A Report on

Study of Technical, Social, Political and Economic Perspectives of Affordable & Clean Energy in India

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By

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Devashish Saurav

Work Plan

Weekly Work Plan for each week starting from Monday to Friday will be as follows. The guidance can be sought on email any number of times. The intern has to communicate the progress of work done on each working day by email in minimum 25 words by 7.00 PM. There will be a weekly discussion with the intern as per the schedule notified on email.

Week 1: Searching the available literature and statistics pertaining to the broader objective.

Week 2: Studying the technological aspects

Week 3: Studying social aspects

Week 4: Searching the political aspects

Week 5: Studying the economic aspects

Week 6:

- Studying the international initiatives in context to affordable and clean energy
- Assimilating the present situation and interconnecting the implications of various factors on the limitations felt by the affordable and clean energy in India

Week 7:

- Writing and submitting an article (upto 1000 words) giving insights into technical aspects of affordable and clean energy in India
- Writing and submitting an article (upto 1000 words) giving insights into social aspects of affordable and clean energy in India

Week 8:

- Writing and submitting an article (upto 1000 words) giving insights into political aspects of affordable and clean energy in India
- Writing and submitting an article (upto 1000 words) giving insights into the economic aspects of affordable and clean energy in India
- Final report writing and its submission for issue of the internship completion certificate

Abstract

Worldwide energy scenario can be understood from the fact that around 1.2 billion people in the world lack electricity. India is said to have around 244 million people without electricity, mostly from low income households from geographically dispersed areas. This absence of affordable and clean from Indian households and sizable population's dependence on inefficient and polluting kerosene, biomass, etc. make it inevitable to analyze and strategize for bringing in affordable and clean energy in India massively. Present study will aim at assessing the Technical, Social, Political and Economic perspective of affordable and clean energy in India.

Keywords: Accessibility, Agenda, Economics, Beneficiary, Employment, Rural, Renewable

Technical, Social, Political and Economic perspective of affordable and clean energy in India

In the era of globalization and climate change, the agenda of policy makers, business executives, civil society and political leaders has undoubtedly tilted towards procurement and production of sustainable clean energy. With the growing market and economy in Asia, there has been a consistent demand and availability of energy from fossil fuels which is leading to an enormous increase in CO2 emissions. India is one of the most prominent states in the association of Southeast Asian nations (ASEAN), so the responsibility of India as an important stakeholder increases. Even though most of the countries of the world are dependent on fossil fuels but majority of them have stepped up and are undertaking measures towards a low-carbon society. India has set an ambitious target for ensuring universal access of energy along with increasing production from renewable sources of energy. But this task is having several hindrances due to lack of social consciousness regarding the benefits of clean energy. India also submitted the Nationally Determined Contribution (NDC) and pledged towards increasing the clean energy capacity in the Paris Agreement on Climate Change (Working Towards Climate Justice, GOI). India is also committed towards reducing the carbon intensity by 33-35% by 2030 from its economy. The Prime Minister has declared publicly a target of achieving 175GW of renewable energy capacity by 2022.

For the survival and continuation of human survival consistent use and supply of energy is necessary. The ultimate source of energy since the ancient period is human energy, as it provides the necessary mechanical power. Slowly, humans started controlling the use of fire. This combustion of wood and the exploitation ability through chemical transformations helped them in cooking food, extraction of metals (bronze and iron) and heat dwellings. Later on energy from flowing wind and water got harnessed. Transport, agriculture and industry started using the energy from draught animals. Human societies advanced by acquiring coal, electricity, steam oil and gas for fulfilling their requirements. Now, it's high time that we should move a step further, towards consumption and supply of clean and affordable energy for welfare of society. For the sustainable development and security of any country, energy is an important factor. The demand for energy is increasing at a fast pace and it has grown considerably in the past few decades. The economic competitiveness, enhanced lifestyle, growing population and production improvements

