



Renewable Energy for Urban, Industrial and Commercial Applications

4.1 Solar energy and technologies for energy recovery from municipal, industrial and commercial wastes have been promoted by the Ministry for meeting certain niche energy demands of urban, industrial and commercial sectors in the country. The programmes implemented during the year are: i) Solar energy systems and devices including solar thermal and solar photovoltaic systems; ii) Energy recovery from urban, industrial and commercial wastes; and iii) Bioenergy and cogeneration in industry.

ENERGY EFFICIENT SOLAR/GREEN BUILDING PROGRAMME

4.2 Buildings are major consumers of energy in their construction, operation and maintenance. Globally, about 40% of energy consumption is estimated to be in building sector. At present India is experiencing heavy construction activities in all spheres, thereby the energy demand is increasing rapidly. This is also due to rapidly growing urbanization and the increasing affordability of the people.

4.3 A green building minimizes the demand on fossil fuel based energy, maximizes the recycle, reuse, renewable energy and energy efficient devices & appliances. The need to reduce energy consumption and increase use of renewable energy in buildings have been an important concern of this Ministry. Consequently, energy conscious architecture has been promoted which includes the use of solar passive design concept, use of eco-friendly and less energy intensive building materials, integration of renewable energy and energy efficiency, water conservation, waste recycling etc. This was the origin of the green building concept.

4.4 The Ministry continued the **Energy Efficient Solar/Green Buildings Programme** during 2010-11 in which the GRIHA rating system is being promoted. (**Box 4.1 & Box 4.2**)

Achievements and Progress

4.5 The Ministry had a target of supporting 4 million sq. meter built up area during 11th Plan. So far, 117 projects with 4.98 million sq. meter built up area with 81 projects from Government Departments with 3.22 million sq. meter built up area have been registered for GRIHA certification. Their construction is in progress.

4.6 The Ministry has created an independent registered society 'Association for Development and Research in Sustainable Habitats' (ADaRSH) for promotion and implementation of GRIHA rating system in the country. Few major achievements are as follows:

- In compliance of a decision of the Committee of Secretaries that all new buildings of Central Government /Public Sector Under takings would at least

meet the requirements of GRIHA – 3 Star, though every effort would



*Center for Environmental Science and Engineering, IIT Kanpur Building
rated with GRIHA 5 Stars Rating*

Box 4.1

GRIHA – A Rating System for Green Buildings

To promote the green building concept, the MNRE in association with TERI has developed GRIHA - Green Rating for Integrated Habitat Assessment, a Building Rating System for promotion of energy efficient Green Buildings in the country. GRIHA is an integrated framework for ensuring design, construction, operation and in turn rating of ECBC compliant green buildings. GRIHA, not only incorporates ECBC as a mandatory provision but also promotes integration of passive, low energy strategies into building design, thus making energy efficient buildings more cost effective. The rating system is suitable to Indian climate and is in harmony with the NBC 2005, ECBC 2007 and other IS codes.

The GRIHA Rating System contains 34 evaluation criteria with 100 points. These criteria have been categorized into (i) Site Planning including conservation and efficient utilization of resources, health and well being during building planning and construction stage (ii) Water Conservation (iii) Energy Efficiency including energy embodied & construction and renewable energy (iv) Waste Management including waste minimization, segregation, storage, disposal and recovery of energy from waste and (v) Environment for good health and well being. Additional criteria for innovative developments such as alternative transportation, environmental education enhanced accessibility for physically/mentally challenged are also awarded points.

GRIHA has a 100-point system consisting of some core points, which are mandatory to be met while the rest are optional, which can be earned by complying with the commitment of the criterion for which the point is allocated. Different levels of rating (one star to five stars) are awarded based on the number of points earned. The minimum points required for rating is 50. Buildings scoring 50-60 points, 61-70 points, 71-80 and 81 – 90 points will get one star, two stars, three stars, and four stars, respectively. A building scoring 91-100 points will receive the maximum rating, which is five stars.

A GRIHA 3 star building aim to be 40-50% more energy efficient than conventional building and 8-10% more efficient than ECBC compliant buildings through incorporation of passive design strategies such as proper orientation, shading, day lighting, etc. In addition, this building saves 25-50% water over conventional buildings and promotes segregation of waste and generation of energy from solid waste. Renewable energy integration is mandated under GRIHA.

