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Effects of Costly Power on Industrial Market Growth and Significance of Promoting Cost-Effectiveness Using Renewable Energy Sources

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Abstract:- Over the next 20 years, a rising portion of the world's energy demand will be accounted for using electricity. A renewed interest in the development of alternative energy sources has emerged in recent years because of rising fossil fuel prices and worries about the environmental effects of greenhouse gas emissions. Renewable energy is currently being compared to nuclear energy because of its low risk and disaster. Investment in renewable energy and energy efficiency is important to reduce the negative economic, social, and environmental impacts of energy production and consumption in Somalia. Currently, renewable energy contributes relatively little to primary energy and even less to the consumption of commercial energy. In this regard, several strategies can be implemented to reduce high-cost electricity, such as increasing the use of renewable energy sources and promoting technological innovation. Reduction of high electricity costs and creation of a sustainable energy source to advance, two main solutions can be implemented: replacing fossil fuels with renewable energy sources as much as possible and improving energy efficiency. In this article, we discuss the use of renewable energy sources and alternative technologies to improve energy efficiency.

Keywords:- *Renewable Energy, Electricity, Energy Resources, Energy use Efficiency, Industrial Market Growth, Cost Reduction.*

I. INTRODUCTION

Energy is a fundamental input to economic activity. Modern energy services light up our homes and schools, fuel economic activity to produce and consume, provide comfort and mobility, pump water, and contribute to health and well-being. Harnessing energy sources to replace manual and animal labor was the platform of the Industrial Revolution: a period of unprecedented economic and social development. The 20th century witnessed large increases in the global population, economic output, and fossil fuel consumption. The gains from growth have been impressive for many. Yet these gains have taken a toll on a range of environmental systems where unsustainable practices have dominated.

The continuing deterioration of natural resources could stress the ability to meet the needs of a growing population and undermine economic activity. Green growth could meet this challenge. Green growth is about fostering economic growth and development while ensuring that natural assets continue to provide the ecosystem services on which our well-being relies. To do this it must catalyze investment and innovation which will underpin sustained growth and give rise to new economic opportunities. Due to population and economic expansion, particularly in big emerging nations, which will account for 90% of the increase in energy demand through 2035, there is a significant rise in the world's energy consumption. At the same time, just 20% of people worldwide have access to power. The way we generate, transport, and use energy has to undergo a significant transition. Though it will take a considerable investment, a dramatic reform of the global energy system is achievable. Using current and developing technologies, global emissions might be cut in half by 2050 with an extra cumulative investment of USD 46 trillion.

Governments must establish the enabling policy environment necessary to spur private sector investment in the transition to a low-carbon energy industry. Acting now will save money in the long run since, by 2035, zero-carbon infrastructure and plants will have to be built for every dollar invested in the energy industry that isn't made before that year. This will allow for a reduction in greenhouse gas emissions of up to 80%.

II. BENEFITS & OPPORTUNITIES

There will be several advantages to shifting economies toward sustainability. High levels of resource productivity and energy efficiency can result in economies that are more competitive and dynamic, which in turn makes them better prepared to adapt to the size of the change that is necessary. Being the first to act and reap the rewards of competitiveness in expanding worldwide markets for goods and services

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connected to green energy might provide countries with an edge. In general, four crucial factors give the economic case for implementing green growth methods in the energy sector:

- *Environmental Harm and Improper Natural Resource Management have Financial Repercussions:*

By causing conventional fossil fuels to become scarcer and more expensive because of increased environmental damage, for example, failing to address environmental concerns and ineffectively managing natural resources pose risks to long-term economic growth as well as to well-being through the deterioration of human health brought on by pollution, for example.

- *Using Innovation to Accomplish Social & Economic Goals:*

Innovation is essential to achieving the goals of green growth because it has the potential to break the link between economic expansion and environmental degradation. It is also at the heart of economic goals like employment growth and productivity improvement. The energy sector is particularly in need of innovation as we look for energy sources with lower environmental costs and strategies to increase usage efficiency as costs grow.

- *Efforts to Increase Production while Balancing Environmental Goals:*

Improved resource productivity and energy efficiency, through innovation or deployment of energy technology or processes, supports decoupling between economic growth, environmental damage, and resource degradation.

- *Opportunities for new markets and industries:*

To transition the energy industry toward green growth, new technology, fuel sources, procedures, and services that can create new markets and businesses are needed. Companies that take the initiative to adapt to these developments will be in a good position to both contribute to and profit from them.

Additionally, while keeping in mind the goals of social development, this article explores policy possibilities for boosting renewable energy in Somalia to lower high-cost power. The present state of renewable energy in Somalia is described for context. The financing and enabling actions needed to promote renewable power are crucial for policy option implementation. Finally, we discuss our findings, provide suggestions, and outline potential directions for further study.

III. RELATED WORK

There has been violence in the Somali region for many years. However, significant donors, the Somali diaspora, local communities, and a flourishing business sector have all contributed to keeping the nation afloat and planting the seeds of a strong and stable economy. However, the amount of cheap energy needed to support further growth stands in the way of further development. There hasn't been much more that has been feasible, but in a few of the places below, these artists have performed with the lights on at night. The generation, transmission, and storage of energy are among the least effective and most expensive in the world due to the region's grid infrastructure being destroyed by decades of violence and isolation.

