

OPPORTUNITIES & CHALLENGES IN INDIA'S NEW & RENEWABLE ENERGY SEGMENT



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2 INTRODUCTION TO THE INDIAN ENERGY SECTOR

India today is the world's fourth-largest economy, after the United States, China, and Japan. Its economy has grown steadily over the last 30 years, averaging 7 percent annually since 2000 and has become a US\$ 1 trillion economy that promises to grow to US\$ 5 trillion by 2020.

India has a power generation capacity of 167,278.36 MW of which only 16,786.98 MW (7.7%) is generated through renewable sources (as of June 2010). Of the total installed capacity, 64.6% comes from thermal power, 24.7% from Hydel, 2.9% from Nuclear and 7.7% from renewable energy sources.

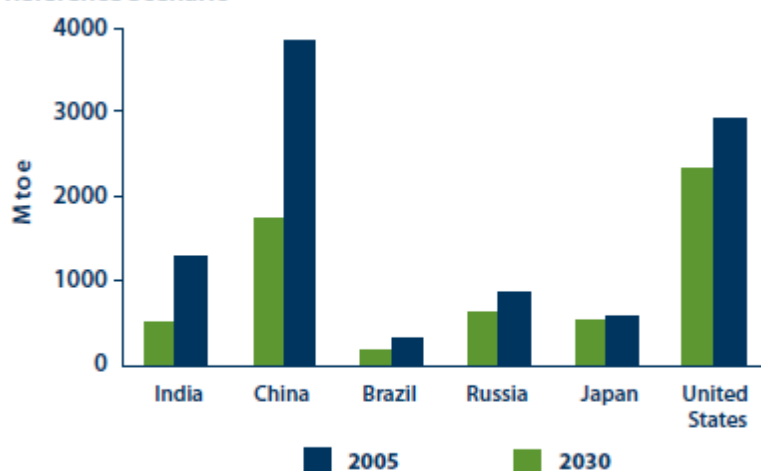
The country is said to be one of the largest consumers of energy, yet the growing and widening gap between consumption and domestic output is a cause of some major concern.

The per capita consumption is 620kwh/annum and the electricity demand is growing @ 8% annually.

Coal is the dominant fuel in India's energy mix, a condition that is expected to persist for at least the next 25 years. India has vast coal resources, but most are of low quality.

Indigenous oil and gas reserves are in short supply while demand for oil almost quadrupled from 1980 to 2005. Oil imports are projected to increase even more going forward, leaving the country more vulnerable to international pricing and potentially unreliable supplies.

Figure 1.1: Primary Energy Demand in Selected Countries in the Reference Scenario



Source: International Energy Agency, *World Energy Outlook 2007: China and India Insights* (Paris, France: OCED/IEA, 2007).

Total Power Installed Capacity:
(as on 30.06.10)¹

Sector	MW	%age
State Sector	82,227.05	52.5
Central Sector	51,867.63	34.0
Private Sector	33,183.68	13.5
Total	1,67,278.36	

Fuel	MW	%age
Total Thermal	108602.98	64.6
Coal	89,778.38	53.3
Gas	17,624.85	10.5
Oil	1,199.75	0.9
Hydro (Renewable)	37,328.40	24.7
Nuclear	4,560.00	2.9
RES** (MNRE)	16,786.98	7.7
Total	1,67,278.36	

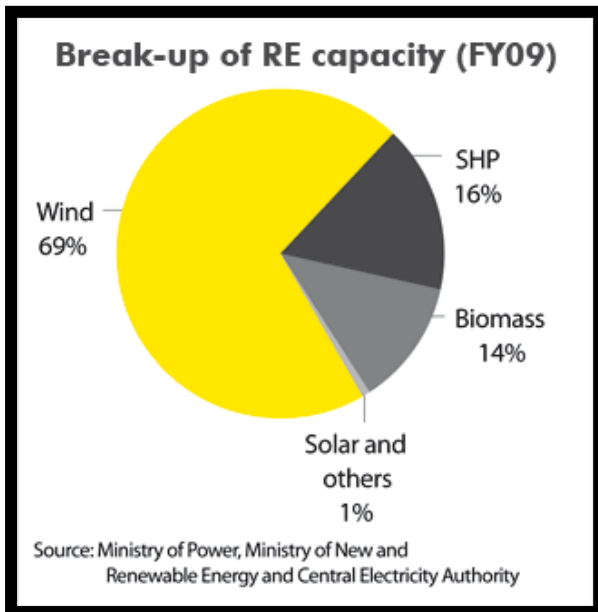
***Renewable Energy Sources (RES) include SHP, BG, BP, U&I and Wind Energy; SHP = Small Hydro Project; BG = Biomass Gasifiers; BP = Biomass Power; U & I = Urban & Industrial Waste Power; RES = Renewable Energy Sources*

India is the 4th largest country with regard to installed power generation capacity in the field of renewable energy sources. Wind, Hydro, Biomass and Solar are the main renewable energy sources.

The country has an estimated renewable energy potential of around 85,000 MW from commercially exploitable sources: Wind 45,000 MW, small hydro 15,000 MW and biomass/bio-energy 25,000 MW. In addition, India has the potential to generate 35 MW per sq/km using solar photovoltaic and solar thermal energy.

¹ Source : Ministry of Power

Of the current total installed renewable energy base, wind constitutes 69 percent, followed by small hydro (19 percent), biomass (co-generation, 11.5 percent), waste-to energy (0.42 percent), and solar (0.03 percent). The regional split is roughly equal. Southern India contributes 29 percent of the country’s installed capacity, the western region 28 percent, northern India 27 percent, and eastern India 16 percent.



“Whilst we focus on specific actions related to dealing with climate change, we have to be guided by the overall imperative of moving global society in the direction of sustainability in growth and development”.

Manmohan Singh – Prime Minister of India, during the 11th Delhi “World Sustainable Development Forum” in New Delhi.

3 DEMAND & SUPPLY SCENARIO

In the recent years, India's energy consumption has been increasing at one of the fastest rates in the world due to population growth and economic development. Despite the overall increase in energy demand, per capita energy consumption in India is still very low compared to other developing countries.

India is well-endowed with both exhaustible and renewable energy resources. Coal, oil, and natural gas are the three primary commercial energy sources. India's energy policy, till the end of the 1980s, was mainly based on availability of indigenous resources. Coal was by far the largest source of energy. However, India's primary energy mix has been changing over a period of time.

Despite increasing dependency on commercial fuels, a sizeable quantum of energy requirements (40% of total energy requirement), especially in the rural household sector, is met by non-commercial energy sources, which include fuel wood, crop residue, and animal waste, including draught animal power. However, other forms of commercial energy of a much higher quality and efficiency are steadily replacing the traditional energy resources being consumed in the rural sector.

Resource augmentation and growth in energy supply has not kept pace with increasing demand and, therefore, India continues to face serious energy shortages. This has led to increased reliance on imports to meet the energy demand.

4 RENEWABLE RESOURCES, CAPACITY AND POTENTIAL

The market for renewable energy business in India is growing at an annual rate of 15%. The scope of private investment currently is estimated to be about \$3 billion. This growth is still expected in the coming years as stricter environmental norms and regulatory pressure are placed on Indian industries.

India is blessed with an abundance of sunlight, water and biomass. Vigorous efforts during the past two decades are now bearing fruit as people in all walks of life are more aware of the benefits of renewable energy. India has the world's largest program for renewable energy.

The country's renewable energy resources potential is significant, with wind energy, biomass and small hydropower, representing the technologies with the largest potential. Wind has been the most successful renewable resource to date and has the most potential going forward. Currently however only nine states use wind energy and they represent over 99 percent of the nation's total wind capacity. Assuming 20 percent grid penetration in the future and an increase in the availability of wind resources in certain provinces – most notably Maharashtra, Andhra Pradesh, Tamil Nadu, and Gujarat – wind could potentially account for up to 45,000 MW of energy per year. The majority of wind resources are found in coastal states, where geographic and climatic conditions are favorable for wind farms.

The approximate potential for biomass utilization (largely co-generation) is estimated at about 22,000 MW.

Waste-to-energy potential is approximately 2,700 MW. It has been estimated that India produces 139 million tons of surplus biomass every year, which can produce about 16,000 MW of electricity. Rajasthan, Punjab, Uttar Pradesh, Maharashtra, Madhya Pradesh, Haryana, and Gujarat account for 76 percent of the projected potential, and Rajasthan alone accounts for 25 percent of the total projected potential. Andhra Pradesh, Karnataka, Tamil Nadu, and Uttar Pradesh account for 77 percent of the total installed capacity in the country. This trend is due to the availability of biomass and Bagasse, which is used as raw material for electricity generation. Maharashtra and Uttar Pradesh are the two major Bagasse-producing states, accounting for 57 percent of India's projected Bagasse potential (3,500 MW total). About 166 MW of renewable energy can be found in distributed non-grid connected generation in India.



Mr. Jairam Ramesh, India's Environment Minister, stated during the 11th Delhi "World Sustainable Development Forum" in New Delhi that "India will continue to approach international environmental issues in a proactive spirit that is acceptable to all the parties".

Ethanol and biodiesel have been identified as key focus areas by the Indian Government, though currently both are in the early stages of commercialization. In 2004, the government mandated a 5 percent blending of gasoline with ethanol, subject to certain conditions. In addition, an autonomous National Biodiesel Board was created to promote, finance, and support organizations that are engaged in oilseed cultivation and oil processing leading to biodiesel production. The state governments of Andhra Pradesh, Chhattisgarh, Gujarat, and Tamil Nadu have even created state biodiesel boards and are implementing buy-back schemes with farmers to promote additional biodiesel development. Private players are participating in the plantation phase of the biodiesel production chain in Tamil Nadu. In Gujarat, private companies are producing quality biodiesel that meets most of the world standards.

India has an estimated hydropower potential of 84,000 MW, of which 15,000 MW is from small hydropower (SHP). The Ministry of New and Renewable Energy (MNRE) has identified 4,227 potential SHP sites, which could account for 10,324 MW of potential energy. India had only 1,748 MW of installed SHP capacity in 2006, meaning the market for SHP is expected to increase substantially. The potential of this sector is however dependent on the availability of water resources, which are thus far abundant in a majority of states. In fact, of the 135,000 MW capacity addition requirement anticipated by the government, 35,500 MW are expected to come from hydropower.

India also receives abundant solar radiation equivalent to over 5,000 trillion kilowatt hours (kWh) per year. The government has had a PV program in place for over two decades, yet the current installed capacity is just 3 MW, only a small proportion of the overall energy mix.

