

MNRE Programme on “Development of Solar Cities”
Guidelines for preparing master plan as per the prescribed format of MNRE

1.0 Background

Ministry of New and Renewable Energy (MNRE) has launched a program on “Development of Solar Cities” (<http://mnes.nic.in/adm-approvals/Scheme-Solar-cities.pdf>). The program assists Urban Local Governments in:

- Preparation of a master plan for increasing energy efficiency and renewable energy supply in the city
- Setting-up institutional arrangements for the implementation of the master plan.
- Awareness generation and capacity building activities.

The program aims at *minimum 10% reduction* in projected demand of conventional energy at the end of five years, which can be achieved through a combination of energy efficiency measures and enhancing supply from renewable energy sources.

This document provides general methodology for preparing the master plan.

2.0 Methodology

The master plan preparation process is divided into five steps:

1. Preparing energy base-line for year 2008

Energy base-line for the city is a detailed documentation of the existing energy demand and supply scenario for the city. Among other things, it consists of sector-wise energy consumption matrix and energy supply-mix for the base year. The main activities in preparation of the energy base-line are:

1.1 Sector wise (residential, commercial and institutional, industrial and municipal) data collection on energy consumption (electricity, petroleum products, coal, biomass, etc).

a) *Residential sector*: In the residential (housing) sector electricity is the major source of energy for lighting and for powering home appliances (air-conditioning, refrigerators, fans, television, electric geysers, washing machines, water pumps, etc.), while, LPG, piped natural gas, kerosene, biomass fuels are used for cooking.

Potential sources of Data:

- Local electricity distribution company/electricity board/ State Electricity Regulatory Commission for data on electricity.
- Oil marketing companies for data on *LPG, natural gas*.
- PDS /oil marketing company for data on kerosene.
- Firewood/biomass sellers for estimation of biomass fuels used for cooking.

b) *Commercial and institutional sector*: This sector includes all offices, shops, shopping centers, multiplexes, hotels, restaurants, advertisement bill boards etc and institutional buildings like hospitals, schools, colleges, hostels, jails, government offices, etc. The major sources of energy are electricity and LPG. In addition, a variety of fossil fuels may be used for power back-up e.g. diesel generators. In some cases, biomass fuels are also used for cooking and water heating.

Potential sources of Data:

- Local electricity distribution company/electricity board// State Electricity Regulatory Commission for data on *electricity*.
- Oil marketing companies for data on *LPG, diesel* and other petroleum fuels.
- Firewood/ biomass seller for estimation of biomass fuels.
- BEE data on electricity consumption in commercial buildings.
- Local chambers of commerce and industries for data on distribution of different types of commercial establishments and typical energy consumption in commercial establishments.
- CPWD, MES, State PWD, Municipal Corporation, etc. for data on energy use in government buildings.
- State Pollution Control Boards for data on DG sets.

c) *Industrial sector*: This includes all types of industries falling within municipal limits. Other than the electricity, other fuels that are used include petroleum products (diesel, natural gas, naphtha, furnace oil, etc), coal, biomass, etc.

Potential sources of Data:

- Local electricity distribution company/electricity board/ State Electricity Regulatory Commission for data on *electricity consumption*.

- Public sector oil marketing companies for data on petroleum products.
- Firewood/ biomass sellers for estimation of biomass fuels.
- Local chambers of commerce and industries, District Industry Centre, MSME Service Institutes for data on distribution of different types of industries and data on energy use.
- State Pollution Control Boards for data on DG sets.

d) *Municipal sector*: This includes municipal services (water pumping, street lighting, sewage treatment, etc). Here also the main source of energy would be electricity.

