitude of mundane tasks; hence, every household must spend a significant amount of their earnings to afford electricity, and it will leave less money to spend on other things. Also, most Americans use cars as their primary mode of transportation, with most of these vehicles containing ICE engines. A sudden necessary switch to Ev's would be financially infeasible for many average households. Also, as production costs for goods increases, consumers must pay extra for basic necessities. These factors are going to lead to short-term economic instability, which need to be addressed before they become long-term issues.

Considering the aforementioned scenarios, total decarbonization

Delivered cost of electricity,¹ \$/MWh, index (2020 = 100), NGFS Net Zero 2050 scenario, global average

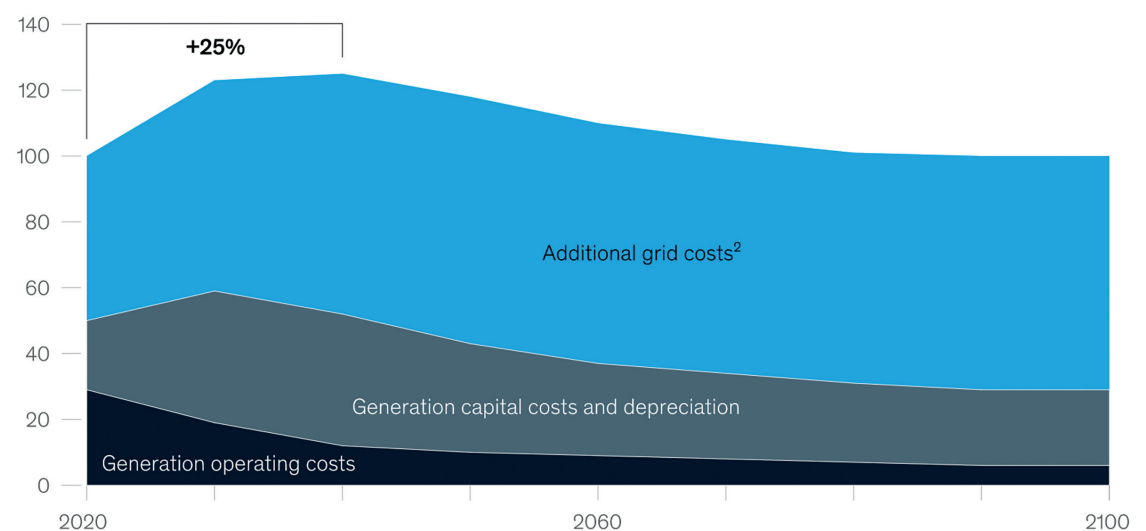


Figure 4: Predicted increase & decrease in energy price [5]

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may be feasible. However, it is vital to understand the market and implement policies that address that particular market to accommodate consumer demand. A recent study claims that by 2021, 81% of new electric generation will depend on solar, wind, and other renewable sources [13]. Therefore, it can be claimed that we are entering the first phase of total decarbonization. Satisfying the requirements to stay on track to reach the 2050 projections outlined by researchers will not be a simple task. As decarbonization happens, there will be a massive shift in the job market, and systematic transitions will be required to keep the unemployment rate in check. Also, the readiness of the world to make the transition smooth should also be taken into account before committing to thorough decarbonization. Moreover, governments should be ready to tackle the rise in consumer goods and energy prices shortly after the transition. One of the ways to battle the short-term price increase could be to provide subsidies to the industry and general public. Therefore, we can

conclude that while the pursuit of a greener future is an arduous task with substantial merit, it should not be undertaken without adequate precaution and ample preparation.

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