PV systems are promoted primarily for rural and off-grid applications, consisting mainly of mini-grids, solar home systems, solar lanterns, and solar street lights. The overall solar water heater potential in India is estimated to be 140 million m² of collector area, of which about 1.9 million m² have been installed in buildings and in industry.

5 ENERGY EFFICIENCY, CO-GENERATION AND TRANSPORTATION

India's energy efficiency potential mostly comes from supply side high-efficiency, low-emission coal, and thermal or electric power generation. Transmission and distribution losses have been recorded to exceed 25 percent, indicating a potential market for firms able to reduce these inefficiencies. Industry has been a major target of the energy efficiency effort, as it accounts for 50 percent of the total commercial energy use in India.

Six key industries—aluminum, cement, fertilizers, pulp and paper, petrochemicals, and steel—account for about two-thirds of total industrial energy use. The energy intensity in these industries is higher than in developed countries, mainly owing to obsolete and energy inefficient technologies. Nonetheless, energy efficiency in Indian industry has increased steadily. In cement, steel, aluminum, and fertilizers, the average energy consumption has been declining as a result of energy conservation in existing units and the development of efficient technologies.

In transportation, the rapid growth in motor vehicle activity in India is contributing to high levels of urban air pollution, among other adverse socioeconomic, environmental, health, and welfare impacts. The demand for transport increased by 1.9 percent per year from 2000–2005, but is projected to double by 2015 and more than quadruple by 2030. The slow growth in demand for diesel to date may be due to improved efficiency of new cars and trucks and switching to compressed natural gas vehicles for public transportation in some major cities. However, like many developing countries, India lacks mandatory vehicle fuel efficiency standards. The Ministry of New and Renewable Energy is promoting several research & development programs as well as demonstration projects including a demonstration project in battery operated vehicles (BOVs), which help in conserving oil and curbing environmental pollutions. In addition, fuel cell–battery hybrid vehicles with domestically developed exchange membrane fuel cells of 10 kW have undergone field performance evaluation, which could lead to domestic production and wider applications of fuel cell systems across the country. Hydrogen fuel is expected to be a major alternative to fossil fuels for India's transport sector by 2020. Various laboratories in the country are developing different technologies for production, storage, and transportation.

6 MARKET ANALYSIS – ENERGY SITUATION

Due to the projected increase in population and the country's continued economic growth, primary energy demand in India is expected to increase from 537 MToe² in 2005 to 770 MToe in 2015 and to 1,299 MToe by 2030 (see Table 1.1). Over the period 1990–2005, the demand grew by 3.5 percent per year. As indicated by the below table, coal is expected to remain the dominant fuel in India's energy mix over the next 25 years. Demand for oil will steadily increase to a projected 328 MToe by the year 2030, still one-half the projected demand for coal. Other renewable energy sources, mostly wind power, are projected to grow 12 percent per year, albeit from a relatively low baseline. Nuclear and hydropower supplies grow in absolute terms, but they make only a minor contribution to primary energy demand in 2030—3 percent in the case of nuclear and 2 percent for hydropower.

Table 1.1: Indian Primary Energy Demand in the Reference Scenario (mToe)

	1990	2000	2005	2015	2030	2005–2030*
Coal	106	164	208	330	620	4.5%
Oil	63	114	129	188	328	3.8%
Gas	10	21	29	48	93	4.8%
Nuclear	2	4	5	16	33	8.3%
Hydro	6	6	9	13	22	3.9%
Biomass	133	149	158	171	194	0.8%
Other renewables	0	0	1	4	9	11.7%
Total	320	459	537	770	1299	3.6%
<i>Total excluding biomass</i>	<i>186</i>	<i>311</i>	<i>379</i>	<i>599</i>	<i>1105</i>	<i>4.4%</i>

Source: International Energy Agency, World Energy Outlook 2007: China and India Insights (Paris, France: OECD/IEA, 2007).

Table 1.2: Key Energy Indicators for India

	1980	1990	2000	2005
Total primary energy demand (Mtoe)	209	320	459	537
Oil demand (mb/d)	0.7	1.2	2.3	2.6
Coal demand (Mtoe)	75	152	235	297
Gas demand (bcm)	1.4	11.9	25.4	34.8
Biomass and waste (Mtoe)	116	133	149	158
Electricity output (TWh)	119	289	562	699
TPES/GDP (index, 2005 = 100)	163	142	120	100
Total primary energy demand per capita (toe)	0.30	0.38	0.45	0.49
CO ₂ emissions per capita (tonne)	0.43	0.69	0.95	1.05
Oil imports	0.5	0.6	1.6	1.8
Electricity demand per capita (kWh)	174	341	553	639

Source: International Energy Agency, World Energy Outlook 2007: China and India Insights (Paris, France: OECD/IEA, 2007, p. 444).

² Million Tons of Oil Equivalent

In India's 11th Five-Year Plan, the government aims to achieve a GDP growth rate of 10 percent and to maintain an average growth of about 8 percent during the next 15 years. This growth will be highly dependent on the expansion of the country's energy consumption. Due to rapidly expanding demand for power, a capacity addition of over 100,000 MW is planned through 2011 and 2012. Though this is largely based on growth of thermal generation, the contribution of electricity from renewable sources is expected to increase, with wind energy continuing to lead the way. As Table A shows, India needs 347,000 additional megawatts of energy through 2020, of which renewables can account for 24 percent of the needed capacity. One of the major requirements for developing this sector is the availability of cost-effective technologies and successful demonstrations. Table A also shows the renewable energy targets in the 11th Five-Year Plan—which goes through 2012. These targets correspond to a need for massive investment in the clean energy sector in India.

In fact, the projected addition of 15,000 MW from renewable energy could lead to \$21 billion in investment over the next ten years. The current capital cost of small hydro and wind in India is similar and ranges from \$900–1300/kW and \$950–1100/kW, respectively. Biomass is slightly less, at \$800–1000/kW. Bagasse co-generation and biomass gasification range from \$600–800/kW. PV is by far the highest at \$5000–6500/kW. The delivery cost for all the above except for PV ranges from \$0.045–7/kWh, with co-generation at the bottom of the range and wind at the top; PV is in the range of \$0.19–40/kWh.

India currently manufactures wind generators with up to 1,650 kW of per unit capacity. To harness the projected wind potential, however, new technologies with higher capacities are needed in the country. India has a fairly developed capacity and technology for designing, constructing, and operating small hydropower plants. There has been continuous improvement with time in India's small hydro technology, with increasingly efficient and reliable domestic equipment. In addition, India has manufacturing facilities for equipment and components used in solar PV systems, though there is a need for megawatt-scale PV power-generating systems. A number of solar thermal applications have also been developed in India, which include water/air heating, cooking, drying of agricultural and food products, water purification, detoxification of wastes, cooling and refrigeration, heat for industrial processes, and electric power generation. Most of the solar thermal devices and systems are manufactured in India.

Manufacturing capability also exists in India for the equipment/machinery required in biomass projects. Biomass co-generation combustion technology is already in operation as well as atmospheric gasifiers, in which the country has significant experience and expertise. Thus, except for critical control equipment and high-efficiency turbines, most of the equipment can be procured from indigenous sources.

India has limited local capacity for waste to energy technology and large-scale operation of bio-methanation, combustion/incineration, pyrolysis/gasification, landfill gas recovery, and other technologies requires import of design, engineering, and equipment.

Three major drivers exist for clean energy demand in India.

- First, the gap between existing electricity supply and demand is large and expected to grow.
- Second, the need to strengthen energy security has caused India to invest in wind, biomass, and hydropower generation as a way to diversify their energy portfolio.
- Third, fossil fuels imports are increasingly susceptible to price fluctuations and leave India vulnerable to supply insecurity; increasing dependence on indigenous and renewable resources is thus an attractive countermeasure. India’s environmental, social, and health concerns are serious—India is a top greenhouse gas (GHG) emitter in the world, with corresponding costs in health and productivity. Indoor air pollution in rural areas from reliance on biomass for cooking, for instance, causes serious health issues for women and children. Nonetheless, India enjoys significant resources for clean energy development including both human and ecological resources, and strong government support. These factors in themselves are important indicators of India’s energy future.

Table A. India’s Renewable Energy Potential and Targets.

	POTENTIAL (MW)	INSTALLED CAPACITY AS OF MARCH 2007 (MW)	TARGET OF 11TH FIVE-YEAR PLAN (MW)
Small hydro	15,000	1,976	1,400
Wind	45,000	7,092	10,500
Solid biomass	19,500	569	500
Bagasse CHP	3,500	615	1,200
Waste-to-energy	1,700	43	400
Solar		3	50
Distributed RE power systems			950
Total	84,700	10,298	15,000

Source: Report of the Working Group on New and Renewable Energy for 11th Five-Year Plan.

7 INDIA'S RENEWABLE POWER POTENTIAL

7.1 SOLAR ENERGY



Solar power remains the brightly promising spot in the field of renewable energy, and its prospects seem to be improving by the day. Already some are of the opinion that within three to seven years, unsubsidized solar power could cost no more than electricity generated using fossil fuels. Generation of electricity from the sun is a flagship program of the Government of India (GOI). India has one of the world's largest programs in solar energy which include R&D, demonstration

and utilization, testing and standardization, industrial and promotional activities.

India has set up a target of 20000 MW of installed capacity by 2022 for harnessing solar energy.

The future of solar photovoltaic development in India seems to be very bright. India's solar mission envisages the promotion of solar energy to harness and distribute environment-friendly power, available with high scalability, for sustainable economic growth by empowering national energy security.

7.1.1 MARKET OVERVIEW:

Solar energy, owing to its ability to power large parts of the earth with renewable power, is an exciting business opportunity for all types of businesses. The availability of abundant solar energy enables organizations to meet their energy challenges and provides an opportunity to offer new and cost effective solutions.

India has today only around 33-35 grid interactive solar photovoltaic power plants with an aggregate capacity of around 2-2.5 MW, that generate around 2.5 million units of electricity in a year, in sharp contrast to the estimated potential of 50,000 MW (assuming a generation of 20 MW per square km).

Most of the existing capacity today is off-grid and for standalone applications in lighting, telecommunication, small power requirements, battery charging, water heating, cooking etc. There are currently around 1.4 million solar PV systems in operation and around .6 million solar cookers in use.

7.1.2 INDIA - POTENTIAL

India is among top 5 destinations worldwide for solar energy development as per Ernst & Young's renewable energy attractiveness index.

India presents substantial potential for investments in the solar energy segment, particularly in the manufacture of solar photovoltaic. The recent Special Incentive Package Scheme (SIPS) for semi-conductors has attracted the interest of several players. Under this program, the GOI would provide an incentive of 20 percent capital expenditure during the first ten years for the units in SEZs and 25 percent of the capital expenditure for other units. Any unit can claim incentives in the form of capital subsidy or equity participation.

