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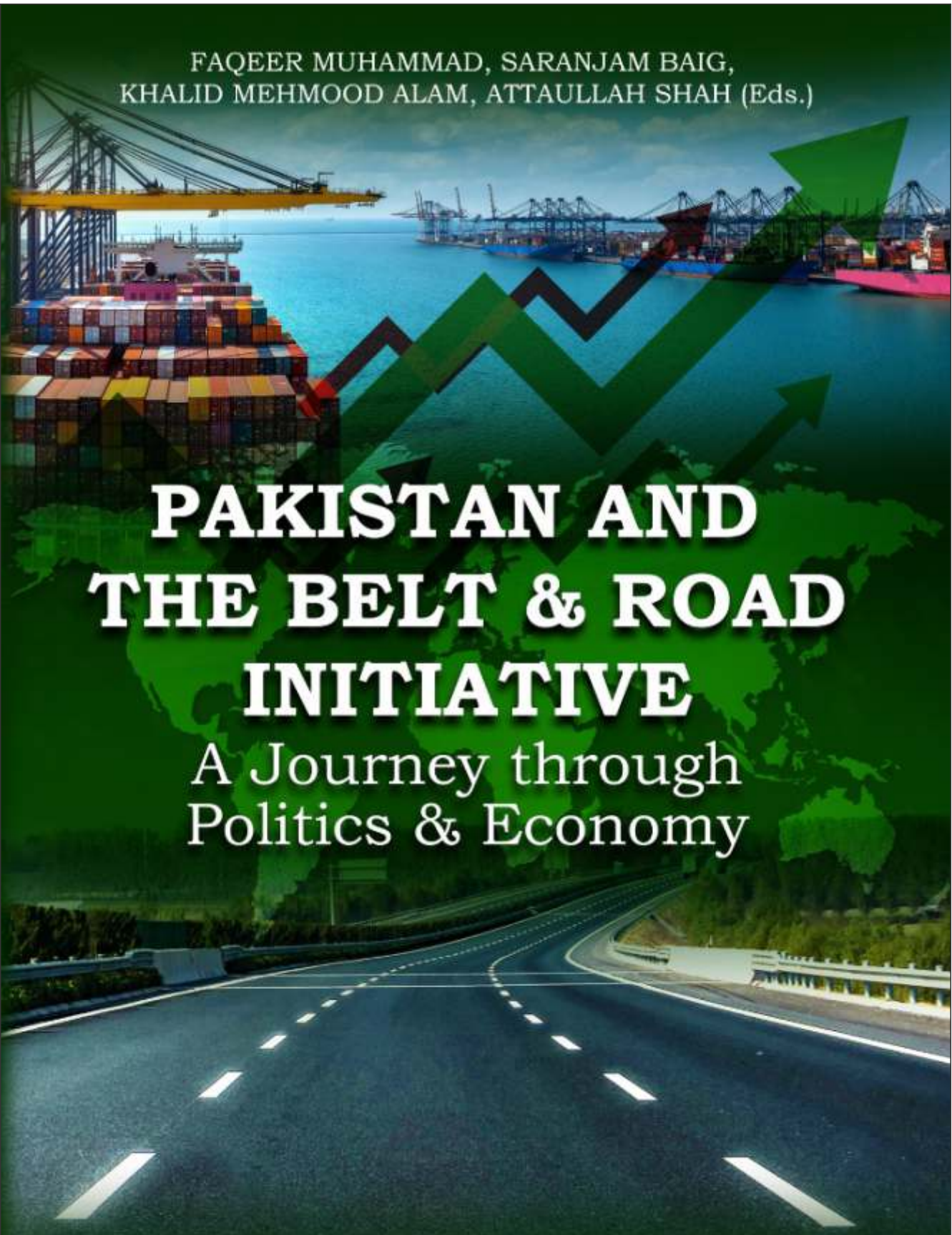

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Powering Sustainable Futures: The Role of CPEC in Achieving Affordable and Clean Energy Access

Syed Waqas Haider Bukhari
https://orcid.org/ 0009-0006-5874-9198
School of International Relations, Minhaj University Lahore, Pakistan

Abstract

Access to energy services in many countries worldwide falls short of the necessary goals for human development. Affordable and clean energy access is not only a global objective, but it is also at the core of the sustainable development agenda of 2030. S DG-7 emphasizes the essential role that energy plays in supporting all other goals across sectors. CPEC projects are intertwined with SDGs for accessible and clean energy. The study focuses on four sectors - socioeconomic, business, industry, and agriculture - to evaluate affordability, while coal, hydel, solar, and wind is the focus of the analysis of clean energy. CPEC energy is a catalyst for socioeconomic development, as energy affordability and economic progress are interdependent. It will provide opportunities for foreign investment inflow and will benefit the common man. CPEC is a strategic move, with the potential to meet the energy requirements of both states and improve the standard of living for their inhabitants.

Introduction

For years, in the energy sector, there has been a prevailing myth that it is difficult to moderate the structure of extremely poor nations cost-effectively. For such nations, the solution to the energy crisis through renewable energy resources is expensive. In most parts of the world, institutions still need affordable and clean energy access. For every state, affordable and clean energy is central to sustainable development. It stimulates social development and enhances productivity. Access to affordable and clean energy is a hard task for a state.

For a state, it is without only achieving sustainable development by gaining access to affordable, sustainable, and clean energy. In SGD-7, for human development, access to affordable and clean energy has tremendous importance. Here, three goals are interlinked: energy access, deployment of renewable energy and energy efficiency. These are essential for the extension

of the services of affordable and clean energy. Through SDG-7, access to energy by 2030 will require investments in sources of clean energy such as thermal, solar, and wind. In the sustainable development agenda 2030, SDG-7 is the backbone of all SDGs. It is only possible to achieve sustainable development by achieving sustainable development by gaining access to affordable and clean energy. For sustainable development, there are three dimensions of energy: economic, social, and environmental. According to SGD-7, access to affordable and clean energy is of tremendous importance to human development.

United Nations declared the 2014-2024 decade the decade of sustainable energy. Its purpose was to launch a global initiative to provide affordable and clean energy services by 2030. UN prioritized sustainable energy access to its member states to achieve this goal. For long-term energy security and sustainability, the government of Pakistan, through the government of Pakistan, through the energy component of CPEC, adopted strategies to fight the energy scarcity. Pakistan, through the CPEC energy component, linked itself with SDG-7 to find a sustainable solution to the energy crisis. SDG-7 is directly and connected with Chinese investment in CPEC energy. In the efforts to achieve the agenda goals of 2030, the CPEC energy component, if securely targeted, would serve itself as a supersonic vehicle on the path of sustainable energy. The parliament of Pakistan has adopted SDGs as an agenda for national development. It's because the self-sufficiency of the energy sector lies in CPEC energy through which Pakistan will shoot for SDG-7.

