Global Journal of Researches in Engineering: J General Engineering
Volume 22 Issue 2 Version 1.0 Year 2022
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4596 & Print ISSN: 0975-5861

Mainstreaming Solar Energy into Residential Sectors of Nashik City

By Seema Sharma & Anoop Kumar

Abstract- Energy is one amongst the foremost vital inputs for economic growth and human development. The economic progress and urbanization are leading to rapid increase in energy demand in urban areas. With appreciation in income levels, people have started depending more on electrical run appliances for their domestic needs. Growth in industrial and commercial sectors also has an ever increasing demand for power supply. Urban areas are heavily dependent on fossil fuels for powering homes, infrastructure, transport, industry and commerce. Although India has huge proven coal reserve, the calorific value and increasing ash content in Indian coal is a major concern. With the proven statistic the oil and natural gas resource in India will last hardly for 18 and 26 years.

Most cities of India are experiencing 15% growth in the peak electricity demand. The government and electricity utilities are finding it difficult to cope with rapid rise in demand, as a result most of cities are facing severe electricity shortages. Long hours of power cuts results in disruption of activities and severely affect economic development of city.

Keywords: *solar energy, urban areas, energy conservation, environment, grid, sewage.*

GJRE-J Classification: *DDC Code: 332.673 LCC Code: K3981*

Strictly as per the compliance and regulations of:

Mainstreaming Solar Energy into Residential Sectors of Nashik City

Seema Sharma [α] & Anoop Kumar [σ]

Abstract- Energy is one amongst the foremost vital inputs for economic growth and human development. The economic progress and urbanization are leading to rapid increase in energy demand in urban areas. With appreciation in income levels, people have started depending more on electrical run appliances for their domestic needs. Growth in industrial and commercial sectors also has an ever increasing demand for power supply. Urban areas are heavily dependent on fossil fuels for powering homes, infrastructure, transport, industry and commerce. Although India has huge proven coal reserve, the calorific value and increasing ash content in Indian coal is a major concern. With the proven statistic the oil and natural gas resource in India will last hardly for 18 and 26 years.

Most cities of India are experiencing 15% growth in the peak electricity demand. The government and electricity utilities are finding it difficult to cope with rapid rise in demand, as a result most of cities are facing severe electricity shortages. Long hours of power cuts results in disruption of activities and severely affect economic development of city. With increased dependency on fossil fuels, urban areas have emerged as one of the major sources of Green House Gas (GHG) emissions, with buildings alone contributing to around 40% of total GHG emissions. CO2 emissions are creating serious global warming issues. SOx, NOx and SPM are contributing to local environmental impacts and flattering a challenge for human well being. In this context there is need to develop a framework that will encourage and assist cities in assessing their present energy consumption status, setting clear targets for and preparing action plans for generating energy through renewable energy sources and in conserving energy utilized in conducting urban services.

This paper provides a framework to harness solar energy potential to reduce the burden of peak energy demands of urban areas.

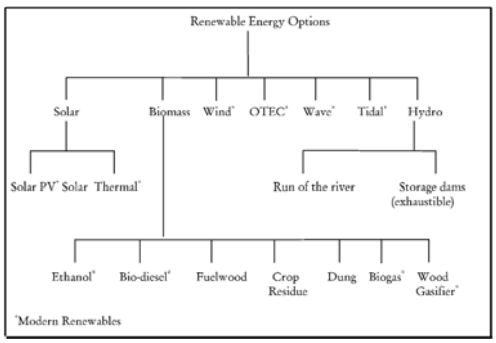
Keywords: solar energy, urban areas, energy conservation, environment, grid, sewage.

I. Energy and Environment

During the last decade the attention of the energy policy-makers, globally, was drawn to the impacts of energy use on the environment. More specially, the apparent linkage between the emissions from the fossil energy use and the green house effect made the environmental concerns a critical component of energy planning. The future energy and emission intensities from the developing countries shall be invariably decided by the development patterns. It is neither efficient nor even feasible for the developing countries to follow the past development paths of the industrialized countries.

Transport, manufacturing, the power sector, commercial and residential energy use, all contribute to problems of air quality. Motor vehicles contribute to all forms of air pollution. Residential burning of unprocessed biomass fuel is the single largest source of carbon monoxide and suspended particulate matter. Power generation contributes most of the nitrogen oxides and sulphur dioxide.

The escalating demand for power, rapid proliferation of motor vehicles, expansion of industries and rising living standards will all combine to have significant impact on the quality of air, especially in urban areas India has huge potentials for the effective use of renewable energy. Various renewable energy sources like small hydro, biomass, and solar energy have power generation potential in India.



