ISSN 2349-5596

GREEN INSIGHTS

NEWSLETTER ON

Eco-Labelling & Eco-Friendly Products

Renewable Energy
Green Power

CERC
SINCE 1978

Volume 9 Number 4 January-March 2015

Publication of Consumer Education & Research Centre Published By ENVIS Centre

Sponsored By Ministry of Environment and Forest, Government of India

Environmental Information System
INDIA
ENVIS

Foreword

Renewable Energy (RE) is energy that comes from sources which are continuously replenished such as sunlight, wind, rain, tides, waves and geothermal sources. Most countries across the world rely heavily on fossil fuels like coal, oil, and natural gas for energy. Fossil fuels are non-renewable, that is, they draw on finite resources that will eventually dwindle, becoming too expensive or too environmentally damaging to retrieve. In contrast, RE resources - such as wind and solar energy - are constantly replenished and will never run out.

RE is also very important because the technologies used to create it are clean and have a much lower environmental impact than conventional energy technologies. It provides an opportunity for developing countries and countries with economies in transition to embrace a low carbon pathway powered by innovative, smart and locally relevant energy solutions. RE has a great potential to help countries become less dependent on energy imports, create jobs and mitigate climate change while contributing to prosperity. Most RE investments are on materials and workmanship to build and maintain the facilities, rather than on costly energy imports.

Hence, thousands of jobs are created for installers, manufacturers and maintenance staff.

India stands among the top five countries in the world in terms of RE. India has a vast supply of RE resources, and it has one of the largest programmes in the world for deploying RE products and systems. India has tremendous energy needs and increasing difficulty in meeting those needs through traditional means of power generation.

On July 30th and 31st, 2012, the world's largest blackout – The Great Indian Outage, stretching from New Delhi to Kolkata, occurred. This blackout, due to failure of the northern power grid, caused nearly 700 million people – twice the population of USA – to be without electricity. To promote RE technologies in the country, the Indian government has put in place subsidies and fiscal incentives.

The present issue illustrates different types of RE and the status and growth of RE in India. It also gives information on how environmentally conscious energy consumers can support RE. We need a Green Energy Revolution. Goodbye to fossil fuels. RE is the energy for the future.

CONTENT

DESIGNED BY
Strategies & Smiles

PRINTING
Jagadish Offset

Renewable Energy (RE) refers to energy resources and technologies which are non-depletable or naturally replenishable. They include sun, wind, falling water, heat of the earth (geothermal), plant materials (biomass), waves, ocean currents, temperature differences in the oceans and the energy of the tides. RE technologies produce power, heat or mechanical energy by converting those resources either to electricity or to motive power. Sources of energy that are renewable are considered cleaner and environmentally friendly and termed 'Green Power.' They help to negate the effects of global warming and pollution.

RENEWABLE ENERGY: CLEAN AND GREEN

Solar Power

The most readily available source of energy is solar energy. This non-conventional source of energy is non-polluting and helps in lessening the greenhouse effect. A photovoltaic solar power generation system harnesses the energy of the sun to produce electricity. Photovoltaic solar modules commonly known as 'solar panels' or 'solar cells' are the key collection tools in a renewable solar energy system. These components convert the rays of the sun into a daily source of clean and sustainable power. Scientists and manufacturers continue to create cheaper and more efficient solar panels and supporting components. These are becoming more efficient, transportable, flexible and easily installable.

In India, the **National Solar Mission** was launched in January 2010 to create an enabling policy framework for the deployment of 20,000 MW of solar power by 2022. According to the Economic Survey for 2014-2015 it is now scaled up five-fold to 1,00,000 MW by 2022.

Wind Power

Harnessing energy from the wind is an ancient practice. Windmills were known to be in use in Europe as long ago as the twelfth century. Wind is used to generate mechanical power or electricity. The kinetic energy of the wind is converted into mechanical power by wind turbines. In olden times, this power was then used to pump water or grind grain. Now, generators can convert this mechanical power into electricity to power homes, offices, schools, and the like.

Wind energy is a free, renewable resource and also a source of clean, non-polluting electricity.

The wind power programme in India was initiated towards the end of the Sixth Plan, in 1983-84. India ranks fifth amongst the wind-energy-producing countries of the world after USA, China, Germany and Spain and is the third largest annual wind power market in the world. The **Ministry of New and Renewable Energy (MNRE)** has proposed **National Wind Energy Mission** in the National Action Plan for Cliate Change (NAPPC). It was drafted by the Ministry in April 2014 to create a conducive investment environment in the wind energy sector.

