

# **How Rapid Urbanization Effects the Energy Security in Pakistan**

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## **Introduction**

Pakistan is facing energy insecurity due to many economic, social, environmental and demographic factors. The unplanned urbanization is one of these factors affecting energy security in Pakistan. This paper investigates the relationship between rapid urbanization and energy security in Pakistan. Generally, energy security is associated with the suitable energy supply which is available to fulfill the energy demand in the future. Where, urbanization is concentration of population in cities where land is used for residential, commercial, industrial and transportation purposes. In Pakistan, more than 35% population is living in the urban areas. Unplanned urbanization is increasing exponentially. Therefore, rapid unplanned urbanization is one of the main threat to energy security in Pakistan. We use the gap between electricity generation and electricity consumption as proxies for energy security. We use urban population density and growth rate of urban population as proxies of urbanization.

## **Increasing Trend of Urbanization in Pakistan**

A study by Detwyler and Marcus (1972) described urbanization as the population growth in the urban areas due to natural growth and migration from rural areas. In Pakistan, more than 35% population is living in the urban areas. Latest population Census indicates that a number of communities are now be the part of urban population which were previously be the part of rural areas. This census also indicated that population of Pakistan was 179.4 million having rate of growth 2.7% per year from 1981-98. It is evident that the growth rate was higher than as projected, and the rate remained 3.5% per year for the period. Fowling table shows urban trends of most populous cities of Pakistan from 1981 to 2017. Data is taken from last four population census.

## URBAN TREND AND MOST POPULOUS CITIES OF PAKISTAN

(Population in Millions)

CITY	1981	1998	2011	2017	Increase during 1981-217	2030 Expected
<b>Karachi</b>	5.208	9.339	11.136	11.34	2.17 times	27.993
<b>Lahore</b>	2.953	5.143	6.658	11.11	3.76 times	14.626
<b>Faisalabad</b>	1.104	2.008	2.600	2.88	2.60 times	6.192
<b>Rawalpindi</b>	0.795	1.409	1.824	5.54	6.96 times	4.149
<b>Multan</b>	0.732	1.197	1.550	4.74	6.47 times	3.025
<b>Gujranwala</b>	0.601	1.132	1.466	5.01	8.33 times	3.143
<b>Hyderabad</b>	0.752	1.166	1.391	2.19	2.91 times	3.005
<b>Peshawar</b>	0.566	0.983	2.103	4.26	7.52 times	10.178
<b>Islamabad</b>	0.232	0.529	1.082	2.00	8.62 times	3.175

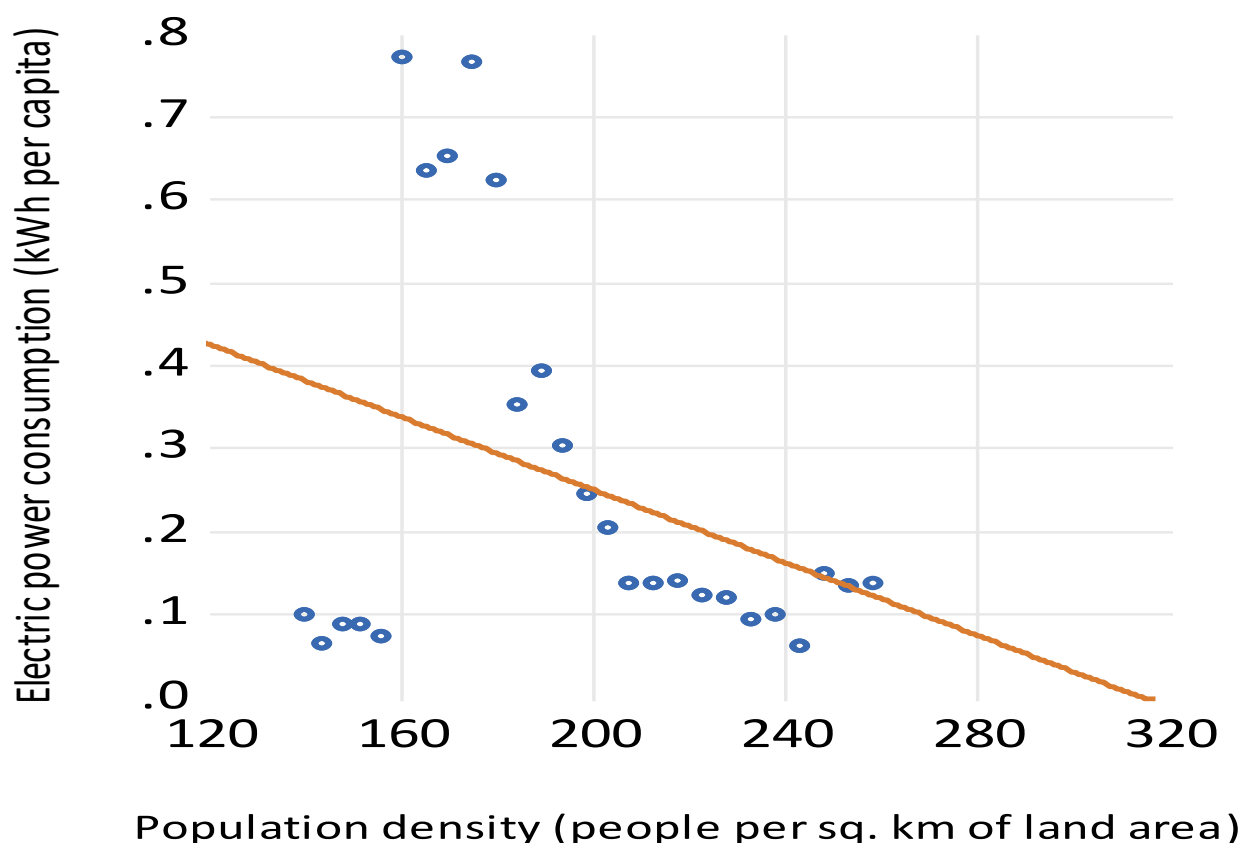
### Impact of Unplanned Urbanization on Energy Security