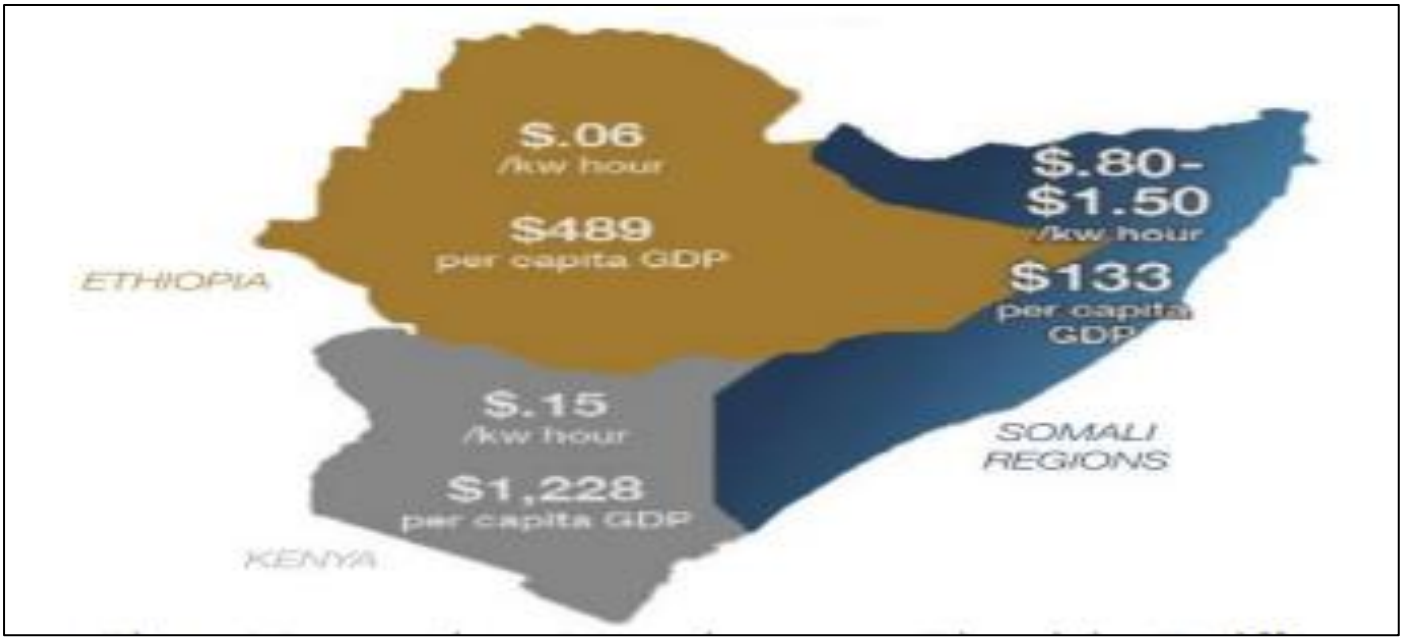

Fig 1 Per Capita GDP and Average Electricity Tariffs.

- *The High Price of Electricity Tariffs*

Even though Mogadishu and Hargeisa have greater levels of urban electrification than similar cities in sub-Saharan Africa, the "tariffs" that companies and people must pay, which range from $0.80 to $1.50 per kilowatt hour, are among the highest in the world. In contrast, the adjacent countries of Kenya and Ethiopia, with average prices per kWh of $0.15 and $0.06, respectively, are significantly less costly. Somalis not only pay far higher power bills, but they also make substantially less money. The estimated GDP per person

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in the Somali area was $133 in 2013, a small amount compared to Ethiopia's ($489) and Kenya's ($1,228).

Geographical factors, infrastructure, and varying energy provider prices all contribute to the wide range of power tariffs within the Somali area. Most energy expenditures are often borne by consumers who live far from metropolitan areas.

According to the African Development Bank (AfDB), grid outages of up to 50% are typical throughout the Somali area. Local Somali electrical grids and their neighbors are shown on the map below as examples of regional electrical transmission losses.

A loss of 40% of electricity due to inefficiency is approximately four times more than the average loss rate across African nations and twice as much as the average loss rate among fragile and conflict-affected nations worldwide. Operators require additional technical knowledge to comprehend load predictions and optimize systems.

- *Unreliable Infrastructure*

The tremendous unreliability of the electricity supply in the Somali region is a last issue, but one that is no less significant. Electrical infrastructure in metropolitan areas has been particularly affected by the fighting in South Central Somalia and Puntland. Government-owned power facilities and unified systems that provided lighting to metropolitan areas were damaged by looting and shelling during the Civil War. Infrastructure in Somalia is not unique.

A study funded by the World Bank found that "power is by far Africa's largest infrastructure challenge." The fragile networks in the Somali area are plagued by shortages and outages because of the infrastructure's current constraints. Most transmission and distribution networks are constructed locally, unregulated, and sometimes by personnel with little formal training.

Low-tension power lines, which typically have average voltages of 400 to 220 volts, but they can also occasionally drop to 220 to 150 volts. This type of force does not go very far from its source. Given the considerable lengths that improvised electricity lines sometimes travel, such low voltages are frequently felt as malfunctioning appliances and flickering lights. High costs, inefficiency, and poor dependability are also caused by the absence of connections between generators. It will cost a lot to build the necessary infrastructure and conduct the necessary research, including system stability studies and synchronization facilities for each generator.