The SDG7: An Overview

The goal of SDG-7 is to ensure access to affordable and clean energy for all. It is necessary because the routine life of a common man deeply depends on and revolves around affordable and clean energy. The smooth functioning of human activities needs a well-established system of energy. It includes education, business, agriculture, communication, medicine, and infrastructure. For many years, functions of human life have been mainly based on the use of fossil fuels, oil, coal, and gas. The burning of fossil fuels causes harmful greenhouse gases. It not only becomes the cause of negative climatic changes but also adverse hurts the well-being of people and on the environment as well. On the globe, the use of energy is increasing rapidly. In a net shell, a smooth supply of clean energy is the essential requirement of every state to support its economy. Currently, more than 1 billion people are living without any access to energy. More than 3 billion people are suffering from bad health. The well-being of these people is badly affected by lack of access to clean energy and is becoming the cause of in-house air pollution. To switch to affordable and

clean energy, there is a need to increase investments in the infrastructure of energy from $400 billion to $1.25 trillion per annum till 2030.

To manage the problem, there will be for a transition towards an affordable and clean energy system. States are required to invest in renewable energy and adopt technologies and infrastructure for clean and affordable energy. States can maintain their business by preserving and protecting the ecosystem. For this, there is the need to focus more on the production of energy through hydropower and renewable energy resources. It requires 100% commitment to produce energy by using renewable energy technologies (Nations, 2023).

Targets and Indicators of SDG-7

According to the United Nations, energy is the fundamental element behind every challenge the world faces today and every opportunity the world is gaining. In the coming decades, the transition of the world economy towards affordable and clean energy sources is one of the significant challenges. Sustainable energy is an opportunity that can transform the economies of the planet.

The objective of SDG-7 is to provide access to affordable and clean energy by the end of 2030. The agenda of 2030 has established sustainable development goal 7. For sustainable development, the significance of energy is recognized through this goal. It is the first ever universal goal of energy, which basically consists of five targets, which are access, efficiency, renewability, and implementation of means. A significant milestone has been represented in SGD-7 because, since 2000, MDGs have not been addressing any energy goal. For the first time in the UN system, energy is recognized as a vital component of the global sustainable development agenda. In many SDGs, the component of energy is interlinked because it is essential for human development.

Through the Inter-Agency and Expert Group on SGDs indicators, United Nations has developed a global indicator framework. SDG-7 has five targets and six indicators. Goals are specified in the targets, while indicators signify the metrics through which the world aims to track the achievement of these targets. The following table shows the targets and indicators of Goal-7 are:

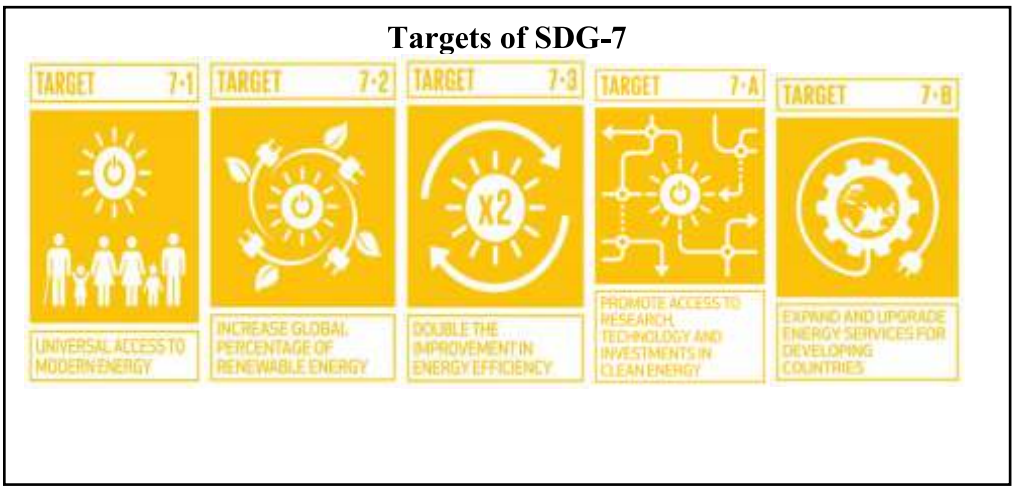
Targets and Indicators of SDG-7

Sr. No	Targets	Sr. No	Indicators
7.1	First target focus on to ensure access to universal energy through affordable and clean energy means by 2030.	7.1.1	Ratio of population with energy access.
		7.1.2	Ratio of population with fundamental reliance on technology and clean fuels.
7.2	The focus of the second goal is on the substantive increase of renewable energy share in international energy mix by 2030.	7.2.1	The share of renewable energy in the total final consumption of energy.
7.3	By target third goal, double the global rate of improvement in energy efficiency by 2030.	7.3.1	The intensity of energy is measured on the basis of primary energy and GDP.
7.A	By 2030, increase global cooperation to facilitate access regarding research on affordable and clean energy. It includes renewable energy, efficiency of energy and advanced technology of cleaner-fossil fuel. Moreover, to promote investment in affordable and clean energy with improvement in energy infrastructure.	7.A.1	Mobilized amount of US dollar per annum starting in 2020 accountable towards the $ 100 billion commitment.
7.B	By 2030, upgrade technology and enhance infrastructure for delivering affordable and clean services of energy in developing countries for all. Particularly, less developed states, land-locked developing states and small island developing states, in accordance with respective program support.	7.B.1	For sustainable development services, investments in energy efficiency as a GDP percentage and amount of FDI in financial transfer for technology and infrastructure.

Source: Sustainable Development Goal 7, United Nations, Sustainable Development Knowledge Platform, Available at: https://sustainabledevelopment.un.org/sdg7 Access On 1-7-2023

The targets of SDG-7 coupled with its indicators is helping the world to eradicate poverty by providing affordable and clean energy by participating in global prosperity through sustainable development. This target of sustainable development goal is essential for achieving sustainable and reliable energy. The following graph explains the concept of affordable and clean energy is

included in target 7.1. In contrast, the concept of sustainability is indirectly included in targets 7.2 and 7.3.



Target 7.1: Universal Access to Modern Energy

In all perspectives of sustainable growth, the target to gain universal access to sustainable services by 2030 is a key to all critical problems. Concerning social perspective, this target of SDG-7 is very vital. It is all because, for social inclusion, the element of energy is very important. This target of SDG is to focus on the poor segments of the globe, especially those with no energy access and who mainly live in undeveloped areas. However, energy access has no universally accepted definition. However, the International Energy Agency has defined modern energy as "a household having reliable and affordable access to clean cooking facilities, the first connection to energy and then an increasing level of energy consumption, over time, to reach regional average. The initial minimum level of energy for rural households is assumed to be 250 kilowatt-hours (kWh), which, for example, could be provided for the use of a floor fan, a mobile telephone, and two compact fluorescent lights- for five hours daily". In 7th SDG, the Target 7.1 emphasizes that energy access is a crucial variable for the development of society. This target aims to provide universally accessible services of reliable and affordable energy by 2030. This target identifies certain specific indicators such as the rate of change of energy, total population without any access to energy, and total population percentage relying on clean fuels (ESCAP, 2017).

