

# Leveraging Global Partnerships to Achieve SDG 7: A Case Study of Pakistan

Khalil Raza (✉ [k.raza@ecosf.org](mailto:k.raza@ecosf.org))

ECO Science Foundation <https://orcid.org/0000-0002-7082-5951>

Sardar MOHAZZAM

National Energy Efficiency Conservation Authority

Saadia QAYYUM

World Bank

Manzoor Hussain SOOMRO

ECO Science Foundation

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## Research Article

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# Abstract

Energy is fundamental to socio-economic growth for the world; but how this energy is generated and distributed would determine whether the world could achieve a sustainable future. There is no denying the fact that energy is one of the primary sources of greenhouse gas (GHG) emissions. Thus, addressing the climate crisis, sustainable energy lies at the core of both the United Nations' Sustainable Development Goals (SDG) and the Paris Agreement. Among other goals, SDG 7 calls for affordable, reliable, sustainable and modern energy for all by 2030 (UNDP, 2017).

Globally, about 1.2 billion people lack access to electricity. The situation is more dire for clean cooking with about 2.8 billion people – 30% of the world's population – lacking access (Sustainable Energy for All, 2020). The fact is that the energy use in developing countries would continue to increase (Catherine, Orie, & Paul, 2012). This growth could provide an opportunity for the deployment of renewable energy sources, as well as the creation of new, more efficient energy infrastructure.

Unfortunately, for developing countries, the clean energy solutions are neither affordable nor accessible, even with the decline in the cost of renewable energy technologies. As a result, many global initiatives and partnerships, such as Sustainable Energy for All (SEforALL), Global Environment Facility (GEF) and Green Climate Fund (GCF) have been established and working towards achieving this goal (Global Environment Facility (GEF), 2017). However, there is still a need to emphasize and reinforce this partnership to achieve the universal energy access by 2030.

The world community has developed many platforms and financing mechanisms to transfer the resources from industrialized nations to developing countries, such as Clean Development Mechanism (CDM) under Kyoto protocol (UNFCCC, 2012). However, these mechanisms have not been really effective in encouraging investments in clean energy due to low carbon pricing.

Hence, this necessitates for international community to come forward for the development of innovative assistance programs for developing nations by investing more resources to achieve SDG 7. Therefore, to accelerate the clean energy transition, global partnerships and technological platforms will be needed to make clean energy investment economically competitive and viable.

This work presents a case study on Pakistan's response to achieve the SDG 7 under the UN global mission of Sustainable Energy for All (SEforALL) program. It discusses the key milestones, barriers and lessons learnt on SDG 7. Based on the experiences of Pakistan, this work explores viable alternatives of financing mechanisms to accelerate sustainable energy. The paper concludes with key recommendations as to how global partnership could unleash the technological and financial opportunities in achieving ambitious and universal goals of sustainable energy.

# Background

Progress towards addressing the climate change has been modest over the past decades despite the ever-increasing significance for action against global warming. Climate change is fundamentally driven by the emissions of Green House Gases (GHGs) into the atmosphere, such as carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) (US EPA, 2016). Therefore, there is a need to halt anthropogenic climate change with radical transformation of GHG emitting sectors. Worldwide, energy sector that drives the global economy is responsible for over 70% of global GHGs (Mengpin & Johannes, 2020). The energy sector includes transportation, electricity and heat, buildings, manufacturing and construction, fugitive emissions and other fuel combustion. Thus, it necessitates that for drastic transformational change in the energy system with a vision to achieve sustainable development and to improve the well being of billions who lack access to reliable and clean energy to meet their basic needs.