Daytime production peak coincides with peak electricity demand making solar ideal supplement to grid.

7.1.3 BUSINESS OPPORTUNITIES BY SCALE OF INVESTMENTS

Scale of Investment

Type of Opportunity

Low	<ul style="list-style-type: none">➤ Installing solar panels➤ Selling solar energy products➤ Training people for the solar energy industry➤ Consulting and industry research➤ Solar equipment servicing
Medium	<ul style="list-style-type: none">➤ Setting up medium scale solar panel manufacturing plants➤ Setting up manufacturing plants for components and accessories for the solar PV and solar thermal industry➤ Setting up manufacturing units for a range of solar energy related products➤ Setting up small and medium scale solar power plants➤ Setting up R&D facilities for solar thermal and solar PV research.
High	<ul style="list-style-type: none">➤ Setting up large-scale solar panel manufacturing plants➤ Setting up large solar power plants or large-scale solar panel/collector installations➤ Centralized grid-connected solar PV plants➤ Centralized grid-connected solar Thermal plants➤ Installing large-scale distributed solar PV panels➤ Installing large-scale distributed solar thermal collectors

7.1.4 INDIA'S ADVANTAGES:

- India has a great potential to generate electricity from solar energy and the Country is on course to emerge as a solar energy hub. The techno-commercial potential of photovoltaic in India is enormous. With GDP growing in excess of 8%, the energy 'gap' between supply and demand will only widen. Solar PV is a renewable energy resource capable of bridging this 'gap'.
- Most parts of India have 300 - 330 sunny days in a year, which is equivalent to over 5000 trillion kWh per year - more than India's total energy consumption per year. Average solar incidence stands at a robust 4 - 7 kWh/sq. m/day.

- About 66 MW of aggregate capacity is installed for various applications comprising one million industrial PV systems - 80% of which is solar lanterns, home/street lighting systems and solar water pumps, etc.
- The estimated potential envisaged by the Ministry for the solar PV program, i.e. solar street/home lighting systems, solar lanterns is 20 MW/sq. kilometer.
- The potential of the solar thermal sector in India also remains untapped. The Ministry proposes an addition of 14 MW during the 11th Five-Year Plan period (2007-2012).

7.1.5 INCENTIVES OFFERED:

The Government of India is providing various incentives and duty concessions for both manufacturers and users of solar products such as:

- To help in running of solar projects, the GOI will provide, through IREDA, a generation-based incentive for solar power of up to INR 12 per kWh for solar photovoltaic power and INR 10 per kWh for solar thermal power that is fed into the grid, after considering the tariff provided by the SERC or the utility;
- Capital subsidy available in case of semiconductor based units;
- Provisions for Accelerated depreciation available for solar manufacturers;
- NIL excise duty for manufacturers;
- Low import tariff for several raw materials and components;
- Soft loans to users, intermediaries and manufacturers
- Following the Central Government's guidelines, a number of states are also pursuing solar energy development aggressively with good response from industry and have come out with their incentives. These include an enhanced feed-in-tariff rate when electricity is sold to the grid.
- Incentives are also provided for Roof Top solar Systems, targeting a capacity addition of 4.25 MW during the rest of 11th Plan. These are:
 - INR 75 per watt of SPV panels to a maximum of 30 percent of the cost of systems to profit making bodies that can also avail accelerated depreciation benefits.
 - Systems could be with or without grid interaction; and support will be available for systems whose capacity varies between 25 to 100 kW.
 - Tax credits and capital subsidies are also provided to solar energy developers. Loans are available through the IREDA at subsidized rates and income tax exemptions are provided for first 10 years of commissioning of project.

7.2 JAWAJARLAL NEHRU NATIONAL SOLAR MISSION

The National Solar Mission is a major initiative of the Government of India and State Governments to promote ecologically sustainable growth while addressing India's energy security challenge. It will also constitute a major contribution by India to the global effort to meet the challenges of climate change.

The main features of the Mission are:

- Make India a global leader in solar energy and the mission envisages an installed solar generation capacity of 20,000 MW by 2022, 100,000 MW by 2030 and of 200,000 MW by 2050.
- The total expected investment required for the 30-year period will run is from Rs. 850 billion to Rs. 1050 billion.
- Between 2017 and 2020, the target is to achieve tariff parity with conventional grid power and achieve an installed capacity of 20 gigawatts (GW) by 2020.
- 4-5GW of installed solar manufacturing capacity by 2017.

More info on the program: <http://mnre.gov.in/pdf/mission-document-JNNSM.pdf>

7.2.1 SALIENT FEATURES:

The mission aims to promote the development and use of solar energy for power generation and other uses in the country. This Mission is one of the eight key National Missions which comprise India's National Action Plan on Climate Change.

The mission has a twin objective - to contribute to India's long term energy security as well as its ecological security.

The Solar Mission would be implemented in 3 stages leading up to an installed capacity of 20,000 MW by the end of the 13th Five Year Plan in 2022. It is envisaged that as a result of rapid scale up as well as technological developments, the price of solar power will attain parity with grid power at the end of the Mission, enabling accelerated and large-scale expansion thereafter.

Mission will establish a single window investor-friendly mechanism, which reduces risk and at the same time, provides an attractive, predictable and sufficiently extended tariff for the purchase of solar power for the grid.

The mission includes a major initiative for promoting rooftop solar photovoltaic (PV) applications. The solar tariff announced by the regulators will be applicable for such installations. The power distribution companies will be involved in purchase of this power.

The mission would have a 'much focused R&D program' which seeks to address the India-specific challenges in promoting solar energy.

7.2.2 SOLAR MISSION TARGETS ARE:

To create an enabling policy framework for the deployment of 20,000 MW of solar power by 2022.

- To ramp up capacity of grid-connected solar power generation to 1000 MW within three years – by 2013; an additional 3000 MW by 2017 through the mandatory use of the renewable purchase obligation by utilities backed with a preferential tariff. This capacity can be more than doubled – reaching 10,000MW installed power by 2017 or more, based on the enhanced and enabled international finance and technology transfer. The ambitious target for 2022 of 20,000 MW or more, will be dependent on the ‘learning’ of the first two phases, which if successful, could lead to conditions of grid-competitive solar power. The transition could be appropriately up scaled, based on availability of international finance and technology.
- To create favorable conditions for solar manufacturing capability, particularly solar thermal for indigenous production and market leadership.
- To promote programs for off grid applications, reaching 1000 MW by 2017 and 2000 MW by 2022.
- To achieve 15 million square meters solar thermal collector area by 2017 and 20 million square meters solar thermal collector area by 2022.
- To deploy 20 million solar lighting systems for rural areas by 2022.
- The Mission underlines the Government’s intention to give a boost to solar energy and is a purposeful step by India towards climate change mitigation”.
- The Solar Mission forms a part of the National Action Plan on Climate Change (NAPCC). An analysis done by Greenpeace shows that the Jawaharlal Nehru National Solar Mission plan could ensure an annual reduction of 434 million tons of CO2 emissions every year by 2050 based on the assumption that solar will replace fossil fuels.

7.2.3 INCENTIVES OFFERED:

Central Electricity Regulatory Commission (CERC) has announced preferential tariff of Rs. 18.44 per unit for solar PV power and Rs. 13.45 per unit for solar thermal power for 25 years;

- Zero or concessional duty applicable on import of certain specific items;
- Zero Excise duty on domestic manufacture of many solar energy devices and systems;
- CERC will review the costs every year and fix tariff accordingly for new projects

7.3 WIND ENERGY



It is estimated that wind energy is about 2% of the total solar energy reaching the earth, which is about 2 billion tons of oil equivalent a year, or 200 times that is consumed by all the world's economies.

However, only a small fraction of the potential has been tapped, although India is one of the world leaders in installed wind power generation with a capacity of over 10,000MW.

7.3.1 MARKET OVERVIEW:

In India a total wind power capacity of 10,386 MW has been established up to June 2009 against an estimated potential of about 48,500 MW for setting up wind farms @ 12 ha/MW in sites having wind power density greater than 200 W/ sq. MT at 50 m hub-height. The country is now the fifth largest wind power producer in the world, after USA, Germany, Spain and China.

7.3.2 BUSINESS OPPORTUNITIES BY SCALE OF INVESTMENTS:

Scale of Investment Type of Opportunity

Low	<ul style="list-style-type: none">➤ Consulting for the wind energy industry➤ Training people for the wind energy industry - training on installation, maintenance and repair➤ Wind turbine and wind farm maintenance➤ Setting up micro wind turbines on private farms and residences➤ Wind turbines and components distribution➤ Land owners and farmers can lease/rent their land for wind farms
Medium	<ul style="list-style-type: none">➤ Developing software that can be used in wind turbines - such as monitoring and instrumentation software➤ Setting up medium scale wind turbine manufacturing plants➤ Setting up manufacturing plants for components and accessories for the wind energy industry➤ Setting up R&D facilities for new research into wind energy
High	<ul style="list-style-type: none">➤ Setting up large-scale wind turbine manufacturing plants➤ Setting up large wind turbine power plants

7.3.3 INDIA'S ADVANTAGES:

- India is endowed with a large, viable and economically exploitable wind power potential.
- Over the last 10 years wind capacity has grown at a CAGR of 22%.
- Cumulative installed capacity is expected to reach 12 GW by 2010.
- India's potential is conservatively estimated at 45,561 MW for setting up wind farms @ 12 ha/MW in sites having wind power density greater than 200 W/sq. MT at 50 m hub-height.
- Indian government envisages a capacity addition of 10,500 MW during the 11th Five – Year Plan period (2007-2012).
- India is placed at the third position in the world in terms of new additions in 2008 and this corresponds to an overall increase of over 40% in new wind power stations.
- India is net exporter of wind turbines and wind turbines components.

- A program entitled “Small Wind Energy and Hybrid Systems” is developed every year for the small wind-power station segment i.e. those with a capacity up to 30 KW and wind-powered water pumps produced in India.

7.3.4 PROMOTIONAL POLICIES:

Fiscal and financial incentives:

- Concession on import duty on specified wind turbine parts
- 80% accelerated depreciation over one or two years
- 10 year income tax holiday for wind power generation projects
- Excise duty relief on certain components
- Some states have also announced special tariffs, ranging from Rs. 3-4 per kWh, with a national average of around Rs 3.50 per kWh
- Wheeling, banking and third party sales, buy-back facility by states
- Guarantee market through a specified renewable portfolio standard in some states, as decided by the state electricity regulator by way of power purchase agreements
- Reduced wheeling charges as compared to conventional energy

Land policies:

- The Ministry of Environment and Forests has issued guidelines for diversion of forest lands for non-forest purposes, particularly to enable wind generation
- Clearance of leasing and forest land for up to a period of 30 years for wind developers.