II. Analytical Framework

There is a need to develop a framework that will encourage and assist cities in assessing their present energy consumption status, setting clear targets for and preparing action plans for generating energy through renewable energy sources and in conserving energy utilized in conducting urban services.

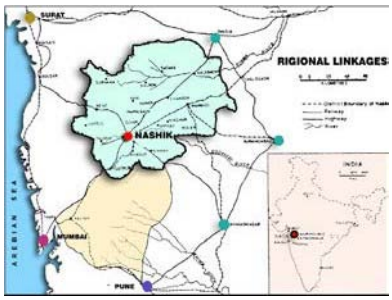
S. No.	Objective	Task	Approach
1	To prepare energy conservation plan	a. Checklist of energy saving devices.	Market survey

Author α: Delhi Technical Campus.
e-mail: seemasharma2286@gmail.com
Author σ: Deputy General Manager, Engineering.
Hartek Power Pvt Ltd. e-mail: anoop.sk@gmail.com

2	To prepare energy generation plan	a. Classify energy generation possibilities at sector level	Literature review,
		b. P.V application details	Literature review, interview with field experts and manufacturers.
3	To check Technical feasibility	a. Check efficiency	Literature review, interview with field experts and manufacturers.
		b. Maintenance	
		c. Life / durability	
4	To check financial feasibility	a. Applicability of subsidies/tax benefit	Review policies
		b. Calculate cost recovery period	Primary and secondary survey of manufacturers
		c. Insurance policies.	Review policies

III. Case Study: Nashik

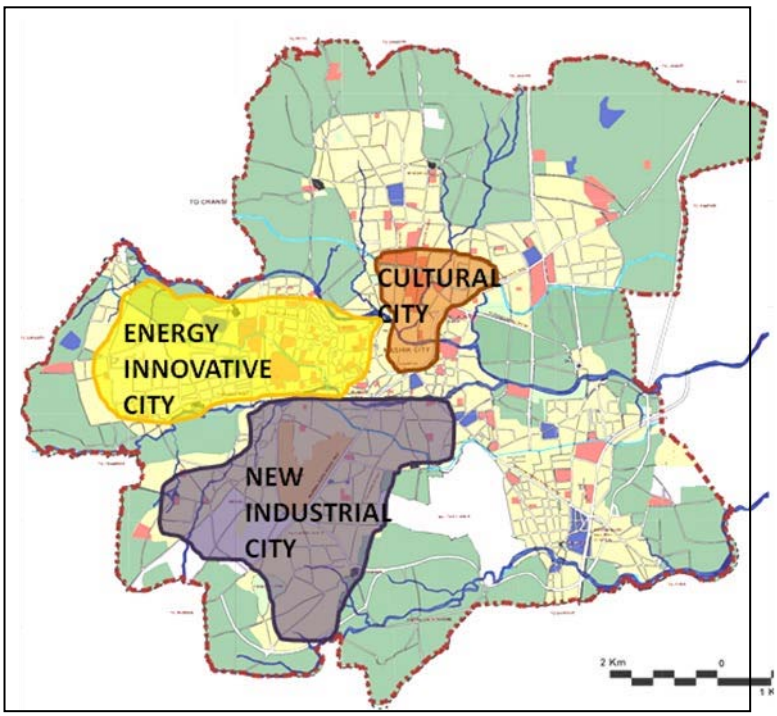
Nashik is located towards the north west of Maharashtra and lies between 19°55' and 20°05' North latitude and 73°42' and 73°55'East longitude. It is located 180 Km, towards north of the state capital, Mumbai and 220 Km towards north of Pune. River Godavari divides the city into Northern Nashik and Southern Nashik. Nashik Urban Agglomeration has a population of 1,620,000 (projected year 2014) and a total area of 259.13sq Km. which makes it the fourth largest urban area in Maharashtra in terms of population.



The coal requirement for NTPS is enormous. For full rated generation, Nashik requires 12 to 13 thousand M.T of coal per day. Nashik is linked for coal supplies with Western Coalfields and South Eastern Coalfields. Nashik being located far away from the collieries, the freight component is considerable and is normally 80 to 100% of the cost of coal.

The power situation during summers becomes worst when the small hydro power plants in the district are at the mercy of rain. MSEDC in 2014 enforced power cut from 16 hours to 40 hours a week in Industrial Areas. Residential Areas faced 6-7 hours power cut daily.

a) Study Area Delineation



The growth pattern indicates that the western area of the city has high potential for future growth to develop as a commercial, institutional and residential hub. Considering the spatial growth pattern, land use, activities and energy demand, the city can be divided into three zones.

i. *Cultural City*

The old city is characterized by narrow, shaded, winding streets, peculiar projections onto the street, streets swelling into a public courtyard and the vibrant and active bazaar streets leading towards the river. The housing typology is *wada* which means a courtyard house with sloping roof. The old city near the Godavari river is established as a rich heritage and pilgrimage centre.