are primary reasons for high energy demand. The demand for cheap energy is directly proportional to the growing global population. Global economies dependent upon fossil fuels and the continuous greenhouse gas emissions have already driven changes in our climatic system. It is a global phenomena and doesn't discriminate between rich or poor, South or North, developing and developed etc. Slowly and gradually the impact is quite evident on all the continents. Expansion of infrastructure and upgradation of technology is highly required by all the developing countries to supply clean energy sources as it will ensure growth and simultaneously help the environment. So it's a high time that humans should start discussing and involving the technical aspects of clean energy at various levels of production, distribution and consumption. Technologies, institutions and economic structures need profound renovation for transformation towards sustainability. With planetary carrying capacity already reaching critical ends, the concept of green energy is getting notified in national and international boundaries. The demand of energy and focus towards sustainability is beneficial for country's requirement and diplomatic stature respectively. State and non-state actors play an important role in directing this green energy transformation, that's why it is important to trace the links and analyse the interactions. The effectiveness, legitimacy and efficiency of the political actors have the capacity to drive clean energy changes. Political motives facilitate clean and affordable energy through social agreement, systematic learning and formation of alliances.

In the case of India, it is a high time that policies should be framed in such a way that it should aim at reduction in dependence on fossil fuels and encourage renewable energy sources. Already, renewable sources of energy like wind, biofuels and solar are offering an alternative as clean sources of energy and this is significant. It is also an advantage in terms of environment, human health and economy. Government should also encourage green industrial, official and residential buildings by providing incentives and low interest rates on loans for installation and equipment. Along with this both private and public investments on research and development should be encouraged, this will surely facilitate the development of renewable/cleaner technology and enhance the energy-efficient methodologies. With COVID-19 pandemic, the financial crisis seems evident, so the investment in clean energy sectors could help in revival of the economy by providing viable employment opportunities to the masses. By focusing upon the clean energy targets, the government can take direct action in delaying/refraining from climate change. When we are talking about a transition towards clean energy then societal support is a necessary

element. It is one of the directing components of the shift as consumption, utilization and distribution is directly linked with the people. This transition has the capacity of bringing profound impact socially, so researchers need to come up with solutions for dealing with the issues that arose in production and distribution processes. The future of India's clean energy initiative is dependent upon the participation and understanding of local communities, their active participation and support towards green initiative is the stimulus for favourable green energy policies coming up from political circles. Community led initiatives with non-profit approach should be followed so that the communities can be involved directly and a sustainable distribution channel can be developed for clean energy. For a green future political reform is necessary in the power sector, state distribution companies should work combindely with the central agencies to come up with viable clean energy alternatives for the people. The clean energy should be made accessible to the poor people by subsidising and consistently providing it.

Conclusion:

Even today, the world relies heavily upon fossil fuels and the socio-economic structure keeps on subsidising them. However, the moral conscience of masses is undergoing a slow transition. The impact and accessibility of energy use is one of the prominent topics among policy makers. From the emission of greenhouse gases to release of health harming pollutants, the concerns due to usage of conventional energy sources have reached record levels. Due to climate efficiency and the feature of releasing less pollutants, the reach and acceptance of clean energy sources is increasing. With technological interventions, clean energy has also become more affordable as it is also available at lower cost and prices. As the clean energy is in the expansion phase, it also holds capacity for job creation and infrastructural growth. This all is ultimately beneficial for the community engaged and involved in distribution. Along with it for dealing with power shortages and for development of energy resilient systems, a transition towards clean energy is necessary. So, clean energy should be made accessible to all.

