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## **Research Brief**

# **Clean and Affordable Energy-The Way Forward for India**

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### About the Organisation:

LexQuest Foundation (LQF) is an independent, non-profit, research and action organisation, established in 2014, in New Delhi. We are striving to create, advocate and implement effective solutions for a diverse range of development issues.

To endorse participative governance, we engage with a broad spectrum of stakeholders, from various sections of the society, to ensure that policy-making remains a democratic process. We utilize pragmatic and futuristic research to disseminate actionable knowledge to decision-makers, experts and the general public.

Our key activities include capacity and skill-building workshops, policy advisory programs, public outreach, and stakeholder consultations. We collaborate with the government, other organizations and individuals for impactful policy formulation and execution.

By employing sustainable and equitable solutions through our multidisciplinary, intersectional initiatives and programs, we are constantly working towards creating empowered communities.



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**“Energy is the golden thread that connects economic growth, social equity, and environmental sustainability. With access to energy, people can study, go to university, get a job, start a business and reach their full potential.”**

**-Ban Ki Moon**

### **‘Transforming Our World’**

Sustainable Development Goals were adopted in the UN Sustainable Development Summit, 2015 by all member countries of the United Nations. Countries agreed upon [The 2030 Agenda for Sustainable Development](#), known as ‘Transforming Our World’, which is a shared blueprint for the development and prosperity of people and the planet. It **comprises 17 Sustainable Development Goals (SDGs) which are to be achieved by all countries by 2030**. These goals provide a holistic approach to move towards sustainable development covering poverty alleviation, health, education, growth, clean energy, and other areas. Certain targets and indicators have been agreed upon to quantify the progress towards these goals.

The need for access to clean energy has been inculcated in [Goal 7](#), i.e., ‘**to ensure access to affordable, reliable, sustainable and modern energy for all**’. The objective of this paper is to analyze the relevance of this goal in the Indian context and to examine the progress made by us against the targets and indicators thereof. This paper also attempts to suggest ways to accelerate the progress towards achieving this goal.



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## [Affordable and Clean Energy for All](#)

There is no development without fueling the engine of growth. Energy is key to all the economic, social and environmental challenges we face today. Clean energy is crucial for sustainable development. Those who don't have access to sustainable sources of energy are devoid of the opportunity to become part of the global progress. And yet, 860 million people around the world don't have access to energy. More than 2.90 billion people in 2017 or **38% of the world's population do not have access to clean fuels and technologies for cooking**. Continuing reliance of economies on fossil fuels will have drastic consequences for our planet. The following five targets, under Goal 7, are to be accomplished if we want to achieve the goal of affordable and sustainable energy for all.

- By 2030, ensure universal access to affordable, reliable and modern energy services.
- By 2030, increase substantially the share of renewable energy in the global energy mix.
- By 2030, double the global rate of improvement in energy efficiency.
- By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.
- By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular, least developed countries, small island developing states and landlocked developing countries, in accordance with their respective programs of support.



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## [India and the Goal of Sustainable Energy](#)

India is an emerging economy with a large population living in different regions which significantly vary in terms of endowments of energy resources. **A significant portion of India's population lives below the line of poverty. This large segment also lacks access to modern sources of energy.** India is still largely dependent on fossil fuels for its energy requirements. We are also **one of the largest importers of crude oil**. India's per capita energy consumption increased to 0.6 tonnes of oil equivalent in 2019, compared to 0.4 tonnes of oil equivalent in the year 2000, however it is still far below the global per capita average of 1.8 tonnes of oil equivalent. **A large portion of India's population relies on solid biofuels which are unsustainable.**

Clean and modern energy becomes even more important in the context of energy requirements of a growing industrial base in India. According to the Sustainable Development Report, 2019, India's score on Goal of Affordable and Clean Energy was 65.4 and India's performance has been marked as 'moderately improving'. The following paragraphs elucidate how India is faring against targets and indicators of the goal of clean and affordable energy and what more does India need to do for achieving this goal within the SDG time frame.