Financial assistance:

The Indian Renewable Energy Development agency (IREDA), the premier finance agency of the Government of India provides soft loans for renewable energy projects, particularly for demonstration and private sector projects.

Wind resource assessment:

- The Government of India has set up the Centre for Wind Energy technology (C-Wet) to map wind energy potentials.
- The C-WET has set up more than 1,000 wind monitoring and wind mapping centers across 25 states
- Wind mapping at 50 meters (C-WET) and 60-80 meters height (private companies)

State Policies:

A number of State Governments have implemented quotas for a renewable energy share of up to 10% and have introduced preferential tariffs for electricity produced from renewable sources. In addition, several States have implemented fiscal and financial incentives for renewable energy generation; including energy buy back (i.e. a guarantee from an electricity company that they will buy the renewable power produced), preferential grid connection and transportation charges and electricity tax exemptions.

Some States with Renewable Portfolio Standards (RPS) or other policies to promote wind generation, have introduced feed-in-tariffs for wind generation which are higher than that for conventional electricity

7.4 HYDRO ENERGY



The electricity generated from Small Hydro Power (SHP) projects is cost-effective. Such projects are simple to operate, have a relatively short gestation period, and are environment friendly. In addition, SHP projects can be located in remote areas for generating power. The global estimated potential of SHP is about 180,000 MW.

7.4.1 POTENTIAL:

India has an estimated potential of 15,000 MW of small hydro power projects (up to 25 MW) is estimated at 15,000 MW, whereas the country has so far set up SHP projects with a cumulative installed capacity of 1,976 MW only, which indicates the substantial possibilities for future growth.

The Government envisages a capacity addition of 1,400 MW during the 11th Five-Year Plan period (2007-2012). Apart from this, projects aggregating to a 394 MW capacity are under implementation.

7.4.2 BUSINESS OPPORTUNITIES BY SCALE OF INVESTMENTS:

Scale of Investment

Type of Opportunity

Low	<ul style="list-style-type: none">➤ Consulting for the Hydel energy sector➤ Training people for the hydro energy industry➤ Setting up micro-hydro energy plants
Medium	<ul style="list-style-type: none">➤ Setting up / implementing small and medium scale hydro energy plants➤ Setting up manufacturing plants for components and accessories for the➤ Hydel energy➤ Setting up R&D facilities for research into hydro energy
High	<ul style="list-style-type: none">➤ Large-scale manufacturing of components and parts for the Hydel energy industry

7.4.3 INDIA'S ADVANTAGES:

Attractive on various counts:

Proven Technology

- Low O&M costs
- Equipments have longer lifetime
- High energy conversion efficiency (around 70%)
- The Government of India is encouraging the development of small hydro projects through public and private sector participation in various States
- Due to the wide distribution of small hydro power stations, India has a well-functioning network of manufacturers and dealers with established international connections and partnerships
- The Government of India has launched a specific nationwide scheme for the financial support for identification of new Potential SHP sites & preparation of state perspective plan

7.4.4 INCENTIVES OFFERED:

Tax incentives such as enhanced capital allowances are available to developers of hydro projects and low interest rate government finance is available to support hydro schemes.

The Indian Renewable Energy Development Agency (IREDA) arranges low-interest loans for Hydel power stations with capacities up to 25 MW. A package of incentives and subsidies, including fiscal concessions, are available for SHP projects. Many states have announced preferential tariff structures for SHP projects.

7.4.5 INCENTIVES, FINANCIAL SUPPORT AND SUBSIDY FOR COMMERCIAL SHP PROJECT DEVELOPERS:

- Incentives for Detailed Project Report preparation (to the Government Department & Agencies);
- Financial support renovation, modernization and capacity up-rating of old SHP stations (to the Government sector);
- Financial support for development/up-gradation of water-mills;
- Government of India provides capital subsidy through financial institutions, which is intended for making payment of the term loan provided to the developer of the SHP Projects by the financial institution

Incentives for New SHP projects:

Areas	Private, Co-operative, Joint Sector etc.		Government / State / Public Sector	
	100 kW to 1000 kW	Above 1 MW & up to 25 MW	100 kW to 1000 Kw	Above 1 MW & up to 25 MW
NE Region, J&K, H.P. & Uttarakhand (Special Category States)	Rs. 20,000 per kW	Rs. 2.00 crores for 1st MW + Rs. 30 lakhs for each addl. MW	Rs. 50,000 per kW	Rs. 5.00 crores for 1st MW + Rs. 50 lakhs for each addl. MW
Other States	Rs. 12,000 per kW	Rs. 1.20 crores for 1st MW + Rs. 20 lakhs for each addl. MW	Rs. 25,000 per kW	Rs. 2.50 crores for 1st MW + Rs. 40 lakhs for each addl. MW

7.5 GEOTHERMAL ENERGY



At the end of 2010, geothermal energy supplied more than 10,000 MW in 45 countries worldwide and now produces enough electricity to meet the needs of some 80 million people. This renewable energy source also has the potential to provide significant opportunities to do businesses both small and large. It is considered possible

to produce up to 8.3% of the total world electricity with geothermal resources, serving 17% of the world population.

According to market studies, investment in geothermal energy is growing globally at 24% a year. This exceptional investing growth rate is expected to continue - and increase even faster - for the foreseeable future.

7.5.1 INDIA - CAPACITY & CONSUMPTION DATA:

There are no operational geothermal plants in India. There is also no installed geothermal generating capacity as of now and only direct uses (ex. drying) have been detailed.

7.5.2 DIRECT USES:

- Total thermal installed capacity in MW: 203.0
- Direct use in TJ/year: 1,606.3
- Direct use in GWh/year: 446.2
- Capacity factor: 0.25

7.5.3 INDIA'S NEED FOR GEOTHERMAL ENERGY:

India has reasonably good potential for geothermal; the potential geothermal provinces can produce 10,600 MW of power. But yet geothermal power projects have not been exploited at all, owing to a variety of reasons, the main being the availability of plentiful coal at cheap costs. However, with increasing environmental problems with coal based projects, India is exploring clean and eco-friendly energy sources for its future needs; one of which could be geothermal.

7.5.4 POTENTIAL OF GEOTHERMAL ENERGY IN INDIA:

From geological, geochemical, shallow geophysical and shallow drilling data it is estimated that India has about 10,000 MWe of geothermal power potential that can be harnessed for various purposes.

7.5.5 POTENTIAL SITES:

- Puga Valley (J&K)
- Tatapani (Chhattisgarh)
- Godavari Basin Manikaran (Himachal Pradesh)
- Bakreshwar (West Bengal)
- Tuwa (Gujarat)
- Unai (Maharashtra)
- Jalgaon (Maharashtra)
 - The various assessment studies and surveys undertaken so far have resulted in the identification of 340 hot springs across India. The discovery of vast geothermal reservoirs at Puga in the north-west of the Himalayas and Tatapani fields on the Narmada in central India also augurs well for the country.

7.5.6 POTENTIAL GEOTHERMAL REGIONS/SOURCES IN INDIA:

With India's geothermal power potential of 10,600 MW, the following are the potential sources/ regions where geothermal energy can be harnessed in India.

Province	Surface Temp C	Reservoir Temp C	Heat Flow	Thermal gradient
Himalaya	>90	260	468	100
Cambay	40-90	150-175	80-93	70
West coast	46-72	102-137	75-129	47-59
Sonata	60 - 95	105-217	120-290	60-90
Godavari	50-60	175-215	93-104	60

7.5.7

7.5.8 BUSINESS OPPORTUNITIES BY SCALE OF INVESTMENTS:

Scale of Investment	Type of Opportunity
Low	<ul style="list-style-type: none"> ➤ Consulting and installation for home-based geothermal systems ➤ Training people for geothermal heat pump installations
Medium	<ul style="list-style-type: none"> ➤ Setting up medium scale geothermal plants ➤ Setting up manufacturing plants for components and accessories for the geothermal energy industry
High	<ul style="list-style-type: none"> ➤ Setting up large-scale geothermal equipment and components manufacturing plants ➤ Setting up large geothermal power plants or home-based geothermal installations ➤ Involving in large-scale distribution of biofuels ➤ Centralized grid-connected geothermal plants ➤ Installing large-scale distributed (home or location-based) geothermal heat pumps.

7.6 BIOMASS & CO-GENERATION ENERGY



Various technologies including gasification, combustion and cogeneration are used for the conversion of biomass materials into electric power. Biomass is an important energy source contributing to more than 14% of the global energy supply. About 38% of such energy is

consumed in developing countries, primarily in the rural and traditional sectors of the economy.

The strong demand for bio-fuel is in response not only to high crude petroleum prices, but also to the growing concerns about global climate change. Two major bio-fuels for the transportation sector, bio-ethanol and bio-diesel have gained worldwide acceptance.

Among various options available for bio-energy - biodiesel, bio-ethanol and biomass gasification are three major options, which have huge potential in India to develop as energy sources and where investments made would be economical.

Biomass could be described as an important source of energy in the Indian context, accounting for approximately a third of the total primary fuel sources used in the country, which could be harnessed to produce electricity.

In India, biomass-based power generation has attracted investments worth USD 120 million and generated more than 5,000 million units of electricity, besides providing an

employment to more than 10 million man-days in rural areas. India ranks second in the world in biogas utilization.

7.6.1 INDIA - POTENTIAL AND CUMULATIVE ACHIEVEMENTS:

Indian climatic conditions offer an ideal environment for biomass production. Bio-energy has remained critical to India's energy mix. The current potential of surplus agro and forest residues to energy is estimated at 16,881 MW along with an additional "waste-to-energy" potential of 2,700 MW. With the setting up of new sugar mills and the modernization of existing ones, the potential of Bagasse cogeneration is estimated at 5,000 MW. The cumulative installed capacity, of grid-interactive biomass and Bagasse cogeneration power was 1,870.83 MW only, as on 30.6.2009. Under the 11th Plan period (2007-12) the Government of India plans to add as much as 1700 MW through biomass and Bagasse cogeneration in various states.

India encourages ethanol as a fuel for automobiles and Regulations provide for the mandatory blending of 5% of ethanol with petrol (to be increased to 10%). The Government also plans to free the movement of ethanol across the country and eliminate local taxes thereby increasing its usage.