Looking at physical, economical and social characteristics of old city, solar thermal or solar photovoltaic initiatives has very less potential. Area has potential of Energy conservation at existing house hold levels. Alterations or replacing electrical devices with energy efficient devices can reduce the overall energy demand within old city area.

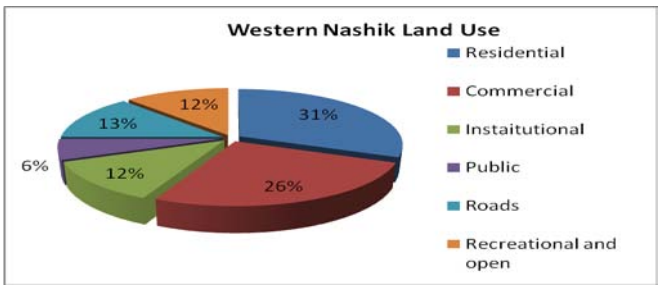
ii. *Energy Innovative City*

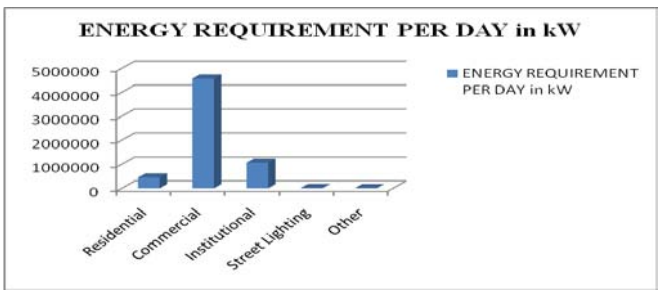
Western Nashik – New development in commercial, residential, and institutional sectors is happening in western Nashik.

Development happening can be seen in a planned approach with uniformity in the land use pattern. There is a majority of higher and higher middle income groups residing in western region.

Thus the western region can be perceived as an energy innovative city, where solar energy resource can find potential in application to reduce the energy demand. New buildings can reduce their energy demands by adopting Green building techniques. Individuals can be active part of the energy management of city, by switching to energy saving devices and solar water heating system installation. Commercial and institutional establishments can generate their own electricity with BIPV systems.

The total area of energy innovative city is 52 Km^2. Major contribution is by residential and commercial sector covering 16.12 Km^2 and 13.52 Km^2 respectively. Institutions cover 6.24 Km^2. Public, Roads, and Recreational has 3.12, 6.76 and 6.24Km^2 area respectively.





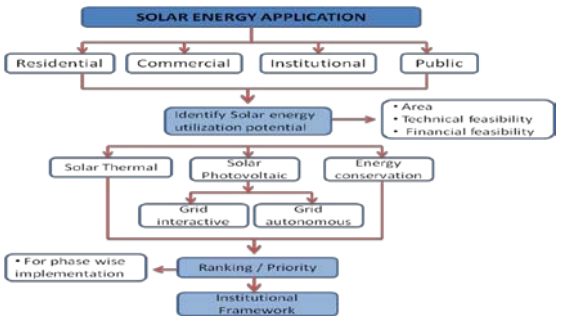
The energy requirement in a day by commercial sector is the highest for western Nashik, followed by institutional which is 4569879.6 and 1065240 kW respectively. Residential sector has an average requirement of 443139.84 kW in a day. Street lighting requires 14919 kW and others like signal lighting, lighting on hoardings and park require 7959.5 kW.

iii. *New Industrial City*

The industrial activity within Nashik Municipal Corporation area is mainly concentrated at the industrial Estates of Maharashtra Industrial Development Corporation viz, the Satpur Industrial Estate & Ambad Industrial Estate. These well planned and established industrial area has a potential to incorporate industries manufacturing solar technology. The new industrial city will encourage use of renewable technology by providing easy local technological assistance.

b) Framework and Proposal for Solar Energy Utilization

i. *Framework*



Solar energy is majorly utilized in two forms, as solar thermal and solar photovoltaic. Solar thermal finds its potential into residential sector, where there is hot

water requirement. Solar photovoltaic has wide application. There are two ways of utilizing the output.

1. Grid Autonomous
2. Grid interactive

Grid autonomous works without the support of the conventional grid. The output is stored in the battery. For example solar street light and in Grid Interactive the panel's output is connected to the mail utility grid with help of converter.

ii. *Energy Saving in Existing House Holds*

Replacing all tubular Fluorescent Lamps (TFL) of 48 Watt/36 Watt lamps and electromagnetic ballasts (copper chokes) to energy saving T-8 or T-5 TFL of 28watt/33 watt and electronic ballasts.