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## Target 7.1: Ensuring Universal Access to affordable, reliable and modern energy services

This target is aimed at ensuring that everyone should be able to access and afford the energy sources which are sustainable for our future.

### Indicator 7.1.1- Proportion of Population with Access to Electricity

#### **Concept and Measurement:**

The percentage of people who have access to electricity is an important indicator within the SDG framework as it addresses many critical issues related to different socio-economic dimensions. Access to electricity facilitates income generation and reduces the burden of household tasks. It also benefits the education of children, the health of family members and facilitates the use of Information and Communications Technology (ICT) services. However, the presence of electricity connection does not necessarily mean reliable and affordable electric supply. Frequent power cuts are prevalent in large parts of India. Moreover, the government's data does not include 'unwilling' households as unelectrified, although **most of the unwilling households rejected connections because of their inability to pay electricity bills.**

#### **Targets and Achievements:**

The national target for 2030 is to ensure access to electricity for all households. According to the Rural Electrification Corporation, in November 2019, 99.99% of the households had access to electricity with 100% electrification being achieved in the urban areas while 18,734 households (0.01%) are yet to be electrified in rural areas. However, it does not include a large number of households that have willingly not taken electricity connections.



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According to [the World Bank](#), in 2017, 92.6% of the Indian households had access to electricity, compared to 76% in 2010. In 2017, access to electricity was 89.3% in rural areas compared to 99.2% in urban areas.

### Efforts and Challenges:

India has taken significant strides in ensuring electricity for all through the [Saubhagya Scheme](#). 2.63 crore households have connected to the electricity grid through the Saubhagya Scheme in the last two years. In April 2018, India achieved the milestone of providing electricity to all the Census villages. However, sub-village units such as tolas/hamlets/majors may still be unelectrified as the scheme brought electricity only to census villages. Moreover, there are [contrasting reports](#) as to the exact number of unelectrified households. **Estimates submitted by State governments to the Center in 2018 showed 6.4 crore households were yet to be electrified. Ensuring the quality and reliability of power supply is also a serious challenge.**

### Suggestions:

- Villages are counted as electrified if at least 10% of the households have electricity connections. Government had set a target to electrify all villages by last year (2018). To complete the target with haste, authorities quickly moved on to the next village after completing the necessary 10% requirement. Also, households unwilling to pay rejected the connection and therefore aren't counted as 'unelectrified'. There is a **need to separately identify particular households which are yet to be electrified after increasing the cut off for relaxation from paying electricity charges. This can be done by local authorities by preparing a database of such households at the local level.**
- The **cut off for relaxation from paying electricity charges should be increased from the line of poverty.** It may, however, lead to an



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unsustainable system in the long term if it is not coupled with economic growth and income generation in rural areas.

- Availability of and access to sustainable energy is closely associated with the development of infrastructure and production systems. There is a **requirement of additional electricity generation capacity** to provide a continuous power supply.
- Coal is still the main source of generating electricity therefore more investments are required for increasing reliance on renewable sources for generating electricity.
- Public Private Partnership (PPP) models in the electricity generation and transmission sector should be promoted by facilitating land and regulatory approval. PPP should be adopted in the distribution sector as well which has largely been a monopoly of the government sector. The PPP model has been effective in bringing operational and financial efficiencies in the distribution system. It has also helped administer better customer satisfaction through quality service and innovative payment options.
- The **transmission and distribution infrastructure needs to be upgraded, especially to reduce the faults and leakages**. The inadequacy and uncertainty in supply results in the continuing use of diesel generators in rural areas. By providing adequate and high-quality supply, rural demand could be increased, ensuring higher utilization of electricity infrastructure, which could lead to long-term sustainability to access.



