

Population growth, urbanization and electricity - Challenges and initiatives in the state of Punjab, India



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ABSTRACT

Punjab is an economically advanced and energy-intensive state of India. However, the state power sector is facing challenges to align energy supply and demand due to steep rise in electricity consumption. Fossil fuel constraints and mandate to reduce greenhouse gas emissions are some of the major challenges to meet growing electricity demand. Accelerated generation of renewable power is the need of the hour, given the abundance of renewable energy resources in Punjab. This paper examines the current state of electricity in Punjab and the impact of increased population, economic activities and urbanization on the power sector of the state. Various initiatives including policies at national and state level to foster renewable energy development in the state have also been reviewed. We observed substantial increase in renewable power capacity through solar and small hydropower installation in the state. However, energy potential from agro-forestry biomass and waste sectors yet to be tapped fully. Bio-energy generation from crop residue should also be a focus area for the state primarily to minimize pollution and health impacts due to residue burning. Appropriate policy intervention along with stable renewable energy market is important to encourage further development of clean energy in Punjab.

1. Introduction

Higher economic growth, increasing production levels and increasing level of development has often been attributed to urbanization. On other hand, urbanization also leads to various developmental predicaments like increasing poverty, housing shortage, higher energy consumption, increasing strain on the resources and urban sprawl [1]. With rapid urbanization and industrialization, energy consumption levels and growth rates are increasing at higher rates especially in developing countries [2]. India's urban population has increased from 17.97% in 1961 to 31.16% in 2011 and is expected to reach 40% by 2030 [3] [4].

Access to adequate and reliable supply of electricity is recognised as a vital instrument for accelerating economic growth and enhancing human development [5] [6]. India is world's third largest producer of electricity but is still power deficit. Besides tremendous increase in electricity generation, there was energy shortage of 5.1% and peak shortage of 2.0% during 2014-15 [7]. For improving living standards, growing demands of economic sector and of population growth,

electricity consumption in India is expected to increase around 4500BkWh by 2031–32 and that to with increase in electricity generation capacity to 800 GW by 2030 [7] [8].

Increased electricity demand has put impetus on the need to shift to renewable energy resources for power generation in India. However, there are many other factors behind India's rise in renewable power, such as shortages in domestic coal and petroleum energy reserves, international commitment to reduce greenhouse gas emission through clean energy deployment and significant potential for renewable power generation in India. Furthermore, declining cost of renewable power, public perception as well as jobs and economic prospects are some other factors that leading to India's renewable power growth.

A large number of renewable energy reforms have been formulated at central and state levels resulting in substantial increase in renewable power generation capacity. Renewable capacity addition has reduced the power deficit in India to 2.4% and with highest ever addition in generation capacity of 29168 MW [9]. Use of renewable electricity generation can also reduce green house gas emissions from 4 to 45% in the coming years [7].

Abbreviations: HDI, Human Development Index; UNDP, United Nations Development Programme; SAS Nagar, Sahibzada Ajit Singh Nagar; LOU, Level of Urbanization; MW, Mega Watt; PSPCL, Punjab State Power Corporation Ltd; NRSE, New and Renewable Sources of Energy; kWh, kilo watt hour; PCC, Per capita Consumption; LGBR, Load Generation Balance Report; T & D, transmission and distribution; PEDDA, Punjab Energy Development Agency; CSP, Concentrated solar power; SHP, Small Hydro Power; PSERC, Punjab State Electricity Regulatory Commission; PV, Photovoltaic; JNSM, Jawaharlal Nehru National Solar Mission; VGF, Viability Gap Funding; CERC, Central Electricity Regulatory Commission; RPO, Renewable Purchase Obligations; REC, Renewable Energy Certificate; MNRE, Ministry of New and Renewable Energy