Energy is the basic need to support necessities of human life such as health, education, and related social services, among others. There is a clear and unequivocal relationship between the availability of energy and the Human

Development Index (HDI). In this case, if the HDI levels are low, a short increase in the availability of energy ensures significant developmental growth. This is the reason why the availability of energy is considered very fundamental, particularly in developing states. Two indicators are considered very important regarding the evaluation of access to energy. The first indicator is to access energy, and the second is soiled fuels used for household activities like cooking and heating (Alloisio, Zucca, & Carrara, 2017).

Access to Energy and Sustainable Development Goals

Energy, as the first indicator, is crucial and valuable for sustainable development. It is clean and can convert into other energy forms with virtually 100 % efficiency. Different electric power may be distributed across extended distances among other forms of energy. Therefore, it is considered a significant factor for the development of the states. For the growth and prosperity of human beings, energy is recognized as a vital component. In 2015, adoption of UN Sustainable Development Goals is considered another level of political recognition for the importance of energy development. Access to energy is crucial for the achievement of the targets of SGDs. However, there are better ways to ensure the economic and social progress of a state than giving easy access to energy for household use. Reliable and affordable energy access for daily household use is not everything but must also be accessible for other income generation and public services. Modern and low-cost technologies give fresh opportunities, providing universal access to energy. Despite these efforts, universal energy access is still a challenge, particularly for providing access to sustainable energy at affordable prices for remote and poor household usage. In all the regions of the world, efforts to promote access to energy have had a positive impact, for it has improved the pace of progress in all the fields. In 2016, the total number of people without access to energy was somewhere near 1 billion. From 2000 to this date, almost 1.2 billion people have gained access to energy. In 2015, China announced a universal access of his people to energy, one of the historic and successful stories. Today, nine out of ten people have access to energy in the region. Based on contemporary strategies, trends are the same and even the region looks forward to having access to universal energy by the start of 2030.

Access to Clean Fuels and Modern Technologies

The second indicator is important because people with limited access to modern energy forms use soiled fuels like charcoal and biomass for cooking and heating purposes. Open devices are used for the burning of these fuels in houses, and from the viewpoint of energy, it is considered very much

insufficient. It is also considered very dangerous from the perspective of health because, among other things, it causes breathing problems (Alloisio et al., 2017).

In 2018, almost 3 million people had no access to clean cooking technologies. In 2016, access to clean fuels and cooking technologies improved gradually, reaching 59 % globally. Since 2010, it is ten percentage points. Despite this development, approximately 3 billion people are compelled to use polluted fuels or combinations of stoves for cooking. There is a need to increase the provision of clean energy for cooking purposes by an annual rate of 3% to get access to universal energy for clean cooking by 2030. If the same tendency continues, by 2030, globally, 2.3 billion people will be left without any way to use clean energy for cooking.

From 2014 to 2016, the success in the provision of energy for clean cooking purposes, despite the outpaced population growth outpaced growth of population in certain parts of Asia, is a great outstanding achievement. During the same period, the success rate was marginal in sub-Saharan Africa because the growth rate of the population of the region was four times more than the rate of gaining access to the technologies for clean cooking.

The speedy deployment of technologies of clean cooking fuels has not yet to receive the required political attention. The solution of clean cooking technologies requires low cost in comparison with electrification. There is a combination of factors which include consumer's lack of awareness regarding the benefits of clean cooking fuels, slow progress in clean cookstove innovation, high entry costs for solutions of clean cooking, and insufficient infrastructure for the production of fuel and its distribution. All these factors have kept widespread solutions out of reach for this challenge. (United Nations, 2018)

Target 7.2: Increase Global Percentage of Renewable Energy

Sustainable development through its three developments is influenced by the target of the share of the energy gained through renewable sources to be included, by 2030, in the total energy mix on a global level. In all parts of the globe, renewable energy technologies represent a substantial element in policies meant for greening economies. Renewable energy is also important in dealing with the changes that arise from climate change. There is a mutual consensus that renewable energy is considered an important factor in attaining low carbon and providing a sustainable energy mix. There is no doubt that the concept of sustainability is vast. Nevertheless, when energy technologies are being analyzed, the dimensions of carbon mitigation may be considered in the

most relevant terms. For example, a target set by the European Union is the European Union that the inclusion of 27% of energy produced by the utilization of renewable sources in overall and final energy consumed must be ensured by the start of the year 2030. If achieved, this could spur the provision of clean energy with a dimension of carbon mitigation on ideal grounds.

Renewable Energy

It is expected that renewable energy technologies like wind, solar, geothermal, tidal and waver power, biomass and hydropower will play an indispensable part in providing universal energy services. Through these technologies, the use of local resources is promoted, reducing the use of expensive oil and facilitating state economy. These technologies help states reduce dependency on imported fuel, improve trade balance, reduce national debt, and protect states from oil price fluctuations. Renewable energy is carbon-free source of energy and also a climate-friendly solution. Over the last few decades, positive developments have been seen in cost reduction and improvement in the performance of such technologies. Due to the maturity of have moved consumers from niche to mainstream market (Bartlett, 2012).

The energy generation, produced by using energy generation, created by using renewable sources, is rapidly enhancing. But, to achieve Goal 7, there will be a need for much greater efforts. In 2018, in many places, with the support of the policies, the rapid fall of the cost has made the energy produced from wind and solar cost-competitive, for it is a source of conventional power generation. Currently, at the globe, such sources account for over 50 % of the annual energy production capacity of the globe.

It is evident that the energy required by the developed gadgets for cooling, heating and transportation is not being equaled by the renewable energy added in the total energy mix of the country. In various states of the world, significant progress regarding renewable energy has been noticed. In 2015, China alone accounted for 30% of its absolute growth in global production of renewable energy and its consumption. In all end uses of energy for cooling, heating and transport, Brazil stood among the top 20 largest energy-consuming countries, which substantially exceeded the average of global renewable energy share. In end uses, there will be the need of more efforts to produce energy to meet the demands such as cooling/heating and transport. In global energy consumption, a combination of both kinds' accounts for 80%. Where penetration of renewable energy in total energy mix is low and where unexplored potential exists: one opportunity would be to utilize renewable energy produced by the use solar, thermal, biomass or geothermal sources on district levels for cooling, heating, and other such purposes. As the energy

sector decarbonizes, relevant energy uses can be switched, increasingly. Moreover, for sustainable development of renewable energy sector, there will be a need of making additional efforts to grid issues of integration. It includes the incorporation of battery storage and technology of a smart grid to support the management of variable generation resources (Nation, 2018).