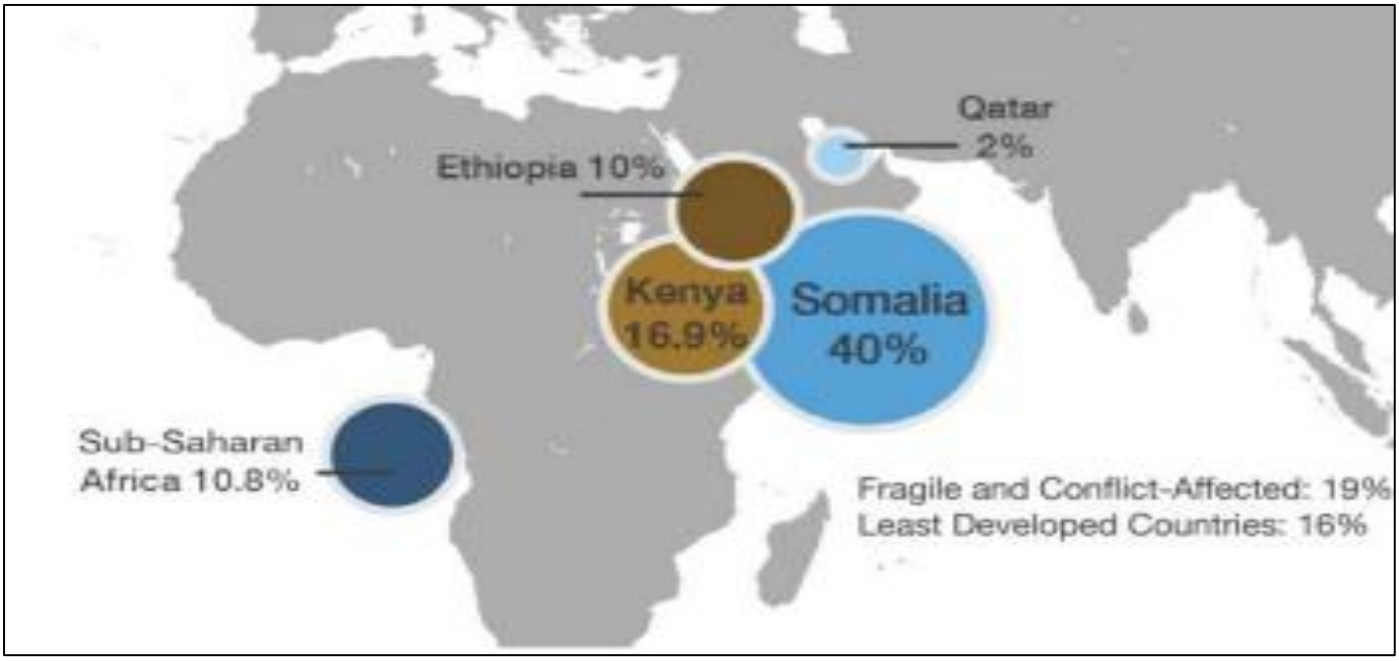

Fig 2 Electric Power Transmission and Distribution of Losses
Source Data: International Energy Agency (IEA).

These stages are costly, but they are more crucial since they call for IPP collaboration, which is just now starting to emerge in the biggest cities where IPP consortia are integrating the grid.

- *Limited Consumption*

The reasons why local energy usage is among the lowest in the world, despite growth, include issues with access, cost, and dependability. With a net consumption of 288.3 million kilowatt hours (kWh) in 2012, Somalia ranked in the lowest percentile globally for electricity use. An even grimmer picture is painted by consumption per capita.

The 28.7 kWh used per person in Somalia is under 1% of the global average of 2,798 kWh, less than half of the 57 kWh used by Ethiopians, and just 19% of the 153 kWh used by Kenyans.

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- *Unsustainable: Assessing the Major Energy Source in the Somali Region*

The fundamental requirements of Somalis are still met by biomass because they lack dependable or inexpensive access to power. Organic fuels including wood, charcoal, and animal dung make up 96% of the nation's energy sources, which also include biomass. As electricity or other fuels are still prohibitively expensive and difficult to get, which exacerbates issues with the environment, the economy, and public health, charcoal continues to be the dominant fuel.

In the Somali region, some 2 million bags of charcoal are thought to be used annually, causing the surrounding woods to be destroyed. Remarkably, overexploitation from domestic charcoal use and illegal exports, particularly those that fund armed groups like Al Shabab, has resulted in a decline in the quantity of forest cover in the Somali region, from an estimated 60% in 1985 to 10% in 2001. This decline is still happening today at an accelerating rate. Additionally, A monthly household's income may sometimes be consumed by charcoal, which has more than quadrupled in price since 2007. This has reduced Somalians' incomes.

Additionally, families that use charcoal run the danger of developing serious health problems including lung cancer and respiratory conditions like infant pneumonia. More than 11,000 people are thought to die in Somalia each year because of indoor pollution, according to the World Health Organization.