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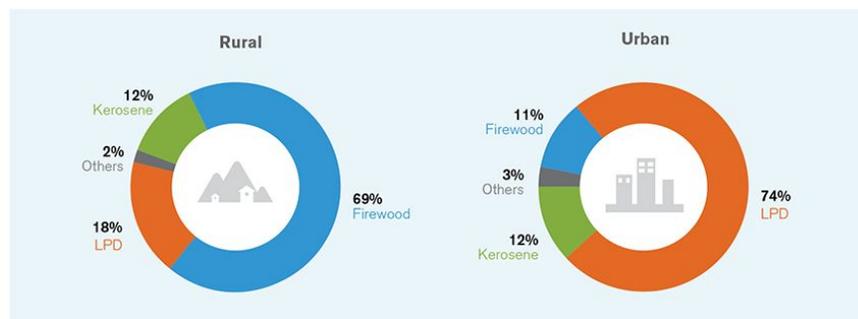
## Indicator 7.1.2- Proportion of Population with Primary Reliance on Clean Fuels and Technology

### Concept and Measurement:

This indicator is defined as the percentage of people using clean fuels and technologies for cooking, heating, and lighting. Clean is defined on the basis of specific fuel recommendations and emission rate targets prescribed in the WHO guidelines for indoor air quality: household fuel combustion. Cooking, heating, and lighting form a large chunk of energy usage in households. **Households in developing countries like India heavily rely on inefficient technologies (solid fuels, open fires, stoves, etc.). These inefficient methods have adverse health impacts as they are associated with high levels of indoor air pollution.** Therefore, the use of clean fuels and technology is crucial for human development. WHO guidelines provide information as to what fuels and technologies are clean based on emissions and efficiency.

### Targets and Achievements:

The target for 2030 is to ensure 100% access to clean fuels and technology for cooking. According to [a report](#) by the International Energy Agency in 2017, 45% of the Indian population had access to clean fuels and technology for cooking. This figure was 36.5% in 2010.





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### Efforts and Challenges:

Air quality in rural areas becomes severe due to the use of solid biofuels like wood or cow dung. It has adverse impacts on the health of residents. Clean fuels and technologies are essential to improve health and the environment in rural areas. Since 2014, the government has adopted City Gas Distribution Networks in urban areas under which piped natural gas is being provided to urban citizens and the DBTL scheme for direct transfer of LPG subsidies. The government also launched the Pradhan Mantri Ujjwala Yojana in 2016 to provide free LPG connections to women belonging to households living under the line of poverty. As of November 2019, 8.03 crore new connections have been disbursed under this scheme. However, the actual **impact of the scheme has been limited because many of the beneficiaries could not afford subsequent cylinder refills**. Also, there is a lack of robust distribution infrastructure. 55% of the population still does not have access to clean technologies for cooking and heating.

### Suggestions:

- A uniform and systematic delivery system should be established which could help reduce the logistical obstacles for rural households in the adoption of LPG.
- LPG filling facilities should be provided in local village markets like *bazaars* and *melas*.
- Oil companies should provide prompt customer service including timely delivery and safety checks so that consumers who can afford gas connections but prefer to use other sources because of poor delivery of services of LPG, especially in rural areas and small towns, will start using LPG.
- Government provides many services through an online platform to LPG consumers. These services include, but are not limited to, applying for connection, applying for refilling, tracking delivery and subsidy transfer. Government should organise public awareness



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campaigns through camps and advertisements to spread awareness about these facilities.

- People should be encouraged to adopt clean fuels. They should be made aware of its benefits by including information in the school curriculum and awareness programs in government hospitals.
- The government should look into promoting 5 kg cylinders which are easily accessible, because in many cases, people prefer to use solid biofuels even though electricity and gas options are accessible. It can happen due to several reasons, such as unawareness about benefits, test preferences, poor logistical services, etc.
- Electric supply should be stable, reliable and affordable, so that people could use electric appliances and not the solid biofuels for heating when required.
- Forest laws should be strictly enforced to prevent cutting of trees to accelerate the shift to clean fuels.
- State governments should consider banning kerosene for domestic use in urban areas where subsidised cleaner fuels are accessible.
- **Piped Natural Gas (PNG) infrastructure should be extended and improved so as to ensure supply for at least all bulk consumers such as hotels, restaurants, colleges and other commercial enterprises.**
- Use of PNG should be made compulsory for mobile towers as backup fuel in the areas where infrastructure is available. Currently, diesel generators are used as backup fuels.
- Commercial and residential buildings should establish waste to biogas plants in their premises to generate energy for street lighting/ cooking in their campuses. It will also help in tackling the problem of waste management. However, proper segregation of organic and non-organic waste is a prerequisite for this.
- **Bio-CNG and biogas plants will also be useful for large generators of food waste such as hotels, restaurants and marriage halls.** Such commercial enterprises should be subjected to penalty in case of