Hydroelectric Power

Hydroelectric power is a form of RE that uses water stored in dams and flowing in rivers to generate electricity. Hydroelectric plants use the energy of falling or flowing water to turn turbine blades. The rotating blades spin a generator that converts the mechanical energy of the spinning turbine into electrical energy.

The amount of electricity generated from each power plant depends on the quantity of the flowing water and the height it falls from the reservoir to the turbines.

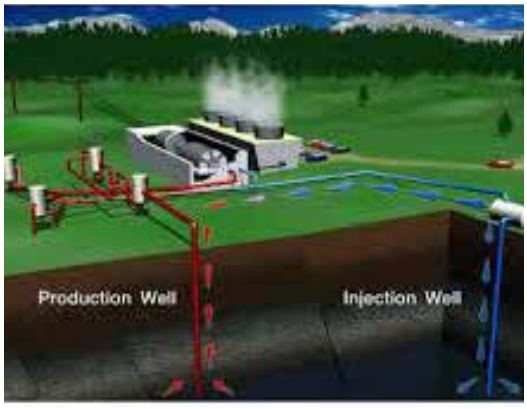
Hydro power projects in India are generally categorised into small and large categories. While the Ministry of Power is responsible for large hydro projects, the MNRE is developing Small Hydro Power (SHP) projects up to 25 MW station capacities.

Biomass Power

Biomass is an important energy source that contributes more than 14% of global energy supply. It is one of the most plentiful and well-utilised sources of RE in the world. Bio-waste is burned to produce steam that turns a turbine to create electricity. New technologies — including pollution control and combustion engineering — have advanced to the point that any emissions from burning biomass in industrial facilities are generally less than emissions produced when using fossil fuels (coal, natural gas, oil).

In India, biomass provides fuel that accounts for about 32% of the total primary energy consumed and caters to almost 70% of the country's population. It is widely available, renewable and carbon neutral. In India, the MNRE has initiated a number of programmes for promotion of efficient technologies for its use in various sectors. Biomass materials used for power generation include bagasse, rice husk, straw, cotton stalk, coconut shells, soya husk, de-oiled cakes, coffee waste, jute waste, groundnut shells and saw dust.

Geothermal Power



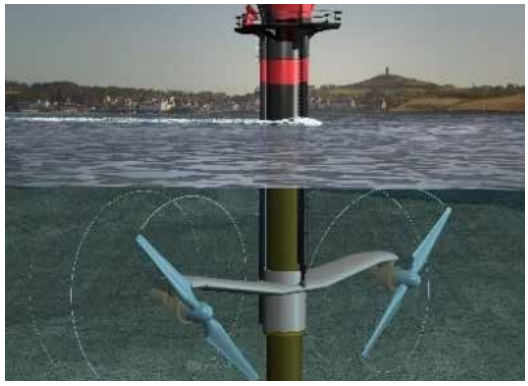
Geothermal energy is generated in the earth's core, almost 4,000 miles beneath the earth's surface. It is one of the potential alternative energy sources, available in the form of vast natural reservoirs of heat energy in the earth's interior, catering to both industrial and domestic energy requirements in many parts of the world.

Geothermal power is cost effective, reliable, sustainable and environmentally friendly and widely used to make electricity. A number of geothermal power plants, which generate more than 10,000 MW power are operational in at least 24 countries of the world. Besides, geothermal energy is being used directly for heating in at least 78 countries. The largest producer of this energy is USA that generates about 3,086 MW of electricity.

The power generation through geothermal resources is still in nascent stages in India. The MNRE drafted a national policy in 2015, which seeks to make India a global leader in the sector, generating 1,000 MW in phase-one, ending 2022. The power generated can be used to electrify rural parts of the country.

