SCIENTIFIC PERSPECTIVE ON SUSTAINABLE DEVELOPMENT GOALS FOR PAKISTAN

*Seeme Mallick**

ABSTRACT

There are a total of seventeen Sustainable Development Goals[1] (SDGs) adopted by the United Nations for 2016-2030. These SDGs are greatly interlinked, and achievement of some depends on others. Each SDG has its own significance for Pakistan, starting from 'No Poverty and Zero Hunger' the SDGs put emphasis on Good Health and Well-Being; Gender Equality; Clean Water and Sanitation; and Reduced Inequality. Achievement of all these goals can become possible due to Quality Education; Decent Work and Economic Growth, based on Industrial Development, Innovation and Infrastructure, and Affordable and Clean Energy. Once achieved, these goals can lead to achieving other goals on Responsible Consumption and Production; Sustainable Cities and Communities; Climate Action for Life below Water and Life on Land. The aggregate effect of all these could be Peace, Justice and Strong Institutions, and national and international Partnerships.

Keywords: *Sustainable Development Goals, SDGs, Renewable Energy, Circular Debt, PEPCO, WAPDA unbundling, NTDC, NEPRA, OGRA.*

1. INTRODUCTION

Imagine the world in 2030, with each of the Sustainable Development Goals (SDGs) fully achieved in each country. People all over the world would have achieved by then:

- Human Dignity;
- Economic Progress;
- Well Preparedness for Climate Change;
- Sustainable Natural Ecosystems and Environmental Processes;
- Collaboration beyond Boundaries.

To complete this epic journey, each SDG needs a separate study to find:

- Implementation requirements and procedures; and
- Financial needs for each SDG implementation plan.

This calls for a review of the Millennium Development Goals (MDGs), its procedures, its funding sources, and its shortcomings. Most developing countries, including Pakistan, were unable to meet most of the MDGs. The main purpose of the MDGs designed for 2000 to 2015 was to design quantifiable targets for the developing countries to overcome poverty, hunger and disease, and reach economic and environmental sustainability in their respective countries. The SDGs are an extension of the same process whereby the fundamental aim is to end poverty in the developing countries, while tackling environmental degradation and climate change. In September 2015, "2030 Agenda for Sustainable Development" was adopted at the United Nations Sustainable Development Summit. The adoption of SDGs was connected with the United Nations Framework Convention on Climate Change (UNFCCC)'s Conference of Parties (COP-21), Paris, France, where Intended Nationally Determined Contributions (INDCs) – for curtailing fossil-fuel carbon emissions from the economic processes – were submitted by each country, including Pakistan. The INDCs by Pakistan includes quantifiable information on:

- The reference point, i.e., a base year;
- Timeframes for implementation;
- Planning processes;
- Assumptions and methodological approaches including those for estimating and accounting for anthropogenic greenhouse gas (GHG) emissions and removals;
- How Pakistan considers that the country's INDCs is fair and ambitious, in light of its national circumstances.

When it comes to SDGs, it is understood that countries cannot pick and choose SDGs; they come as a collective package from the UN. That is the reason why research papers explain the scientific research options and identify funding resources for SDGs for Pakistan. The SDGs that have been chosen for this paper for detailed analysis are:

- Affordable and Clean Energy (SDG-7);
- Decent Work and Economic Growth (SDG-8);
- Industry, Innovation and Infrastructure (SDG-9);
- Responsible Consumption and Production (SDG-12);
- Climate Action (SDG-13).

[1] "2030 Agenda for Sustainable Development" consisting of seventeen Sustainable Development Goals was adopted at the "United Nations Sustainable Development Summit" in September 2015 held at UN Headquarters in New York, USA.

* Center for Climate Research and Development (CCRD), COMSATS Institute of Information Technology (CIIT), Islamabad, Pakistan
Email: dr.seeme.mallick@comsats.edu.pk

For each of these SDGs, the discussion is to focus on the following two issues:

- Science and Technology options for SDGs in Pakistan;
- Investment, Finance and Economic Management for SDGs in Pakistan.

Alongwith the United Nations, World Bank, and Asian Development Bank, many international organizations like International Institute for Sustainable Development-IISD (IISD Reporting Service, 2016) and the International Institute for Environment and Development-IIED (IIED's Human Settlements Group, 2016) have highlighted SDGs in their global development agenda.

Local organizations like Pakistan Institute of Development Economics-PIDE (PIDE, 2015) and Sustainable Development Policy Institute-SDPI (SDPI, 2015) are putting a lot of efforts into bringing the SDGs to the forefront, so that development policies and financing for these policies include SDGs. In Pakistan, efforts are being made by the present Government to include SDGs along with Vision 2025 and China Pakistan Economic Corridor (CPEC) into mainstream economic planning.

The starting point for identifying the implementation possibilities for SDG-7 on Affordable and Clean Energy in Pakistan is based on the reality of energy sector of Pakistan and its effects on economic growth in the country. A brief history of Pakistan's energy sector is as follows.

1.1 History of Energy Sector in Pakistan

Starting from Karachi, K-Electric was incorporated in 1913. In 1952, the company was taken over by the Government of Pakistan. During 1994 to 2005, Pakistan Army managed K-Electric. In 2005, K-Electric was privatized and sold. In 2009, K-Electric was sold to international owners. In 2016, electricity demand still exceeds electricity supply in Karachi.

