**India’s energy resources**

India’s need to increase energy provision for its population and fast growing economy poses a formidable challenge which is perceived as both a great opportunity as well as a necessity for the country to increase the share of renewables in the overall energy mix. India has been making continuous progress in conventional as well as renewable power generation. India’s approach is to meet its energy needs in a responsible, sustainable and ecofriendly manner. The country has made a remarkable growth in last 2–3 years in the field of renewable energy power generation. The past few years saw a record addition of 2332 MW of renewable energy sources i.e. solar, wind, biomass, geothermal and hydro, etc. which could make important contributions to sustainable development. All these development have taken place in 11th plan period. The bulk addition is in wind generation at 1565 MW, small hydro power segment recorded an addition of 305 MW, cogeneration 295 MW and biomass 153 MW. The lowest additions were in the solar at 8 MW and waste to-energy segments at 4.7 MW. A target of 14,000 MW capacity addition has been set for the 11th Plan (2007–08 to 2011–12). The need for renewable energy arises as energy Security is important to our country. As per World Energy Outlook report, India will become the third largest net importer of oil before 2025 after the United States and China. This will not be sustainable in the long run given the high volatility of international crude oil prices. Coal imports are also likely to increase from 12 per cent in 2005 to 28 per cent in 2030. In order to insulate itself from any future supply disruption and price shocks of fossil fuels and furthermore to achieve energy security and also meet global climate change objectives, renewables are a must and has indeed caught the imagination of India. Riding on the crest of a high growth trajectory and in pursuit of sustainable sources to meet its rising domestic energy demand and access to energy for overall development, the country is focusing on harnessing renewable energy production through maximising the utilisation of renewable energy. Currently, their exploitation in commercial markets is low, being constrained by costs and uncompensated beneits, as well as intermittent supplies and other technical and institutional considerations. But they have hold on social consideration for:

1. Enhanced energy security by providing supplies that are abundant, diverse and indigenous.

2. Reduced global and local atmospheric emissions when used in place of fossil fuels.

3. Improved options in rural areas and in newly industrialising and developing countries.

4. Increased local and regional employment opportunities in energy infrastructure manufacturing, installation and maintenance for developed and developing countries.

**Renewable energy sources**

Conventionally, natural resources, like, wind, solar and hydro are termed as renewable energy sources. These terms can be easily understood. Bioenergy, which is another important renewable energy source covers a wide spectrum of energy activities from direct production heat through combustion of fuel wood and other biomass residues, to the generation of electricity and the production of gases and liquid fuel and chemicals. It is widely used globally. The geothermal resources are the internal heat of the earth. Its use covers a range of option from power generation to space heating and/or air conditioning.

**Renewable energy capacity in India**

All sectors of renewable energy are being developed and promoted. However, the wind power program has been the fastest growing contributing to around 75 per cent of the grid-connected renewable energy power installed capacity. Wind power: Wind power has seen a phenomenal growth of around 33 per cent CAGR (compound annual growth rate) in the last 5 years and the total capacity at end of 2010 was 12129 MW (as on 31-7-2010) with most of the capacity installed in the state of Tamil Nadu in India. Solar energy: Among various renewable energy resources, India possesses a very large solar energy resource which is seen as having the highest potential for the future. The irst, recently announced, very ambitious Jawaharlal Nehru National Solar Mission with a target of 20,000 MW grid solar power, 2000 MW of off-grid capacity including 20 million solar lighting systems and 20 million sq. m. solar thermal collector area by 2022 is under implementation, likely to be implemented in three phases. The irst phase will be of three years (up to March, 2013), the second till March 2017 and the third phase will continue till March 2022. The target for phase-I is to set up 1100 MW grid connected solar plants including 100 MW of roof top and small solar plants and 200 MW capacity equivalent off-grid solar applications and 7 million sq.m. solar thermal collector area. The main objectives of the mission are to help reach grid parity by 2022 and help set up indigenous manufacturing capacity. Mini hydro plants: Mini hydro plants are supposed to have a 15 GW potential out of which 2.5 GW has been realised. Biomass energy: Biomass energy has 25 GW of potential out of which around 2.1 GW has been realised. Rural electriication to meet unmet demand through renewable energy is a priority by itself. 150 villages have been covered in last 2 years through mini grid by rice-husk based gasiication systems in Bihar. There are plans to cover about 10,000 villages from biomass-based systems and over 1000 villages from solar power by 2022. The grid interactive projects (up to 2 MW) at the tail end of the grid at 11 kV to reduce the transmission and distribution losses and stabilise grid voltages are now being piloted. So far, about 112 MW equivalent biomass gasiier systems have been set up in industries for captive power and thermal applications.