Energy plays a critical role in enabling sustainable development, as highlighted at the Rio+20 Sustainable Development conference (UN DESA, 2012). Furthermore, United Nations Secretary-General Ban Ki-moon declared 2012 the year of 'Sustainable Energy for All' (SEforALL) and launched a new global initiative that explicitly focuses on taking energy as a starting point to achieve several global sustainability objectives, including defeating poverty and ultimately halting anthropogenic climate change (UN SEforALL, 2015). The SEforALL initiative is built on three core energy objectives, each of which should be reached by 2030:

## **1. Ensuring universal access to clean and reliable energy**

Three billion people lack access to either electricity or clean fuels for cooking, or both; this has severe, adverse implications for human health (WHO, 2009). In practice, ensuring universal access means providing electricity to remote and poor rural areas, as well as the substitution of traditional biomass such as solid fuels or firewood by cleaner and modern energy services and appliances using efficient cookstoves, natural gas, or liquefied petroleum gas (LPG).

## **2. Doubling the share of renewable energy in the global energy mix**

This requires increasing the share of renewables in global final energy mix, which is final energy available to actual users from 15% to 30% by 2030 (IRENA, 2017). For example, the wind, solar, hydropower, biomass and geothermal power are all sources of renewable energy.

## **3. Doubling the rate of improvement in energy efficiency**

Energy efficiency of the global economy is interpreted as a goal to reduce the amount of energy required to provide products and services. This objective has been translated to an average improvement rate for global energy intensity, which is measured in units of final energy per gross domestic product of a nation.

More specifically, this signifies the target of achieving a global energy intensity improvement by an average rate of 2.4% per year between 2015 and 2030 in comparison to historical rate of 1.2% annually (Djaheezah, 2017).

## **Sustainable Energy For All (Seforall) Initiative In Pakistan**

This work utilizes the guidelines established by the Global Tracking Framework on SDG 7 to assess the interventions needed to meet SEforALL targets for Pakistan using a bottom-up approach. The Global Tracking Framework is a joint effort of multilateral development agencies to track the world's progress towards the three SEforALL goals to be achieved by 2030 (ESMAP, 2016). In this process, national and provincial stakeholders were identified to provide their inputs on creating a reliable, affordable and sustainable energy market.

This study is based on consultations, policy dialogues with federal and provincial governments, interviews of private sector stakeholders, review of plans and policies of different energy sector institutions, financial and technical analysis of financial institutions, and evaluation of international donor agencies programs in Pakistan. As an outcome, a comprehensive and integrated National Action Plan (NAP) was developed with technical and financial support of United Nations Development Program (UNDP) to accelerate transition towards SEforAll goals for Pakistan in short, medium and long term goals (UNDP, 2019).

Energy is one of the most important contributors that drives economic growth for Pakistan. Access to clean and reliable sources of energy is essential to achieve desired socio-economic development in Pakistan. Pakistan is blessed with an enormous amount of renewable energy resources. The country has an excellent solar insolation; an extremely good wind energy potential; 1054 KM long coastal line with a resource of tidal energy; large livestock population and agricultural waste to generate bioenergy (AEDB, 2015). Despite the massive energy resource potential, energy infrastructure in Pakistan is still underdeveloped and energy resources remain underutilized. The existing energy infrastructure is insufficient to meet the energy needs of the people, particularly those living in the remote locations (Ichord, 2020).

As a developing country, Pakistan faces a number of challenges related to overcoming poverty and improving the health, education, and employment opportunities for its large and lower income population. The energy sector is vital in addressing these problems, however, the major constraints are inadequate investment, unreliable energy supplies, weak governance, and poor fiscal management.

Pakistan's energy sector remains one of the main obstacles to economic growth. Although Pakistan has managed to increase power generation since 2013 and mitigate power blackouts that plagued the country over the past decade. After spending decades tackling electricity shortages, Pakistan now faces a new and unfamiliar problem: too much generation capacity (Mangi, 2021). In past decades, the country's energy sector relied on expensive fuel sources mostly on imported energy products, chronic natural gas

and electricity shortages, major debt in the power sector, and aging and insufficient transmission and distribution systems have prevented the sector from growing and modernizing.