- *Constraints on the Economy*

The research shown below reveals that, in addition to being a significant obstacle to human development, the energy shortage in the Somali area is also the main impediment to economic progress, outpacing other factors including violence, corruption, a lack of land, and capital. There are significant overall consequences on economies because of the cost of electricity outages and unstable service on productivity in emerging countries. Due to the forced shutdown of activities by businesses when the power goes out, an average of 1 to 2% of GDP might be lost each year due to Africa's inconsistent electricity supply.

Low-income and unstable countries such as Malawi and the Democratic Republic of the Congo (and presumably the Somali area) lose up to 4.5% of their GDP per year due to underpricing, unreported losses, and collection inefficiencies in the energy sector. Owing to these challenges, businesses have been forced to lower their production locally; some have even relocated to neighboring countries like Ethiopia, where manufacturing costs are lower due to large-scale hydropower and other efficiencies. The difficulty with firms closing or moving isn't only the immediate financial losses; investors are frequently scared off by such failures.

Particularly in unstable and conflict-affected states is this true? For instance, during the early years of the country's post-conflict recovery, access to power was seen to be the biggest barrier to investment in Uganda. The World Bank Enterprise Surveys confirm this experience, finding that enterprises in unstable and conflict-affected states cite electricity as their biggest challenge. Concerns about corruption and political unrest were even outweighed by concerns about electricity.

Our firm belief is that the Somali area can be transformed and can contribute to the development of much-needed legitimacy, stability, and economic prosperity through the provision of inexpensive, accessible, and stable electricity, a large portion of which may be provided by hybrid power plants that use renewable energy.

The financial means, the ability to lead, and the market knowledge necessary for such a revolution are all there and growing rapidly, even if large-scale investments in the Somali area will strain existing resources and take time and coordination.

But several inquiries need to be made: Is it possible to scale up generating to provide enough energy for industry? What channels are available for Somali businesspeople to reach out to international and diaspora investors to profit from their initiative? The bulk of the energy requirements of Somalis be met by biomass fuels, or will they be replaced?

Moreover, what are the best ways for funders, the private sector, and civil society to integrate renewable energy into the conventional power mix? The potential for the energy sector to advance clean energy, cost savings, environmental protection, and climate change will be examined in the section that follows. Additionally, it will cover in-depth how investment is evolving in this rapidly growing sector and look at how new developments in business practices and renewable energy technologies are spurring investment and growth.

IV. ACHIEVING THE VISION OF POSSIBLE RENEWABLE ENERGY

The growth of the power industry in the Somali area has the potential to alter the direction of its development. By increasing energy access, the nation's businesses could become more productive and competitive, contribute to the reduction of poverty (which in turn could encourage more investment), improve sustainable energy production, lower the price of electricity, and have a positive impact on the environment. Electricity investment has a significant economic multiplier impact and may support the expansion of both new and established enterprises.

The inventive new technology and growth-financing strategies may be partially credited for this, but the Somali private sector's ingenuity and perseverance also play a significant role. Some of the most significant benefits that enhanced electrification will have on Somalia's economy and society are discussed in this section. To reach these developmental benchmarks, it also evaluates the investment environment, maps out the sources of renewable energy, and talks about the technological and administrative tools that may be used to access these resources.

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➢ *Renewable Energy Supply Technologies*

The availability of renewable energy is always growing. In recent years, significant investments have been made, and technological advancements have made it possible for nations to produce renewable energy more profitably. The number of nations producing more than 100 MW of renewable energy is anticipated to rise considerably by 2017 (IEA, 2012d). Promoting and developing renewable energy supply technologies is vital since there are some undesirable and irreversible externalities associated with traditional energy generation.

These technologies might not be economically competitive with traditional fuels in terms of production costs, but they might be if we consider their related externalities, such as their effects on the environment and society. It is also important to keep in mind that economies of scale may be a major factor in lowering the cost per unit of manufacturing. Technologies and prices for transmission and distribution between conventional and renewable energy are similar. The primary methods for supplying renewable energy have developed in the ways described below. (Abdirizak Yasin Yusuf and Mohamed Abdirahman Sid Ahmed 2024).

➢ *Sources of Energy*

The ability of Somalis to access energy is constantly growing, whether it is derived from traditional fuels such as petroleum or kerosene, large-scale hydropower, or renewable sources like solar and wind. With the help of technological advancements, innovative financing options, and the volatile nature of global fuel prices, there is a growing range of methods to acquire energy. The next section explores the potential of new energy sources to rejuvenate the energy industry in the Somali area. It also provides both short- and long-term solutions to address the energy challenges.

➢ *Diesel and Heavy Fuel Oil*

As was already established, the majority of IPPs use older, reconditioned diesel generators that might be challenging to maintain. However, some IPPs are making investments in upgrading outdated systems to make them more effective, swapping out outdated generators for newer models, or upgrading current generators to make them able to run on less expensive fuels.

Renewal and refurbishment efforts are already underway to address IPP inefficiencies in Somalia. Converting to heavy fuel oil (HFO), a less expensive but potentially dirtier and less effective oil used as naval bunker fuel is the major energy producer of the nation. Banadir Electric Company (BECO), which feeds most of Mogadishu, relies on this source. According to Abdullahi Hussein Kahie, general manager of BECO, such a step aims to lower generation costs so that customers may benefit from the savings. Since carbon-based fuels are expected to continue to be the predominant source of energy in the Somali area for the foreseeable future, such advancements among IPPs are crucial.