Ocean Power

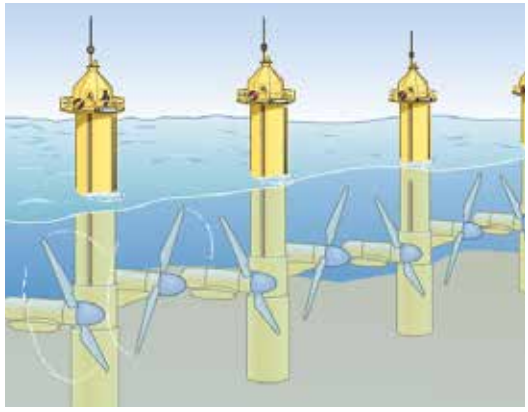
Ocean energy comes from a number of sources. In addition to tidal energy, there's the energy of the ocean's waves, which are driven by both the tides and the winds. The sun warms the surface of the ocean more than the ocean depths, creating a temperature difference that can be used as an energy source. All these forms of ocean energy can be used to produce electricity. This technology is still under-utilised.



Tidal Power

Tidal energy is generated by the surge of ocean waters during the rise and fall of tides. Tidal turbines are installed on the seabed at locations with high tidal current velocities, or strong continuous ocean currents where they extract energy from the flowing water. The submerged rotors harness the power of the sea currents to drive generators, which in turn produce electricity. To generate tidal energy a large dam called a barrage is also used.

Total identified potential of tidal energy is about 9000 MW in west coast - Gulf of Cambay (7000 MW) and Gulf of Kutch (1200 MW). In the east coast, in the Sunderbans in West Bengal, the potential for small scale tidal power development is about 100 MW.



Global Scenario

Several counties are not only accelerating RE installations but are also integrating RE into their existing infrastructure. Iceland gets 85% of the country's electricity from the earth's heat. Norway is 98%

dependent on RE and uses hydroelectric, geothermal and wind. Portugal relies on hydroelectricity for 38-58% of its electricity production while wind power contributes one-fifth of its energy needs. Scotland has a mandate to become 100% renewable by 2020. Paraguay uses hydropower and provides 90% of its electricity and 19% of Brazil's by using Itaipu dam. Denmark uses 30% wind and 15% biomass for its energy needs. Germany uses 98% RE. Stanford professor Mark Jacobson in his study 'The Solutions Project' reported that USA can meet 100% of its energy demand through RE by 2050. Costa Rica achieved a clean energy milestone by using 100% renewable energy for a record 75 days in a row.

>>http://www.efficientgreenpower.com
>>http://www.windpowerindiacom/index.php?option=com_content&view=article&id=2:notables&catid=4:notables
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India has the fifth-largest power generation portfolio worldwide. The country transitioned from being the world's seventh-largest energy consumer in 2000 to the fourth-largest one within a decade. In 1992, the Government of India established the MNRE, the world's first ministry committed to RE. MNRE undertakes policy and planning activities and also supervises national-level RE institutes such as the Solar Energy Centre and the Centre for Wind Energy Technology. The Indian Renewable Energy Development Agency (IREDA) provides financial support and innovative financing for RE.

The Government has enacted several policies to support the expansion of RE like:

- Electricity Act 2003: Mandates that each State Electricity Regulatory Commission (SERC) establish minimum renewable power purchases; allows for the Central Electricity Regulatory Commission (CERC) to set a preferential tariff for electricity generated from RE technologies; provides open access of the transmission and distribution system to licensed renewable power generators.

- National Electricity Policy 2005: Allows SERCs to establish preferential tariffs for electricity generated from renewable sources.

- National Tariff Policy 2006: Mandates that each SERC specify a renewable purchase obligation (RPO) with distribution companies in a time-bound manner with purchases to be made through a competitive bidding process.

Strategic plan for RE sector for the period 2011-17

The present Strategic Plan attempts to quantify the aspirations in terms of SMART (Specific, Measurable, Achievable, Realistic, Time-bound) targets for different renewable resources. The contribution made by renewable resources to the generation of power is targeted to rise from 16% to about 18% by 2022.

The major contributing renewable power sources are wind power turbines, biofuel production through non-food feedstock, solar energy and small hydro power. Some of the aspects of India's RE strategy for the period 2011-2017 are to:

- Promote the concept of small power plants for both solar and biomass
- Develop entrepreneurship for rural electrification through biomass waste, rice husk and solar power
- Push for making technologies more efficient, viable and acceptable, especially for solar cooking
- Identify niche areas for application of RE technologies and reducing consumption of diesel
- Identify possible business models to promote large-scale adoption of improved cook-stoves
- Develop new financial instruments including Risk Guarantee Fund
- Promote plantation of fast growing species of bamboo/other trees to provide feedstock for small capacity biomass power plants
- Build capacity and awareness of green buildings and campuses
- Demonstrate projects for new technologies such as solar thermal hybrid for small plants
- Develop pilot projects for off-shore wind generation