Target 7.3: Double the Improvement in Energy Efficiency

This target of SDG affects all economic sectors. It includes commercial, agricultural, transport, energy industry and household. The economic sector, including its sub-sectors, needs access to modern energy to support economic growth and industrial development. In almost all the states of the world, energy is required to support the economy, and providing this elemental energy for services is expensive. A considerable part of the state economy's revenue is spent on importing energy and its resources.

Efficiency of energy is based on the relationship that exists between energy input and its output. On the domestic front, opportunities regarding energy efficiency progress differently- mainly across states. Hence, there is a need to substantiate the target on domestic circumstances. In SGD-7, the targets of 7.1 and 7.2 may be associated generally with the concept of sustainability, particularly with the viewpoint of affordability. The concept of energy efficiency revolves around the object to provide not only energy services but to achieve high level of energy services with low input of energy. There are two advantages of energy efficiency; one is on supply side to provide energy services at low costs and second for energy consumers to grant them the opportunity to utilize efficient energy at cheaper cost. The concept of efficient energy may not be easily understood, which deals with the terms in general. Nevertheless, its evaluation could easily be calculated through the intensity of energy. The ratio between GDP of a country and the statistic of energy is a sure way to express it. For example, it could be defined as the amount of energy to generate an income from a single currency unit (Alloisio et al., 2017). With the current rate of development in the world, energy efficiency needs to be accelerated. From 2014 to 2015, in light of the intensity of world primary energy, energy efficiency measures fell by the rate of 2.8%, the fastest decline after 2010. Hence, as per need of energy intensity, the annual rate of fall of energy was calculated to be 2.2% per annum over 2016 to 2030, compared with an average rate per annum of 2.2 % over the five years from 2010 to 2015. It necessitates a vital ramp-up in combination with global policy (Nations, 2018).

Target 7-A: Promote Access to Research Technology and Investment in Clean Energy

United Nations defines it as the expansion of global cooperation to promote accessibility towards clean energy research and technology. It includes efficiency of energy, renewable energy, clean and advanced technology of fossil fuel, and promotes investments in clean energy technology and energy and in infrastructure (Tracker, 2023).

Target 7-B: Expand and Upgrade Energy Services for Developing Countries

According to the United Nations, by 2030, upgrade technology and enhance infrastructure to provide sustainable and modern services and energy to the inhabitants of the countries that are under development. Especially landlocked developing states, developing states of islands, and the least developed states in special reference to their respective support programs (Tracker, 2023).

A sustainable supply of energy is compulsory for smooth economic development and swift running of the daily business of the state. Efficient Energy policies are compulsory for better energy management. There is a list of the states that have insufficient energy reserves, but they are managing their state affairs by fulfilling energy needs through efficient energy policies. On the other hand, there is another list of the states that are rich in terms of natural energy reserves. Still, due to poor and lame energy policies, they lack the energy required to run state affairs and are unable to fulfill energy requirements. Thus, it is evident that better and efficient energy policies hold the power to cover up the insufficiency of energy reserves. Still, efficient energy reserves cannot cover up the inefficiency of energy policies.

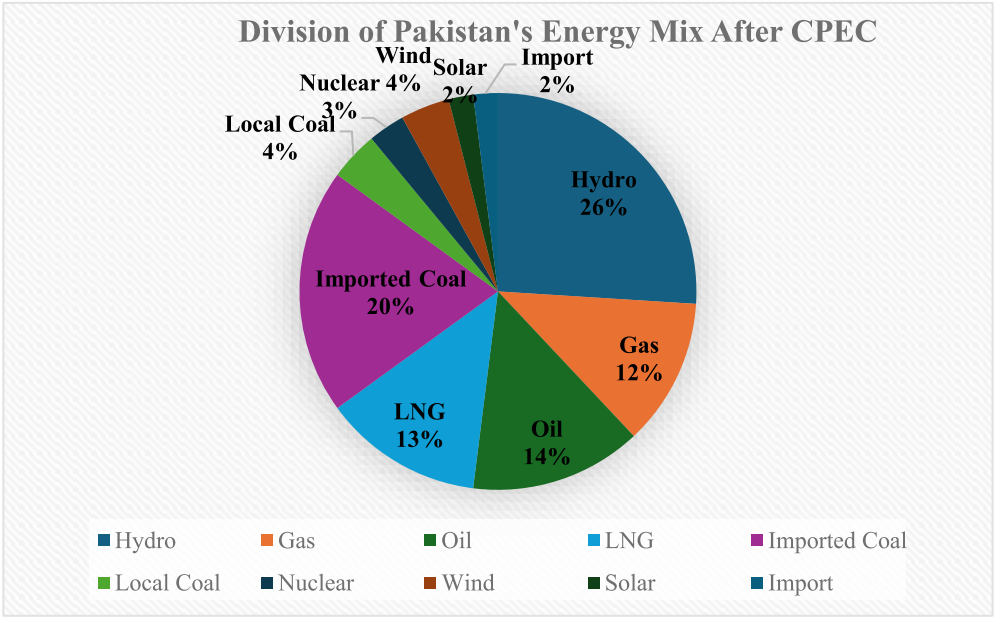
In Pakistan, CPEC has been touted as a gateway to sustainable development. CPEC has the potential to provide affordable and clean energy to Pakistan and lead the nation towards energy security. The lack of sustainable, affordable, and clean energy affects the industry and relevant commercial consumers. It becomes the cause of economic insecurity and puts national security in peril. There are enormous reasons for this scarcity, but political decisions are at the heart of problems.

CPEC opens new horizons of affordable and clean energy in a systematic way to support socio-economic activities in business, industry, and agriculture. The discussion over them goes:

The CPEC Perspectives on Affordable Energy

Energy projects of CPEC, through optimization of energy structure, would reduce dependence on expensive furnace oil for energy production. In 2013, solar and wind energy share in the total energy mix was 5%. In 2022, it will become 10%. Similarly, in 2013, gas and furnace oil provided 57% of total energy mix. In 2022, with the completion of CPEC-prioritized energy projects, it will fall to 25%. As expected, in the same period, the energy mix from indigenous coal will increase from 0.14% to 9.08%, and energy production through bagasse will also increase from 1% to 2%. (Jabri, 2018) In 2015, the energy mix of furnace oil was 39%. Soon, coal in the energy mix will rise to 24%, hydroelectric to 26%, liquefied natural gas to 13%, and non-hydroelectric renewable to 6% (Rafiq, 2017).