➢ *Wind*

In terms of wind and solar energy resources, the Somali area is especially well-endowed. The Somali region has the greatest potential for onshore wind generation of any African location, according to research by the African Development Bank Group. Based on a recent report by the World Bank, it is suggested that Somalia has significant potential for onshore and offshore wind energy, as well as tidal and wave energy along the Somaliland coast. In the long term, this could potentially generate more electricity than Ethiopia's hydroelectric capacity.

According to an analysis of NASA data, wind speeds in the Somali region fluctuate seasonally but are consistently powerful enough to sustain wind-generated electricity. Most of the nation experiences wind speeds of more than 6-8 (m/s) in most regions, which are ideal for producing electric energy. This number is frequently reported. But these figures may even be on the lower side of the scale.

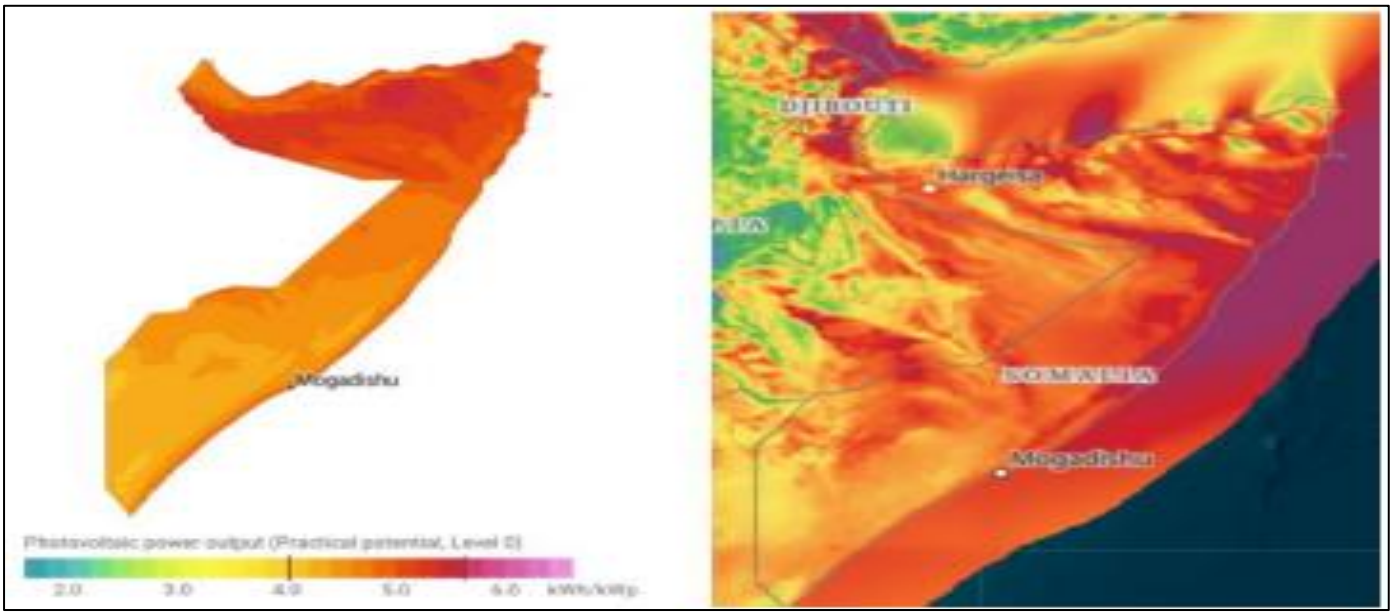

Fig 3 Global Mean Solar Irradiance and Wind Speed.

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The linked map indicates mean wind speeds of more than 9 m/s at 80 meters elevation (the height of a typical 1.5 MW turbine is 100 meters), even though concentrations vary by location with Somalia being on the low end for wind. Most of the wind energy is generated in the coastal region, with potentials ranging between 30 and 45 GWh/km2 throughout much of coastal South-Central Somalia and into the interior, according to some estimations. This is equivalent to the amount of wind energy produced by the whole Somali area in four square kilometers using diesel and hybrid power. At these sizes, wind energy seems to be a resource that might contribute to meeting a sizable amount of the energy demands of the Somali region.

However, to scale up wind power to this level, significant investments in generation, storage, management, and distribution technologies, as well as highly qualified staff, as well as the necessary infrastructure and equipment to set up and operate these systems, would be necessary.

➢ *Advantages of Wind Energy*

- Does not cause air or water pollution.
- Is a "free" source of power.
- There are alternative uses for the land around wind farms.
- The expenses associated with building wind farms are not excessive.

➢ *Disadvantages of Wind Energy*

- Continual and substantial wind is necessary.
- Wind farms require significant amounts of land.
- May greatly influence a landscape's aesthetics.

➢ *Solar Energy*

In the two decades prior, researchers looked at the financial sustainability of solar power for use in residential, commercial, and industrial settings. Due to the scarcity of natural primary energy sources, industrialized nations like Japan and Germany are looking into alternative energy sources like solar power. Early in the 1990s, Germany and Japan both began to utilize solar photovoltaic (PV) energy to generate huge amounts of electricity. The creation and production of solar power technologies are currently dominated by both countries. With the help of inexpensive labor and government subsidies, China has more recently built up a massive solar power capacity, which has helped lower the price of solar energy production.