## **Objective 1: Access to Modern and Clean Energy in Pakistan**

There are many variants and definitions of energy access. However, we take the energy access as percentage of the households with an access to either electricity connection or gas pipeline network. It is also important to understand that access to the grid or piped network does not guarantee an adequate or reliable supply of energy because many households face intermittent or low voltage/pressure of supply of energy.

In Pakistan, 73% of population has an access to grid electricity (Syed Aziz, *et al.*, 2019). This means 55 million people or 8.8 million homes with an average household size of 6.354 are living without access to electricity. Insufficient generating capacity and lack of grid network for rural areas are one of the major challenges to electricity access. There are 32,266 villages in the country which will remain without grid access (NEPRA, 2020). These villages have sparsely distributed population and are in remote locations which is making expansion of grid financially unviable and technically challenging.

It is pertinent to note that the connection to the grid does not equate to the availability of electricity. Most of the villages officially listed as electrified, continue to experience long hours of blackouts; thus being forced to spend more than half of the day without electricity. According to the Solar Consumer Perception study conducted by IFC Lighting Pakistan program (2015), 73% of the country's population experiences few hours of blackouts. Thus, SEforALL goal is to achieve 100% electricity access in all the regions and to ensure 24 hours of uninterrupted supply of electricity to the customers.

In terms of access to natural gas network, only 25% of population has an access to natural gas network. This indicates that more than two-third of population have to rely on inefficient and unhealthy recourses such as fuel wood, dung and other biomass to meet their basic energy needs for cooking, space heating and water heating etc. Thus, it requires scaling up the off grid-solutions and other renewables in large part to bring energy access to millions of people. The high capital cost of laying gas pipelines and due to depleting reserves of natural gas, households continue to switch to more expensive LPG cylinders (transported from down-country) or those who cannot afford LPG fulfill their heating and cooking requirements through firewood and coal.

Traditional fuels like firewood, dung and residues currently contribute a major share in meeting the everyday energy requirements of rural and low-income urban households in Pakistan. Our analysis demonstrated that in Pakistan, almost 60% of the country's population uses wood for cooking, followed by gas (22%), crop residuals (11%) and dung (7%).

Scaling up of renewable energy technologies would be the most preferred and cost effective route to ensure improved energy access in rural or remote areas of Pakistan, as it eliminates the need of extending new power and gas network to those far off areas which would ultimately result in huge savings in capital expenditures.

Worldwide, the costs of these clean energy technologies are constantly declining and their efficiencies are improving; some of these technologies have already reached grid parity. Given this trend of improved economics and technical viability, renewable energy technologies are the most suitable options for generating clean electricity for both the large scale – grid connected plants and also an excellent choice for the off-grid applications.

Also, it is uneconomical to connect these remote areas to electricity grid mainly because of low energy demand in remote regions where population density is low, towns/villages are located far away from each other and most importantly, the limited paying capacity of people living in those areas. Therefore, we have to rely on solar and other renewables in large part to bring energy access to millions of Pakistanis.

## **Objective 2: Doubling the share of renewable energy in Pakistan**

Pakistan has tremendous potential to harness renewable energy, which includes wind potential of over 50,000 MW (Renne, 2007) in several wind corridors, and an exceptionally good solar resource with an annual average Global Horizontal Irradiance (GHI) of 2322 kWh/m<sup>2</sup>[1] and; large livestock population and agricultural waste to generate bioenergy.

However, Pakistan has been transitioning at a much slower pace in terms of renewable capacity additions of solar and wind both at utility and distributed generation scale. Although hydropower has traditionally been the most prominent source of renewable energy in Pakistan – making up almost a third of electricity generation with current installed capacity of 9.8 gigawatts (GW) in 2020 (NEPRA, 2020).

Despite this massive resource potential, cumulative contribution of solar, wind and biomass stood less than 3%[2] in total electricity generation with current installed capacity of 1248 MW wind, 530 MW solar and 369 MW in 2019-20 (NEPRA, 2020).

