

The Journey in Making ‘Smart Cities’ smarter with Solar Energy

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Abstract— Growing urbanization has meant the influx of a larger population into cities, a tremendous increase in the demand for resources such as water, electricity and thereby, an inevitable strain on them. Urban India has been a witness to this trend, necessitating the need for renewable sources of power and energy efficient measures. The work on solar cells forms part of a broader initiative to harness high tech knowledge in the physics sciences to tackle global challenges such as climate change and renewable energy. This paper has discussed and analyzed the integration of solar energy for electricity production in smart cities.

I. INTRODUCTION

The Smart Cities initiative by the Government of India presents an opportunity to transform the way in which we run our cities. While conversations on important topics such as sanitation, transportation, municipal finance, and water are ongoing, a crucial issue that is not sufficiently discussed from the perspective of cities and local governments is energy. The UN estimates that cities are responsible for close to 75 per cent of global primary energy and 70 per cent of global carbon emissions. The situation in India is particularly severe - peak electricity demand in our cities is rising each year and yet over 400 million people in India are still waiting for access to reliable sources of energy. British Petroleum's Energy Outlook 2035 states that energy demand in India is expected to increase by 132 per cent by 2035 while the growth in production will be near 112 percent. For India to achieve smarter and more livable cities it is vital for stakeholders to articulate strategies for achieving low-carbon, energy efficient and energy secure cities in India. With 70 per cent of India's building stock for 2050 yet to be built and potential annual savings from energy efficiency pegged at 42 billion USD the opportunities are immense. However, realizing these opportunities and unlocking cleaner options such as rooftop solar and bio-methane from sewage demand integrated action by municipalities, utilities, urban planners, Scientists, Technologists, citizens, State Governments and the Government of India.

India and Africa have also invested high capital in the renewable energy sector following the conference. India and France have also formed the ‘International Solar Alliance’ which is determined to boost Solar Power production in developing countries. The renewable energy sources, of which include the Solar energy, have paved way to produce

tons of kilo watt hour of electricity to meet the electricity demands of the people and also care for the environment.

As a result, the concept of Net Metering, i.e., Compensating consumers who produce their own electricity and provide the excess electricity to the electricity grid bloomed with high enthusiasm.

A smart city is an urban development vision to integrate multiple information and communication technology (ICT) and Internet of Things (IoT) solutions in a secure fashion to manage a city's assets – the city's assets include, but are not limited to, local departments' information systems, schools, libraries, transportation systems, hospitals, power plants, water supply networks, waste management, law enforcement, and other community services. The goal of building a smart city is to improve quality of life by using urban informatics and technology to improve the efficiency of services and meet residents' needs.

II. EXISTING INTERNATIONAL ‘SMART CITIES’

There are a number of cities all over the world that are actively pursuing a smart city strategy. The Amsterdam Smart City initiative which began in 2009 currently includes 79 projects collaboratively developed by local residents, government and businesses. A number of homes have also been provided with smart energy meters, with incentives provided to those that actively reduce energy consumption. Other initiatives include flexible street lighting (smart lighting) which allows municipalities to control the brightness of street lights, and smart traffic management where traffic is monitored in real time by the City and information about current travel time on certain roads is broadcast to allow motorists to determine the best routes to take.

An alternative use of smart city technology can be found in Santa Cruz, California, where local authorities analyze historical crime data in order to predict police requirements and maximize police presence where it is required.

According to India, it's a retrofitting and urban renewal program being spearheaded by the Ministry of Urban Development, Government of India. The Government of India has the ambitious vision of developing 100 cities by modernizing existing mid-sized cities.

III. GOVERNMENT INITIATIVES:

The Union Ministry of Urban Development is responsible for implementing the mission in collaboration with the state governments of the respective cities. The government of India, under Prime Minister Narendra Modi's Influence, has a

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vision of developing 100 smart cities as satellite towns of larger cities and by modernizing the existing mid-sized cities.

Earlier Prime Minister Narendra Modi had also started the 'Smart Cities Awaz Yojna Mission' which tries to turn Delhi into a smart city by building more housing complexes with high tech facilities.