7.6.2 INDIA'S ADVANTAGES:

Close on the heels of the Kyoto protocol recommending a phased changeover to bio-diesel through blending, the Government of India has taken a number of initiatives to promote bio-fuels.

The availability of biomass in India is estimated at about 540 million tons per year covering residues from agriculture, forestry, and plantations. By using these surplus agriculture residues, more than 16,000 MW of grid quality power can be generated.

India has approximately 50 million hectares of degraded wasteland that lie outside the areas demarcated as national forests, and another 34 million hectares of protected forest area, in much of which tree cover is severely degraded.

In addition, about 5,000 MW of power can be produced from sugar mills residues. Thus the estimated biomass power potential is about 21,000 MW. India has approximately 50 million hectares of degraded wasteland that lie outside the areas demarcated as national forests, and another 34 million hectares of protected forest area, in much of which tree cover is severely degraded.

7.6.3 PROMOTIONAL POLICIES:

Besides the Central Financial Assistance, fiscal incentives such as 80% accelerated depreciation, concessional import duty, excise duty, tax holiday for 10 years etc., and are available for Biomass power projects.

The benefit of concessional custom duty and excise duty exemption on equipments is also available.

In addition, State Electricity Regulatory Commissions have determined preferential tariffs and Renewable Purchase Standards (RPS).

Indian Renewable Energy Development Agency (IREDA) provides loan for setting up wind power and Bagasse cogeneration projects. In addition, capital subsidies are also given for the establishment of Bagasse and Biomass units.

8 INDIA'S POLICY SUPPORT FOR RENEWABLE ENERGY

The policies in India are being geared up towards the support of renewable energy. They are characterized by trade-offs between four major drivers:

- Rapidly growing economy, with a need for dependable and reliable supply of electricity, gas, and petroleum products;
- Increasing household incomes, with a need for affordable and adequate supply of electricity, and clean cooking fuels.
- Limited domestic reserves of fossil fuels, and the need to import a vast fraction of the gas, crude oil, and petroleum product requirements, and recently the need to import coal as well; and
- Indoor, urban and regional environmental impacts, necessitating the need for the adoption of cleaner fuels and cleaner technologies.

The supply of adequate, yet affordable electricity generated and used cleanly is a continuing challenge because expansion of supply and adoption of cleaner technologies, especially renewable energy, often means that the electricity is too expensive for many Indians, particularly in rural areas. A road map has been provided in various policies / legislation for supporting the movement of renewable energy in India.

8.1 INTEGRATED ENERGY POLICY OF INDIA

The Government of India has formulated an Integrated Energy Policy covering all sources of energy including renewable energy sources, in December 2008. The policy document has highlighted the need to maximally develop domestic energy supply options and diversify energy sources, including increased exploitation of renewable energy, especially solar. It has further projected that with a concerted push, renewables may account for 5 to 6 per cent of India's energy mix by 2031-32. Main features of the policy include:

- Incentives for promoting renewables should be linked to outcomes (energy generated) and not just outlays (capacity installed).

- Power Regulators should create alternate incentive structures such as mandated feed-in-laws or differential tariffs or specifying renewable portfolio percentage in total supply.
- An annual renewable energy report should be published providing details of
- actual performance of different renewable technologies at the state and national levels.
- Appropriate policies, regulatory systems and fiscal measures duly leveraged by funding available under global climate mechanism should be designed to accelerate the development of solar technology for large-scale deployment.
- Fuel wood plantations, bio-gas plants, wood gasifier based power plants, biodiesel and ethanol should be promoted.



During the 11th Delhi "World Sustainable Development Forum" in New Delhi, Dr R K Pachauri said, "With an increasing focus on energy-efficient, renewable and low-carbon technologies globally, this exhibition organized by TERI is an excellent platform to create mass awareness about latest technologies. Today's technology provides us opportunities. It is for us to rise together to take advantage of these technologies and translate them for the betterment of mankind."



The Union Minister for New and Renewable Energy, Dr. Farooq Abdullah with the Minister of Industry, Energy and Mining of Uruguay, Mr. Roberto Kreimerman, in a bilateral meeting, in New Delhi on February 25, 2011

8.2 FOREIGN INVESTMENT POLICY OF INDIA

The government has created a liberal environment for foreign investment in renewable energy projects. Key highlights of the foreign investment policy are:

- Foreign investors can enter into joint venture with an Indian partner for financial and/or technical collaboration and for setting up of renewable energy-based power generation projects.
- Liberalized foreign investment approval regime to facilitate foreign investment and transfer of technology through joint ventures

- Proposals for up to 74% foreign equity participation in a joint venture qualify for automatic approval; 100% foreign investment as equity is permissible with the approval of Foreign Investment Promotion Board (FIPB)
- Various chambers of commerce and industry associations in India can be approached for providing guidance to the investors in finding appropriate Partners.
- Foreign investors can also set up a liaison office in India
- Government of India is also encouraging foreign Investors to set up renewable energy-based power generation projects on build-own-operate basis

8.2.1 INCENTIVES FOR THE PROMOTION OF CLEAN ENERGY TECHNOLOGY

NO .	SECTOR	INCENTIVES/ SUBSIDIES/TARIFFS/QUOTAS
1.	All RE projects	<p>Customs duty for RE projects under 50 MW fixed at 20% ad valorem. Central sales tax exemption.</p> <p>Minimum purchase rates of \$0.057 per unit of electricity.</p>
2.	SHP	<p>10.75% interest rates (interest rate subsidy).</p> <p>Fifteen states—Andhra Pradesh, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarakhand, and West Bengal—have declared buy-back tariffs from SHPs.</p> <p>Thirteen states—Andhra Pradesh, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, and West Bengal—have declared quotas for purchase of power from SHP.</p>
3.	Wind power	<p>10.25% interest rates (interest rate subsidy).</p> <p>Eight states — Andhra Pradesh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Rajasthan, and Tamil Nadu — have declared buy-back tariffs.</p> <p>Tax holidays for wind power generation projects.</p> <p>80% accelerated depreciation on the equipment during the first year. Concessions in customs and excise duties.</p> <p>Liberalized foreign investment procedures. Preferential tariffs for</p>

		wind power.
4.	Biomass/ Bagasse/ co-generation	10.75% interest rate (interest rate subsidy) for biomass.
		11.25% interest rate (interest rate subsidy) for Bagasse.
		Twelve states—Andhra Pradesh, Chhattisgarh, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, and Uttar Pradesh—have declared buy-back tariffs for Bagasse.
		MNRE provides interest subsidies for co-generation projects. In addition, it provides capital subsidies to Bagasse-based co-generation projects in cooperative with public sector sugar mills. State governments also provide various fiscal and financial incentives.
		MNRE provides subsidies for installation of biomass gasifiers systems. Financial incentives valued at \$30,000 per 100 kWe are provided for 100% producer gas engines, with biomass gasifiers systems for both off-grid and grid-interactive applications. 80% depreciation on equipment during first year.
		Five-year tax breaks with 30% exemption for projects with power purchase agreement.
5.	Energy from urban and industrial waste	The 12th Finance Commission has recommended that at least 50% of the grants provided to ULBs through states should be utilized to support the cost of collection, segregation, and transportation of waste.
6.	Solar PV systems	Implementation of the water pumping program was continued through the state nodal agencies and IREDA. A subsidy is provided under the scheme at \$75 per watt of SPV array used, subject to a maximum of about \$1,200 per system.
	Solar water heating systems	GOI, through MNRE, has provided various interventions in terms of subsidies and other fiscal benefits to promote solar water heating systems.

7.	RE technologies for distributed generation	MNRE provides financial assistance for meeting up to 90% of the project costs and for comprehensive maintenance for periods up to 10 years.
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8.3 POSITIVE FACTORS FOR INVESTING IN INDIA

Some of the many factors that make India a great investment destination for new and renewable energy firms across the world are:

- Electricity demand growing @ 8% annually
- Capacity addition of about: 92,000 MW required in the next 10 years
- The Size of the Indian Market and the unmet demand: India has a large domestic market with immense absorptive capacity for electricity. According to a study by the McKinsey Global Institute (MGI), India's consumer market will be the world's fifth largest (from twelfth) in the world by 2025 and India's middle class will swell by over ten times from its current size of 50 million to 583 million people by 2025.
- Largest number of listed companies - 10,000 across 23 stock exchanges, India has the third largest investor base in the world.
- Healthy banking system with a network of 70,000 branches is among the largest in the world.
- Large pool of skilled, talent and English speaking workforce: India's chief strength comes from its large pool of well-educated, managerial, technical, scientific and skilled people, adept in the English language with innovative skills and talent. India has been mentioned as one of the most favorable location for investments according to the World Investment Prospects Survey carried out by UNTAD for 2009-11. According to the World Fact Book, India is among the world's youngest nations with a median age of 25 years as compared to 43 in Japan and 36 in USA. Of the BRIC— Brazil, Russia, India and China, India will see 70 million new entrants to its workforce over the next 5 years.
- Cheap labor has been cited as another factor for favorable destination for investments by the TNCs in India according the above UNTAD survey.
- Other factors that make India as favorable destination in foreign direct investments (FDI) from world over include: It's speeding growth, its future potential and it's political and economic stability, liberal investment policies and reforms, innovative and technologically advanced products being manufactured in India and low cost and effective solutions.
- India has been ranked at the third place after China and USA in global foreign direct investments this year, following the economic meltdown, and will continue to remain among the top five attractive destinations for international investors during

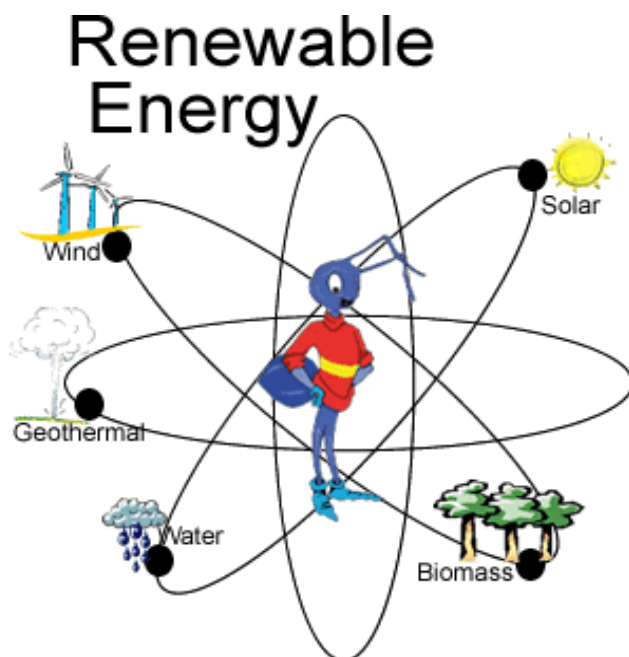
the next two years, according to United Nations Conference on Trade and Development (UNCTAD) in a new report on world investment prospects titled, 'World Investment Prospects Survey 2009-2011'. In Asia, India has been placed second most favored destination, after China, to receive more Foreign Direct Investment (FDI) in the coming years, according to the above Survey.