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Annexure 1

Social aspects of affordable and clean energy in India

For the survival and continuation of human survival consistent use and supply of energy is necessary. The ultimate source of energy since the ancient period is human energy, as it provides the necessary mechanical power. Slowly, humans started controlling the use of fire. This combustion of wood and the exploitation ability through chemical transformations helped them in cooking food, extraction of metals (bronze and iron) and heat dwellings. Later on energy from flowing wind and water got harnessed. Transport, agriculture and industry started using the energy from draught animals. Human societies advanced by acquiring coal, electricity, steam oil and gas for fulfilling their requirements. Now, it's high time that we should move a step further, towards consumption and supply of clean and affordable energy for welfare of society. If we look in a broader sense then history is a story of energy control for upliftment and upgradation of society. Sustainable energy is also defined in the sense of availability of energy intensive goods and the services it provides to people and also the earth preservation for future generation in equitable manner (Tester et al).

Humans need to recognize that social needs get satisfied by energy and we have to understand that energy supply and consumption do not end in themselves. The services provided by energy sources like coal, oil, gasoline and electricity etc. matters the most, not the sources per se. Hence it is important to think at multiple levels on the side of demand, use, service and impact these energy systems incorporate. Clean and affordable energy are crucial for society, as they provide inputs for adequate food, clothing, shelter, water, medical care, schooling, information and sanitation. So in social aspects of development and poverty clean energy is an important dimension and plays a vital role. In the present context clean energy is integral to society as they are contributing in meeting the requirements of cooked food, lighting, appliance use, a comfortable living, water supply, health care, communication and transport. Socially, clean energy is an added advantage in activities like agriculture, manufacture, commerce, mining etc.

After noting the role of clean energy in daily functioning of society it is important to understand the association between clean energy and poverty. In this context we need to understand the term ‘Energy poverty’ which is defined as the absence of affordable, safe, adequate, high-quality and environmentally safe energy services for supporting socio-economic development. Human

society in either developing or developed countries has its own disadvantaged population, though the energy aspect is different for them. The poor of industrialised countries are not poor in sense of energy availability. The impact of energy consumption also varies among rich and poor, as the underprivileged masses are more vulnerable to the adverse impacts than rich who have means to mitigate. Clean energy systems need to be adopted and followed because it will not only contribute towards a better environment but will also affect the health and livelihood of poor masses. It has the scope to involve them in setting up the clean energy setups thus providing jobs and continuous energy access. So clean energy is directly proportional to welfare of each element of the society.

Moving forward we need to look at a few important aspects of clean energy through the gender lens. Poverty too is more harsh on women. Out of 1.3 billion people (approximately) living under poverty, 70 % are women (UNDP,1997). For survival activities women spend more time than men in developing countries, the time spent is not recognized in present reporting methods of energy statistics and patterns (UNDP,1997). In some of the least developed countries biomass accounts for 90% of total energy whereas in developing countries it is around one-third. Approximately 2 billion people still rely upon traditional fuels for their regular energy needs (UNDP,1997). Due to these datas it is important to think about the changes in functioning and survival of women that clean energy can bring about. Sustainable energy and women are linked in diverse ways (Reddy et.al). These linkages are at multiple levels and layers, that are distributed over time, between urban and rural, between countries and across classes. There are variations as well as similarities common among women, children and men of any given era, country or class. But crucial features of the associations between women and energy are worth considering. Clean energy and women are linked through the nature of energy sources, the prevailing energy policies, women's position in the community and the characteristics of economy and household. Clean and green energy is an organizing issue for the women because it is of primary concern in their daily life. In case of India, the massive success of Ujjawala scheme as reflected in policy concerns and landslide victory of NDA (National Democratic Alliance) proves the necessity and grassroot demand of clean energy for women. In this context it is important to note that, if used in a consistent manner the improved wood-burning stoves hold the potential of livelihood benefits and reduction in environmental impacts. It will also result in saving time, and fuel saving (Rosa et al., 2014; Bensch and Peters,2013, 2015).

The scarcity of clean energy reach, cost, reliability and quality is a constant concern for policy makers these days. So in the context of globalization each woman can contribute in improving the situation. They need to understand the role of clean energy and importance in their daily life. Even though their individual contribution is important as well, a collective approach towards clean energy demand can help them in their upliftment socially as well as politically. Women need to organise themselves like farmers (mostly men) so that they can put up a similar demand for reliable and affordable supply of energy. Women need to broaden these movements by broadening their agenda, clean energy has the potential to enhance skill building among women.