**Renewables and the environment**

Renewable energy is usually more environmental friendly than alternative energy sources. Life-cycle emissions from renewable energy use are small compared with those from fossil fuel plants. Nuclear power generation does have a major environmental impact, it releases no sulphur dioxide (SO2 ) or nitrogen oxides (NOx ) and little carbon dioxide (CO2 ). Its life-cycle emissions of these gases fall within the ranges shown for non-hydroelectric renewable energy. Renewable energy entails a number of other potential environmental impacts. On the negative side, renewable energy can make large tracts of land unusable for competing uses, disrupt marine life, bird life and lora/fauna, and produce visual and noise pollution. Generally though, these potential environmental impacts are site-speciic and there are a number of ways to minimise the effects, which are usually small and reversible. There are environmental beneits from renewable other than reduction of greenhouse gas and other air emissions. For example, hydroelectric schemes can improve water supplies and facilitate reclamation of degraded land and habitat. The use of bioenergy can have many environmental beneits if the resource is produced and used in a sustainable way. If the land from which bioenergy is produced is replanted, bioenergy is used sustainably and the carbon released will be recycled into the next generation of growing plants. Bioenergy plants have lower emissions of SO2 than coal and oil plants, but they may produce more particulate matter. These emissions are controllable but they increase generating costs. The environmental and social effects of large-scale hydropower are site speciic and are the subject of much controversy. Large-scale projects may disturb local ecosystems, reduce biological diversity or modify water quality. They may also cause socio-economic damage by displacing local populations. Mini- and micro-hydro systems have relatively modest and localised effects on the environment, but their kWh cost is generally higher. Hydropower emits some greenhouse gases on a life-cycle basis (especially methane generated by decaying bioenergy in reservoirs), but in most cases far less than the burning of fossil fuels. Geothermal plants may release gaseous emissions into the atmosphere during their operation. These gases are mainly carbon dioxide and hydrogen sulphide with traces of ammonia, hydrogen, nitrogen, methane, radon, and the volatile species of boron, arsenic and mercury. This could slow the future development of geothermal resources. Emissions can be managed through strict regulations and by control methods used by the geothermal industry to meet these regulatory requirements. Hydrogen sulphide abatement systems reduce environmental damage but are costly to install.

**Перевод:**

Потребность Индии в увеличении энергообеспечения своего населения и быстро растущей экономики представляет собой серьезную проблему, которая воспринимается как прекрасная возможность, а также как необходимость для страны увеличить долю возобновляемых источников энергии в общем энергетическом балансе. Индия постоянно развивает как традиционную, так и возобновляемую энергетику. Подход Индии заключается в том, чтобы удовлетворять свои энергетические потребности ответственным, устойчивым и экологичным образом. За последние 2-3 года страна добилась значительного роста в области производства электроэнергии из возобновляемых источников. За последние несколько лет было введено рекордное количество возобновляемых источников энергии (солнце, ветер, биомасса, геотермальная и гидро энергия) мощностью 2332 МВт и т.д. что может внести важный вклад в устойчивое развитие. Все эти разработки были осуществлены в период 11-го плана. Основной прирост приходится на ветроэнергетику - 1565 МВт, в сегменте малых гидроэлектростанций зафиксирован прирост в 305 МВт, когенерацию - 295 МВт и производство биомассы - 153 МВт. Наименьший прирост был в сегментах солнечной энергетики - 8 МВт и безотходной энергетики - 4,7 МВт. На 11-й план (с 2007-08 по 2011-12 годы) был установлен целевой показатель увеличения мощности на 14 000 МВт. Потребность в возобновляемых источниках энергии возникает, поскольку энергетическая безопасность важна для нашей страны.

Развиваются и продвигаются все отрасли возобновляемой энергетики. Однако программа развития ветроэнергетики развивается наиболее быстрыми темпами, обеспечивая около 75% установленной мощности подключенных к сетям возобновляемых источников энергии. Ветроэнергетика: За последние 5 лет наблюдается феноменальный рост ветроэнергетики - около 33% в годовом выражении (совокупный годовой темп роста), а общая мощность на конец 2010 года составила 12129 МВт (по состоянию на 31-7-2010), причем большая часть мощностей установлена в штате Тамилнад в Индии. Солнечная энергия: Среди различных возобновляемых источников энергии Индия обладает очень большим запасом солнечной энергии, который, как считается, обладает наибольшим потенциалом для будущего. В стадии реализации находится первая, недавно объявленная, очень амбициозная Национальная солнечная миссия имени Джавахарлала Неру с целью создания к 2022 году 20 000 МВт сетевой солнечной энергии, 2000 МВт автономной мощности, включая 20 миллионов солнечных систем освещения и 20 миллионов квадратных метров площади солнечных тепловых коллекторов, которая, вероятно, будет реализована в три этапа.

**Саммари:**

India's Energy Needs and Renewable Energy

India faces a significant challenge in meeting the growing energy demands of its population and economy. Renewable energy sources offer a promising solution to address this challenge and ensure energy security.

India's Progress in Renewable Energy

India has made significant progress in developing renewable energy sources, particularly in wind power. The country has set ambitious targets for renewable energy capacity addition, including 20,000 MW of solar power by 2022.

Benefits of Renewable Energy

Renewable energy offers several benefits, including:

Enhanced energy security by reducing reliance on fossil fuels

Reduced greenhouse gas emissions

Improved options in rural areas and developing countries

Increased local employment opportunities

Types of Renewable Energy Sources

India is harnessing various renewable energy sources, including:

Wind power: India has the fourth-largest installed wind power capacity in the world.

Solar energy: India has a vast solar energy potential and has launched the Jawaharlal Nehru National Solar Mission to promote solar power development.

Mini hydro plants: India has a significant potential for mini hydro power generation.

Biomass energy: Biomass, including agricultural residues and waste, is widely used in India for energy production.

Environmental Considerations

Renewable energy is generally more environmentally friendly than fossil fuels. However, it can have some environmental impacts, such as land use and noise pollution. These impacts can be minimized through proper planning and mitigation measures.

India's focus on renewable energy is crucial for its energy security and environmental sustainability. The country has made substantial progress in this area and is committed to harnessing renewable energy sources to meet its future energy needs.