Renewable Energy Market in India 2014-2022

According to the **India Renewable Energy Status Report 2014** released by Bangalore-based market research company NOVONOUS, the total RE potential from various sources in India is 2,49,188 MW. The untapped market potential for overall RE is 2,16,918.39 MW. The MNRE has set a target of achieving overall RE installed capacity of 41,400 MW by 2017 and 72,400 MW by 2022. This creates an opportunity worth $10.51 billion for the RE market in India till 2017. India has the fifth-largest electricity generation capacity in the world which currently stands at 243 GW. However, RE, including large hydro, constitutes only 28.8% of overall installed capacity. The demand for power has been growing at a rapid rate and has overtaken supply, leading to power shortages in spite of manifold growth in power generation over the years, the Report said.

Industrialisation, urbanisation, population growth, economic growth, improvement in per capita consumption of electricity, depletion of coal reserves, increasing import of coal, crude oil and other energy sources and the rising concern over climate change have put India in a critical position. It has to take a tough stance to balance economic development and environmental sustainability. One of the primary challenges for India would be to alter its existing energy mix which is dominated by coal and have a greater share of cleaner and sustainable energy sources.

India's Renewable Electricity Roadmap Initiative

The rapid adoption of RE to power India's growing economy at a price that consumers can afford and on a scale large enough to make a dent in shortages was the challenge confronting the India Renewable Energy Roadmap Initiative, a project commissioned in November 2013 by NITI (National Institution for Transforming India) Aayog (erstwhile Planning Commission). The process to create the **'Report on India's Renewable Electricity Roadmap 2030'** was facilitated by the NITI Aayog. The report was prepared by the Confederation of Indian Industry (CII) in partnership with the Shakti Sustainable Energy Foundation and the Regulatory Assistance Project.

The objective of the report is to capture and synthesise the inputs of stakeholders in the renewables sector at state, national and international levels as to what

should be done differently to drive a dramatic scale-up of RE, particularly solar photovoltaic and wind power. The report presents the opportunities and barriers to renewable electricity and a summary of the rationale, as well as benefits and costs of renewable electricity within the context of the Indian power system. It suggests a framework for an integrated policy strategy for rapid implementation on RE projects that complements both the existing and planned conventional power projects.

Roadmap

The RE Roadmap Initiative Report aims to assist policymakers and stakeholders to grasp what is at stake and what needs to be done to make a successful choice in favour of renewables. The main points are summarised below:

- Discussion of deployment targets and systematic assessment of relative benefits, costs and risks of RE

- Key policy tools at present and how they may evolve as RE reaches high penetration level

- Discussion of supply chain aspect of RE deployment, manufacturing, adequacy of human resources and research and development

- Assessment of investment in RE, including source of investment, private and public sector roles

- Transportation of electricity to the consumer through transmission and distribution networks and how it should be planned efficiently

- Operational aspects regarding how the issues and uncertainties in output of solar and wind can be managed reliably

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Renewable Energy Status in India