When all CPEC projects are operational, they will provide affordable energy to Pakistan. With the start of these energy projects, the share of hydro will reach 26%, followed by imported coal at 20%, furnace oil at 14%, LNG at 13%, Gas at 12%, local coal and wind at 4%, nuclear at 3% at, solar 2% and imported from Iran 2%. Following figure shows the perspective of Pakistan's energy mix, when once the energy prioritized projects of CPEC are duly completed.



Source: Division of Pakistan's Energy Mix After CPEC

To manage the energy crisis, there is a need for some concrete initiatives with the aim of achieving notable achievements in the energy sector. When energy projects of CPEC start to function, the composition of the energy mix of Pakistan will undergo notable changes. By the end of 2020, the renewable energy projects have given sufficient input to the system. Furthermore, Pakistan's energy mix will be tilt towards coal. Till now, the share of coal in the energy mix is negligible.

In CPEC-Energy Priority Projects, there are 15 projects with 11,110MW production capacity. Currently, seven projects are functioning while the remaining are under construction with 6910MW production capacity. Currently, Sahiwal Coal-fired power plant (2*660MW), Three Gorges second and third wind power plants, Zonergy Solar Park (300MW), Port Qasim Coal-fired power plant (2*660MW), Sachal wind farm (50MW), Jhimpir UEP wind power projects and Dawood Wind Farm (50MW) are functioning. Through these projects, 3240MW of energy has been added to the national grid. ("Latest Progress on the CPEC," 2018) These projects provide affordable energy to the national grid to support the socio-economic, business, industry, and agricultural sectors of the state.

In the contemporary arena, energy plays a pivotal role in every domain of human life, which includes socio-economic, business, industry, and agriculture. Energy has become a necessity because human daily life revolves around this. Indeed, energy is a fundamental element of the progress and development of a country because it has a huge impact on social and economic uplift. Many third-world nations are facing the problem of a severe energy crisis, including Pakistan. Pakistan is suffering from adverse effects of energy crises. Pakistan has plagued the manufacturing industry, falling agricultural yield, reducing exports, which is directly affecting the economy and the business community, and due to this, unemployment is increasing. The export of the country is declining in a constant manner continuously, thus creating a massive trade deficit. The balance of payment crisis is evident nowadays. Textile units in different parts of the country stopped working, and most of them have shifted abroad. It is safe to envisage this thing that our economy is becoming like a casino economy. The crisis is soaring poverty and has wrecked lower GDP growth and economic progress. It is very accurate to say that the contemporary energy problem is hampering the overall progress of the country discretely. It seems that the government is not serious about dealing with this problem because they have made no serious effort to counter it in the last two decades. As Ishrat Hussain, former state bank governor, calls these decades a lost decade in his recent book. Simultaneously, the demand for rapid growth, energy theft, and transmission losses due to poor infrastructure have worsened the adverse situation. But after these long-term woes, CPEC looks

like a ray of hope accomplished with various energy projects will help in a potential way to overcome these crises. Both countries, China and Pakistan, have made plans to produce new power plants. Desert Thar could generate almost quadrant of the state's conductivity. In the muddy and crumbly area of the Thar desert, Pakistan has started to scrape out the desert, which is full of mineral and natural resources. It is also considered muddy, dirty and inferior, which is not true. it is one of the biggest resources and a full desert which can generate advanced power plants that can boost the state finances. This task is very costly than the rest of the others, but as China is propping up Pakistan, so it has developed each one for $62 billion fiscal cooperation.

In the developmental life of a state, energy brings wealth, and wealth brings prosperity. The society of Pakistan is under a crisis caused by an energy crisis. Therefore, energy consumers- socio-economic, business, industry, and agriculture- pay high prices to deal with the energy crisis. However, considering the energy crisis's complexity, previous governments took certain measures to provide energy at affordable prices. They started CPEC projects, with the support of China, to manage the energy crisis. CPEC will provide sustainable energy at affordable prices to bear fruitful results in transforming their miseries. For developing nations like Pakistan, affordable energy is necessary for development. The affordability of CPEC energy and its relationship with development is discussed in the following sections.

CPEC, Energy and Socio-Economic Development

Globally, the prime concern of policymakers is to provide sustainable and affordable energy to many populations. Affordable and reliable energy plays an important role in the socio-economic progress of a nation. In Pakistan, to support socio-economic activities, CPEC is providing affordable energy in a diversified way. Energy affordability through CPEC is bringing numerous changes that give the common man a deep-seated benefit. Like many developing nations, to support socio-economic activities, Pakistan, through CPEC energy, is also struggling to provide affordable energy to society.

A sustainable and affordable energy supply brings economic uplifts and thus contributes to the socio-economic betterment of a nation. China's investment in energy infrastructure for socio-economic development is highly welcomed. The crisis of energy supply outstrips every year. This energy crisis frequently causes blackouts and power outages, which pose a 2% GDP loss per annum. The country's population, worsening the situation, is increasing at 2% per annum. The youth, almost half of the total population, is unemployed and lacks productivity. Due to no job or lack of job security, unemployment is

increasing and affecting the social and economic life of people (Markey & West, 2016).

For socio-economic development, CPEC energy is the lifeline. A sustainable supply of energy will improve the social sector and also bring sustainability to the economic sector. Experts believe that sustainable and affordable energy is essential for the success of a nation. An energy-self-sufficient state strongly supports the welfare of its masses. Affordable energy gives a strong foothold to a nation to improve the social and economic life of the common man. In a state where the economic condition of the masses is sound, the ratio of crime and robbery will be meek. Sound economic to conditions bring social awareness, which will ultimately benefit the national economy. Unfortunately, the socio-economic progress of Pakistan is stuck in an energy crisis. It also disturbs GNP and GDP. However, the affordability of CPEC energy will bring positive changes in the economic and industrial development of the nation. CPEC energy is a pedal ship for socio-economic development because energy affordability and economic development go hand in hand. It will provide opportunities for inflow of foreign investment and support the betterment of a common man (Khan, Ahmed, & Malik, 2013).

The supply of affordable energy will improve economic progress, which is hampered by a severe energy crisis. CPEC energy will help the economic sector in three ways.

1. Through various energy projects, trade flow will be increased and improve socio-economic condition of society.
2. Improved energy conditions will help industry to produce high-quality goods, and infrastructural projects of CPEC will reduce the transportation cost.
3. Road connectivity with other regions will improve regional economic integration, promoting trade opportunities and benefit local businessmen and common people. (Markey & West, 2016)

An affordable and sustainable supply of CPEC energy will provide various job opportunities. The International Labor Organization says that CPEC will provide about 40,000 job opportunities. Applied Economic Research Centre calculates that from 2015 to 2030, CPEC will provide 700,000 job opportunities to local people (Pakistan, 2016). Given another report, CPEC will employ 30,000 people in various fields. Infrastructural development will facilitate around 13,000 people by providing jobs, while the energy sector will facilitate only 16,000 people (News, 2017).