Replacing all general Lighting Service (GLS) bulbs of 100 watt/ 60 watt to compact Fluorescent (CFL) of 20watt/16watt.

Replacing all existing ceiling fans that consume 60 watt to 80 watt, varying with size and age to energy efficient 50 – watt ceiling fans.

Replacing all existing refrigerators with BEE labeled refrigerators.

Replacing all household electrical irons that consume 1100 watts to energy efficient 750- watt irons.

IV. Result

After conservation measures, following are the power consumptions for different categories of houses as per Devices.

a) HIG group Household

Appliance	Wattage of regular device kW	Wattage of energy efficient device in kW	Appliance per house hold	Use per day (hrs)	Power consumption/ day kW	Power consumption after conservation measures/day kW
Tube Light with regular ballast	0.048	0.033	5	3.5	0.84	0.5775
Incandescent Lamps	0.06	0.02	2	2	0.24	0.08
Television	0.1		1	10	1	1
Fans	0.075	0.05	3	8	1.8	1.2
Refrigerators	0.1		1	24	2.4	2.4
Geysers	2		1	0.75	1.5	1.5
Electric iron	1	0.75	1	0.2	0.2	0.15
Washing machine	0.5		1	0.5	0.25	0.25
Computer	0.1		1	2	0.2	0.2
Mixer grinder	0.5		1	0.5	0.25	0.25
Air cooler	0.25		1	6	1.5	1.5
TOTAL	10.18	9.1075				
Total Energy saving per day	**1.07**					
Annual Energy saving per HH in kW	**391.46**					

b) MIG Household

Appliance	Wattage of regular device kW	Wattage of energy efficient device in kW	Appliance per house hold	Use per day (hrs)	Power consumption/ day kW	Power consumption after conservation measures/day kW
Tube light with regular ballast	0.048	0.033	2	4.5	0.432	0.297
Incandescent Lamps	0.06	0.02	3	2	0.36	0.12
Fans	0.075	0.05	2	8	1.2	0.8
Television	0.1		1	8	0.8	0.8
Refrigerator	0.1		1	16	1.6	1.6
Geyser	2		1	0.5	1	1
Mixer Grinder	0.5		1	0.5	0.25	0.25
TOTAL					5.642	4.867
Total energy saving in kW						**0.775**
Annual Energy saving per HH in kW						**282.875**

c) LIG Household

Appliance	Wattage of regular device kW	Wattage of energy efficient device in kW	Appliance per house hold	Use per day (hrs)	Power consumption/ day kW	Power consumption after conservation measures/day kW
Tube light with regular ballast	0.048	0.033	2	3.5	0.336	0.231
Incandescent lamps	0.06	0.02	2	3	0.36	0.12
Television	0.1		1	6	0.6	0.6
Fans	0.075	0.05	1	9	0.675	0.45
Mixer grinder	0.5		1	0.2	0.1	0.1
TOTAL	2.071	1.501				
Total energy saving per day	**0.57**					
Annual Energy saving per HH in kW	**208.05**					

V. Conclusion

Energy consumption plays an excellent role in every country's sustainable growth and environmental performance. In general, energy capacity has focused on energy efficiency. Being efficient in the use of all resources makes an important involvement toward both environmental and economic sustainability.

The study describes the findings to be aware of the factors and strategies that deal with energy efficiency. The information concerning energy policy and program improvement is important to generate strategies to develop technology with the aim of increasing productivity and optimizing energy consumption. The results highlight the need for policy makers and scientists to increase their attention towards energy efficiency, especially to have a positive impact in non-energy intensive sectors as well.

Less impact on the environment with the avoidance of new plant and related transmission lines. Reduction of electricity demand through the use of more efficient equipment will mean a reduction in the burning of fuel for the generation of electricity, thereby minimizing the emission of pollutants into the atmosphere.

If the entire community uses energy efficient appliances and installations, such as energy efficient lighting and air-conditioning systems, both the demand for electricity and the user's electricity bill will come down.

References Références Referencias

1. Metcalf G., 2008. An empirical analysis of energy intensity and its determinants at the state level. The Energy Journal 1-9.
2. Mukherjee K., 2008. Energy use efficiency in the Indian manufacturing sector: An interstate analysis. Energy Policy 36, 662-672.
3. Shashank S. Nadganda et al. "India studies non utility power for new capacity. Power Engineering International pp.33-34 May 1993.
4. Edward M. Kennedy, "Energy in Developing countries "Congress of the United state office of Technology Assessment.
5. "Energy Conservation in Developing countries" Report of the Executive Director United Nation Energy Programme.
6. Report of working group on Energy conservation Planning commission 2005.
7. TERI Information Digest on Energy Vol.4., No. oct-dec.2011.
8. Energy Conservation (Challenges and opportunities) Advisory Board on Energy.