Seemingly, Pakistan has undertaken a number of policy interventions to promote renewables in the country. With promulgation of its first ever Policy to promote Renewable Energy in 2006; outlining incentives to spur green growth – adding up roughly 2,000 MW of solar and wind to the national grid over the course of 14 years. Apparently, these are not impressive numbers and do not correspond with growth potential of renewables that exist in the country.

Pakistan's total installed power generation capacity stands at 39,000 MW, of which 66% of energy comes from fossil fuels, 24% from hydro, and 6% from renewable sources (wind, solar and bagasse) and 4% from nuclear. In the current scenario, renewable energy (RE) resources can play an important role in closing the deficit. Government of Pakistan has set the target of 30% of total power generated from renewable energy sources by 2030 (AEDB, 2019).

SEforALL target for Pakistan outlines doubling the share of renewable energy in the total final energy consumption (TFEC) from 7% in 2018 to over 15% by 2030. TFEC is the secondary energy that is received after the transformation processes and related losses, e.g. electricity, petrol, heat and natural gas if used for heating and cooking. The current share of renewables in total final energy consumption in Pakistan is about 7% and it needs to be doubled to 14% by 2030. In order to meet the policy objectives of achieving 30% of renewables and SEforALL target, solar and wind capacity additions would have to increase to 24,000 MW by 2030 from the existing capacity of 902 MW in 2018.

Source	Installed (2018)	2,020	2,022	2,025	2,030
1 Hydel	7,122	12,089	12,089	27,196	34,500
2 Oil & Gas		13,370	13,370	13,370	12,000
3 Domestic Coal		810	4,440	8,400	13,225
4 Imported Coal	16,370	2,640	3,600	3,600	3,600
5 Imported LNG	633	3,600	3,600	3,600	3,600
6 Nuclear	705	2,445	3,545	4,645	8,000
7 Imported Electricity			1,000	1,000	1,500
8 Bagasse	146	850	919	1,200	2,000
9 Wind and Solar	902	2,231	4,732	9,582	24,000
Total	25,878	38,035	47,295	72,593	102,425

Source: Authors' estimate based on Energy Year Book 2017 and Ministry of Energy data

Another important consideration is the rapid innovation in technology, which is driving down the combined cost of renewables plus electricity storage at a significant rate, while improving their conversion efficiencies. If RE market continues to achieve such a drastic level of reduction in costs and improvements in battery technology, this would be a game changer especially for the off-grid and unelectrified regions of the country.

## Objective 3: Doubling the Rate of Improvement of Energy Efficiency

Rising costs, increasing energy demand and declining resources are one of the key reasons, the world is on the path towards achieving higher energy efficiency. The energy intensity of some developed countries is already declining due to increased measures in the energy efficiency. The capital cost of new energy supply is often higher than the cost of investing in energy efficiency improvements. Therefore, increased energy efficiency measures can be one of the easiest and least-cost pathways for Pakistan to reduce the demand-supply gap. There is huge potential for energy efficiency in Pakistan as substantial amount of energy is wasted in supply side (production, transmission, distribution) and also in the demand side (consumption) of various energy items like oil, gas and electricity in the various sectors of economy.

Key indicators	Unit	2014	2000/14 (%/year)
Primary energy intensity (at ppp)	kgoe/\$GDP	0.117	-1.7
CO2 intensity (at ppp)	kCO2/\$GDP	0.189	-1.3
CO2 emissions per capita	tCO2/cap	0.766	0.9
Source: EnerData & World Energy Council (EnerData, 2014)			

Energy intensity measures the efficiency of an economy in which a given country converts energy into production. It is expressed as the ratio of total energy consumption per unit of economic output or Gross Domestic Product. Countries with a high level of energy intensity use more energy to create a unit of GDP than countries with lower levels of energy intensity. Whereas, the energy efficiency is the ratio of energy input per unit output, typically measured in physical terms and relatively challenging to measure across various countries. Thus, using energy intensity as an indicator for energy efficiency works well when making country-wide comparisons.