In Balochistan, Gas was discovered in Sui in 1952, and production and distribution started in 1955. Gas is managed in Pakistan by Sui Northern Gas Pipelines Limited (SNGPL) founded in 1963 and Sui Southern Gas Company (SSGC) founded in 1954. In 2002, the Oil and Gas Regulatory Authority Ordinance established Oil and Gas Regulatory Authority (OGRA), in Pakistan. Gas rationing and gas load-shedding in winters is an annual feature for last many years in Pakistan.

Water and Power Development Authority (WAPDA) of Pakistan was established in 1959. Mangla and Tarbelas Dam were inaugurated in 1967 and 1976, respectively. PEPCO was incorporated in 1998 and became functional in 1999. NEPRA was established under Pakistan National Electric Power Regulatory Authority Act during the same time. National Transmission & Dispatch Company (NTDC) was established in 1998. In 2007, Pakistan Electric Power Company (PEPCO) was independently formed by splitting WAPDA. Hydropower management stayed with WAPDA, while PEPCO was formed for management of thermal power in the country. However, currently both hydropower and thermal power are not adequate to meet the present demand for electricity in Pakistan.

In 1985, World Bank, WAPDA and the Government of Pakistan signed a Tripartite Agreement for facilitating private sector to provide thermal electricity in Pakistan. The process of commercialization and privatization of the energy sector, i.e., WAPDA unbundling in Pakistan began under the 1992 Strategic Plan. Under the 1994 Power Policy, Independent Power Producers (IPPs) were invited to provide electricity to consumers in Pakistan. A new problem of circular debt has come up since then.

WAPDA unbundling has already taken place, resulting in multiple electricity production, transmission and distribution agencies. The next and more crucial process of privatization and commercialization of these multiple GENCOs and DISCOs in the electricity supply sector is yet to be completed. Although the system has been unbundled and segregated, it is still in the control of the federal government (Khalid, 2014). This slow reformation in the electricity supply sector has highlighted the shortcoming of the "standard template" that was applied to many developing countries by the multilateral development agencies under the pretext of "new neoliberal policies". This "neoliberal economic theory" envisions electricity supply under corporate control and commercially viable rather than under public governance (Kessides, 2013). A very important pre-requisite to this process is preparation of the banking sector to finance the transition from public sector to private energy supply sector (Yi-chong, 2006). The depth needed for the financial infrastructure is missing in Pakistan and many other developing countries in comparison with financial sector's involvement in the energy sector in the USA, UK and EU. The currency markets, bonds markets and the stocks markets need to prepare before this transition is initiated. Keeping in view the

capabilities of the country's banking and currency, as well as stocks and bonds markets, the ownership of the restructured power sector of Pakistan must be transffered to the corporate sector very systematically and slowly. With each province preparing its own privatization plan, a step-wise method must be applied where each province must start with assessment of its provincial banks, both public and private, and then float bonds and shares for its energy sector agencies for shared ownership that should culminate in moving ownership of energy supply sector to commercial and private corporate sectors.

In 1974, Pakistan's Nuclear programme was given impetus the then President, Zulfikar Ali Bhutto. Initiation of the construction of Kalabagh Dam was the most important event that did not take place during the eleven years of General Zia-ul-Haq's regime (1977 to 1988). Kalabagh Dam exists only on the drawing board. Established in 1956, the Pakistan Atomic Energy Commission (PAEC) has designed Karachi Nuclear Power Plant (KANUPP) to provide electricity to Karachi city and surrounding areas, while Chashma Nuclear Power Plant (CHASNUPP) is designed to provide electricity to select areas in the Punjab Province. This technology of nuclear energy-based electricity plants is yet to reach KPK, Balochistan and Sindh Rural.

Later, Benazir Bhutto was twice Prime Minister of Pakistan (1988-1990 and 1993-1996). There was no chance for Kalabagh Dam approval during her regime, but she linked Sindh, particularly, interior Sindh to the same existing electricity grid, adding new demand load for electricity supply.

During 1990 to 1993 and then again during 1997 to 1999, Mian Muhammad Nawaz Sharif was the Prime Minister of Pakistan. Two things happened; Punjab, along with the rest of the country faced regular interruption in electricity supply in the form of load shedding and, in 1998, Pakistan developed weapon grade nuclear technology.

From year 2000 to 2013, Pakistan continued to face electricity load shedding and gas rationing. Successive governments have tried but electricity supply is insufficient for meeting the electricity demand in the country (NEPRA, 2015). Similarly, gas supply and CNG supply are not sufficient during the months of winter.

The reform needed in the energy sector is to have a consolidated energy agency in Pakistan that identifies energy demand (electricity and transport); size and location, three months in advance and lets the suppliers (government and corporate sector) know about that so that arrangements are made to match energy supply with energy demand in Pakistan. Fragmentation in Pakistan's energy sector governance is a hindrance in implementing this reform in Pakistan.

"Energy-Consumption" is different from "Energy-Demand" in an energy-deficit country, like Pakistan. In energy-balanced and energy-surplus countries, energy-consumed is equal to energy-demanded (Mallick, et al., 2000). In these countries, energy demand is estimated in advance and energy infrastructure ensures this energy supply; so that, energy supply is sufficient to meet the energy demand. In these countries, energy-consumed is equal to energy-demand; in addition, these countries ensure strategic energy reserves.

Financing of the energy sector requires substantial resources. Pakistan has insufficient financial resources to keep its energy sector operational. Pakistan's energy sector has two types of financial problems:

- Circular Debt – specifically for fuel purchase for thermal electricity sector; and
- International Debt – for both hydropower construction and purchase of fuel for thermal power infrastructure.