The development and improvement in the efficiency of concentrated solar power technologies in the US have further reduced the cost of energy in the solar power industry in addition to the cost reduction in power generated by traditional solar PV technologies (Gevorkian, 2012). On the other hand, solar technology also has drawbacks that affect land use, regular and inadvertent chemical emissions, the aesthetics of buildings, etc. (Tsoutsos et al., 2005). The solar photovoltaic industry has remarkably increased in the last five years. In 2011, there were 69,371 MW available on the market, up from 9,564 MW in 2007.

Like wind energy, solar energy is abundant in the Somali region and is becoming more and more popular as a source of power for rural communities, small enterprises, and facilities since it requires less cash and technical expertise to use than wind energy. The greatest sun irradiation occurs in Puntland and Somaliland to the north, in contrast to wind, which is greater towards the central coast.

The horizontal sun energy is at least 200 W/m^2 in the graph above, to review, or around 200 kW/km^2, across a large portion of Somalia. The Somali region receives 2,900 to 3,100 hours of sunlight on average a year.65 There can be one of the highest daily averages of sun radiation overall. Additionally, the nation's average annual temperature of 27°C is an acceptable temperature that allows solar PV systems to operate successfully for an extended period. The daily solar radiation horizontally is 6 Kilowatt an hour meter square day.

➢ *Advantages of Solar Energy*

- Unlimited supply
- Causes no air or water pollution.

➢ *Disadvantages of Solar Energy*

- May not be cost-effective.
- Storage and backup are necessary.
- Reliability depends on the availability of sunlight.

V. THE CHALLENGE STILL FACING THE RENEWABLE ENERGY SOURCE

The energy sector in Somalia faces numerous technical challenges, such as insufficient transmission and distribution networks, a lack of energy output and consumption measurement capabilities, and various social, financial, and physical obstacles that hinder the synchronization of producers and grids. The renewable energy industry has challenges due to the import of massive gear like wind turbines and the lack of capital goods like cranes required to install these things.

As was already noted, the absence of vital infrastructure like phones, bridges, and roads has a severe negative impact on Somali enterprises. Instead, they must depend on ingenuity, incur exorbitant costs, or even postpone anticipated spending. The energy technological revolution is necessary to move towards a sustainable energy future. It is feasible to cut global energy-related CO2 emissions by half by 2050 compared to present levels by using a mix of new and existing technologies. Not only will this be difficult to accomplish and expensive, but there will be big rewards as well.

A further 17% increase in clean energy expenditures above baseline levels would be required to decrease emissions from 2005 by half by 2050, according to estimates of USD 46 trillion in additional investments. Investments in low-carbon energy technologies, essential for a low-carbon energy system in 2050, averaged over USD 165 billion annually between 2007 and 2009 (IEA, 2010a). In 2010, investments reached almost USD 250 billion.

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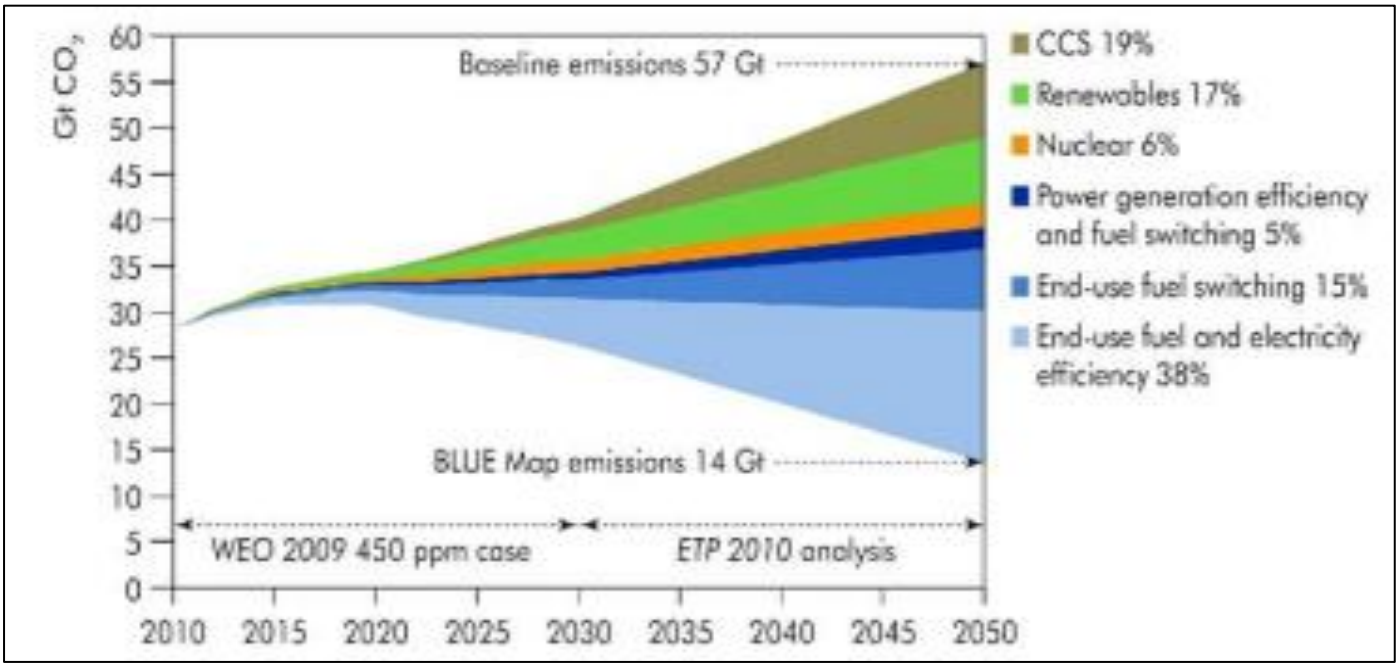