Box 4.2

Scheme on Energy Efficient Solar/Green Buildings

The Energy Efficient Solar/Green Buildings Programme aims to promote the large-scale construction of energy efficient solar/ green buildings in the country through a combination of financial and promotional incentives. The scheme has provisions for i) providing reimbursement of 90% of the rating-cum-registration fee for buildings rated for their performance under National Rating System, ii) providing incentives to architects and consultants to design buildings on Green Architectural concepts and get them rated under GRIHA, iii) providing financial support for promotional activities, iv) providing incentives to local urban bodies, v) institution of awards/incentives for green buildings rated 5 star, and vi) organizing various other activities related to development of web based tools, e-learning modules, etc. The scheme has the following provisions:

The Scheme provides for the rating and registration fee to private and government projects as follows:

Project size (Total built up area)	Rating cum registration fee
<5000 sq.m.	₹3,14,000 (₹ 2,50,000 fixed cost for registration and secretariat fees + ₹64, 000 for evaluation)
>5000 sq. m.	₹3,14,000 (fixed cost for projects up to 5000 sq. m.) + ₹3.75/sq. m. over and above 5000 sq. m. of built area

Private owners of buildings are required to register with GRIHA Secretariat (ADaRSH) and to pay the Registration-Cum-Rating fee for the project at the time of registration, however, 90% of this fee is reimbursed to the owners through GRIHA Secretariat after validation of Star Rating for projects rated 3-Star having built area up to 5000 sq. m. and for projects rated 4-Star having built area above 5000 sq. m. For Government projects that commit for achieving a high level of rating i.e. a 3 Star for buildings upto 5000 sq.m. built-up area and a 4 Star for buildings larger than 5000 sq.m MNRE pays these fees up front. The incentives to Architects and Design Consultants are provided upto ₹ 5.0 lakh for each project upon achieving the above targets. Some financial incentives for promotional activities i.e. organizing workshops/ seminars/ training programmes/ meetings of NAC/ publications/ awareness campaigns etc. to implementing agencies including GRIHA Secretariat are provided. If Urban Local Bodies formulate Green Building Promotion policies through discounts on premium and property tax a one-time grant of upto ₹ 50 lakh is provided to facilitate the process of policy formulation and awareness building.

- be made by them to achieve higher star rating wherever site conditions permit to do so. Ideally all organizations would aim to reaching GRIHA 4 – star rating, all Central Government Ministries, Departments and Public Sector Undertakings were approached to acquire GRIHA ratings in all buildings to be constructed by them in future.

CPWD has taken a decision to follow GRIHA ratings in all buildings built by them in future. CPWD is in process of amending its work manual commensurate with the GRIHA rating.

- An orientation training programme was organized in association with Ministry of Human Resource Development for various upcoming educational institutions including IITs, NITs, Central Universities, IIMs, IISER etc. on 2nd June, 2010 at New Delhi which was participated by heads of these institutions.
- Suzlon One Earth, Pune and Police Training School, Tasgaon have been rated with 5 Stars and 4 Stars respectively under GRIHA rating. Further, Fortis Hospital, Shalimar Bagh, New Delhi (3 Star) and Hindustan Unilever Limited, Mumbai (2 Star) have also been rated under GRIHA, so far.
- Eleven Evaluators & Trainers Workshops for providing trainings to the Architects, Engineers and Officials from Central & State Governments and PSUs including Central Public Works Department, National Buildings Construction Corporation, National Thermal Power Corporation Ltd. etc. were organized. Over 600 building professionals have taken part in these programmes and nearly 200 of them have qualified in the examination as trainers or evaluators. These GRIHA Certified professionals are further generating awareness.



Fortis Hospital, Shalimar Bagh, New Delhi -GRIHA 3 Stars Rating

- CPWD Training Institute, Ghaziabad has been recognized as 'Centre of Excellence for Green Buildings'. The centre will provide technical and training support to professionals including Government Officials, Engineers and Architects, besides the consultancy services on green buildings.
- A National Conference was organised on 7th and 8th January 2011 at New Delhi through ADaRSH and TERI which was attended by over 300 stakeholders who committed for promoting GRIHA. A 'Meeting of the Minds' with leading builders was organised to motivate them for adopting green buildings on this occasion in presence of Hon'ble Minister of Urban Development and Minister of New and Renewable Energy. An exhibition on green building material was also inaugurated by Dr. Farooq Abdullah, Hon'ble Minister of New and Renewable Energy.
- GRIHA Manual containing a set of 5 volume has been prepared and was released

by Dr. Farooq Abdullah, Hon'ble Minister of New and Renewable Energy in the National workshop on Green Buildings on 7th January 2011.