Clean energy strategies should also be combined with population growth because the life expectancy and child mortality is somehow dependent on it as well (Goldemberg and others, 1988). Clean fuels and advanced cooking devices drastically reduces the required physical labour by children in household chores like fuelwood gathering, fetching drinking water, cooking and livestock grazing etc which ultimately improves the life of women. In India the migration from rural to urban areas is a major issue, the cities are almost full and are crossing their carrying capacity. Clean energy can play a major role in high-density settlements with minimum impacts and investments. The affordable energy sources can also act as a weapon to reduce migration by providing enhanced energy in rural areas. The COVID lockdowns and generated problems have already shown the glimpse of dark sides of migration, so we need to think on these lines. Along with it the Government of India needs to aware people through community participation and workshops, so that they can understand the importance of devices that conserve energy and benefits of clean energy. Psychological acceptance of clean energy is important for the success of any clean energy project in India.

Accessibility of clean and green energy is fundamentally linked with poverty reduction and social upliftment, but still many countries in Asia and the pacific including India are unable in ensuring reliable, affordable, sustainable and efficient energy resources. It is a significant threat and challenge for environmental sustainability and social stability. Along with the growing demand of distribution, production and use of clean energy, the recognition of the existing synergies and parallel social welfare with clean energy access is growing. Even in the Sustainable Development Goals (SDGs) the energy target aims at increasing and expanding the social benefits with minimum environmental impacts.

Annexure 2

Political aspect of clean and affordable energy in India

Technologies, institutions and economic structures need profound renovation for transformation towards sustainability. With planetary carrying capacity already reaching critical ends, the concept of green energy is getting notified in national and international boundaries. The demand of energy and focus towards sustainability is beneficial for a country's requirement and diplomatic stature respectively. State and non-state actors play an important role in directing this green energy transformation, that's why it is important to trace the links and analyse the interactions. The effectiveness, legitimacy and efficiency of the political actors have the capacity to drive clean energy changes. Political motives facilitate clean and affordable energy through social agreement, systematic learning and formation of alliances.

The political influence brings about systematic transformation, as it synchronizes the green energy policies with other policies by incorporating public investment and trade. Clean energy policies are also influenced by political agendas which comprises dealing with technological uncertainty as it aims at looking towards commercial viability of technologies (Altenburg & Lu¨tkenhorst, 2015). Political associations also help in importing technologies from advanced countries thus reducing technological lags and energy wastage. But it should be kept in mind that, though the government needs to play an active role, they cannot bring about the revolution in reach and accessibility of clean energy in an affordable manner. Non State actors need to coordinate with governments for ensuring the cost benefits and for the optimization of the distribution system fairly. This coordination will also help in management of conflict interests and social issues, so that any project can be implemented smoothly. This public and private alliance in fostering the transformation towards a greener world (Schmitz, 2015, p. 177). These alliances bring together the interests of larger sections of society as it is legislation and policy driven. A politically conducive environment is necessary for investments and trust factor, as Evans (1995) rightly claimed that "without a predictable environment of political rules and decisions long-term investment is foolish" (p.247).

From Nehruvian era to Modi's 21st century the political language and approach have changed drastically. From Nehru's dams to Modi's International Solar Alliance we see a glimpse of major shift, we need to understand it in context of socio-cultural and economic shift but a major force

behind it is the populist ethos prevalent in the society. The ban on plastics initially in hill states and later on in political hubs like Delhi is bargained in the elections, an attempt is usually made by leaders to project them as a green or eco friendly person. In this context we cannot ignore the international recognition that leaders receive because of the eco friendly steps they take in their respective countries, we get a glimpse of it in form of applause that Modi received due to Ujjawala yojana.