Fig 4 Energy Technology Perspectives
Source: IEA (2010)

➢ *Eliminate Fossil Fuel Subsidies.*

Eliminating wasteful fossil fuel subsidies is a very effective strategy for transitioning to green growth in the energy industry. These are still prevalent in several nations. They lower the cost of carbon emissions, which directly contradicts any policy purpose aimed at reducing emissions. Furthermore, they lead to a suboptimal distribution of resources and distortions in the market, often falling short of achieving their intended goals.

Due to Russia's invasion of Ukraine and the interruption of natural gas supplies to Europe in 2022, fossil fuel prices were high and unstable. Customers did, however, pay less for these fuels in many other nations. Although policy interventions protected consumers from skyrocketing costs, they maintained the artificial competitiveness of fossil fuels relative to alternatives with lower emissions.

According to projections from the International Energy Agency (IEA), global subsidies for the use of fossil fuels are expected to reach over USD 1 trillion in 2022—the highest yearly amount ever recorded. While oil subsidies increased by over 85%, natural gas, and power consumption subsidies more than quadrupled from 2021 to 2022. Over half of the subsidies are in nations that export fossil fuels, with the majority going to emerging markets and developing economies.

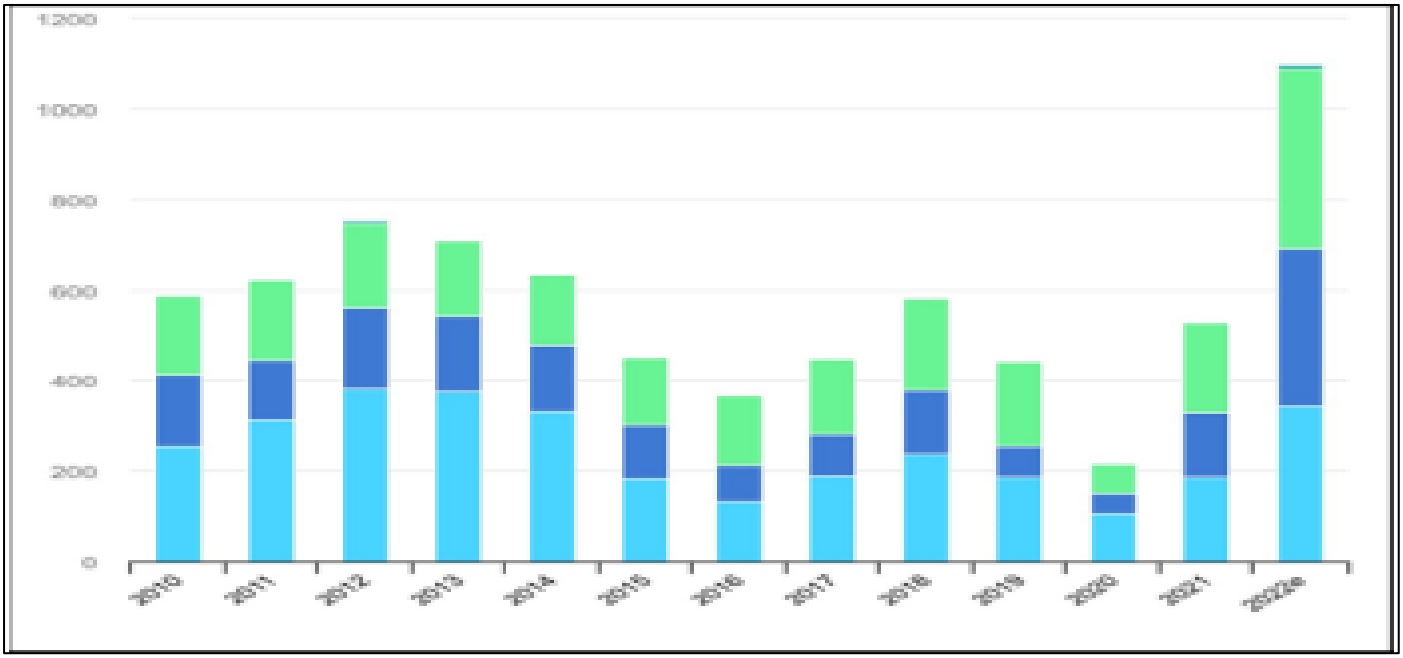

Fig 5 The Global Energy Crisis Pushed Fossil Fuel Consumption Subsidies to an All-Time High in 2022

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➢ *Global Fossil Fuel Consumption Subsidies*

According to the International Energy Agency (IEA), advanced economies would spend over USD 500 billion more in 2022 to lower energy costs, with around USD 350 billion going towards Europe. Since average end-user prices remain high enough to cover the market fuel's worth, this investment is not necessarily seen as a subsidy for the usage of fossil fuels. However, governments must bear a heavy financial burden from this investment, which is often ill-targeted and may reduce the motivation to convert to cleaner fuels or consume less energy.