Energy intensity measured is influenced by a variety of factors, including the efficiency of underlying processes, factors such as changes in sectoral structure of GDP, annual variations in weather, climatic conditions and geographical sizes of the countries. It is important to note that the energy intensity of GDP actually measures energy productivity and it is not a definitive indicator of energy efficiency from a

technical perspective, as it takes into account various effects and factors that are not directly linked to energy efficiency of a country.

The target for energy efficiency under SEforALL is to double the rate of improvement of energy efficiency. Therefore, it is important to identify and assess the current rate of improvement of energy efficiency which has to be doubled by 2030. Currently, the rate of improvement of energy efficiency has been improving at the rate of 1.7% annually since 2000 as shown in the table 1 (i.e., 27% over the last 14 years) (EnerData, 2014). In other words, the primary energy intensity of Pakistan has decreased by 1.7% annually since 2000. In order to achieve the SEforALL target, this rate of improvement needs to be doubled by 2030, which means that there has to be reduction in the primary energy intensity by 3.4% annually or by about 50% over the next 14 years.

Broadly, the SEforAll NAP underscores these high impact action areas, in order of following priority:

1. Modern Cooking Appliances and Fuels
2. Distributed Electricity Solutions
3. Grid Infrastructure and Supply Efficiency
4. Development of Large-Scale Renewable Power Projects
5. Sustainable Development of Hydropower
6. Enhancing Industrial and Agricultural Efficiency
7. Sustainable Transportation
8. Energy Efficiency and Building Appliances
9. Super-Efficient Equipment and Appliance Deployment
10. Business Model and Technology Innovation

## **Investment needs to finance SEforALL**

There is a global consensus that financing needs to achieve SEforALL target will be huge. Morgan Stanley (2020) estimates the financing cost to achieve SDGs could be over \$50 trillion mark. Meeting SDGs will require the global community to increase development financing from “billions” to “trillions,” which implies a substantial financing gap (International Finance Cooperation (IFC, 2019). McKinsey estimates required global infrastructure spending to be on the order of \$6 trillion a year through 2050. The Global Commission on Adaptation (2019) concluded that adapting to the climate change that cannot be avoided will be a multi-trillion-dollar expense. A recent analysis in Carbon Tracker (2020) estimates that replacing the global fossil fuel infrastructure will cost about \$22 trillion.

Providing energy access requires considerable capital expenditures in building the infrastructure to support energy supply, as well as on-going operations and maintenance. We identify that overall

financing requirement to meet SEforALL goal in Pakistan by 2030 across renewable energy, energy efficiency and universal access - is estimated to be over US\$ 66 billion.

For access to clean energy and reliable energy, we underline that millions of people in Pakistan live in rural communities with no grid connection. They are widely dispersed with very low levels of density. So, reaching these households is capital intensive and time consuming. On top of it, there is a challenge affordability, which means project developers are unable to charge full cost-recovery prices for the infrastructure, and services. This means that in order to achieve universal energy access, off-grid solutions must be scaled up to a certain level so that the projects become financially viable and economical. We identify high impact areas to improve clean energy access in Pakistan with investment requirement of about US\$ 30 billion as illustrated in the Table 3 below.

Access to Clean and Modern Energy (Billion US\$)		
1	Off- Grid Lightening in remote districts	2.50
2	New Gas Connection	4.50
3	Solarization of Schools and Basic Health Units	3.00
4	Access to Clean Cooking	4.15
5	Powering Schools and Colleges Solar PV	4.50
6	Capacity Additions Renewables (Solar+wind)	4.44
7	Installation of LPG Plants	2.00
8	The SEforALL Small GrantsProgram	0.25
9	Provision of improved Cook Stoves	5.22
	Total	30.56

While progress is being made to scale-up financing, current annual financing required to achieve these targets are significantly lower in Pakistan. We identify that there is a considerable annual energy financing gap with billions of dollars, and the available volumes of finance is not sufficient to meet set targets. This is in line with global trends which underline a widening gap between required and actual investment to achieve universal energy access in high-impact countries in sub-saharan Africa and Pakistan (Sustainable Energy for All, 2020). Hence, interventions from global financial institutions must be targeted to support and mobilise creation of viable commercial markets, as the scale-up of private sector financing will play a central role in financing.