CPEC is a multi-billion-dollar project under which improved and affordable energy conditions will enhance the opportunities of employment and improve

the socio-economic condition of society. Completion of CPEC projects will lessen the ratio of unemployment and give benefit to local people. Better socio-economic conditions will create a society with a good lifestyle. CPEC will provide strong footholds to the economic sector and will bring prosperity to Pakistan.

CPEC, Energy and the Business Sector

Energy is an engine of economic development and a major factor in easing power outages and improving the business of millions of people. CPEC energy is a morale booster for the business sector, which has lagged other South Asian States, except Afghanistan. CPEC energy affordability for the business sector will bring stabilization, development, and prosperity. CPEC energy projects aim to bring advancement in the business sector and make them compete with the international business community. A representative of the Business Council in Pakistan argued that CPEC is primarily a geopolitical project, and economics is merely added to it. However, the business community does not hold this view. Some believe that, despite fragile economic conditions, CPEC may demonstrate useful impacts.

CPEC is more than trade routes and infrastructural projects. Infrastructure is important for long-term economic stability. Nevertheless, CPEC energy projects are assistance, providing affordable energy which is crucial for the development of the business sector, which is crucial for the development of the business sector development. The government's top priority through CPEC is to provide sustainable energy on affordable prices to facilitate business. It is because the success of the business sector eventually enhances the economic prosperity of a nation. Production of energy and its availability at affordable prices for business is the key to prosperous economic development.

CPEC will provide affordable energy to the national grid and will support millions of public and private businesses. An affordable and clean supply of energy will bring improvement and award ease to business. It will also increase prospects of higher business. The biggest issue with the energy sector is the production of expensive energy. In CPEC, the production of cheap, affordable, and sustainable energy will bring prosperity by supporting businesses and the business class.

CPEC, Energy and Industrial Development

Economic development of a country revolves around industrial production. The availability of sustainable and affordable energy for industrial development is the top priority of the government. It is a key to long-term

sustainable industrial development, as the industry needs sustainable supply at affordable prices. In 2013, under CPEC, it was planned to provide affordable energy to industrial estates with reduced power outages. It would support the GDP growth rate, which is expected to increase to 7.5% by 2030. It will provide millions of jobs, and unemployment will be reduced. In Pakistan, it is predicted that urbanization will increase by 50% to 60%, and the growth of GDP reach 8% by 2025. This GDP growth with rapid urbanization and industrial development will increase energy demand (Vision, 2014).

Thermal energy is 64% of the present energy mix. Furnace oil is the major source which is used to run thermal energy plants. The major ratio of this oil is imported. So, when oil prices increase in international markets, it also shocks the national economy. This imbalanced energy mix is highly vulnerable and burdens the economy. The reliance of CPEC energy on indigenous resources is expected to have positive impacts on industrial development and the balance of payments. The affordability of CPEC energy for the industrial sector will improve not only the capability of production but also the cost of production. Thus, the industrial sector will be relaxed and get rid of the present financial crunch (Mirza, Fatima, & Ullah, 2019).

The industry of Pakistan is facing a severe energy crisis. The rapid increase in economic activities due to CPEC connectivity projects with other regions will influence energy security and the economy as well. The establishment of Special Economic Zones (SEZs) under CPEC will be an additional burden on the energy sector. Therefore, energy projects' top priority is to provide affordable energy to industry. The successful completion of energy projects will satiate industrial energy demand. With the establishment of industrial zones, energy consumption is expected to grow at a higher pace. The affordability of CPEC energy will provide energy security to industries, which will strengthen the national economy (Mirza et al., 2019). For Pakistan, industrial development cannot be achieved without an affordable supply of CPEC energy.

Energy affordability will provide an opportunity for the industrial sector to increase its production at a lower cost. It will increase trade volume, giving the commons a direct benefit. Compatible prices of local industrial production will meet domestic needs and compete in international markets. Affordable energy will be a golden opportunity for the industrial sector, and products of local industries like garments, cotton, wheat, the industrial sector, and products of local industries like garments, cotton, wheat, and the like will compete in the international market (Perveen & Khalil, 2015). A sustainable and affordable supply of energy through CPEC will also have positive impacts on commerce and trade.

CPEC, Energy, and Agriculture

In low-income economies, agriculture always serves as the backbone for the state's economic growth. Generally, it is the source of employment and income in rural areas. During the last decade, the agriculture of Pakistan has been facing a downfall, which is the outcome of the energy crisis. Pakistan is an agrarian economy. Most people are affiliated with this sector and rely on it for their livelihood. The income of 65% of people is linked with agriculture, and it contributes to around 24% of the GDP. More than 43% of labour is related to agriculture and is a significant foreign exchange earnings source (Hafeez, 2018). Thus, this sector has become an important pillar of the economic life of the people of Pakistan. Despite its persuasive significance, it has failed to perform at its utmost capacity due to the energy crisis. Energy crises render farmers incapable of giving in-time crop yields, affecting agricultural goods' export.

Initially, in CPEC, the agriculture sector was completely ignored. Later, in the Long-Term Program of CPEC, agriculture appeared as the top priority. In ongoing energy projects of CPEC, this sector received great benefits as tube-wells benefits as tube wells, which were running on expensive diesel or WAPDA energy, are converted to cheap energy sources like solar energy (Ahmed & Mustafa, 2016). Tube-well irrigation is very expensive due to high energy tariffs ("CPEC- Prospects and Challenges for Agriculture in Pakistan (Vision-2025)," 2023). Renewable energy sources of CPEC are introducing new concepts of cheap energy production. Energy affordability, using efficient technology, is bringing positive changes.

This sector is a direct or indirect beneficiary of CPEC energy through the development by developing fresh ideas in energy production, which would open forward linkages. The affordability of CPEC Energy will uplift the agricultural sector and enhance the trade of agricultural products. In this sector, CPEC energy will bring stability. Affordable energy will boost the confidence of farmers' confidence, and better infrastructure will open avenues of export in the international market. Energy projects of CPEC will provide sustainable energy to local farmers, which will end up the problems caused by power outages. Energy affordability for the agricultural sector will bring economic stability to the country. Overall, economic benefits will also facilitate farmers (Energy, 2023).

It is expected that the successful completion of CPEC energy projects will not only provide affordable energy to agriculture, but it will also bring revolutionary changes in the growth of agricultural products.