When it comes to building new hydropower infrastructure, Pakistan has neither the political will nor the financial resources to create it nationally or at the provincial level. The whole country has to seek huge international loans and debts on market interest rates to build the hydropower infrastructure. Similarly, the thermal sector was run on imported oil until recently. Arrangements have been made to run the thermal energy sector on imported LNG along with imported oil. There is some discussion about future plans for running thermal energy on imported coal, as well. This means that to run the thermal energy sector of this size in Pakistan, there is constant need for imported oil, LNG, and coal. All this needs money.

If Pakistan starts to print energy sector money (something similar to WAPDA Bonds for the thermal sector) these printed bonds or money could pay for purchase of dollars or whatever currency is used for making payments for oil, LNG and coal. This could result in devaluation of currency with each purchase

due to trade imbalance, if the other country is not buying exports of same financial value from Pakistan. The other option is to take loans for purchase of oil, LNG and coal. This means that at the end of that year, loan provider will have to be provided with loan payback plus interest incurred. Fuel purchased using loan money is much more expensive, due to additional interest. Using-up money in circulation exerts pressure on local commercial banks in Pakistan and eventually on State Bank of Pakistan. The Government of Pakistan is using up cash in market for paying for circular debt.

To weigh the future prospects, it is important to see which SDG will take Pakistan's economy to a higher level. In the next sections, each of these SDGs is analyzed for their purpose and scientific underpinnings and also for identifying financial priorities for the next fifteen years.

2. THE PURPOSE OF SDGs

The two most important SDGs are: No Poverty and Zero Hunger. These SDGs form part of conditions that will fulfill the basic requirements for human dignity by 2030. It is of utmost importance that these two conditions are fulfilled along with: Good Health and Well-Being; Gender Equality; Clean Water and Sanitation; and Reduced Inequality. Improvement in life expectancy rates and better quality of living for all depends on each of these SDGs. With better social cohesion due to reduced inequalities, better economic outlook could be envisaged.

To reach this level of human dignity and human security, economic progress needs to be made so that Quality Education is provided; that makes Decent Work and Economic Growth possible, based on Industry, Innovation and Infrastructure, and Affordable and Clean Energy accessible to all. Here SDG on Affordable and Clean Energy will play a pivotal role. The progress on all SDGs hinges upon this SDG. As educational institutions provide nationally and economically appropriate education and training, this will result in improved labour markets and dynamic economy. As country brings improvement in the energy sector, it will head in the direction of sound industrial development and scientific innovation resulting in better and environmentally appropriate infrastructure.

Along with those addressing human dignity, human security and economic progress, the SDGs that need appropriate attention and funding are the SDGs relating to climate change and environmental processes. As paths are set for new dynamism for economic growth, Responsible Consumption and Production will set the boundaries that will change footprints size for consumable fuels and natural resources in the future. As people would then live in the Sustainable Cities and Communities, their commute and travelling will be emission free, their indoors temperature controls will be based on innovative technologies consuming renewable energy sources. Markets for good and services will have reduced impact on the transportation system by producing many essential products in the city's periphery.

Special attention would be given to Climate Action by establishing appropriate institutions that focus on fuels and air quality in each city and industrial production areas. To keep pace with innovations in the food technology industry, scientific research institutions will be dedicated to study of Life below Water and Life on Land. Human activities have direct bearing on flora and fauna of land and water. For future sustenance in food and fuel, scientific community will need to focus attention on processes that restore and sustain the balance in ecological systems.

For national and international Partnerships, it is imperative to have Peace, Justice and Strong Institutions in countries and communities globally. The national institutions working on SDGs will have two-fold responsibility: to implement SDGs nationally and to have constant contact with regional and global institutions performing similar duties.

2.1 Scope for Scientific Research and Innovation

Reduced Inequality will play a fundamentally important role along with Zero Hunger and No Poverty. To improve yields from agriculture, farmers need technology, energy resources and finances. Inequality in access to technology, energy resources and finances hinders speed on which a farmer can improve agricultural yields from the same field. Agriculture Technology Experts, Engineers, Scientists and Agriculture Finance Experts will need to work with this triangle: No Poverty; Zero Hunger; and Reduced Inequality.

Good health and well-being, gender equality, clean water and sanitation are all very closely linked. In most rural areas of Pakistan, women are responsible for fetching water for the household. As a result of Gender Equality, women of the household are equally healthy

and nourished enough to take care of their responsibilities efficiently. Healthcare and sanitation facilities should be available to all women in a rural community, particularly, in the form of mother and child health centers.

As the masses have adequate food crops, with nutrition and health facilities in both rural and urban areas of Pakistan, they would be at an acceptable level of Human Dignity. Then the focus shifts to rapid Economic Progress and Engine of Growth, i.e., Education, Employment, Innovation and Energy Resources. The SDG on Quality Education is closely linked with SDG on Decent Work and Economic Growth. Both these SDGs are dependent on SDGs on Industry, Innovation and Infrastructure and Affordable and Clean Energy. Quality Education builds a base for Industry, Innovation and Infrastructure. No economic activity can take place without readily available energy sources; therefore, Affordable and Clean Energy is central for Decent Work and Economic Growth in Pakistan, from now to year 2030. Scientists, engineers, innovators and financial experts will need to team-up to build a system of quality educational institutions that will bring Innovation to Industry, Infrastructure and Energy sectors of the economy. These could take Pakistan to sustained economic growth to the year 2030.