SOLAR CITY PROGRAMME

4.7 Under “**Development of Solar Cities Programme**” the Ministry had proposed to support 60 cities/towns for Development as “Solar/ Green Cities” during the 11th Plan period with the aim to promote the use of renewable energy in urban areas by providing support to the Municipal Corporations for preparation and implementation of a Road Map to develop their cities as Solar Cities. At least one city in each

State to a maximum of five cities in a State was to be supported.

4.8 The scheme has been revised in January 2011, which provides the following support:

- Up to of ₹50 lakh for each city is provided for preparation of the Master Plan (up to ₹10 lakh), setting up of Solar City Cell in the City (up to ₹10 lakh) oversight of its implementation (up to ₹10 lakh) and organizing other promotional activities (up to ₹20 lakh).
- Ten Cities to be developed as ‘**Pilot Solar Cities**’. The financial support upto ₹2.50 crore will be provided for each Pilot Solar City provided the equal amount of ₹2.50 crore is given by the Municipal Corporation/City Administration/State or any other resources including public private partnership for installation of renewable energy projects/systems.
- Four Cities will be developed as ‘**Model Solar Cities**’. The financial support upto ₹9.50 crore will be provided for each Model Solar City provided the equal amount of ₹9.50 crore is given by the Municipal Corporation/City Administration/State or any other resources including public private partnership for installation of renewable energy projects/systems.
- Apart from 60 Solar Cities, 50 new **Small townships/Campuses** duly notified/permitted by the concerned Authorities being developed by the promoters/builders, SEZs/ industrial towns, Institutional campus etc. will be developed as Solar Township/Solar Campus. The financial support upto ₹10.00 lakh will be provided for each new small townships/campuses for preparation of Master Plan/DPR including the action plan for renewable energy installations, green campus development, awareness generation and trainings etc.



Suzlon -One Earth, Pune Building rated with GRIHA 5 Stars Ratings

Achievements and progress

4.9 Based on the proposals received and the cities identified by 23 States/UTs, 'In-Principle' approval has been given to 14 Cities during the year making a total of 48 Cities namely, Agra, Moradabad, Rajkot, Gandhinagar, Surat, Nagpur, Kalyan-Dombiwali, Thane, Nanded, Aurangabad, Indore, Gwalior, Bhopal, Imphal, Kohima, Dimapur, Dehradun, Haridwar-Rishikesh, Chamoli-Gopeshwar, Chandigarh, Gurgaon, Faridabad, Coimbatore, Vijaywada, Bilaspur, Raipur, Agartala, Guwahati, Jorhat, Hubli, Mysore, Thiruvananthapuram, Amritsar, Ludhiana, Ajmer, Jaipur, Jodhpur, Bhubaneswar, Aizawl, Panaji City & Environs, Itanagar, Hamirpur, Shimla, Howrah, Kochi, Rewa, SAS Nagar Mohali and Shirdi for developing them as Solar Cities.

4.10 Sanctions have been issued for 17 Cities during the year making a total of 31 Cities namely Agra, Moradabad, Rajkot, Gandhinagar, Nagpur, Kalyan-Dombiwali, Kohima, Aizawl, Dimapur Dehradun, Chandigarh, Gurgaon, Faridabad, Thane, Panaji City & Environs, Bilaspur, Raipur, Imphal, Itanagar, Jodhpur, Jorhat, Guwahati, Agartala, Ludhiana, Amritsar, Shimla, Hamirpur, Haridawar & Rishikesh, Vijaywada, Aizawl, Mysore, Hubli and Gwalior. Funds for preparation of their Master Plans have been released which is under progress.

The draft Master Plans have been prepared for 11 cities namely Kalyan-Dombiwali, Kohima, Amritsar, Nagpur, Thane, Rajkot, Imphal, Moradabad, Indore, Chandigarh, and Agra which are under finalization.