A further challenge for financing SEforALL objective is high-cost financing for low carbon technologies. Given low-carbon energy's upfront capital intensity, low-carbon energy is penalized from high financing

costs compared to the conventional energy projects. Such high financing costs can reflect a range of low-carbon energy investment risks that exist in early-stage markets. Debt and equity capital provider price these risks into their cost of financing. These kind of barriers limit the availability of capital and financing opportunities to promote sustainable energy markets in developing countries.

Financing for sustainable energy involves many stakeholders, including public and private, domestic and international. Public actors include domestic governments and international actors (bilateral and multilateral agencies, development banks, and climate funds). Private finance involves a wide range of players: businesses, banks, capital markets, institutional investors and philanthropy. However, private financing for renewable and large scale energy infrastructure projects have not been so prominent in Pakistan.

Renewable energy financing requirements to meet SDG 7 by 2030 are estimated at US 18 billion as illustrated in the Table 4 below.

Table 4	
Doubling the Share of Renewable Energy (Billion US\$)	
1. Municipal Solid Waste to Energy	0.24
2. Biomass Energy Solutions in the Rural Areas	1.00
3. Biomass Fuel Generation	0.10
4. Installation of Cogeneration Plants in Sugar Mills	0.40
5. Solar Water Heater	2.00
6. Off grid solar systems to low-income households	1.50
7. Solar Powered Water Pumps	2.00
8. Heating Pipeline Network	0.11
9. Local Manufacturing of Renewable Technologies	2.03
10. Hydropower Generation (Small, and medium)	5.00
11. Wind Energy Projects	2.00
12. Production of Biodiesel	0.12
13. Conversion of Gas Geyser to Solar Water Heater	1.50
Total	18.00

In 2015, Pakistan signed an agreement through China-Pakistan Economic Corridor (CPEC) for financing projects worth more than \$62 billion, targeting the energy sector and other infrastructure projects. CPEC is considered as a breakthrough in the development of Pakistan's energy sector, under which financial

outlay of around US \$35 billion has been made for projects including power generation and transmission projects (Hamzah & Maini, 2016). However, the bigger chunk of this financing have gone into development of fossil fuel based energy projects, such as coal and natural gas fired power plants. Givent the fact that Pakistan is amongst those countries which are extremely vulnerable to extreme climate change events, it would need much stronger support in terms of financing the clean energy projects to achieve SEforALL targets (Global Climate Risk Index 2016, 2015).

It is important to recognize that many of the developed nations today made rapid industrialization, which have been primarily fueled by coal and other fossil fuel in their early stages of growth and development. Thus, they have an important role in supporting the deployment of sustainable energy interventions in the developing countries.

It requires transfer of resources, funds, and technological knowledge from developed countries is a crucial part of sustainable energy deployment in the developing world, and must be a collaboration involving research, business, and government organizations. So industrialized nations not only have to accelerate their actions, but they must also support the developing countries as they make the transition to low-carbon economic growth. Table 6 presents the high impact areas with potential investment for energy efficiency towards SEforALL.