A total of ₹ 980 billion (US\$15 billion) has been approved by the Indian Cabinet for development of 100 smart cities and rejuvenation of 500 others. For the smart cities mission, ₹ 48,000 crores (US\$7.1 billion) and for the Atal

Mission for Rejuvenation and Urban Transformation (AMRUT), a total funding of ₹ 50,000 crores (US\$7.4 billion) has been approved by the Cabinet. In the 2014 Union budget of India, Finance Minister Arun Jaitley allocated ₹ 7,016 crores (US\$1.0 billion) for the 150 smart cities. However, only ₹ 9.24 billion (US\$140 million) could be spent out of the allocated amount till February 2015. Hence, the 2015 Union budget of India allocated only ₹ 1.43 billion (US\$21 million) for the project. First batch of 20 cities selected in the second stage of competition will be provided with central assistance of ₹ 2 billion (US\$30 million) each during this financial year followed by ₹ 1 billion (US\$15 million) per year during the next three years. The remaining money has to come from the states, urban bodies and the consortium that they form with corporate entities. Also, 10 per cent of budget allocation will be given to states / union territories as incentive based on achievement of reforms during the previous year.

The Ministry of Urban Development received proposals from the 97 cities to be beneficiaries of the first year financing from 2016 onwards. Minister of Urban Development Venkiah Naidu announced the selected top 20 from among them on 28 January 2016. Bhubaneswar topped the list of top 20, followed by Pune and Jaipur. They were shortlisted by three different panels of experts based on the feasibility of the proposal, cost-effectiveness, result orientation, citizen participation, strategic plan, vision and goals, among other things.

The cities selected have started project preparations and implementation. The projects launched by Ahmedabad were "sewage treatment plant, housing project and smart learning in municipal schools". Bhubaneswar launched "railway multi-modal hub, traffic signalization project and urban knowledge Centre". New Delhi Municipal Council launched "mini-sewerage treatment plants, 444 smart class rooms, Wi-Fi, smart LED streetlights, city surveillance, command and control Centre".

IV. POWER GENERATION

The Ministry of New and Renewable Energy later has Collaborated with the Ministry of Urban Development in providing renewable energy from sources such as sunlight, wind and hydroelectricity for the smart city's electrical grid.

A total of 37288 MW of power were successfully produced for the smart cities, out of which 4345 MW of power were produced from Solar Energy, 4419 MW of power produced from biomass and 24377 MW of power produced from Wind Energy.

The Ministry of new and renewable energy aims to produce a total of 175 GW of electric power, 100 GW from Solar, 60 GW from Wind energy, 10 GW from Hydroelectric plants, and 5 GW from Biomass.

As for the Solar Power, The MNRE aims to produce 20 GW from Solar Parks, 10 GW from Unemployed Youth/Farmers, 30 GW from Govt./Private Companies like Essel, SunEdison, L&T, etc., and 40 GW from Solar Rooftop.

The Honorable Prime Minister Shri Narendra Modi's vision of making 100 smart cities were with emphasis to Smart Energy which includes Renewable energy generation, Smart Meters and Assured electricity supply, and Sustainable development.

The Smart Cities Guidelines insist that 10% of the total electricity be produced from Solar Energy. Therefore, MNRE has decided to produce electricity from solar energy in houses and offices by using solar panels in the rooftop, Solar water heaters for hot water, Solar PV Rooftop for electricity, Solar Street Lighting, Solar Pumps for water lifting, Solar concentrators for steam based cooking and Solar traffic signals. The MNRE also wishes to promote energy efficient buildings on solar passive design.

V. INSPIRATION FROM EXISTING SMART CITIES

Germany, USA and Japan are leaders in adopting grid-connected SPV Rooftop systems. Germany has highest PV installed capacity of over 38 GW of which 71% is in rooftop segment (as on 31.08.2015). Italy has 12.7 GW PV installation with over 60% rooftop systems. In Europe, A of total 50.6 GW PV installation, over 50% is produced in rooftop segment.