In Pakistan, CPEC has been touted as a gateway to economic stability. CPEC has potential to solve Pakistan's energy crisis and lead the nation towards energy security (uddin Ahmed, Ali, Kumar, Malik, & Memon, 2019). Under CPEC, major focus is on energy production to manage chronic energy crisis of Pakistan. This energy scarcity and lack of reliable and affordable energy supply has affected industry and relevant commercial consumers. It has become the cause of economic insecurity, and it has put the state's national security in peril. There are enormous reasons of this scarcity, but political decisions are at the heart of the problem. Successive political governments failed to prioritize energy and the implementation of long-term energy development plans.

The energy production cost of CPEC coal-based energy projects is less than hydro, solar and wind. In terms of tariffs, coal-based projects will give direct benefits to consumers. There is immense pressure on the government to provide affordable and clean energy to consumers. CPEC, through its energy projects, is providing affordable and clean energy to energy consumers of Pakistan. Considering affordability, CPEC energy production, per unit cost will be cheap. The cost of imported coal based one unit will be Rs 8.5/U, followed by local coal Rs 8/U, LNG fuel RS 9.5/U, Solar Rs 5/U (Awan, 2018) and hydro Rs 5.17/U. (Rana, 2019) When CPEC energy projects will provide energy to national grid, there will be sharply decreased in tariff 16-18 rupees to around 8 rupees per unit. Through these plants, reliance of energy-mix on furnace oil and gas will also reduce (Asif, 2009). This affordability of CPEC energy will become a source of affordable energy through indigenous resources for developing the national economy.

SDG-7 and Clean Energy

The impacts of energy on systems of the environment include the local and global pollution from fuel combustion, the use of coal for different purposes and climate changes that affect the stability and reliability of various ecosystems. The actual impacts are based on the sources of primary energy, the location and size of the system, the technology of conversion, and other related factors. Energy is also a key factor behind human health problems, mainly due to air pollution caused by fuel consumption. In the United Nations Environment Program, it is believed that a sustainable supply of energy provides certain ways to transfigure and glorify the lives of the citizens and the economies of states, safeguarding the ecosystem of the planet. That is why, through SDG-13, the United Nations is working with the states to improve the efficiency of energy and to promote the increased use of energy produced by

the use of renewable energy sources. Through this goal, the UN is focusing on four areas of energy.

1. Improve the understanding of science, promoting the link between the environment and energy.
2. Provide some advice to governments on sound environmental policy.
3. For clean energy, catalyze private and public finances.
4. Support uptake of technologies related to clean energy.

Different partners of the UN are jointly working to improve the efficiency of energy in buildings, urbanization, transport, and appliance manufacture. They are working to strengthen the business case for energy efficiency, in emerging economies and developing states, which also includes the efforts made on city level. The work of the UN contributes to SDG-7 (Energy) and 13 (Climate Action) implementation and supports major processes of the UN like the UN Framework Convention on Climate Change (UNFCCC). It also includes sustainable energy for all initiatives. UN Environment, in partnership with the Copenhagen Centre on Energy Efficiency, the Government of Denmark and the Danish Technical University, established the hub of energy efficiency and sustainable energy for all. This Centre also functions as the secretariat of the Global Energy Efficiency Accelerator Platform (Nation, 2018).

CPEC Perspectives on Clean Energy

The optimized energy structure of Pakistan will ensure certainty of a clean energy supply. CPEC has twenty-one energy projects to meet rising energy demands. These projects are divided into three separate categories.

1. First, CPEC-Energy Priority Projects, has fifteen top priority-based projects. It has 7 Coal, 3 Wind, 3 Hydropower and 1 Solar based project for energy production. It also has a project with 2 transmission lines. They will not only provide a sufficient and clean supply of energy to the national grid but also support the rest of the CPEC projects.
2. Second, CPEC-Energy Activity Promoted Projects. It has 4 energy projects: 1 Coal, 2 Wind and 1 Hydro.
3. Third, CPEC-Potential Energy Projects. It has 2 hydel energy projects.

In CPEC energy, share of coal-based projects is high. In 7 coal-based projects 3 projects are Thar coal based and 4 are based on imported coal. However, hydropower comes on the second in the total energy mix. Three hydel power projects are installed on different rivers, as per technical feasibility. The share of solar energy is higher than wind. There is 1 solar project and 8 wind based projects. Though the share of renewable energy is not up to mark, yet it is a

bright spot for Pakistan. Following table shows sources of CPEC energy projects.

Sources of CPEC Energy Projects

Sr. No	Source	Share in Total
1	Coal	69%
2	Hydro-Power	21%
3	Solar	7%
4	Wind	3%

Source: China-Pakistan Economic Corridor 2017, http://cpec.gov.pk/

In CPEC energy projects, four key sources, coal, hydel, wind and solar are being used. Pakistan is also focusing on enhancing the share of renewable energy in energy mix. For a long time, Pakistan has been focusing on renewable energy resources. CPEC renewable energy projects are solely focusing on this dimension. These projects are environmentally friendly, and Pakistan has substantial renewable energy potential. This positive dimension of renewable energy technologies has increased the desire for China to invest broadly. By 2020, China invested $400 billion in renewable energy. By 2030, it desires to constitute 20% of its renewable energy mix. That is why. These technologies have central place in the energy projects of China is promoting renewable energy through CPEC. These technologies have a central place in the energy projects of the corridor. These projects will provide Pakistan with an opportunity to manage its energy insecurity. They can potentially reduce the level of energy insecurity while providing affordable and clean energy to energy mix. Based on various types of technologies, CPEC energy projects have great potential for the energy sector of Pakistan because this sector is struggling hard to cope with the energy crisis, and these crises are affecting the GDP of the country.

This massive investment in China will increase sustainability, certainty, and affordability in the energy sector of Pakistan. Through this $34 billion investment, CPEC energy projects will produce 1700MW of energy, which is sufficient not only to manage the current energy crisis but also to have surplus energy. This surplus energy will boost the industrial capacity of the nation and improve the socio-economic condition of people.

In CPEC, the key focus is on energy production, utilizing four technologies. CPEC energy production portfolio source A major source of the CPEC energy production portfolio is based on coal which will provide 9540MW, followed by hydropower 2919MW, solar power 1000MW and wind 347MW (Awan, 2018).

Green energy is at the heart of all ecological strategies. Green energy effects a state in social, economic and environment related areas. It is a sustainable energy which does not harm the environment. The process of production of green energy is clean and it basically participate in reduction of pollution. Sources of green energy are wind, solar, hydro, geothermal and etcetera.

Clean and Green CPEC Energy

In December 2020, during a meeting between the authorities of both sides agreed green initiative of CPEC. Special assistant of Prime Minister on climate change briefed a delegation headed by Chinese ambassador regarding Pakistan's initiative on 'Clean Green Pakistan'. In it, the major initiative was "Ten Billion Tree Tsunami program". The government of Pakistan has initiated "Ten Billion Tree Tsunami Program" with the cost of 125.1843 rupees. It is a four-year program (2019 to 2023) and is being implemented through the Ministry of Climate Change. According to the ministry plantation target of 430 million trees has been achieved and till 30 June 2021, the target of 1 billion plantation will be achieved (Coordination, 2023).