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waste generation beyond a certain limit without any arrangements to convert it into energy.

→ Measures should be looked into for promoting LNG as transportation fuel such as setting up infrastructure and fiscal measures.



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## **Target 7.2: Increasing the share of Renewable Energy**

This target is aimed at ensuring the share of renewable energy in the global energy mix. Share of renewable energy is **measured in terms of both, installed capacity and final consumption**. Final energy consumption has been accepted for the purpose of this goal.

### **Indicator 7.2.1- Renewable energy share in the total final energy consumption**

#### **Concept and Measurement:**

This indicator is defined as the percentage of final consumption of energy which is derived from renewable sources. Renewable energy is usually defined as all those forms of energy whose consumption does not reduce their availability for future usage. Such sources **include solar, wind, ocean, geothermal energy, hydropower, biofuels, biogas, and waste**. This indicator is based on the final consumption of energy rather than the capacity of production which could not be fully utilized. It also tackles the issue of some energy sources being more prone to energy losses along the production chain. However, this indicator **fails to address the fact that a substantial proportion of renewable energy consumed in India comes from the use of solid biofuels such as wood and charcoal which are unsustainable and inefficient**. Therefore share of renewable energy in total installed capacity is still a useful indicator in India and is used for the SDG India index.

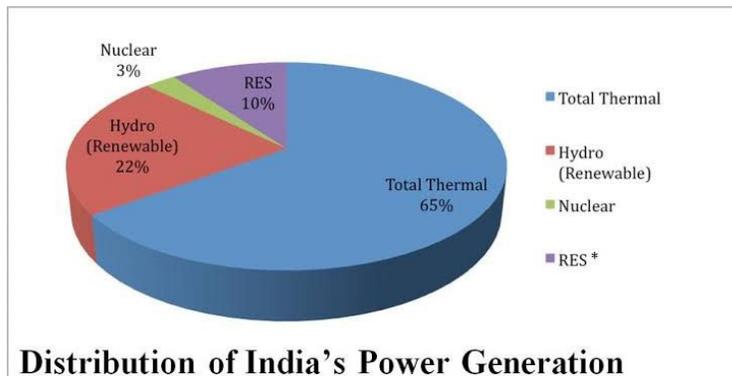
#### **Targets and Achievements:**

Share of renewable energy in total final energy consumption decreased from 40.7% in 2010 to 34.0% in 2017, out of which, 31.4% is solid biofuel like woods. Other sources of renewable energy constitute 2.6% of consumption.



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The share of renewable energy in terms of total installed capacity is 21.12% at the end of the year 2018. The share was only 1.46% in 2010 and 19.93% in 2012. The total generation capacity by renewable sources is 72 GW. The target for 2030 is to increase this share to 40%.



**Distribution of India's Power Generation**  
\*Renewable Energy Sources(RES) include Small Hydro Projects, Biomass Gasifiers, Biomass Power, Urban and Industrial Waste Power and Wind Power.