Innovative infrastructure will result in achieving the SDG on Sustainable Cities and Communities and innovation for economic growth will help in achieving the SDG on Responsible Consumption and Production. Scientist, engineers and financial planners will need to build the base for technological innovation that will result in Sustainable Cities and Communities. The defining trait of these Sustainable Cities and Communities would be Responsible Consumption and Production. Energy consumption and waste disposal are the two biggest urbanization problems along with transport congestion. As most of the commodities that are needed in high population density areas are produced elsewhere, these are transported to the city centres. The most responsible innovation would be to produce most of the commodities needed in the areas near or inside the cities. This would reduce the transportation costs and transport-based fuel emissions. Town planners, economic development experts, corporate sector and transport sector experts will need to get together to design new cities and retrofit existing cities with Responsible Consumption and Production and efficient transport patterns for Sustainable Cities and Communities.

The SDG on Climate Action is becoming center-stage as climate change impacts are becoming visible. Changes in biodiversity of flora and fauna of land and marine ecosystems have direct repercussion on the food that humans consume. Ocean coral bleaching, storm-surges, coastal cyclones and unusual terrestrial temperatures and precipitation are all signs that need to be reckoned and dealt with. Air pollution has direct impact on human and animal health and in severe cases for trees and other flora. Fossil fuels and carbon emissions are central to climate change discussions. Air pollution comprising of particulate matters, smoke and smog persists in most high density urban centres. Climate action will need to focus on air quality for urban centres. The improvement in the transport sector will result in air quality improvements. Water quality matters for drinking water and also for water used for crop and vegetable growing. Toxic heavy metals in water could enter food chain and cause health problems. For sustained Life Below Water, oceans, rivers and lakes will need quality management practices. Life on land, with all its biodiversity, needs eco-friendly economic development plans, where town planning includes green spaces for seasonal movement of animals and other creatures. A wide spectrum of scientists, technical experts and natural resources consumers/managers, like farmers and fishermen will need to stay attuned with the signs and symptoms of deterioration in both flora and fauna and put all efforts to maintain a healthy ecosystem.

With Peace, Justice and Strong Institutions in the country, Partnerships for the Goals will be easy to build. The scientific and technical experts in their respective fields would then have ample opportunities to collaborate at national and global levels. The outputs would be innovative and efficient technologies for each of these SDGs.

3. FOCUS AREA FOR PAKISTAN

Although all seventeen SDGs have their own individual importance, but SDG number seven, i.e., Affordable and Clean Energy, plays a pivotal role. This SDG has separate descriptive for 'Energy', 'Affordable' and 'Clean'. Sufficient supply of energy resources with well-managed energy pricing mechanism will make energy resources affordable in Pakistan. The reason for selecting this SDG is that as Pakistan ensures 'Affordable' and 'Clean' energy; it will also have to ensure the availability of energy. With young and increasing population, with ever-increasing energy-demand and with responsibility to ensure GDP

growth rates from 4% to 7%; energy supply needs to increase on an increasing rate. In Pakistan, present energy production capacity is between 15,000 MW to 25,000 MW, this will need to be increased from 50,000 MW to 60,000 MW by year 2030 to turn Pakistan into an energy-sufficient and energy-balanced economy (International Resources Group, 2011).

Presently, in Pakistan, the issue of fuel subsidies is also a matter of discussion. Particularly, for developing country like Pakistan where value of own currency depreciates as additional printed money hits the markets due to fuel subsidies and circular debt. This creates two problems:

i. On subsidized rates, consumers demand more energy resources than they can normally afford;
ii. Government becomes part of the market mechanism as it provides subsidies to energy consumers and grantees fuel supply to energy producers in the private sector. It also guarantees electricity purchase from the Independent Power Producers (IPPs).

In most instances, unusual market shocks, like spikes in oil prices, compel the Government to provide a buffer of subsidies to energy consumers. Without subsidies, persistently high international prices of energy commodities reduce national economic processes proportionally, contracting GDP growth, but constant provision of energy subsidies could cost national exchequer reduction in wealth and hence additional tax to pass-on this burden of subsidies. Subsidy is the amount that is not charged in bills to energy consumers and that expense is absorbed internally by the government. So the subsidy buffer for energy consumers has its direct and indirect costs. For many Governments in the developing countries 'Affordable Energy' for consumers, based on subsidies is a big economic and political risk.

When it comes to 'Clean Energy' it means energy sources that are not dependent on fossil fuels or are very efficient fossil fuels with very low carbon emissions. For a futuristic energy innovation plan to reach year 2030, this is a technologically intense SDG. To set the energy consumption path to reduced carbon emissions, clean energy resources are imperative. The two other processes that can go parallel for reducing carbon emissions are: carbon sequestration and carbon capture and storage. In most instances carbon emissions result in direct air quality deterioration, particularly, in the urban centers. With 'Clean Energy', urban centres would improve their air quality to have positive health benefits. Therefore, 'Affordable and Clean Energy' is the central resource that will provide the impetus for positive results towards all other SDGs. Globally, all economies are dependent on fossil fuels. This means that within a brief period of fifteen years, all global and national economies will need to have a significant shift away from fossil fuels towards renewable energy sources, reducing carbon emissions along the way.