- Solar energy is not even a fraction of the total Renewable energy potential that India generates, though the country receives abundant sunshine throughout the year. But India hopes to move from near-zero to 20,000 megawatts of solar electricity by 2022, as part of the National Action Plan on Climate Change.
- Announced in June 2008, the plan is a structured response to combat global warming and part of a proposal India pitched at the climate change summit in Copenhagen in December 2009. The centerpiece of the plan is the National Solar Mission, which is aimed at harnessing India's neglected energy source.

9 INDIA'S INDUSTRIAL POLICY FOR RENEWABLE ENERGY DEVELOPMENT

The Government of India is promoting medium, small, mini and micro enterprises for manufacturing and servicing of various types of renewable energy systems and devices. The industrial policy measures include:

- Exemption of industrial clearance for setting up of renewable energy industry
- Exemption of clearance from Central Electricity Authority for power generation projects of up to Rs 1,000 million.
- Five-year tax holiday for renewable energy power generation power generation projects
- Soft loan made available through IREDA for renewable energy equipment manufacturing
- Facilities for promotion of export-oriented units for renewable energy industry
- Financial support extended to renewable energy industries for taking up R&D projects in association with technology institutions
- Power project import allowed
- Allowance to private sector companies to set up enterprises to operate as license or generating companies
- Customs duty concession for renewable energy parts/equipment, including for machinery required for renovation and modernization of power plants.
- Excise duty on a number of capital goods and instruments in the renewable energy sector has been reduced/ exempted.



Opportunities for foreign clean tech firms are numerous in India thanks to the scope of energy demand and the government's warm response to energy efficiency and renewable technologies. According to India's integrated energy policy, in order to deliver a sustained growth of 8 percent through 2031, India will need to expand its primary energy supply by at least three to four times and electricity supply by five to seven times its current consumption. As such, the power sector is expected to add over 150,000 MW over the next 15 years, of which at least 10 percent is expected to come from renewable energy technologies. Different states are in the process of issuing tariff orders for renewable energy electricity generation and specifying quotas for power from renewable energy in accordance with the Electricity Act of 2003. This government push can translate into major opportunities for foreign firms.

Other major government initiatives include an installment of 1 million household solar water heating (SWH) systems, rural electrification of 24,000 villages using renewable mini-grids, and deployment of 5 million solar lanterns and 2 million solar home lighting systems throughout the countryside. Investment opportunities are available for corporate users of power, long-term investors in power, promoters of clean power, and trading credits for emission reductions. Private-sector companies can set up enterprises to operate as licensee or generating companies. A foreign investor can enter into a joint venture not only for renewable energy devices/products but also for manufacturing renewable-energy-based power generation projects on a build, own, and operate basis. At the sector level, small hydropower (SHP), wind, and solar energy offer the maximum scope for clean energy development. However, these sectors are relatively mature with significant local capacity; therefore, the foreign companies may face competition in these sectors. Geothermal and tidal energy sectors offer the advantages of early entry into the Indian market.

Opportunities for foreign firms include products, equipment, demonstrated technology, and project development in these sectors. There is a need to assess the potential of geothermal resources in India and to harness these resources for power generation and for direct heat applications for space heating, greenhouse cultivation, and cooking. The potential of tidal energy and harnessing it for power generation also needs to be assessed. In general, a lack of technical expertise exists in installation, operations, maintenance, troubleshooting, and other aspects of clean energy implementation. Technological needs in the SHP sector include technology for direct drive low-speed generators for low-head sources, technology for submersible turbo-generators, and technology for variable-speed operation. There is also a need for proven high capacity wind turbines, generally greater than 1-2 MW. In addition, there is a need for turbines adapted to low-wind regimes and improved design for rotor blades, gear boxes, and control systems. In the PV sector, there is demand for thin-film solar cell technology, technology for megawatt-scale power generation, and improvements in crystalline silicon solar cell/module technology. Building integration for PV and solar thermal systems is also an area of opportunity.

In bio-energy, opportunities are many and include development of megawatt-scale fluidized bed biomass gasifiers; development of poly-generation facilities for the production of liquid fuels, a variety of chemicals, and hydrogen in addition to power production; development of more efficient kilns for charcoal production and pyrolysis of biomass; and raising the system

efficiency of small (up to 1 MW) combustion and turbine technologies. Bio-fuel needs include engine modifications for using more than 20 percent biodiesel as a diesel blend.

There is a need for waste-to-energy technological development across the board, including the successful demonstration of bio-methanation, combustion/incineration, pyrolysis/gasification, landfill gas recovery, densification, and pelletization.

In the nascent geothermal and ocean power sectors, there is a need for technology suppliers, equipment manufacturers, and project developers. Finally, energy-efficiency service companies and energy efficiency equipment suppliers for buildings and industries could be extremely profitable.

10.1 FOREIGN FIRMS IN INDIA

Prominent global companies have already started exploring the Indian renewable energy market, either directly or through joint ventures. Prominent among them are:

3TIER, USA
ABENGOA, Spain
APPLIED MATERIALS, USA
BP, UK
DU PONT, USA
ENERCON, Germany
E-SOLAR, USA
FIDELIS ENERGY, USA
GAMESA, Spain
GE, USA
IBC SOLAR, German
SHARP, Japan
SIEMENS, German
SUN TECHNICS (CONERGY Group), Germany
VESTAS, Denmark,

10.2 POTENTIAL BARRIERS FOR FOREIGN FIRMS

Given the existing market conditions in India, the foreign firms may encounter challenges in the areas of competition from local suppliers and equipment manufacturers in the SHP, wind, and solar energy sectors. In addition, there appears to be a lack of coordination and integration of renewable energy and energy efficiency policies across broader development issues, including certain disconnect between Indian government ministries, states, and sub-sectors. Policies are often unclear and inconsistent and distortions may arise because of uneven price settings across and within sub-sectors.

Regulatory issues such as time delays, complexity in the permitting and setting of projects, and the lack of monitoring of legal and financial disclosures present additional barriers.

The potential is huge. There are new market segments that have emerged in the past few years.

India expects investments of up to \$ 55 billion in the next five years in the renewable energy sector, which would generate 35,000 MW of power. India which is one of the leading producers of wind power is encouraging investments in renewable energy to curb emissions and reduce dependence on oil as the country imports nearly three quarters of the oil it consumes.

The government is targeting to electrify 10,000 remote villages across the country by 2012 at a cost of Rs. 5000 million. Renewable energy sources are India's answer to growing power needs. India needs more energy, more power to grow, from towns to villages – to power homes, schools, hospitals and industry.

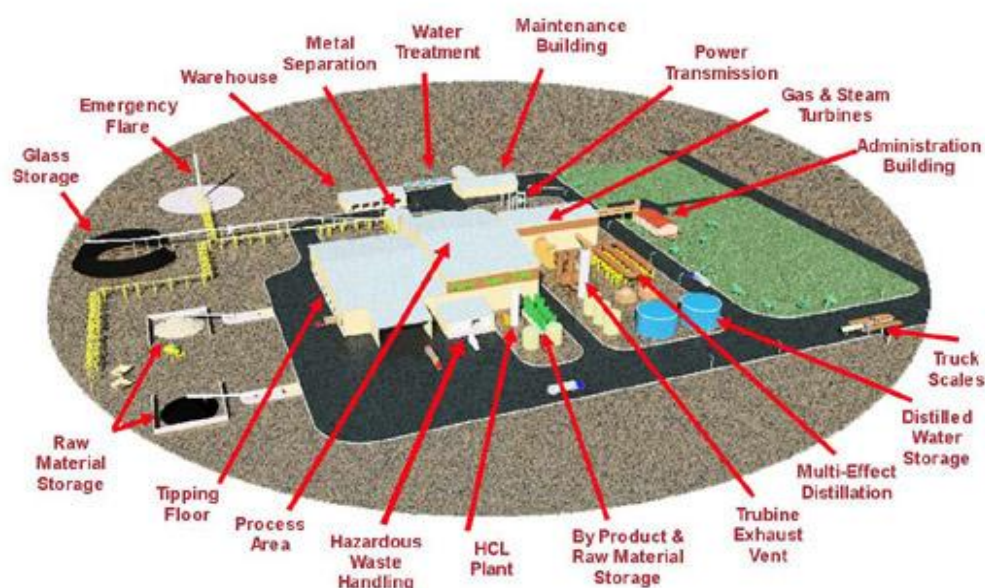
The Government will make it mandatory for mobile phone towers to be powered by solar energy, hoping to cut pollution and tamp down a key driver of diesel consumption in the country. Over 200 crores litres of diesel are used every year by up to 3,50,000 cell towers across the country. The new scheme is being spearheaded under the Jawaharlal Nehru Solar Mission that aims to increase solar power capacity by 20,000 MW BY 2022.

A number of facts and factors make the Indian renewable energy market exciting for entrepreneurs and investors. Here are some highlights:

- India is the most developed renewable energy market in South Asia, with an annual turnover of about \$500 million.
- India is the third most attractive country to invest in renewable energy, according to Ernst & Young.
- The demand-supply gap in power is currently at 8% and is one of the key drivers of renewable energy in the country.
- The utilization of renewable energy sources is still relatively low in India, thus presenting excellent business potential.
- The Indian Government expects the renewable energy sector to grow to \$19 billion from 2008 to 2012, with renewables making up 20% of the 70,000 MW of total additional energy planned from 2008-2012.
- India has been attracting over \$2.5 billion every year in capacity addition
- The Indian Government has received proposals worth \$30 billion for solar PV power plants alone (as of Dec 2009)

12 SOME CONCLUSIONS

Clean energy technologies have moved to the forefront of India's energy infrastructure and investments opportunities. This is driven by the need to enhance energy security and fuel diversity, meet increasing energy needs in an environmentally sustainable manner, and advance economic and social development, all while reducing poverty and sustaining economic growth. Though barriers exist from a technology, policy, and investment perspective, India promises to be one of the largest markets for clean energy, and Belgian companies can have a significant role to play in both trade and investment. The advantages of the Indian clean energy technology market includes a strong industrial base and fast-growing economy; availability of skilled, relatively cheap labor; one of the world's largest renewable energy programs; the world's only dedicated federal ministry to support renewable energy (MNRE) and the only government financial institution exclusively supporting renewable energy and energy efficiency (Indian Renewable Energy Development Agency—IREDA). These are buttressed by a favorable government policy environment, low inflation and moderate tax rates, and a strong and growing carbon finance market.