- Nagpur and Chandigarh are being developed as **Model Solar Cities**. The proposal of Gandhinagar for developing as Model Solar City has been received and is under consideration.
- Over 30 Stakeholders Meetings/Consultations were held in different cities with Municipal Corporations, Consultants, Electricity Department and other City Representatives.etc. Their inputs were included in the Master Plans being prepared for the Solar Cities. In addition, two review meetings were organized in

MNRE and 7 meetings in respective cities with the consultants, Municipal corporations, State Nodal Agencies and other stakeholders.

AKSHAYA URJA SHOPS

4.11 The programme of establishment of Akshay Urja Shops (earlier Aditya Solar Shops) was continued during the year. Under the programme, shops are being established in each district to make renewable energy products easily available to people and provide after sales and repair services. The programme is in operation through State Nodal Agencies (SNAs). Financial support in terms of soft loans from designated banks and a maximum of ₹2.40 lakh as recurring grant/incentive for first two years of operation from the Ministry is available for establishing such shops. Service Charge is also provided to SNAs. A total of 294 shops in 31 States / UTs, (including 113 Aditya Solar Shops) have been established under the scheme. During the year, 16 Akshay Urja Shops were supported in Andhra Pradesh, A&N Islands, Assam, Bihar, Jharkhand, Madhya Pradesh & Uttar Pradesh.

ENERGY RECOVERY FROM URBAN AND INDUSTRIAL WASTES

4.12 Increasing urbanization, industrialization and the developments taking place in the country also lead to generation of larger quantities of wastes necessitating increased efforts for their management and safe disposal for reducing adverse impact on the environment. Technologies are now available that help in generating substantial quantity of decentralized energy besides reducing the quantity of waste for its safe disposal. According to a recent estimate, there exists a potential for generation of over 3600 MW of power from urban and industrial wastes in the country.

4.13 The Ministry is promoting all the technology options available for setting up projects for recovery of energy from wastes. While incineration and biomethanation are the most common technologies, pyrolysis and gasification are also emerging. Thus, energy can be recovered in the form of biogas, heat and/or power. The major benefits of recovery of energy from wastes are to bring about reduction in the quantity of waste by 60 % to 90% for safe disposal; reduction in demand for land as well as cost for transportation of wastes to far-away landfill sites; and, reduction in environmental pollution, besides generation of substantial quantity of energy.

Programme on Energy Recovery from Urban and Industrial Wastes

4.14 During the current year, the Ministry has continued the implementation of the Programme on Energy Recovery from Wastes through three schemes aimed at a variety of wastes, such as municipal solid wastes, vegetable market and slaughterhouse wastes, cattle dung, along with agricultural residues and agro-industrial wastes. Financial assistance being provided for projects of various types is as follows: as follows:

- **Setting up five pilot projects on energy recovery from Municipal Solid Wastes:** ₹2 crore per MW, subject to ceiling of 20% of project cost and ₹10.00 crore per project, whichever is less, is provided for five pilot projects.

- **Power generation from biogas generated at Sewage Treatment Plants:** 40% of the project cost subject to a maximum of ₹2.0 crore/MW for projects for generation of power from biogas being produced at Sewage Treatment Plants.
- **Power generation from other Urban Wastes and mix of Urban and Agricultural / Agro-industrial Wastes:** 50% of project cost subject to a limit of ₹3 crore per MW for projects based on biomethanation technology for power generation from cattle dung, vegetable market waste, slaughterhouse wastes, night soil and any other urban wastes. Financial assistance of 30% of project cost subject to upper limit of ₹3.0 crore / MW is provided for projects based on biomethanation technology for power generation from a mix of cattle dung, vegetable market and slaughterhouse wastes along with agricultural residues and agro-industrial wastes. In case of projects for generation of only biogas for thermal application, the financial assistance is limited to ₹1.0 crore / MWeq (i.e. biogas production of 12000 cu.m / day).
- **Energy recovery from industrial wastes:** Financial assistance of ₹0.50 to ₹2.00 crore per MW depending upon the type of waste, technology deployed and the end use, subject to a ceiling of 20% of the project cost.

4.15 The schemes are applicable to both, Private as well as Public Sector entrepreneurs and organizations as well as Non-Governmental Organizations (NGOs), for setting up of waste-to-energy projects on the basis of Build, Own & Operate (BOO), Build, Own, Operate & Transfer (BOOT), Build, Operate & Transfer (BOT) and Build Operate Lease & Transfer (BOLT).