Sufficient supply of Affordable and Clean Energy will result in Industry, Innovation and Infrastructure contributing to Decent Work and Economic Growth. This will set the path for Responsible Consumption and Production; Sustainable Cities and Communities; and Good Health and Well-Being. This will in turn, provide meaningful results to No Poverty and Zero Hunger. People will be provided with Quality Education and Clean Water and Sanitation. All these will result in Reduced Inequality; Gender Equality; and Peace, Justice and Strong Institutions. It means that Affordable and Clean Energy will bring economic progress that will result in better quality of life and improved human dignity.

Affordable and Clean Energy; Decent Work and Economic Growth; and Responsible Consumption and Production are dependent on five processes:

i. Upgrading energy sector by attracting sector specific investment;
ii. Bringing macroeconomic stability to Pakistan, create effective, strong and supportive financial institutions for attracting investment;
iii. Improving transport infrastructure for efficient links with national and international markets;
iv. Greening of the industrial and agricultural production processes for reduced emissions;
v. Channeling scientific research at higher education centres towards SDGs implementation.

These processes will ensure strengthening of the energy sector; banking and the financial sectors; transport sector; industrial and agricultural productivity; and expansion of markets and trade. This will also ensure that research at the academic scientific institutions is connected with the process of implementation of SDGs in the country.

To make energy sector 'Affordable' with an increased proportion of "Clean Energy", the first two processes are linked with the fifth process. As Banks and other financial institutions build investment base to strengthen energy sector, the higher education centres must provide innovative ideas, and science

and technology support to this SDG. Here, the process needs to be started to help identify financial resources for scientific research and development for achieving this SDG.

The link between industry, chambers of commerce and higher education centres will need to efficiently channel scientific innovations and technological improvements for:

- Energy efficiency of fossil fuels;
- Market integration of renewable energy;
- Intensify hydropower and other renewables for energy consumption;
- Enhance productivity for the industrial and agricultural sectors while reducing emissions;
- Making transportation sector environmentally friendly.

The agenda for using science and technology for SDGs needs to be based on systematic allocation of funds for specific sectors of the economy. Science and technology must become an integral part of the SDGs implementation in Pakistan. Therefore, higher education centres should coordinate with market forces to channel and develop technologies that enhance productivity and improve efficiency. For using science and technology for SDGs, higher education centres will need to design new research and development centres for SDGs. The core values, goals and objectives of these centres of excellence must highlight links with SDGs. A dedicated system of academic research should also be made to focus on the outcomes and results of SDGs in the country.

Affordable and 'Clean Energy' also supports Climate Action helping in ensuring pristine 'Life below Water' and provide safeguards for biodiversity and 'Life on Land'. This could take Pakistan on a path to being well-prepared for Climate Change and with 'Sustainable Natural Ecosystems and Environmental Processes'.

In many instances, 'Affordable Energy' also means efficient. For efficiency, the standard measure is GDP produced per unit of energy consumed. As energy efficiency increases, its carbon emissions reduce. This path of low-carbon has its limits, but could help reduce the fossil-fuel consumption. Two of the most important Climate Actions for reduced carbon emissions are:

- Improvement in efficiency and reduction in emissions in fossil fuels;
- Increase in demand and increase in production capacity of renewable energy technologies, like those used to harness energy from solar; wind; hydropower; geothermal; and ocean-waves sources. These need investment in both infrastructure and machineries. Development of these 'Clean Energy' technologies depends on local and international investment interest. Strong, well-supported and effective financial institutions will open channels for investment to reach these innovative renewable energy technology options.

4. TECHNOLOGIES FOR SDGs IN PAKISTAN

The technologies that will take a country, like Pakistan, to a future where all the seventeen SDGs are met, matter the most. To develop or purchase these technologies from abroad, huge amounts of funds are required.

Using SDGs: For 'Affordable and Clean Energy' and 'Industry, Innovation and Infrastructure', a plan could be chalked out for funding SDG-led economic growth in Pakistan. To align the SDGs and financial needs nationally and provincially, it can be said that financial resources are needed for developing the energy sector, particularly renewable energy to be available at affordable prices. This then connects to financial resources needed for industrial development; innovation in science and technology, and investment needs for infrastructure development in the country. If each province provides energy sources that are in abundance and are easy to develop provincially, a systematic financial planning can be designed for each of the provinces. Four types of energy resources are available in Pakistan:

i. Hydropower;
ii. Fossil Fuels;
iii. Nuclear;
iv. Renewable Energy.

Four different types of government departments are working for development of these technologies and designing projects within these four domains (Box-1).

Punjab province of Pakistan is an interesting case; it has no hydropower of its own and is heavily dependent on rivers flowing from Kashmir. Punjab has true potential for renewable energy, particularly, solar energy and bio-fuels. There is future potential for electricity from nuclear energy, but stringent safety measures will need to be applied, if new sites near urban centres are to be developed.