By 2012 — the completion of the 11th Five-Year Plan — the Indian Government has set a goal for at least 10 percent of power generation to come from renewable energy sources, with a 4–5 percent share in the electricity mix.

Presently at over 10,000 MW of installed capacity, renewable energy is projected to reach over 24,000 MW by 2012. India's rich renewable energy resource endowment provides opportunities across a spectrum of technologies — biomass, solar PV, solar thermal, wind, hydropower, solid and industrial waste-to-energy, geothermal, and tidal energy. The prospects for foreign firms are encouraging, including research, development, and demonstration; technical collaborations; product and equipment sales; project design,

development, and promotion; power generation and production; operational and maintenance (O&M); project monitoring; carbon finance/trading; and consulting services.

Flemish companies should find ample opportunity to enhance their competitive position in India's rapidly expanding marketplace.

13 GOVERNMENT BODIES

Bureau of Energy Efficiency, (Govt. of India)

4th Floor, Sewa Bhawan

R.K. Puram

New Delhi - 110 066

Phone Numbers +91 11 26179699

Fax +91 11 26178352

Email dg-bee@nic.in, amathur@beenet.in

Website www.bee.india.nic.in

Notes Its objective is to assist in developing policies and strategies with a thrust on self-regulation and market principles.

Contacts

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Central Electronics Ltd. (A Public Sector Enterprise)

4, Industrial Area,
Sahibabad - 201 010

Phone Numbers +91 120 2895155, 2895156

Fax +91 120 2895142, 2895147, 2895148

Email cel@celsolar.com

Website www.celindia.co.in

Notes Central Electronics Limited (CEL) is the pioneer and the largest manufacturers of Solar-Photovoltaic (SPV) Cells, Modules and Systems in India.

Haryana Renewable Energy Development Agency (HAREDA)

SCO No. 48, Sector-26

Chandigarh

Phone Numbers +91 172 2790917-9

Fax +91 172 2790928

Email hareda@chd.nic.in; drehareda@gmail.com

Website <http://www.hareda.gov.in>

Notes For taking full advantage of fiscal and financial incentives made available by the Ministry of Non-conventional Energy Sources (MNES), Govt. of India and Indian Renewable Energy Development Agency (IREDA) and to give impetus to the process of implementation, State Govt. has set up a new agency called Haryana Renewable Energy Development Agency (HAREDA). This agency is acting as a nodal agency to implement the various centrally and state sponsored schemes/projects in the area of renewable energy in the State.

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Fax +91 11 26717416

Email cmd@ireda.in, majumdar_deb@hotmail.com

Website <http://ireda.in>

Notes

IREDA is a Public Limited Government Company which promotes renewable energy and energy conservation projects. It is under the administrative control of Ministry of New and Renewable Energy (MNRE) to promote, develop and extend financial assistance for renewable energy and energy efficiency/conservation projects with the motto : " ENERGY FOR EVER " Objectives :

1. To give financial support to specific projects and schemes for generating electricity and / or energy through new and renewable sources and conserving energy through energy efficiency.
2. To maintain its position as a leading organization to provide efficient and effective financing in renewable energy and energy efficiency / conservation projects.
3. To increase IREDA's share in the renewable energy sector by way of innovative financing.

Contacts

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Website <http://www.mnre.gov.in/>
Notes Mr. Singh - +91 11 24362288
Mr. Sukumaran - Wind power, energy, biomass

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Mr. N.P. Singh Scientist-G/Advisor (SHP, Waste to Energy)
Mr. K.P. Sukumaran Scientist-G/Advisor (Wind energy, biomass)

NTPC Vidyut Vyapar Nigam Ltd.

7th Floor, Core 3, Scope Complex,
7 Institutional Area, Lodi Road,
New Delhi - 110 003
Phone Numbers +91 11 24361929, 24360290
Fax +91 11 24362009, 24361771
Mobile +91 96 50990830 Goyal
Email akgoyal@ntpc.co.in
Website <http://nvvvn.co.in>
Notes NTPC Vidyut Vyapar Nigam Ltd. (NVVN) was formed to tap the potential of power trading in the country thereby promote optimum capacity utilization of generation and transmission assets in the country and act as a catalyst in development of a vibrant electricity market in India.

Contacts
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Fax +91 11 26959759
Email info@sesi.in; jsjawa@rediffmail.com
Website <http://www.sesi.in/>
Notes The Solar Energy of India (SESI) is the Indian Section of the (ISES). Its interests cover all aspects of renewable energy, including characteristics, effects and methods of use, and it provides a common ground to all concerned with the nature and utilization of this non-polluting resource. The Society is interdisciplinary in nature, with most of the leading energy

researchers and manufacturers of renewable energy systems and devices of the country as its members.

Contacts

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The Energy Efficiency and Renewable Energy Management Centre

(Delhi Transco Limited)

SLDC Building, Minto Road

New Delhi - 110 002

Email eo.ec@delhitransco.gov.in

Website www.delhitransco.gov.in/

Notes <http://www.delhitransco.gov.in/EnergyEfficiency/Context.htm>

It seeks to create partnerships between industry, consumers, manufactures and instituions to give a new direction to this movement. A state designated agency of Govt. of NCT of Delhi for Energy Conservation & Noday Agency of Ministry of New & Renewable

Energy in Delhi

DELHI TRANSCO LIMITED

Shakti Sadan, Kotla Marg,

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Contacts

Executive Officer (EE & REM)

Independent Power Producers Association of India (IPPAI)

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Mobile +91 99 90411686

Email heena@ippaimail.org

Website <http://www.ippai.org/index.php>

Notes Heena Arora

Since its establishment, IPPAI has been an interface between all stakeholders in the power sector, including policy makers (both at central & state level), electrical utilities, financial institutions, power developers, Indian & multinational Companies, equipment suppliers, EPC contractors & consultants. Over the years, as cross-sectoral interdependencies have increased, IPPAI's focus areas have broadened to include initiatives across key sectors of the

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Website www.windpro.org

Notes The Indian Wind Power Association is a 1000 member strong pan Indian Association of the people who have invested in wind power sector. The other stake holders like the turbine manufacturers, ancillary equipment manufacturers and service providers are also members of the Association. The main objective of the Association is to promote the wind power in the country. The vision is to main stream Wind Energy IN INDIA as a commercially viable utility scale power plans with 20% grid penetration by 2020 by ADDRESSING the key & critical technical or policy related or capacity building issues ahead and creating a roadmap.

Contacts

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Mr. G. V. Srinivasan Chief Executive

Mr. K.K. Kasthoorirangaian Chairman

Indian Wind Turbine Manufacturers Association

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15 MAJOR PRIVATE SECTOR COMPANIES

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Bengaluru - 560001
Phone Numbers +91 80 66595601
Email miskumar@mmm.com
Website www.3m.com
Notes Their Renewable Energy Division Manufactures Scotch shield Films, Solar Concentrators Lens Panels For CPV , Solar Mirror Films For CSP, Tapes, Adhesives & Labeling Material, Wind Energy: Wind Tapes, Wind Blade Protection Tapes, Reflective Tapes Etc.
Contacts
Mr. Manoj Kumar Bus. Devlpt. Manager

3TIER India Private Limited

T 2 Farhaan Centre # 24 /1
Walkers Lane, Langford Road Cross, Richmon Town
Bengaluru - 500025
Phone Numbers +91 80 40918220
Email india@3tier.com
Website www.3tier.com
Notes It's a renewable energy information center for all three weather driven resources- wind, solar and hydro. They use sophisticated tenvironmental prediction systems that incorporate advanced computing technologies and proprietary methodologies

Access Solar Ltd.

S -5, Phase II
T.I.E. Balanagar
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Phone Numbers +91 40 23076010
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Notes Manufacturers Of Solar Modules
Contacts
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ACME Tele Power Limited.

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E.H.T.P
Gurgaon
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Notes Acme Is A Leading Provider Of , Green Energy Infrastructure
Solution For Wireless Communication, Alternate Energy &
Environment Impact Solution.
Contacts
Mr. Arvind Prasad VP - Solar Business.

Akson's Solar Equipment Pvt Ltd.

42/1, Sahajanand Society,
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Pune - 411038
Phone Numbers +91 20 25398771
Fax +91 20 25380109
Email Info@aksonsolar.com
Website www.aksonsolar.com
Notes Manufacturers Of Solar Flat Plate Collectors

BHEL, Solar Division

Asscp Main Gate - 16TH MILESTONE

Gurgaon Faridabad Highway,village Gwalpahari

Gurgaon

Phone Numbers +91 124 2579216, 2579221

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Website www.bhel.com

Notes

BHEL is the largest engineering and manufacturing enterprise in India in the energy-related/infrastructure sector. BHEL's operations are organised around three business sectors, namely Power, Industry - including Transmission, Transportation, Telecommunication & Renewable Energy - and verseas Business.

Valued at Rs.420 Million, the order for setting up the Solar Photovoltaic (SPV) Power Plant at Yapalaniddi village in Raichur District of North Karnataka, has been placed on the company by Karnataka Power Corporation Limited (KPCL). Backed by a vast experience of over three decades, BHEL is one of the few leading players in the field of Solar Photovoltaics and SPV power plants in India. The SPV modules are manufactured at its ultra-modern manufacturing facility located at Bangalore. As another step towards supporting Government of India's Green Energy Initiative, BHEL has recently enhanced its SPV Module manufacturing facility from 3 MW to 8 MW per annum.

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Email cm.aggarwal@gmail.com

Website <http://www.indiamart.com/electroplast/>

Notes It is engaged in manufacturing, exporting and supplying a wide range of solar energy products like commercial solar power systems and residential solar lighting systems. Their range of solar energy products includes solar torch, solar lantern, solar charge controller, solar blinker, solar road stud, solar inverter, solar street light, residential solar lighting systems, solar home lighting systems, commercial solar power systems, solar water heating systems, led's, solar panels and solar garden light.