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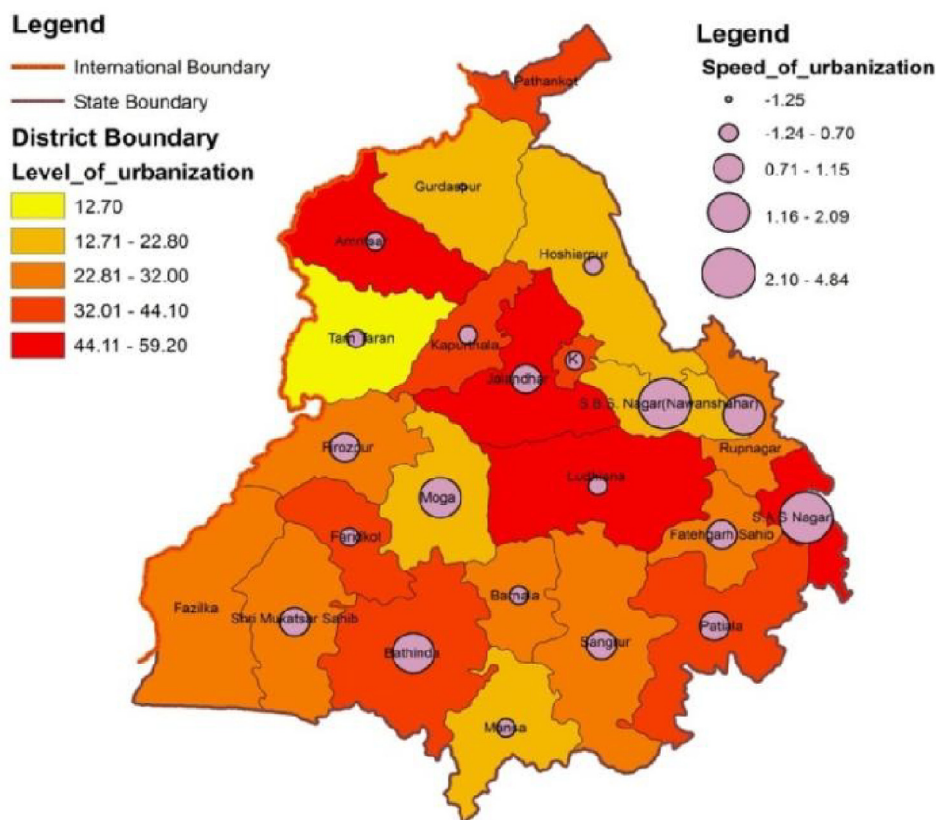


Fig. 1. Level of urbanization and speed of urbanization¹.

Punjab is a fast urbanizing state with 37.5% urbanites in 2011 as compared to 33.9% in 2001. Punjab is among the five states, which will be urbanized by more than 50% by 2030 [4]. As per census of 2011, population in Punjab is 27.7 million, which is 2.29% of India's total population. Total population is spread over 22 districts in Punjab. Rapid urbanization along with economic growth has led to 10% annual increase in total installed electricity generation capacity. Besides electricity from non-renewables, state is making addition to electricity generation capacity through renewable sources.

This paper aims at identifying implications and challenges of population increase and urbanization on electricity demand, consumption patterns and human development. Second objective of this paper is to make an account of renewable initiatives in the state and their contribution in meeting electricity demand. For the same, this paper focuses on installed electricity capacity, electricity consumption in different sectors, per capita electricity consumption and renewable energy initiatives in the state in relation to the growing population and urbanization.

This paper examines district-wise relationship between urbanization and electricity consumption in Punjab using geographical information system (GIS) as spatial analysis tool. GIS is a useful planning tool as it provides freedom to the user in analysing different conditions [10]. In this paper maps are prepared using district-wise data as attributes and spatial representation has been done using symbology.

2. Population growth and urbanization

Urbanization with rapid population and economic growth has been a key aspect of transitional societies. Urbanization in India has increased from 27.7% in 2001 to 31.1% in 2011 – an increase of 3.3% during 2001–2011 compared to an increase of 2.1% during 1991–2001 [3] [17]. The growth rate of economy has also accelerated from 6% per annum during the 1990s to more than 8% in 2011 [11]. Population in

the state is growing at average growth rate of 1.39% as compared to national average growth rate of 1.78%. Urbanization in Punjab, which was 33.95% as against the national level of 27.78% in 2001 has risen to 37.49% in 2011 and is likely to reach 45% by 2021 [12]. In comparison to other states Goa was the most urbanized state with 62.17% and urbanization in Himachal Pradesh was lowest with only 10.03% population living in urban areas in 2011, followed by Bihar's 11.29% [13].

Within Punjab, seven districts namely S.A.S. Nagar, Tarn Taran, Bathinda, Patiala, Sri Muktsar Sahib, Amritsar and Ludhiana have higher annual growth rate than state average growth rate as concentration of economic activities is higher in these districts resulting in increased urbanization. Two districts Gurdaspur and Ferozpur show negative growth rate as these are further bifurcated into two districts - Pathankot and Fazilka districts respectively. Ludhiana is the most densely populated district followed by Amritsar with density of 975 and 932 persons/sq. Km. S.A.S. Nagar has maximum population growth and is the third highest densely populated district in Punjab.

Districts having maximum population growth are also urbanizing rapidly. Urbanization is the process in which population shift happens from rural areas to urban areas and economy of the area also shifts from primary to secondary and tertiary sector. The process involves social, economic and physical transition [14]. Energy supply and demand also increases during the process of urbanization. Kingsley Davis [15] has explained urbanization as a finite process and can be categorised into three stages. In the initial stage, urbanization goes up to 25% and development is quite slow. In the acceleration stage, urbanization goes from 25% up to 80% and development speeds up in this stage. In the terminal stage urbanization remains constant.

¹ Rate/Speed of urbanization is calculated based on the percent change of level of urbanization over the years, [Speed of urbanization = $\{((\text{LoU } 2011 - \text{LoU } 2001) / \text{LoU } 2001) * 100\} / \text{number of years}$].

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