The gradual shift towards clean sources of energy is getting major boost in the developing world, India is the distinguished leader of the pack. Even before signing Paris climate agreement, India announced its ambitious energy goals which aims at quadrupling the energy capacity to 175 gigawatts by 2022. Since 2017, the energy capacity of India has increased by 68%. But India's attempt to match the settled target is often threatened or restricted due to political roadblocks. It still lacks demonstrated efforts, comprehensive policy, rigid framework that can facilitate easy shifts towards clean energy. A 2013 World Bank report suggests that the market mechanism which includes continuous falling prices are insufficient for ensuring long-term sustainable infrastructure for clean energy. Clean energy market in India remains mostly a domestic affair and it has significant barriers for foreign direct investment (FDI) and trade. This restricts the growth of clean energy in India. Even at a slow pace things have started taking a turn in India, as the political will to develop renewable and affordable energy sources is increasing. We need to understand it in context of land regulations and land acquisition policies as well, because the initial and primary requirement for developing any infrastructure is availability of land. Now we need to focus on a few numerical data in the sense of India, for understanding the role of governments in establishing clean and affordable energy as a viable opportunity for conventional energy sources. In India the capacity for renewable energy is steadily growing with 20% per annum (Factchecker Team 2015), but this capacity needs a tremendous increase for meeting the ambitious target that was announced in November 2014. India aims at generating renewable energy capacity to 175 GW (GOI 2015). With investment of around US$7.4 Billion in 2014, India is among the largest investors in the renewable energy sector (FS-UNEP 2015). The NDA government led by Prime Minister Modi pledged the national and international organizations for deploying 266GW of renewable energy in five years and installed financial institutions which is committed for financing renewable energy projects that amounts to 78GW (Bhaskar 2015; Ghosh 2015). Prime Minister Modi also launched the International Solar Alliance and India is

aiming to be the second largest solar market by 2030 (IEA 2015c). Former Prime Minister Manmohan Singh had launched the original solar mission which aims at installing 20GW by 2020, this target increased fivefold to 100 GW by PM Modi. The Modi's regime also encouraged the foreign investment in the solar sector by attracting US$100 Billion to the sector by 2022 (Parkes 2015). Already India has secured a deal with German government of US$2.25 Billion for renewable energy technologies and solar energy (Reuters 2015) and a deal with the US Export-Import bank has also been secured for facilitating shipping equipment from the United States of America (Parkes 2015). Modi while he was the Chief Minister of Gujarat tried to transform the state economically and also in sense of solar sector. Gujarat accommodates 40% of India's solar capacity by 2014 (Pearson and Chakraborty 2014), and in 2015 Gujarat became the third largest wind producer in the country (Parkes 2015). This was one of the primary reason behind providing stable energy access to all the citizens of the state. So Gujarat successfully represents the political and geographical factors that can bring about change in energy dynamics. The combination of political capacity and focus on clean energy made renewable energy technology a feasible tool for addressing the socio-economic demand of energy access.

So, we see that the international and national forces are directly involved in clean energy matters. At the Center for Strategic & International Studies, Anand Kumar (Secretary of India's Ministry of New and Renewable Energy) emphasized that India needs to prioritize its domestic industry for clean energy distribution and establishment. As per the World Bank's Ease of Doing Business index India's rank is 77, this is behind major clean energy competitor China. So even in sense of economic feasibility of clean energy India needs to follow a rigorous process. Youth nations like India are having capacity and will power to transform its entire energy sector, India is moving on that path. The contribution of Youth is even recognized in the political circles, that's why political leaders usually try to link and communicate the issues of clean energy through them. The Climate Policy Initiative also emphasized that India requires a foreign investment of $189 to meet the desired energy goals. India's clean energy ambition is high and political circles are not letting any page unturned to bargain it.