Progress during the Year

4.16 A total of 11 projects with an aggregate capacity of 28.77 MW based on industrial wastes have been completed up to January 31, 2011. Execution work on the project for generation of 8 MW power from municipal solid waste in the city of Bengaluru is in final stages and the project is expected to be commissioned within the financial year 2010. In addition, ten projects with an aggregate capacity of about 25 MW are under installation. These include projects based on starch industry wastes, biogas at distilleries, paper industry and poultry litter.



1.4 MW Power Project based on mixed industrial wastes at Jalgaon (inset Bio-gas engines)

4.17 One project for generation of 16 MW power from municipal solid waste is under construction at Okhla, New Delhi. This project is likely to be commissioned by July 2011.

4.18 Work on two projects of 4 MW each, based on mix of urban and agricultural wastes, is in progress in Ropar and Khanna, Punjab.

4.19 Work on development of five projects for generation of 400 kW power from cattle dung and agricultural wastes and residues is in progress at five Gaushalas in Haryana. Development has been slow due to delay in securing permission to change the land use.

4.20 As part of the new initiative taken for development of biogas upgradation systems for converting biogas into Natural Gas (NG) quality fuel for supplementing the supply of CNG, proposals for setting up three demonstration projects are under development.

4.21 One workshop-cum-field visit each on energy recovery from paper mill wastes was organized at Coimbatore, Tamil Nadu and Kashipur, Uttarakhand. A conference on methane recovery from livestock and agro-industrial wastes was also organised in February 2011, at New Delhi.

Programme on Biomass Co-generation (Non-Bagasse) in Industry

4.22 The industrial sector today consumes approximately 35% of total electricity generated

Box 4.3

Industrial Waste-to-Energy in Nammakkal and Salem Districts of Tamil Nadu

The Districts of Salem and Namakkal in Tamil Nadu host around 400 Sago & Starch Mills and over 1000 Poultry Farms, whose wastes pose serious environmental problems with attendant health hazards. On the other hand, these bio-wastes could be productively converted into bio-energy through Biomethanation Projects. An assessment for these two districts has indicated a potential for recovery of over 150 MW energy from biomethanation of poultry droppings and sago factory wastes along with agricultural wastes/residues. Ministry has initiated efforts to develop an intensive programme for setting up of biomethanation projects for power generation from a mix of substrates as a commercially sustainable proposition in these two districts of Tamil Nadu. An Investors' Meet and interaction with sago/starch mills have been held during the year. While about ten sago mills have set up biomethanation projects for energy recovery from their effluents, a number of large-scale commercial projects are expected to get developed in near future.

in the country. In the absence of good quality, reliable power from the grid, they are increasingly generating their own power, largely through diesel generators and are meeting their thermal energy requirements through fossil fuels such as coal, oil or natural gas. Several industries require electrical as well as thermal energy for their operations, which can either be met through different energy sources or through co-generation using only one fuel. The power and steam generated from such co-generation plants can be used for meeting the captive requirements and the surplus power produced can be exported to the grid. Such projects are being set up in a number of industry sectors namely paper and pulp, solvent extraction, rice mills, pharmaceutical industries, etc.

4.23 The Ministry is implementing a programme on "Biomass Energy & Cogeneration (non-bagasse) in Industries" for exploiting the vast potential of thermal energy and power for captive use in industry and captive electricity requirement of institutions, with the following major objectives:

- i. To encourage the deployment of biomass energy systems in industry for meeting thermal and electrical energy requirements.
- ii. To promote decentralized / distributed power generation through supply of surplus power to the grid.
- iii. To conserve fossil fuel use for captive requirements in industry.

4.24 Capital subsidy on re-imburement basis is being provided after commissioning of the projects @₹20 lakh per MW for biomass co-generation projects.

Progress during 2010-11

4.25 A total of 20 projects with a capacity of over 60 MW have been completed up to January 31, 2011. In addition, eight projects with an aggregate capacity of about 30 MW are under implementation.

4.26 Four issues of Quarterly Newsletter, namely, "Industrial Co-generation in India" were published during the year for creating awareness at various levels. The Newsletter is being circulated to various stakeholders such as technology providers, project promoters, banks/ financing institutions, Government Agencies/ Departments, NGO's and industry Associations.