Potential sources of Data:

- Sample Local electricity distribution company/electricity board/ State Electricity Regulatory Commission for data on *electricity consumption*.
- Municipal Corporation for electricity consumption in its facilities.
- Reports on energy audits of municipal services

1.2 surveys for understanding energy use patterns & efficiency of use

Data collection from secondary sources (as described in 1.1 above) may not provide a complete information on energy consumption. Information on aspects such as, energy consuming appliances, consumption patterns, consumer preferences, efficiency of use , etc can be gathered through sample surveys. Sample surveys may cover aspects such as:

- Information on energy appliances/equipments used.
- Energy performance indicators or efficiency of utilization
- Reliability and cost of energy services/fuel supply
- Consumption patterns and consumers preferences
- Experience with use of renewable energy systems
- Design and construction practices for different types of buildings having an impact on energy consumption

1.3 Preparation of energy baseline report

Based on the collected secondary and primary data, energy baseline would be prepared for each sector. As far as possible the secondary data should be collected for at least 5 previous years, which helps in understanding the trends and help in predict sectoral growth rates.

Good data is essential for energy planning and as the number of sources of data is large, it is not easy for the consultant to collect all the data in a limited time period. In order to facilitate data collection, it is advisable that the Municipal Corporation should organize a meeting (or inception workshop) of all concerned departments/institutions at the beginning of the project. In such a meeting the consultant can make a presentation on the data requirements and Municipal Corporation can identify right agencies that would provide data to the Consultant. Municipal Corporation and MNRE should also write letters to all concerned agencies introducing the project, with a request for providing data.

2.0 Demand Forecasting for 2013/2018

This step involves predicting the energy demand for 5 year and 10 year periods. To estimate the demand, growth in energy use in different sectors needs to be established. These growth rates are established based on immediate past trends and future growth plans. Thus, the consultant would have to study various growth plans which may impact energy use in the city. These include:

- City development plans
- JNNURM master plan
- Electricity infrastructure/utility plans
- Industry and business forecasts by local chambers of commerce and industry
- Planning Commission documents

Based on the past time-series data and information on growth plans, growth rate in energy demand for different sectors can be estimated. These growth rates are used for making future projection of energy demand in each sector for year 2013 (five year) and 2018 (10 year).

3.0 Sector wise strategies

This step involves carrying out techno-economic feasibility of different renewable energy and energy efficiency options for each sector and making a priority listing of the options.

3.1 Renewable Energy

A renewable energy resources assessment should be done to identify the potential renewable energy sources for the city. This would include assessment of solar radiation, wind power density and availability, biomass resources and municipal/industrial wastes.

The next step would be listing of all potential renewable energy technology options. An indicative list of renewable energy technologies/systems is given below.

3.1.1 Solar energy

Thermal Systems

- i) Solar water heating systems
- ii) Solar cookers (Box and dish type)
- iii) Scheffler cookers for indoor cooking
- iv) Solar steam generating systems
- v) Solar drying/air heating systems
- vi) Solar refrigeration and air conditioning plants
- vii) Solar concentrators for process heat applications

Photovoltaic Systems

- viii) Solar lanterns
- ix) Solar home lighting systems
- x) Solar generators
- xi) Street light solar control systems
- xii) Solar hoardings
- xiii) Solar street light/garden lights
- xiv) Solar traffic lights
- xv) Solar blinkers
- xvi) Road studs
- xvii) Solar power packs
- xviii) Building integrated photovoltaic
- xix) SPV power plants for decentralization applications
- xx) Roof top plants for replacing DG gensets
- xxi) Solar charging stations

3.1.2 Biomass & Waste to Energy Projects

- i) Power projects based on Municipal and Urban Waste and also on industrial waste through combustion/bio-methanation technologies
- ii) Power projects based on methane available from STPs
- iii) Bio-mass gasification and co-generation projects in industries
- iv) Biomass gasifiers based crematoriums
- v) Projects on methane utilization for thermal & electrical applications in industries

3.1.3 Wind turbines for power generation

3.1.4 Micro-hydel plants

3.1.5 Solar passive architecture in buildings/housing complexes

Major components of solar passive architecture are orientation of building, sun shades, double glazed windows, smart glazing window overhangs, thermal storage wall/roof, roof painting, ventilation, evaporative cooling, day lighting, wind towers, earth air tunneling, construction materials etc. Incorporation of specific components will depend in which climatic zone the building is being constructed.