Annexure 3

Technical aspects of affordable and clean energy in India

The demand for cheap energy is directly proportional to the growing global population. Global economies dependent upon fossil fuels and the continuous greenhouse gas emissions have already driven changes in our climatic system. It is a global phenomena and doesn't discriminate between rich or poor, South or North, developing and developed etc. Slowly and gradually the impact is quite evident on all the continents. Expansion of infrastructure and upgradation of technology is highly required by all the developing countries to supply clean energy sources as it will ensure growth and simultaneously help the environment. So it's a high time that humans should start discussing and involving the technical aspects of clean energy at various levels of production, distribution and consumption. The properties, safety concerns, effect on performance and storage implications are major elements of the technical aspects of clean and affordable energy. Along with it we need to discuss and focus upon the emissions, efficiency and barriers that are latent in the technicalities of clean energy consumption in India.

Undoubtedly, India is making efforts to accelerate energy technology, so that they could meet the policy goals which includes enhancement of country-wide accessibility to energy and foster economic growth. The domestic as well as international politics plays a remarkable role in this context, because on one side the air pollution of Delhi suffocates the parliament on the other hand Prime Minister's remarks on Paris agreement ring bells in Pentagon. We cannot even miss the role of capitalism in reaching and accessibility of the clean energy, private actors and sectors are increasing their stake and policies need to put a check on changing scenarios brought up by the private participation. With initiatives like 'Make in India' and International Solar Alliance the government's focus is on public-private cooperation cum collaboration. But with incentives, tax rebates, finance availability and administrative support to Private firms, the situation has changed as they are scaling up their reach in national technology deployment and development. For a country like India there is a need to focus on certain primary sources of energy like Solar and Tidal, it is also important to move away from conventional sources like coal and diesel to match the ambitious target of 175 GW renewable energy generation. Owing to the enormous potential that India holds the policy measures should be made more investor-friendly, so that India can become a global leader in green and clean energy. As per the data of Mission Innovation(2018) Country Report and Progress, the total Public-sector expenditure on research

development and deployment of clean energy is just USD 110.61 millions. Government needs to maintain the equilibrium and the unhindered hegemony of private sectors in technologies related to green energy should be checked with the public sector's efficient participation and contribution in it. This is important, as it will reduce the chances of misutilization and increase the chances of equitable distribution (without profit making intentions) of clean energy in an affordable manner. As per the UN India around 237 million people still don't have access to energy in India so the scope of success for clean energy is high.

For developing countries like India and China, a sudden shift towards green and clean sources of energy seems like a difficult task. Primarily with the expansion of the economy and rise in purchasing power of masses the demand for conventional energy sources is increasing as well. For example with ongoing urbanization, the demand for electrical appliances is increasing drastically as they run on electricity, so it is the duty of the government either to ensure electric supply through renewable sources of energy or supply electrical appliances that can run directly using renewable energy sources like solar bulbs etc. Another example of agriculture where the demand for production and food requirement is followed by mechanization of agriculture, which is pushing for groundwater irrigation and the demand is met by using pumping sets and tractors which functions usually on diesel. So several examples suggest that in this era of globalization and competitions the loss of traditional systems with indegenous knowledge is actually pulling the demand for conventional energy sources like diesel or petrol. Hence we need to focus upon the revival of indegenous knowledge and wisdom to reduce the consumption of non-renewable sources of energy. The energy access to communities is undoubtedly making things easy for them but it holds several harmful impacts, that they are not concerned presently but it will have an adverse impact in the long run.

The Government of India funded the Million Solar Urja (Energy) program which aimed at dissemination of 1 million solar study lamps in the rural households of 72 sub-districts of India. The strategy of localization was adopted and the focus was on the capacity building of the local community. But a lot of technical glitches are unable to get sorted out, this happens due to issues of repair and maintenance. So while working on these aspects of green energy, the technical support required for maintenance and on-time repair can be crucial and it will also lead to the success of low-cost technological intervention in the energy field.