### Efforts and Challenges:

The Government of India has set **renewable capacity targets at 175 GW by the end of 2022, which includes 100 GW from solar power, 60 GW from wind power, 10 GW from biomass power, and 5 GW from small hydro-power, while committing to have 40 percent of non-fossil fuel sources by 2030**, as a measure towards energy security. International Solar Alliance (ISA) has also been established as an initiative by the Indian government to promote the use of solar energy, however, serious challenges remain on this front as well. This huge potential sector still remains largely underutilized. Although 21% of installed capacity of electricity generation is from renewable sources, its share in actual electricity generation fluctuates between 7 and 12 percent. Electricity distribution network problems exist with energy by renewable sources as well. There are regional disparities in the distribution of electricity



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generation from renewable sources. Land acquisition, import duties, and tariff caps have not helped the cause either.

### Suggestions:

- Hybridization of Solar and Wind plants in one facility is essential as it offers several advantages-
  1. Solar energy is available in the day time while wind energy is available mostly in evening when wind speed is higher. Through hybridization, electricity can be generated for most parts of the day.
  2. Transmission lines will be same leading to a reduction in transmission costs.
  3. Many components and infrastructure required are the same hence allowing producers to make better use of the available framework.
  4. Higher capacity utilisation and better return on investments.
- Establishment of **plants on barren land, and not on the agricultural land** needs to be promoted. In many cases, land provided by the government for establishing solar power plants is fertile agricultural land, which adversely affects the farmers. Therefore, such plants should be established on barren land, unless it is impossible to do so.
- The infrastructure in solar parks needs to be upgraded; park charges, tariffs and maintenance charges should be reduced for companies established in such parks.
- Transmission and Distribution losses in India are **very high** compared to other countries. To minimise such deficiencies, infrastructure needs to be upgraded, transmission lines need to be improved, capacity of transformers should be increased, smart metres should be used, and the quality of conductors should be improved, et. al.
- Investments need to be increased in transmission lines for efficient **transmission of energy from power abundant States to power deficient States.**



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- Promotion of business models operating on software solutions based on demand response programs that can shift loads according to demand, is necessary.
- Documentation, digitalization and proper maintenance of authentic land records to facilitate commercial negotiations for efficient land utilization is crucial.



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### 7.3: Doubling the Rate of Improvement in Energy Efficiency

This target is aimed at doubling the rate of improvement in energy efficiency measured in terms of energy intensity. Energy intensity in terms of primary energy and GDP is used as an indicator for this purpose.

#### Indicator 7.3.1- Energy intensity measured in terms of primary energy and GDP

##### **Concept and Measurement:**

Energy intensity is used as a proxy for efficiency with which an economy is able to utilize energy to produce economic output. Energy intensity is defined as the amount of energy used to produce per unit of economic output. A lower ratio indicates that less energy is required to produce one unit of economic output. However, **energy intensity is not a perfect measure of energy efficiency as it is prone to get affected by several factors such as climate and structure of the economy**, amongst others.

##### **Targets and Achievements:**

According to the International Energy Agency, energy intensity declined from 5.4% MJ/USD in 2010 to 4.5% MJ/USD in 2016. The energy intensity decreased by 3.0% annually during 2010-2016, compared to a 2.6% annual decrease during 2000-2010. The objective is of an annual 2.6% drop in energy intensity between 2010 and 2030. In rupee terms, the energy intensity of GDP (at 1999-2000 prices), declined from 0.1594 MJ/rupee to 0.1355 MJ/rupee, and then increased again to 0.1518 MJ/rupee in 2013.

##### **Efforts and Challenges:**

The Bureau of Energy Efficiency (BEE) was established in 2002 for initiating standards and labeling programs for energy-efficient products. The National Mission for Enhanced Energy Efficiency (NMEEE) was introduced in 2008 to enhance energy efficiency in energy intensive industries. A



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number of government schemes are operating to achieve better levels of energy efficiency. In recent years, the distribution of LED bulbs, tube lights and energy efficient appliances through the UJALA program have contributed to the increased efficiency. Private enterprises have come together to form the [Alliance for Energy Efficiency](#) to promote research and development in making energy-efficient products. There is much to achieve on this front. High leakage and inefficient transmission systems lead to ineffective energy distribution. The [National Smart Grid Mission](#) (NSGM) has been initiated for smart and efficient distribution, but it is still in its nascent stage.