1	Provide Improved Cookstoves	0.66
2	Industrial Energy Efficiency Retrofits	3.00
3	Energy Efficient Appliance	0.05
4	Improvement in Process Operation	0.05
5	Installation of Heat Recovery Systems (HRS)	0.05
6	Thermal Insulation of Steam Lines and Valves	0.03
7	Installation of Variable Frequency Drive (VFD)	0.30
8	Improvement of Maintenance Operation	0.07
9	Textile Industry - Energy Efficiency	1.10
10	Energy Efficient Technologies for Sugar Industry	0.23
11	Single Stage Dry Kilns for Cement Units	0.50
12	Implementation of Simple Energy-Saving Techniques in Leather Sector	0.13
13	Energy Efficiency in Fertilizer Sector	0.60
14	Boiler and Burner Tuning of Pulp and Paper Mills	0.07
15	Introduction of Zig-Zag Technology	0.60
16	Smart Metering Technology	1.00
17	Upgradation of the Electricity Grid	8.86
18	Replace Maximum Possible Tube Wells Pumps	0.70
	Total	18.00

The energy efficiency and renewable energy interventions mentioned above will clearly not occur without mobilizing the adequate financial resources. An effective implementation of the SEforALL objectives does not necessarily mean the cost-optimal path to climate protection; and in terms of who pays for the transformational change required globally, there is still no clear consensus, particularly among the industrialized world. How the investment burden for SEforALL objective has to be distributed over countries and regions is not essentially a scientific question, but rather a political one.

## Conclusion

While addressing the climate crisis, sustainable energy lies at the core of both the United Nations' Sustainable Development Goals (SDG) and the Paris Agreement. SDG 7 particularly calls for affordable,

reliable, sustainable and modern energy for all by 2030. For developing countries like Pakistan, it is critical to meet SEforALL objectives in order to achieve sustainable economic development. Achieving the three SEforALL targets could put entire world on a path towards global climate protection. However, meeting those targets would require massive investment.

As a developing country, Pakistan faces a number of challenges related to overcoming poverty and improving the infrastructure, health, education, and employment opportunities for its large and lower income population. The sustainable energy sector is vital in addressing these problems, however, the major constraints are inadequate investment, unreliable energy supplies, weak governance, and poor fiscal management.

Many of the developed nations today made rapid industrialization, which have been primarily fueled by coal and other fossil fuel in their early stages of growth and development. Thus, industrialized nations have an important role to play in supporting the deployment of sustainable energy interventions in the developing countries.

We determine the investment needs of over US\$ 66 billion for Pakistan to achieve its SEforALL objectives. It is clear that Pakistan like many other developing countries would not be able to make this huge investment on its own and requires leveraging external support from the developed and industrialized nations. Hence, Pakistan would require substantial amount of financial support from the industrialized nations to mobilize enough financial resources to materialize the SEforALL objectives.

China is expanding its influence in the region and has made Pakistan a top focus of its Belt and Road Initiative through CPEC, with its heavy investment in power and infrastructure projects. Given the growing climate change impacts and stresses on water resources, it is critical for Pakistan to elevate both mitigation and adaptation in its policies and budget and investment priorities.

Therefore, transfer of resources, funds, and technological knowledge from developed countries is a crucial part of sustainable energy deployment in the developing world, and must be a collaboration involving research, business, venture capital, and government organizations. Hence, industrialized nations or developed world not only have to accelerate their actions, but must also support the developing countries as they make the transition to low-carbon economic growth.

## **Declarations**

## **Funding**

This research is an outcome of outcome, a comprehensive and integrated National Action Plan (NAP) was developed with technical and financial support of United Nations Development Program (UNDP) to accelerate transition towards SEforAll goals for Pakistan (UNDP, 2019).

## Conflict of interest

The authors declare that they have no conflict of interest. This article does not contain any studies with human participants or animals performed by any of the authors.

## Availability of data and material

The datasets generated during and/or analysed during the current study are taken from UNDP Pakistan's SEforALL section and they are available from the corresponding author on reasonable request.

## Code availability

Not applicable

## Authors' contributions

Khalil RAZA, Sardar MOHAZZAM, Saadia QAYYUM and Manzoor Hussain SOOMRO contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript.

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