Box-1: Pakistani Departments/Institutions Working in Different RETs

Box-1: Pakistani Departments/Institutions Working in Different RETs			
Hydropower	**Fossil Fuels**	**Nuclear Energy**	**Renewable Energy**
The Water and Power Development Authority (WAPDA) National Transmission & Despatch Company (NTDC)	Pakistan Electric Power Company (PEPCO) Private Power and Infrastructure Board (PPIB) Independent Power Producers (IPPs) Karachi Electric Supply Company (KESC) Oil and Gas Development Company Limited (OGDCL) Hydrocarbon Development Institute of Pakistan (HDIP)	Pakistan Atomic Energy Commission (PAEC) Pakistan Institute of Nuclear Science and Technology (PINSTECH) Pakistan Institute of Engineering and Applied Sciences (PIEAS) Khan Research Laboratories (KRL) Pakistan Nuclear Regulatory Authority	Alternative Energy Development Board (AEDB) Pakistan Council of Renewable Energy Technologies (PCRET)

The future energy projects associated with mega-projects, like China Pakistan Economic Corridor (CPEC); Iran-Pakistan (IP) Gas Pipeline; Central Asia South Asia Electricity Transmission and Trade Project (CASA-1000); and Turkmenistan-Afghanistan-Pakistan-India (TAPI) gas pipeline paint a rosy picture for all, particularly, the Punjab province of Pakistan, in terms of electricity and energy supply. What matters most is that Punjab is most probably populated by a hundred million to a hundred and fifty million people. Their energy demand is also increasing on an increasing rate. Imported fossil fuels and international supply of electricity is planned for the future for this ever-increasing energy and electricity demand in the Punjab province.

What could eventually be added to this ensemble of energy supply and electricity supply project is imported electricity from nuclear sources from Iran and China. As long as the nuclear electricity generation plants are on the borders between China and Pakistan, and Iran and Pakistan, it would ensure timely supply and stringent maintenance of machinery and equipment. As most of this energy supply system will be passing through Khyber Pakhtunkhwa (KPK) and Balochistan, a future agenda of energy supply and sharing will need to be devised between provinces and the capital.

When it comes to KPK, there is huge potential for Hydropower in KPK, with resources like Indus, Swat, and Chitral rivers. Main focus on developing hydropower in KPK will produce surplus electricity that can then be transmitted and dispatched to other provinces. KPK also has a huge potential for discoveries of fossil fuels, such as Oil, Gas, and Coal. The new and emerging trends in KPK for renewable energy sources are for Solar; Wind; and Bio-Fuels. One reason given for solar technology proliferation in KPK and Waziristan is that it is a private source of energy with one-time investment and no recurring bills from the government. It is hoped that CASA 1000 and TAPI, both passing through KPK, will bring new electricity and energy sources to Pakistan and India, particularly, to their Punjabs.

Sindh and Karachi have very different energy demand and supply relationships with the Center. Karachi is a coastal city and has access to imported fuels. This gives Karachi an advantage that it can produce surplus energy and sell it to rest of the country, particularly, to Sindh and Punjab. An intensive energy and electricity production system could be developed by combining Karachi-Hub-Gadani sites. As administration from both Sindh and Balochistan provinces would be involved, therefore, an inter-provincial energy/electricity coordination committee could be convened. Karachi already has provision for electricity from nuclear energy source that could be further enhanced in future. Sindh has huge lignite coal reserves. Scientific possibilities include below-ground on-site coal gasification. Based on this, Sindh province has a huge potential to provide surplus electricity and transport energy (converting coal to liquid fuel) to other provinces, particularly, Punjab.

Balochistan has the potential for fossil-fuel discoveries and pipelines from Iran to the rest of the country and beyond, particularly, both Pakistani and Indian Punjabs. Gwadar to China transport of fuel from the Middle East, and China to Gwadar transport of commodities will bring the biggest surge in economic growth in Pakistan. Renewable energy potential is also quite huge in Balochistan. Balochistan could sell

surplus electricity from renewable sources, particularly, solar, to other provinces. Due to severe shortage of water during the lean Monsoons, Balochistan will need to design scientifically innovative water projects for its population using technology for desalinization of seawater.

CPEC is the project that will involve all provinces of Pakistan. Science and technology for SDGs and CPEC will need to be linked during the next fifteen years. With the investment in CPEC infrastructure development project in Pakistan, efficiency will improve in the transport and energy sectors of Pakistan. Trade, commerce and industry will function at a regional level. The science and technology for SDGs could link higher education centers with industry and chambers of commerce as these expand due to CPEC. Fuels and efficiency of fuels will get precedence in research and development as transport, industrial and energy sectors come in focus. This is where renewable energy technologies could also enter the expanding economic system as part of CPEC. The new trade routes built on traditional trade routes will bring new demands for commerce and trade. Productivity enhancing technologies will bring industrial and agricultural productivity and quality to international market standards, and would help in meeting demands in a timely manner.

5. FINANCING OF TECHNOLOGIES FOR SDGs

To make the energy technologies needed for SDGs investable and to make electricity and transport energy affordable during the next fifteen years in Pakistan, there is a need for systematic investment and financial planning in energy sector infrastructure. Development of financial, banking and investment sector will bring new impetus to infrastructure development for energy and transport sectors. Increased financial allocation to science and technology for energy and transportation sectors will increase the role of higher education institutions and improving the economic outlook for Pakistan.

There is a strong push for privatization and commercialization of thermal energy sector of Pakistan. The hydro-power, particularly large dams, are still not commercially viable to be privatized at the construction phase. Once the dams are constructed by the federal government and its international loans paid, the commercial entities like commercial banks could take-up partial ownership of operations, maintenance and some other activities.

Renewable energy has the most potential for commercial activities in Pakistan. In most cases, investments are huge and result in immediate financial returns on electricity produced. The down side to all this is that solar energy infrastructure (without storage batteries) is not a hundred percent efficient, because of reliance on only daylight hours. Additional expense of batteries enhances efficiency but also incurs installation costs.