Solar
Potenatial = 100,000 MW
Installed = 2,647 MW

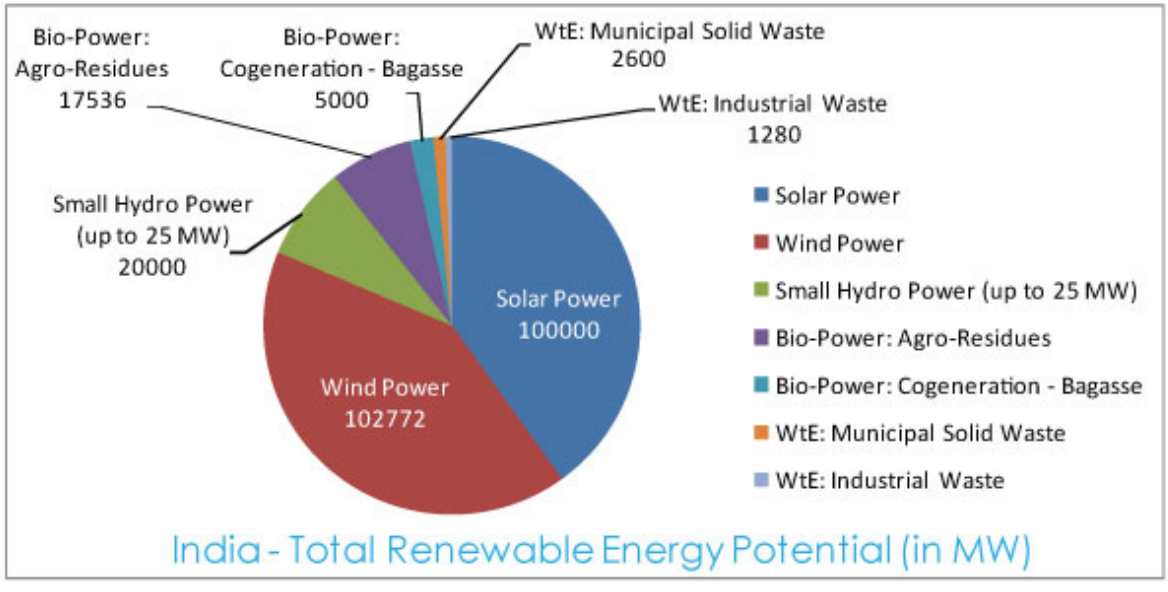
Wind
Potenatial = 102,772 MW
Installed = 21,136.2 MW

Biomass / Bagasse
Potenatial = 22,536 MW
Installed = 4,562.9 MW

Small Hydro
Potenatial = 20,000 MW
Installed = 3,816.91 MW

Waste to Energy
Potenatial = 3,880 MW
Installed = 106.6 MW

Expected Indian RE Market Size by 2022 = US$ 83.35 billion



>> http://www.novonous.com

CONSUMERS AND RENEWABLE ENERGY

An 'Energy and Environment Consumer Survey' conducted by US-based Navigant Research seeks to find out consumer attitudes toward a number of clean and RE concepts, such as, solar energy, wind energy, hybrid vehicles and electric cars. It analyses the survey responses as a basis for comparing consumer views on 10 energy and environment topics. The level of consumer awareness within each topic is also noted. The survey indicates that consumers are generally supportive of the more established renewable energies that harness naturally occurring power sources.

Mercom Communications India conducted a survey on 'India Consumer Perceptions on Renewable Energy'. Over 1,700 residential, commercial and industrial customers were surveyed. Solar energy emerged as the most recognised source of RE. A significant percentage of consumers were willing to pay more for solar. Customers believed it was very important for India to develop and generate more solar power. The survey also found that a strong industry-driven campaign is needed to educate and inform consumers further.

'Green' Electricity

It's the simplest, most effective thing you can do to make sure that the electricity you use is produced with power from clean, local, RE. Most households across the world are reliant on electricity.

There are many ways that you can make alternative energy choices right at home. The two most popular ways are installing solar panels or wind turbines on your property.

Solar Panels

Solar panels, collections of solar cells, are devices that convert light into electricity. Some scientists call them photovoltaics which mean 'light-electricity.' Many small solar cells spread over a large area can work together to provide enough power to be useful. The more light that hits a cell, the more electricity it produces. Efficiency of solar panel depends on solar insolation - a measure of solar radiation energy received on a given surface area in a given time. Weather conditions affect the output of solar panels. Other factors are shade caused by obstructions to direct sunlight and the angle and position at which the solar panel is installed. Solar panels function the best when placed in direct sunlight, away from obstructions that might cast shade, and in areas with high solar insolation ratings.

Many homeowners are making the choice to install solar panels on their roof to reduce their utility bills and their carbon footprint.

Wind Turbines

Wind turbines are very large and generally built in remote areas that are windy like coastal areas. Homeowners who want to generate their own green power can install a small wind turbine. It is difficult to generate enough power this way to independently power a home. A single turbine with a 5-kW generating capacity can meet electricity needs of a home. A turbine of this size has a diameter of approximately 18 feet. The exact size needed to power a home, however, can range from 2 kW to 10 kW (12 to 25 foot diameter) based

on a home's energy use, average wind speeds and the turbine's height above ground. Typically, areas with average sustained wind speeds of more than 11 km per hour are the best areas for setting up wind turbines.