In 2020, Prime Minister Imran Khan, during his address before Climate Ambitions Summit, had expressed his desire that Pakistan will fulfil 60 percent of its energy needs through renewable energy resource at the end of 2030. To meet this target, the government has initiated tsunami tree plan, but this is not enough. There is a need of encouraging investments in renewable energy generation. It is also necessary to convert coal-based power plants to reduce CO^2 emission levels. According to Xinhua (News Agency), in CPEC, a few coal-based energy projects (i.e., Rahimyar Khan Imported Coal Power Plant) have been stopped and government is planning in increasing the share of renewable energy projects which is a good sign. To counter climate change threats on CPEC, there is the need of more attention i.e., increasing focus on renewable energy projects, instead of stopping coal-based energy projects. Under energy projects of CPEC, China is specially focusing on non-polluting sources of energy production (Amount Not Specified Yet). Both China and Pakistan are strengthening their bilateral cooperation in renewable energy production and CPEC is utilizing three sources of clean energy which include Hydel, Wind and Solar (Duan, Khurshid, Nazir, Khan, & Calin, 2022).

It is necessary for Pakistan to enhance its cooperation with China in getting environmentally friendly sustainable energy. In CPEC, Pakistan must give priority to renewable energy projects to address environmental challenges. Both China and Pakistan are required lot of work if they want to turn CPEC into a blueprint for greening the ambitious BRI. (Ali, 2021) There are certain

obstacles in greening the CPEC, but renewable energy projects provide opportunities for clean energy Investment in CPEC.

It is not easy to undo the CPEC energy provided so far. There are certain obstacles to ramping up this energy. When the idea of coal power plant was initiated before the CPEC, Pakistan was facing the problems of Sever power shortage, high generation cost and circular debt. In 2015, there was 5000MW to 7000MW of demand and supply gap and the nation was facing terrible energy crisis. So, coal became the solution of these crisis. Government of Pakistan wants to use coal to replace expensive oil and gas imported from overseas. When CPEC was initiated in 2015, it became an opportunity for Pakistan to use coal as window to achieve its power development goals. Pakistan has abounded coal reserves and it attracted foreign investors for coal-based power plants and facilitate them. Renewables were not comparative as coal in terms of the generation cost during that time. But now the situation is quite different there is the tendency of power surplus in Pakistan and coal power is losing advantage over renewables in terms of the cost. At present, the share of coal-based energy is very basic and it not easy to undo this energy. However, things can be managed by increasing the share of renewables. But it will increase the cost which cannot be determined yet and will also take time. There are also certain obstacles in greening the CPEC as:

1. State Owned Enterprises and government bodies driving decisions.
2. Access to finance
3. Preference for fossil fuels among policymakers in Pakistan
4. Reflects of BRI trends

Despite of above mentions hurdles, Pakistan is also making its new renewable targets. Now both sides are focusing on making the project greener and environmentally sustainable. They are also incorporating long term issues like climate change and ecological risks into the decision making. Greening BRI and CPEC is Chinese official project which is a positive step. It also shows how seriously things are being taken at the top level. China will also help Pakistan in green CPEC because there are strong moments in and outside China regarding the promotion of green energy. On CPEC, China’s reputation as green leader is at stake.

CPEC renewable energy projects will be significant to improve environmental sustainability. Moreover, Chinese experience in renewable energy production will for benefit Pakistan’s journey towards renewable energy. At present, expensive furnace oil is used for energy production. At the time of any critical situation, the country's reliance on furnace oil may lead to price shock and increase vulnerability in future.

Focusing on SDG-7, CPEC is directly related to achieving this SDG's targets in Pakistan. Like many other developing countries, around 30% of Pakistan is population lives without any energy access. Energy projects of CPEC are the key source of providing affordable and clean energy to support the energy sector of Pakistan. There are four major CPEC sources of energy production, and till now, the country has made considerable progress in getting the share of energy. Among 21 energy projects, 7seven projects have, and 7 started to function within three years of their groundbreaking ceremony in 2015. These seven projects are providing 2937MW of energy to the national grid. At the same time, construction of the remaining projects is in progress. The development of CPEC projects will improve Pakistan's energy sector.

Conclusion

All energy experts agree that CPEC will provide Pakistan with affordable energy. The cost of CPEC energy units will be very low, affecting the present high price of energy. Unanimously, CPEC energy will bring sustainability to the supply of energy supply which will ultimately benefit people, businesses, industry, and agriculture. On the side of clean energy, 13 experts agree that the environment will have no issue with CPEC energy projects. They also give their expert opinion that Pakistan is much lower in terms of carbon emission when and if compared with developed or other regional states. Four energy production sources of CPEC, the problem lies on the coal side, which can be controlled by using advanced and efficient technologies which the four energy production sources of CPEC; the problem lies on the coal side, which can be controlled by using advanced and efficient technologies that reduce CO_2 emission. However, in the opinion of two experts, CPEC coal-based energy projects will harm the environment. At the same time, other energy sources have no issue with the environment.

By of completing CPEC long-term energy projects, the energy mix of Pakistan will acquire a sustainable balance by 2030. Pakistan's energy security. Through CPEC energy, the current reliance of Pakistan on both expensive furnace oil and seasonal hydel power will be diversified towards renewable energy technologies. CPEC Energy will enable Pakistan to provide cheaper energy by 2030. CPEC energy will give a better chance to reduce the cost-tariff deficit. the energy system of Pakistan will be resolved by the reduction of the cost-tariff deficit. The reduction of the cost-tariff deficit will resolve the issue of circular debt in the energy system of Pakistan. The Utilization of cheaper and renewable energy will also reduce production costs, which will directly benefit end users.

The purpose of sustainable goals is to achieve sustainable development in each country. With the support of the United Nations, every country is trying to

these goals' objectives by 2030. In the network of sustainable development goals and their indicators, Pakistan, compared to other middle-income states, is doing better. The government of Pakistan, with the support of relevant stakeholders, adopted Pakistan Vision 2025. To manage the energy crisis, China is supporting Pakistan through CPEC. The major focus of CPEC is on energy, of which a sufficient amount has been fixed. The key purpose of CPEC energy for Pakistan is to gain energy independence. Energy independence will finally lead towards energy security. As CPEC energy mainly depends upon indigenous resources, through it, Pakistan will gain a realistic way of energy security. These energy projects will bring sustainable and durable energy to Pakistan to overcome its energy scarcity.

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