So lack of efficient technical support to clean energy reduces the quality and experience, which creates a strain in implementers and consumers' relationships. The mere implementation of clean energy projects is not a viable option in a country like India. These projects should follow and focus upon the capacity building of the communities, it should involve imparting technical skills and training. Government programmes like 'Skill India' can play a major role in it, a holistic plan and frame under which local people can learn the use and maintenance of clean energy establishments will help in making it more affordable to the people.

Non-combustible and combustible components compose the clean gaseous fuels like biogas. The presence of Methane (CH_4) in biogas improves the fuel quality and it even enhances the thermal efficiency. This also reduces the soot formation and enhances anti-knocking property. Due to these benefits, the Ministry of New and Renewable Energy (MNRE) is promoting gasifiers based upon biomass and biogas plants for generating electricity with the help of locally available resources. These plants have been installed in different parts of the country with capacity ranging from 10-500 KW. The main purpose of these units is to provide lighting in houses and on streets, irrigation and water pumping and for meeting the energy requirements of small-scale industries. So we can analyse that solar projects on one hand are unable to meet the desired results because of technical issues, and on the other hand the combination of technology and local participation is an advantage for the biomass plants.

Since time immemorial 'revolution' in literal sense hasn't reached India, but in the field of energy demand and supply, there is a need for a grassroot revolution in innovation. Innovations have the capacity to use sustainable technologies for energy production and distribution and pave a way for community empowerment and socio-political mobilization. In the technological movements of the 1970's and People's science movement of the 1980's we saw evidence for growth of grassroot innovations. Many of the Western technologies in the field of clean energy fail in India and South-Asia, because of totally different demography and understanding. So indegenous innovations which are based upon informal practices of common people need to be encouraged and supported by the government, so that it could act as an alternative epistemology to western technology and science. Projects and policies favouring the creation of indegenous community energy niches should be the priority of the government, as it will enable the experiments in sectors of clean energy which will be visionary in character with social goals and challenges running along with it.

Technique of Decentralized Solar PV systems is developing as an alternative, especially in unelectrified areas. But there are certain barriers in the implementation and sustenance of solar PV systems. The inadequate understanding and connection between adoption, implementation and diffusion of these systems in daily life is still a major issue for its success. Localization, saturation and affordability is necessary for sustained use and adoption of Solar PV systems at least for resource scarce communities. The situation is similar in case of other innovative, energy efficient and renewable systems as well. Even though the access to clean fuel is one of the sustainable development goals, the transition from non-renewable and polluting energy sources to renewable and clean energy has yet not achieved in India. India is working extensively in the rural electrification sector and the Government of India claims that India is completely electrified. In this sense small-scale electricity generation out of grid with the help of mini/micro-grid can act as a revolutionary technological intervention. These interventions have potential to target towards global energy access.

A combination of push with policies and pull with technology is required for promotion of renewable and clean energy in India. Technological advancements gave pathways to conservation of environment and energy and it guarantees that clean energy sources are used in a cost-effective and instant manner

Annexure 4

Economic aspects of clean and affordable energy in India

For the sustainable development and security of any country, energy is an important factor. The demand for energy is increasing at a fast pace and it has grown considerably in the past few decades. The economic competitiveness, enhanced lifestyle, growing population and production improvements are primary reasons for high energy demand. From 1971 to 2014 the energy usage has increased by 44% (World Bank, 2017a, 2017b). A sense of energy insecurity continuously prevails upon countries that are dependent upon fossil fuels and import it. Around 71.5% of the total oil reserve is held by the Organization of the Petroleum Exporting Countries (OPEC) while the rest of the countries depend upon producing states (BP,2017). One-third of the total energy consumption is oil, it is the most consumed fuel of the planet. To maintain the development rate and economic prosperity a long term energy security is necessary to avail that clean energy sectors are the only viable option. In the case of conventional fossil fuels a continuous sense of insecurity revolves around the importing countries because of the volatile market and situation prevailing in the exporting countries. So for ensuring stability and energy assurance it is high time that India should decrease the dependency on fossil fuels and invest heavily towards the renewable and clean energy source available because a small disruption in the demand and supply balance of energy generates heavy economic repercussions. Energy is one of the prime pillars for economic growth, energy availability with assured supply quality has an influence and impact on the services related to health, security and food. It is the key for sustainable economic development (Khurana, 2004). In future, India is expected to maintain its growth in economic sense so this fast-growing economy and increasing population raise concerns about energy security of the nation.