Benefits of RE Use

RE provides substantial benefits for our climate, our health, and our economy. Wind, solar and hydroelectric systems generate electricity with no emissions. Geothermal and biomass energy systems emit some air pollutants but total emissions are generally much lower than those of coal and natural gas-fired power plants. Each source of RE has unique benefits and costs. According to data collected by the International Panel on Climate Change, life-cycle global warming emissions associated with RE — including manufacturing, installation, operation and maintenance, and dismantling and decommissioning—are minimal.

Investing in RE can also lead to job creation in everything from installation to manufacturing, according to the Environment Protection Agency.

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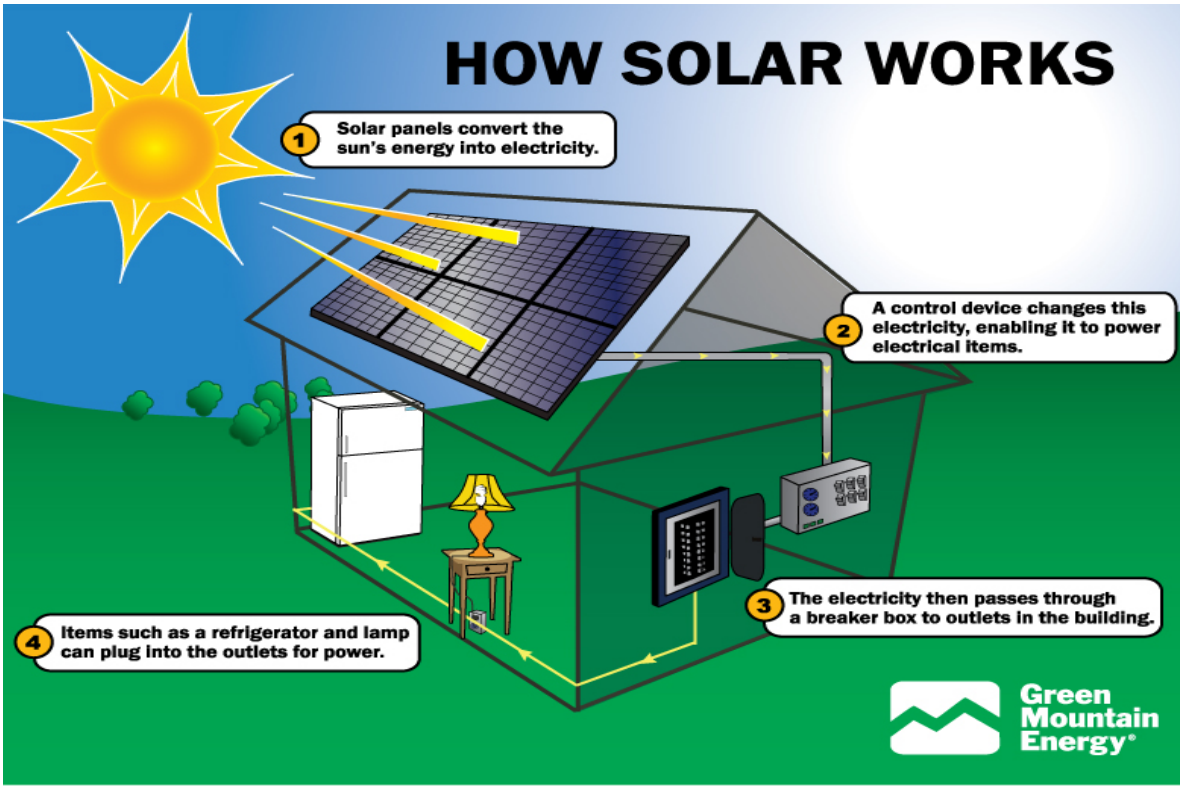

The Environment information System acronymed as ENVIS was implemented by the Ministry of Environment & Forest by end of the 6th Year Plan as a Plan Scheme for environmental information collection, collation, storage, retrieval and dissemination to policy planners, decision makers, scientists and environmentalists, researchers, academicians and other stakeholders.

The Ministry of Environment and Forest has identified Consumer Education and Research Center (CERC), Ahmedabad, as one of the centers to collect and disseminate information on Eco-labelling and Promotion of Eco friendly Products. The main objective of the ENVIS Centre is to disseminate information on Eco products and International and Naitonal Eco Labeling Programmes.

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Environmental Information System
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Volume 9 Number4 January-March 2015

PERIODICAL PRINTED & PUBLISHED BY
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