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Mobile +91 98 11227179

Email anil.ahuja@enerconindia.net; eil.delhi@enercondia.net;

Website <http://www.enerconindia.net>

Notes Providing end to end solution to the customer – from identification of good potential site, developing project, installing Wind Turbine Generator and maintaining the Wind Turbine Generator over 20 years lifespan

Corp. Office

Enercon Tower, Plot No. A-9, CTS No. 700,

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Notes Entegra is a pioneer in the global arena with an integrated approach to renewable energy development, solutions, products and services harnessing resources such as water, wind, sun

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Notes The country's leading solar cell manufacturer, having 160 MW of current capacity,

Production Facility:

3C/1, EcoTech-II,

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Website www.intersolarsystems.com

Notes Services given : Solar Feasibility Study & Solar Contracting Inter Solar Systems Pvt. Ltd. an ISO 9001:2000 Certified Co. and manufacturer of ISI Marked solar energy products like Solar Flat Plate Collector , Solar Water Heating Systems, Solar Air Heating Systems, Solar Swimming Pool Heating Systems, Solar Power Plants, Wind Solar Hybrid Systems etc. approved by Min. of Non-conventional energy sources & IREDA.

Contacts

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Email kecdomestic@kecrpg.com

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Notes It is of largest Transmission EPC companies in the world.

Contacts

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Mr. Ramesh D. Chandak Managing Director & CEO

Kenersys India Pvt Ltd

ECC Training Centre, 2nd Floor

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Pune - 411036

Phone Numbers +91 20 30462899, 71

Fax +91 20 30462888

Email info_india@kenersys.com; cr.vishwanathan@kenersys.com

Website <http://www.kenersys.com/>

Notes Kenersys is a global wind turbine manufacturing company with an in-depth knowledge in on-shore multi-megawatt wind turbines. It is a part of Kalyani Group which is the largest manufacturer of various forged and machined components for the automotive and non-automotive sector.

Contacts

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Pune - 411038

Phone Numbers +91 20 25457940

Fax +91 20 25457939

Email gtc.kitl@kirloskar.com

Website <http://kitlgreen.com/>

Notes KITL has an exhaustive research background in “biomass to energy” processes and has filed several patents in these areas. Kitl offers distributed sustainable solutions in green technologies & renewable energy on turnkey basis.

Contacts

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Email solar@lancogroup.copm

Website <http://www.lancogroup.com>

Notes LANCO has proven expertise in power generation from conventional and non-conventional sources of energy including gas, coal, biomass, hydro and wind. Lanco Solar aims to be one of the largest players in solar energy in India. They are setting up a fully-integrated manufacturing project for high purity poly-silicon, silicon

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Gummidipoondi – 601 201

Thiruvallur Dist.

Tamil Nadu

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Email marketing@lsml.in

Website www.leitwind.in

Notes Manufacturers of Gearless Wind Energy Converters.

Maharishi Solar Technology (P) Ltd.

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Phone Numbers +91 11 26959800, 26959701, 26959529

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Notes Manufacturer / Supplier of Solar Energy Products.

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Uttar Pradesh, India

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Notes Maharishi Solar Technology (P) Ltd., an ISO 9001:2000 accredited company has its corporate Office in Delhi and manufacturing facilities at Noida, Uttar Pradesh and Andhra Pradesh. Maharishi Solar has set up a vertically integrated manufacturing facility at Srikalahasti, Andhra Pradesh, India for manufacturing solar grade Polysilicon, Multicrystalline Ingots, Wafers, Multi & Mono-crystalline Solar Cells, Modules and SPV Systems.

Maharishi Solar is the only company having facility in India to make Multicrystalline Wafers and is the first company in India to produce Solar Photovoltaic Modules with Mutlicrystalline Cells.

Maharishi Solar also designs, engineers and manufactures a wide range of Solar Water Heaters, Solar Air Conditioning Systems, Swimming Pool Heating etc. for various Residential, Commercial & Industrial projects. All components are manufactured in-house and with stringent control over Quality, Delivery and after-sales service.

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Mobile +91 98 10126719

Email dinesh.narang@moserbaer.in;
sidharth.newatia@moserbaer.com

Website www.mbccl.in; www.moserbaersolar.com

Notes MBCEL is a renewable energy development company, with a focus on the implementation of grid connected solar photovoltaic (PV) projects worldwide.

Established in Sept 2008, MBCEL in a very short span of time has acquired a pipeline of projects aggregating to over 100 MWp in India and Europe.

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Moser Baer Photo Voltaic

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Email rajiv.arya@moserbaer.net; ratul.puri@moserbaer.net;
pvinfos@moserbaer.in; pvsystems@moserbaer.in

Website <http://www.moserbaerpv.in>

Notes Moser Baer Photo Voltaic Limited (MBPV) and PV Technologies India Limited (PVTIL) are subsidiaries of MBIL and were launched between 2005 and 2007 with the primary objective of providing reliable solar power as a competitive non-subsidized source of energy. Are in the business of manufacturing photovoltaic (PV) cells and modules and developing integrated PV systems. They manufacture solar cells and modules by straddling multiple technologies, including crystalline silicon, concentrators and thin films. The companies currently have production lines in crystalline silicon cell manufacturing and thin film in the renewable energy SEZ in Greater Noida.

Plant Address

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Contacts

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Website <http://www.nepcindia.com>

Notes NEPC INDIA Limited is a Public Limited Company promoted by the Khemka Group with the primary objective of promoting wind energy. This successful Group has a multi crore turnover from diversified activities in the field of Power Generation from Wind Energy and manufacture and marketing of Wind Turbine Generator (a renewable energy device)

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Website www.regenpowertech.com

Notes Manufacturers of Gearless Wind Energy Converters.

Ritika Systems Pvt. Ltd

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Noida - 201301

Phone Numbers +91 120 2586610

Fax +91 120 2586609

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Email info@ritikasystems.in

Website <http://www.ritikasystems.in>

Notes

Started its photovoltaic operations in 1986. The company conceptualizes, manufactures and designs Solar Photovoltaic Systems , Solar Lanterns, Solar Home Lighting Systems, Solar Street Lighting Systems, Solar Power Plants and other systems for miscellaneous applications. The company has highly qualified, experienced and competent directors in this field. The Company employs nearly 100 personnel covering managers, engineers, technicians & staff. The company manufactures SPV systems whose clientele includes various Government Nodal Agencies, Government Departments, Railways, Paramilitary Forces, Communications & Utility Organizations. The company closely works with various NGO's and institutions on various rural lighting systems and other applications. The Company also supplies Balance Of Systems to various OEMs like Tata BP

Contacts

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Shriram EPC

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Tamil Nadu

Phone Numbers +91 44 28361817

Fax +91 44 28363518

Email info@shrimepc.com

Website <http://www.shrimepc.com>

Notes

Shriram EPC Group is one of the largest integrated services provider in India in the areas of Renewable Energy, Process & Metallurgy and Municipal Services through Shriram EPC (SEPC) and its subsidiaries and associates.

Shriram EPC Limited is in the Wind Energy & EPC (engineering, procurement, construction) Businesses:

Shriram EPC's Wind Turbine Generator (WTG) business has been focused on developing, manufacturing, erecting and commissioning 250KW WTGs, and is currently developing

megawatt-class WTGs through Leitner Shriram Manufacturing Limited, an associate company.

Contacts

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SN Power India Pvt Ltd.

C-1, Sector 2

Noida - 201301

Phone Numbers +91 120 4605100

Email rahul.varshney@snpower.com

Website www.snpower.com

Notes A renewable energy company which invests in emerging markets. Wants to become a leading hydropower company.

Contacts

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Notes It is India's first monthly magazine on solar energy.

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Website www.sujana.com

Notes Sujana Energy leverages on patented and proven technologies to promote energy production with emphasis on distributed electricity generation & sustainable infrastructure using solar thermal, solar pv and led lighting technologies, bringing clean and innovative use of electricity to consumers and commercial markets worldwide.

It is part of the Sujana Group, which has significant presence in construction and structural steel, power transmission and

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Email tanya.singhal@sunborneenergy.com
Website www.sunborneenergy.com
Notes They are a solar power developer who aim to provide cost effective utility scale solar power to achieve grid parity.
Contacts
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Suzlon Energy Ltd.

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Phone Numbers +91 11 41805501-2
Fax +91 11 41805504
Mobile +91 98 18232687 Mr. Naik
Email marketing.india@suzlon.com; avn@suzlon.com
Website www.suzlon.com
Notes Suzlon is the market leader in Asia and 3rd largest wind turbine manufacturer in the world.

In 2008-09: the total projects commissioned by Suzlon Clocked 782 MW giving the company a market share of 52%

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Notes

Tata BP Solar is a Joint Venture between Tata Power Company and BP Solar. It provides customized solar solutions that illuminate homes and streets; pump water to fields and heat water for residential and commercial applications. It also provides solar power to wide-ranging sectors from education and banking to healthcare and telecommunications. Specialist applications include Solar Power Systems for Railway Signaling Systems .

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Notes

TERI has created an environment that is enabling, dynamic and inspiring for the development of solutions to global problems in the fields of energy, environment and current patterns of development, which are largely unsustainable. research & development organisation in various areas of environment and sustainable development.

Contacts

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Notes They provide sustainable solutions in the area of energy and environment

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Notes UD Energy Systems designs, manufactures, installs & maintains off grid & grid connected wind solar and wind solar diesel intelligent hybrid power plants.

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Website www.vestas.com
Notes Vestas is headquartered in Chennai with world class manufacturing facilities in chennai and puduchery. It has installed over 2300 MW in wind rich states of Tamil Nadu, Karnataka, Maharashtra, Gujarat, Kerala and Rajasthan.

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Inter Solar India

Dec 2011, Mumbai

<http://www.intersolar.in>

10th Green Energy Summit & Expo

15-16th December 2010, Hotel Lalit, New Delhi

www.indiaenergyforum.org

India Solar Energy Summit

17-18th February 2011, New Delhi

<http://www.indiasolarenergysummit.com/>

RenewTech India 2011

17-19th February 2011, Mumbai

<http://www.renewtechindia.com/>

PV + Solar India Expo 2011

April 19-21st 2011, Mumbai

<http://www.electronicstoday.org/solar/2011/solarindiaexpo2011.htm>

Power-Gen India & Central Asia

May 5-7th 2011, New Delhi

<http://www.power-genindia.com/index.html>

17 SOURCES & ACKNOWLEDGMENTS

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<http://www.worldenergyoutlook.org/>

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<http://www.indiasolar.com/MNES-PROFILE.htm>

MINISTRY OF POWER – NEW DELHI

<http://www.powermin.nic.in/>

MINISTRY FOR NEW & RENEWABLE INDUSTRY – NEW DELHI

<http://www.mnre.gov.in/>

<http://www.dae.gov.in/>

<http://www.hareda.gov.in/>

<http://www.bee-india.nic.in/>

PLANNING COMMISSION OF INDIA – NEW DELHI

http://planningcommission.nic.in/aboutus/committee/wrkgrp11/wg11_renewable.pdf

US COMMERCIAL SERVICES – NEW DELHI