Essel Group, India's leading business conglomerate has signed a Memorandum of understanding (MOU) with the Government of Rajasthan to develop a Solar Park at Bikaner and Jaisalmer with the total investment of Rs. 4,000 Crore. The group has also shown keen interest in developing major infrastructural projects in the state of Rajasthan for verticals like Roads and Waste to Energy. Going forward, Essel group will explore and endeavor to setup manufacturing facility for Solar PV module in future.

In the Development of Solar Cities, Solar Cities Aims to assist urban local bodies in assessing their present energy consumption & future demand and preparing Master Plans for energy savings & generation through Renewable Energy installations & energy efficiency measures. Each city to reduce their projected energy demand by 10% over 5 years. 60 cities are being developed as solar cities. Master plans for 50 solar cities prepared. In solar cities, Municipal Corporations have come forward to implement the scheme and setup RE Projects. A total of 34 solar cities are falling in the list of smart cities including, Coimbatore, Gwalior, Kochi, etc. These cities may work in association with Smart Cities. All Smart Cities to be taken under solar cities program and help in the Creation of a Renewable Energy Cell in all Smart Cities.

The Ministry provides up to Rs. 50 lakhs per city for Preparation of a Master Plan, setting-up a solar city cell, awareness generation, capacity building and oversight of implementation. Most of the urban local bodies are not taking

advantage of financial assistance of solar cities. Urban Local Bodies have agreed to set up Solar City Cell. Many advantages include: Savings in transmission and distribution losses, Low gestation time, no requirement of additional land, Improvement of tail-end grid voltages and reduction in system congestion with higher self-consumption of solar electricity, Local employment generation, Reduction of power bill by supplying surplus electricity to local electricity supplier, Battery elimination makes easy installation and reduced cost of system.

VI. ECONOMICS OF SOLAR ENERGY

Initial cost of a solar roof top is Rs. 75,000 per kWp and the Cost of electricity generation Rs.7.00 per kWh. therefore, Cost of generation with 30% subsidy of MNRE is about Rs.5.50 per kWh, most of commercial, industrial and Government establishments pay about Rs.8- 10 per kWh. Hence the solar rooftop is economically viable.

Currently 16 states have agreed to the government's solar policy supporting grid connected rooftop systems which include Tamil Nadu, Telangana, Gujarat, Haryana, etc.

VII. SUPPORT FROM CENTRAL AND STATE GOVERNMENTS

The Ministry of New and Renewable Energy is ready to do the following: Potential assessment for rooftop installations using GIS techniques, Preparation of Master Plans for renewable applications in cities, Central Financial Assistance of RE projects, Consultants/hand holding, Publicity/awareness/workshops and Capacity building.

Although the vision of 100 smart cities remains ambitious, the criticisms of smart cities revolve around the bias in strategic interest may lead to ignoring alternative avenues of promising urban development. Sometimes The focus of the concept of smart city may lead to an underestimation of the possible negative effects of the development of the new technological and networked infrastructures needed for a city to be smart.

VIII. CONCLUSIONS:

This Plan is no doubt a good move, however it cannot be ruled out that clarity in implementation still requires in depth knowledge of local socio- economic environment and governance issues. The key benefits upon implementation of the program are related to environment and climate change, scope for creating industrial growth and employment opportunities, migration of rural population to cities, cultural and living styles etc. The government needs to concentrate on sustainable cities rather than smart cities with more than 1.3 billion to survive in both rural and urban locations. Therefore, Jawahar Sadak yojana and other rural development programs should run in parallel to Smart city mission. Agriculture is equally a profitable and employable industry.

The success of the government's Smart City Mission is largely dependent upon the finance generation at the State-level as well as private investments. The Centre has set aside Rs. 48,000 Crore for the mission and the money will be released to urban local bodies at frequent intervals in the next five years. The Centre has asked the State governments to generate the rest of the Rs. 48,000 Crore as the grand total of

the mission is estimated at Rs. 96,000 Crore.

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