Electricity used in the agriculture sector is mostly subsidised therefore there is no incentive for farmers to shift to more efficient appliances, for e.g. water pumps.

### Suggestions:

- There is a requirement of declaring an **'Energy Efficiency Policy'** by the government. This policy should **entail appliance standards, building codes, schemes, measures and targets; guiding frameworks** for different energy consuming industries and applications.
- **Energy efficiency should be made a priority lending sector** for commercial banks and NBFCs.
- Old vehicles should be phased out, and measures should be looked into, to improve the technology to make vehicle systems more energy efficient. The **use of electric vehicles should be promoted by incentivizing electric vehicle manufacturing and battery production industry** to begin with. The government should look into fiscal incentives, tax benefits and import duty exemptions, besides setting up charging infrastructure in large cities, on expressways and important highways.



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- The Energy Conservation Building Code (ECBC), has been adopted to increase the energy efficiency in residential and commercial buildings. The government should ensure its successful implementation by developing compliance procedures and through **capacity building of engineers, designers, builders and local authorities through training and education**. The material should meet the standards prescribed in ECBC, and should be available in abundance. Moreover, many States have not even notified the code, which should be done as early as possible.
- The government should invest in the research and development for advancing energy-efficient technologies and products.
- Energy efficient systems should be identified for numerous industries, and **should be adopted, promoted and if feasible, made compulsory**, for e.g., energy efficient suspension pre-heaters in large cement plants, modern and efficient furnaces in glass industry, etc.



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## 7.A: Enhancing International Corporation

This target is aimed at enhancing international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology.

### Indicator 7.a.1- International financial flows to developing countries in support of clean energy research and development and renewable energy production, including in hybrid systems

International flows to developing countries usually take place through either OECD or International Renewable Energy Agency (IRENA). Funding for renewable energy **increased** from USD 1.3 billion in 2000 to USD 18.6 in 2016. IRENA has been actively involved in stimulating cooperation between different countries to promote renewable energy. India is one of the largest recipients of this fund but it is **not clear** exactly how much funding is received by India. Also, much of this funding is not separate from other fundings, rather part of the climate finance funds like the green climate fund. **Government should consider establishing a National Climate Fund to better channelize international climate funding and to effectively coordinate the resources and their effective utilisation.**

India needs more funds to support its efforts to promote clean energy. India has been repeatedly pressing for more financing from developed countries. Moreover, very less proportion of this funding is in the form of grants; most of the funds are to be paid back.



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## **7.B: Expanding Infrastructure and Upgrading Technology**

This target is aimed at expanding infrastructure and upgrading technology for supplying modern and sustainable energy services for all in developing countries, in particular, least developed countries, small island developing states and landlocked developing countries, in accordance with their respective programs of support.

### **Indicator 7.b.1- Investments in energy efficiency as a proportion of GDP and the amount of foreign direct investment in financial transfer for infrastructure and technology to sustainable development services**

India has **witnessed high investments in clean energy**. In 2018, India spent **0.5%** of its GDP on renewable energy resources. FDI has also risen in recent years in the energy sector. India **has received** USD 4.5 billion in FDI on renewable energy. The Asian Development Bank (ADB) **approved** USD 250 million loans to India in December 2019 to expand energy efficiency investments in India.



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## Conclusion

Fossil fuels from conventional sources are finite and are depleting fast. Those from difficult sources will also run out sooner or later. If we put all our energy and resources into continued fossil fuel extraction, we will lose the opportunity to have invested in renewable energy. Accessible, affordable and clean energy is a *sine qua non* for sustainable development of India. It is closely linked with other sustainable development goals such as poverty alleviation, healthcare, and economic growth. Despite notable progress in recent decades, **sustainable energy still faces persistent financial, regulatory and technological barriers**. It is time to identify these barriers and adopt a systematic and persistent approach to remove them so as to ensure a sustainable future for the next generation.



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