To provide 'Affordable and Clean Energy' to off-grid areas, far away from urban centers could be a potential market for solar panels and wind turbines. Government loan or investment projects or personal or commercial investments will bring these renewable technologies to KPK and Balochistan very quickly. Punjab, Sindh and Northern Areas of Pakistan also have high up-take potential. The higher education institutions in the country could design centers of excellence for identification and grading of renewable energy technologies, and innovations in fuel-efficient machinery and energy efficient buildings.

The SDG on 'Affordable and Clean Energy' is closely linked to the SDG on 'Industry, Innovation and Infrastructure'. The financing of science and technology for this SDG is closely connected with the SDG relating to the energy sector. In most cases, industrial productivity is energy intensive. One of the most needed innovation in the industrial sector is energy efficiency. All forms of infrastructural developments are highly energy intensive. It is not possible to achieve infrastructural development for expanding industrial sector without, first, increasing the size and efficiency of the energy sector in Pakistan. Most engineering and industrial innovations are for energy efficiency and for renewable energy equipment design.

Examples of two cities in Pakistan, Karachi and Faisalabad, can be taken. In addition to the labour and raw materials, these cities are dependent on: energy sector; transport sector; and innovations in industrial processes and infrastructure. Karachi is a port city but Faisalabad uses existing road and rail infrastructure to get fuels and raw materials to reach its industrial areas and to distribute its products, mainly cotton-based, to international markets. The crunch that both Karachi and Faisalabad have faced in recent past in the form of slowing down of their industrial growth is mainly due to reduced supply of energy resources. These industrial hubs need energy supply on an increasing rate, to keep the productivity at par with international market demands. Even highly innovative and technologically

advanced machineries cannot support the producers to compete in the international market without constant energy supply. This need for energy supply is consistent with the SDG on Affordable and Clean Energy. In next fifteen years, the achievement of the SDG 'Industry, Innovation and Infrastructure' in Pakistan will depend on the achievement of the SDG 'Affordable and Clean Energy'. This is where science and technology for SDGs could link research and development with local demand-driven processes. At the level of scientific research institutions, research focus should be concentrated on technology-driven research for fuels and energy resources. Energy efficiency in the industrial sector is one of the key components of technological innovation. Financing of these technological processes and other components of SDGs need systematic planning at government level, where corporate and banking sector is encouraged to participate.

Both CASA (Central Asia-South Asia) 1000 and TAPI (Turkmenistan–Afghanistan–Pakistan–India Pipeline) will connect electricity and gas from the West to KPK and Islamabad. Both of these projects are planned due to availability of loans. International Finance Corporation, World Bank, and USAID have specifically designed Energy Projects Financing Facilities (EPFF) for Pakistan. China is one the few countries that have interest in EPFF for Pakistan; this could also facilitate energy infrastructure development in the future. Iran-Pakistan gas pipeline is another possibility to be included under CPEC funded EPFF.

In Pakistan, monetary capabilities of the banking and currency markets, and stocks and bonds markets need to be strengthened. This will benefit the commercialization process of the ownership of the restructured electricity sector of Pakistan as it is transferred to the corporate sector. Floating of energy sector specific bonds and securities by the government, and floating of shares for energy sector agencies will bring financial boost to energy sector transition. As GENCOs and DISCOs reach their full potential, their shares and ownership could be traded at the stock markets in Pakistan.

Considering that every year about forty per cent of GDP is spent on debt services and loans repayment, other methods need to be identified for funding energy sector projects in Pakistan. Energy demand in Pakistan is much larger than energy supply. This means that if this sector is not brought to balance, all other economic activities would shrink. A separate energy sector investment plan needs to be prepared. This is where a research project funded by the Higher Education Commission (HEC) of Pakistan could be useful. Under one of the components of HEC's National Research Programme for Universities (NRPU) Project, titled 'Financial Planning for Energy Security in Pakistan: The Way Forward for Renewable Energy', the Commission has an objective to sign an MoU to design and establish Climate Change financial institution in Pakistan, titled "Climate Change Investment Bank".

Although this institution was dubbed the 'Climate Change Investment Bank', it will provide financial support for Energy Security in Pakistan (Mallick, 2015). The main focus here is to promote Renewable Energy in Pakistan by attracting investments in energy sector projects. As finances will be channeled through this institution, a clear financial accountability system will emerge. It is envisaged that each province will have dedicated investment banking structured for energy sector. This will ensure that energy projects are clearly defined in the financial terms, i.e., energy projects are made "bankable" and attractive to investors. These energy projects must have two supporting clauses to be financeable:

i. Have appropriate risk management mechanisms for potential investors;
ii. Have favorable internal rate of return (IRR).

The Climate Change Investment Bank must focus on infrastructure projects for the energy sector. Soft project components, like capacity-building, and training of technicians for technological development, will be made part of the larger infrastructure projects. Each energy project will be technology-innovation driven.

The definition of "renewable" is kept flexible by the Climate Change Investment Bank in its MoU. This is contingent upon the terms and conditions set by the investors as they provide investment funding for specific projects. As the Charter for the Climate Change Investment Bank takes its shape, the measures available to investors for covering risk will become evident. The prevailing interest rates and direction of future interest rates in the local and international market will have impacts on Net Present Value (NPV) and hence internal rate of return (IRR). As the Investment Bank becomes functional, all-out efforts need to be made to ensure that each province is provided investment by Climate Change Investment Bank for energy projects.