For the material welfare of humanity access to clean and affordable energy like LPG is indispensable. The consequence of energy poverty is multidimensional in nature (Pereira et al. 2011 and Day et al. 2016). A country or society having scarcity of energy resources will face challenges like ill-health, poverty, gender discrimination and illiteracy (Sovacool, 2013 and Groh, 2014). The provisions for secure, clean, modern and affordable energy for citizens is one of the central elements to economic growth and poverty reduction and it is also mentioned in IEA (2017).

As per the report of the International Renewable Energy Agency (IRENA), if the current share of renewable energy is doubled in the global energy mix then the Global GDP will increase by $1.3 trillion (approx.) by 2030 i.e 1.1% increase. Being a source abundant country with availability of Solar and Wind energy India also holds a golden chance to grow and prosper in this field. Clean energy holds economic benefits at micro and macro levels. Worldwide in the renewable energy sector around 10 million people are engaged, only in 2017 around 500,00 new jobs were added. Presently, India is going through an economic crisis and millions of youth are unemployed, the unemployment growth is further aggravated with the onset of COVID pandemic. So India needs to use the opportunities available in clean energy sectors for creating jobs, increasing the present positions in installation, manufacturing, sales, marketing, engineering and more. Clean energy sectors have an additional advantage as it holds capacity to enhance the economic capacity of both skilled and unskilled masses, rural and urban masses etc. For example the installation of Wind turbines or Solar photovoltaic plants in rural areas, provide an opportunity for landowners to offer their land on lease thus generating continuous income and also supporting green movement. But this is quite difficult to follow in India as the feasibility depends upon the removal of middlemen, non-progressive policies and security arrangements.

Switching to clean energy is also a way for industrial, residential and commercial customers to save on their bills. For example installing Solar panels on the rooftop of a private property can ensure the energy availability and even reduce the bill on energy to zero. But several factors work combinedly for its success as conducive environmental conditions, energy demand etc. plays an important role too. A recent report of the Universal Ecological Fund claims that, around $240 billion per year is the cost of climate change in the U.S. economy. The Fourth National Climate Assessment, found that around 10% contraction of the U.S. economy is expected if climate change continues in the same way. These economic losses are evident and India will not be an exception, melting of glaciers and direct Impact on coastal areas will make India more prone to it because of its geography. Thus India needs to think about reducing the pollution, mitigating extreme weather events, sea level rise etc. as it will help them in reducing the economic loss as well. Hence switching from conventional forms of energy towards clean energy could contribute in slowing down climate change thus avoiding the potential loss to the economy. So we need to invest more towards the clean energy sector because it has major benefits for human health and economic stability. We need to keep in mind that the clean energy

technologies are labor intensive so they create more jobs than conventional energy sources. Also the clean energy technologies offer more scope for the primary use of locally available resources therefore it helps in keeping the benefits of investment at home only.

Along with the issues discussed above we have to keep this in mind that at individual scale one time investment is required for accessing clean energy, India being a developing country should assure that the initial cost factor should not be a burden for the masses. The impact of clean energy usage is more beneficial for the underprivileged masses as they have no option to mitigate the harmful impact of the conventional energy sources. Richer sections of the society have at least an option or way to deal with the problems generated out of fossil fuel burning whereas poorer sections have no way to deal with it. Thus clean and affordable energy is the necessity of time. If the policies are made conducive for the clean energy growth then owing to the availability of clean energy sources, India can emerge as an exporter of energy in near future. It will also help in making India self-sufficient in many senses.