A sector-wise techno-economic analysis of potential renewable energy technologies should be done. Both, decentralized and centralized options should be considered. The goal will be that renewable energy should be able to reduce at least 5% of the projected total demand of conventional energy at the end of five years.

4.0 Energy Efficiency (EE) and Demand side management (DSM)

While renewable energy technologies would provide clean energy, EE and DSM measures would help in reducing the energy demand. An indicative list of EE and DSM measures for different sectors is shown below:

Municipal sector

- Water pumping: Generally, there is a potential of 15-25% energy savings in the municipal water pumping systems.
- Street lighting: Energy savings are possible with efficient lighting and control systems

Commercial and institutional buildings

- Lighting: Use of efficient lighting and control systems
- HVAC: Use of efficient HVAC systems
- EE in new buildings: Energy savings are possible by following the guidelines as given in Energy Conservation Building Codes (ECBC)
- Storage: Thermal storage for peak demand reduction

Residential

- Lighting: Use of efficient lighting (e.g. CFL and T5) and control systems
- Appliances: Use of BEE star rated appliances
- EE in new housing: Simple guidelines could be made/building bye-laws can be amended to achieve energy savings

Industrial

- Lighting: Use of efficient lighting and control systems
- Energy efficiency in motors, furnaces, boilers, etc.

A sector-wise techno-economic analysis of potential energy efficiency and DSM measures should be carried out.

5.0 Stakeholders Consultations

Stakeholders' consultation is a very important step in master plan preparation. Two stakeholders' consultations are suggested (excluding the inception workshop) -- one immediately after the analysis of sector-wise strategies; and one towards the end to discuss the draft master plan. The participants can include elected representatives, local research and academic institutions, resident welfare associations, industries and corporate organizations, NGOs, SNA, etc. Stakeholders committee formed under JNNURM scheme could also be consulted.

6.0 Implementable Project Proposals/DPRs

The Master Plans should contain few good proposals for implementable projects and few good DPRs that emerged out of interaction with various quarters. These projects will be called the pilot projects.

7.0 Preparation of master plan

The outline of the master plan document as per MNRE prescribed format is enclosed as Annexure-I.

Indicative guidelines for preparing Master Plan & organizing other activities for City to be developed as a 'Solar City'

A. Master Plan

1. Projection for energy demand and supply for 10 years
 - i) Sector Wise
 - ii) Total
2. Base line of energy utilization & GHG emissions
 - i) Residential
 - ii) Commercial/Industrial
 - iii) Institutional
 - iv) Municipal Services
 - v) GHG emission
3. Energy Planning (Sector-wise)
 - I) Resources
 - II) Options for energy savings & demand reduction
 - III) Supply side option based on renewables
 - IV) Techno-economic of energy conservation & measures
4. Year-wise goals of savings in conservation energy through demand side management & supply side measures based on renewables
5. Action Plan for achieving the set goals & expected GHG abatements. This will include capacity building and awareness generation.
6. Budget estimates and potential sources of funding from respective sources (both public and private)

Note: Before finalization, the Master Plan would be discussed in a Stakeholders Consultation Workshop having representation from elected representatives, local research and academic institutions, resident welfare associations, industries and corporate organization, NGOs, SNA, etc. The Master Plan will set a goal of minimum 10% reduction in projected total demand of conventional energy at the end of five years to be achieved through energy saving from energy efficiency measures and generation from renewable energy installations.

B. Other activities

1. Details to be provided on 'Solar City Cell' and 'Solar City Stakeholder Committee' to be set up for implementation of the Master Plan
 2. Details of training programmes/ workshops/ business meets etc. to be provided which will be organized for implementation of the Master Plan
 3. Details of publicity & awareness campaign to be provided
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