This is just one of many examples of new ideas that are under preparation for energy sector investment in Pakistan. Due to the close proximity of some of the SDGs with UNFCCC's COP process, it is envisaged that Global Climate Fund (GCF) will be providing funds to Pakistan for both climate change adaptation and mitigation. With SDG7 in focus, the climate change mitigation funding coming to Pakistan could support the provinces in implementing their energy sector strategies for SDGs.

6. CONCLUSIONS

When it comes to future planning for Pakistan's energy sector, Pakistan is being run by three independent political parties at the moment. This means that they have very different political agendas on future economic development in the country for Punjab, KPK, and Sindh. When it comes to hydropower, thermal power, and below-ground coal gasification technology, they all have different investment policies. KPK and Punjab might place hydropower as a priority. However, being a lower-riparian province, Sindh will oppose construction of any hydropower projects up-stream. When it comes to finding investors for below-ground coal gasification technology for the coal reserves in the Thar desert in Sindh, provincial and federal governments are not on the same page regarding investment responsibilities and financial liabilities before actual earnings and returns on the project begin.

Similarly, for the thermal energy sector, imported oil is needed to keep this energy sector running. Huge and long-term debts are being arranged to add LNG to energy-mix for thermal power generation. Future investment from China is expected under CPEC in coal-run thermal plants. Under hydropower, various dams are under construction in the northern mountainous areas; these could take another five to ten years to complete. Pakistan has a potential to increase its nuclear based electricity supply. The new and emerging technologies for renewable energy are there to invest in.

Pakistan needs to achieve SDG-7, whereby Affordable and Clean Energy is made available to all by year 2030. For this, each province of Pakistan will need to design its own individual plans and make commitments for energy sector related SDGs and related financial and implementation strategies. These need to be part of the Provincial Development Strategies; for example, Punjab Growth Strategy-2018 and KPK Industrial Policy-2016. Each year Federal and Provincial Annual Development Plans from 2016-2017 to 2029-2030 must highlight commitments to SDGs, particularly, the SDG-7. These Provincial Development Strategies and Annual Development Plans must be prepared in consultation with academia and corporate sector. The HEC of Pakistan has requested all academics with new academic research projects, to highlight the connection of their research with SDGs. This directly involves university level academics in planning and designing new technologies for achieving SDGs in Pakistan. The department within the Pakistan's Planning Commission dedicated to Poverty Alleviation, MDGs, and SDGs will need to take the responsibility of monitoring and evaluating 'SDGs Implementation Strategies' in these Provincial Annual Development Plans, and measure financial resources allocated for energy sector development in each province of Pakistan.

The SDGs that will benefit the most from the goal of 'Affordable and Clean Energy' are: 'Industry, Innovation and Infrastructure'; 'Quality Education'; and 'Decent Work and Economic Growth'. Once this is achieved, Responsible Consumption and Production; and Sustainable Cities and Communities could be designed and managed efficiently in Pakistan.

Within Pakistan and globally, intense effort is needed for reaching the SDGs: 'Zero Hunger'; 'No Poverty' and 'Reduced Inequality'. As the condition of people living in absolute poverty improves, it would become easier to focus on other SDGs, i.e., 'Good Health' and 'Well-Being', 'Clean Water and Sanitation', 'Gender Equality' and local 'Peace, Justice and Strong Institutions'. For Pakistan, climate resilient economic development and infrastructure design is a must, so that a sustained level of economic development is reached resulting in human dignity and protection of ecological and environmental processes while achieving the SDGs. Climate Action for Life below Water and Life on Land will then become achievable, nationally, as it becomes a global priority.

REFERENCES

- International Resources Group, 2011. Pakistan Integrated Energy Model (Pak-IEM), ADB TA-4982 PAK, Final Report Volume II, Policy Analysis Report.
- IIED's Human Settlements Group, 2016. Where are the Local Indicators for the SDGs? Blog: David Satterthwaite @Dsatterthwaite.
- IISD Reporting Service, 2016. News: Secretary-

General Presents Report on Progress towards SDGs. Progress towards the Sustainable Development Goals, UN Statistics Division News.

- Kessides, I.N., 2013. "Chaos in Power: Pakistan's Electricity Crisis." Journal of Energy Policy, 55, 271-285.
- Khalid, Z., 2014. Restructuring of WAPDA: A Reality or a Myth. MS (Energy Management) Thesis. COMSATS Institute of Information Technology, Islamabad, Pakistan.
- Mallick, S., 2015. First Draft Title: Climate Change Investment Bank Pakistan (CCIB-PK)-Design; Structure; and Processes. CCRD, CIIT Islamabad, Pakistan.
- Mallick, S., Sinden, J.A., and Thampapillai, D.J., 2000. The Relationship between Environmentally Sustainable Income, Employment and Wages in Australia, Australian Economic Papers, v 39, n 2, p. 231 (14).
- PIDE, 2015. Two Days Workshop on: "Moving from MDGS to SDGS: Policies and Options for Pakistan", Department of Development Studies, Pakistan Institute of Development Economics (PIDE).
- NEPRA, 2015. State of Industry Report 2015. National Electric Power Regulatory Authority, Government of Pakistan, Islamabad, Pakistan.
- SDPI, 2015. Workshop: "Sustainable Development Goals - The Way Forward". SDPI, Islamabad, Pakistan.
- UN Division for Sustainable Development, 2016. Sustainable Development Goals (SDGs), United Nations Department of Economic and Social Affairs, New York, USA. Accessible at