In addition to having serious fiscal ramifications, inefficient resource allocation, increased pollution, and a bad goal rate, subsidies safeguard consumers by keeping prices low. Sustainable results may be aided by eliminating subsidies and using the money raised for improved social expenditures, taxation, and investment. Fuel prices exceeded consumer expenses in 2022 because of disturbances to the energy system, which caused global fossil fuel subsidies to top USD 1 trillion for the first time.

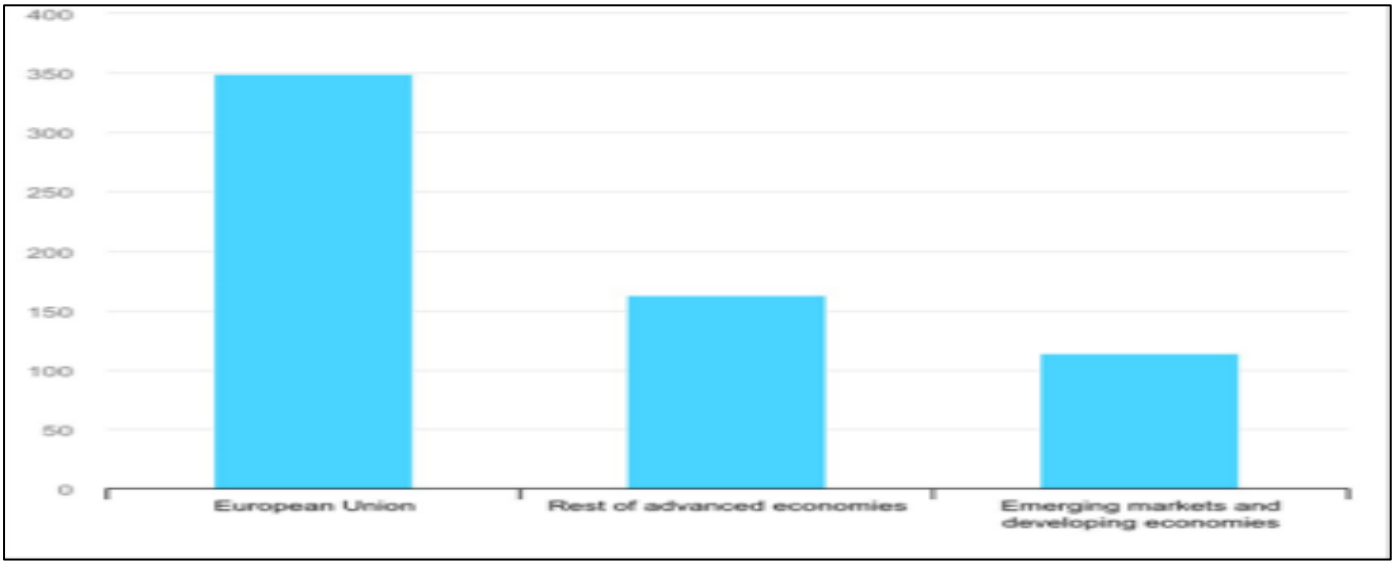

Fig 6 Government Consumer Measures to Reduce Energy Bills during the Energy Crisis

According to IEA research, subsidies for the use of fossil fuels have doubled globally in 2022 and have now reached an all-time high of $1 trillion. Given that the Glasgow Climate Pact highlighted the need to gradually eliminate fossil fuel subsidies to achieve a successful renewable energy transition, this is a notable increase over the previous year. However, the present global energy crisis has also brought attention to the political difficulties in bringing about this change.

VI. CONCLUSION

This article presents an outline of the review of the impact of high-cost electricity on industrial market growth & importance of promoting cost-effectiveness using renewable energy. As a result, technology has made precise and practical information available that can be used by many market parties in their decision-making processes.

Each technique has benefits and drawbacks that vary depending on the region, accessibility, technological prowess of manufacturers, available resources, available budget, and environmental factors. The beginning circumstances unique to each town, region, or nation dictate the energy mix that can be generated at the lowest cost while limiting the harm to the environment. Therefore, there isn't a single answer to every energy issue or requirement; rather, there is an ideal, site-specific renewable solution.

The persistence and robustness of the Somali region's recovery from decades of conflict and underdevelopment will be determined by the ability of the economy and state's key components to maintain economic expansion, investment, and the delivery of basic services. One of these crucial components is electricity. Businesses that have access to affordable electricity can improve output, compete with imports, and enter regional and worldwide markets.

Businesses will continue to be forced to cut back on operations in the absence of inexpensive energy, and investors will continue to hunt for risk where there is opportunity. Another basic need is electricity, which has a significant influence on how well-off, productive, educated, and healthy people and communities are. Investments in the energy industry may give social, economic, and perhaps political dividends to the degree that individuals and governments are willing to put out the effort.

The private sector has already made considerable strides in raising the standard of living for ordinary Somalis and acting as an economic multiplier by providing firms, the government, and civil society organizations with the motivation to serve the general population. Increased investment in renewable energy sources can help to address a variety of difficulties in Somalia, including high energy prices, low reliability, and restricted access, particularly for rural and nomadic people. The renewable energy industry is already

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expanding due to the abundance of wind and solar resources in the area, as well as the increasing accessibility of renewable energy products.

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