In 2011 urban population was counted as 59.7 million. Therefore, it is safely concluded that urban population in Pakistan is about 35% of its total population. Most of urbanization is unplanned. Unplanned urbanization has negative externalities. Rapid and unplanned urbanization has economic and environmental impacts in terms of low growth trap, unemployment, pollution and energy crises. Due to this unplanned urbanization in which most of inhabitants of the areas do not have enough access for proper sanitation, electricity, water supply and energy (Drakakis-Smith, 2000). The unplanned urbanization could affect the existing energy system and energy security in Pakistan.

Energy security is defined as “it is reliable and suitable supply of energy at reasonable prices” (Belicki, 2002). Sustainable energy supply of energy is necessary in order to meet the required energy demand. Therefore, in this study we analyses relationship between unplanned urbanization and energy security in Pakistan. we use the gap between electricity production

and electricity consumption as proxies for energy security. We use urban population density and share of urban population in large cities as proxies of urbanization

Pakistan is facing energy insecurity due to inefficient energy infrastructure, especially in the generation, production and distribution of electricity. Therefore, energy crisis is emerging in Pakistan. Pakistan has achieved considerable economic growth in last few decades but this growth has not been translated into the improvement in installed capacity of electricity generation. On demand side electricity demand is increased due to distribution and transmission losses due to poor electricity infrastructure. Consequently, the electricity demand exceeds its demand. Pakistan needs around 15,000 to 20000 MW electricity per day, however, currently it is able to produce about 11,500 MW per day hence there is a shortfall of about 4000 to 9000 MW per day.



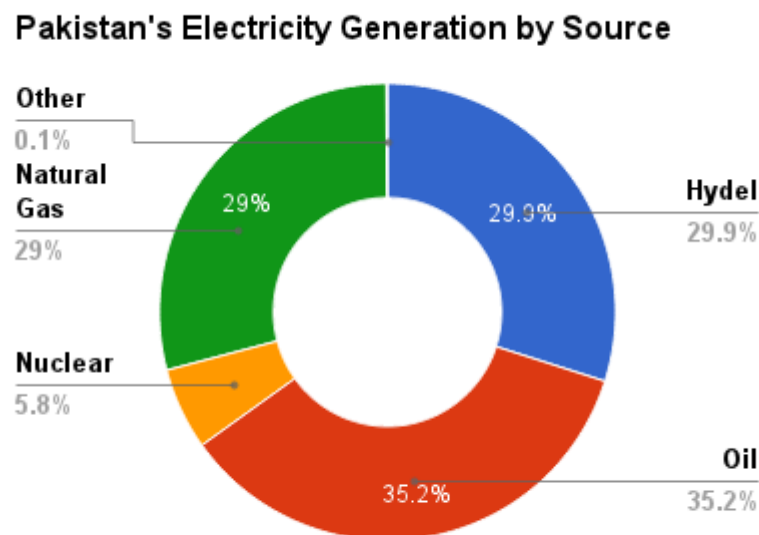
*Figure 1: Relationship between Population Density and per capita electricity consumption*

Source: Authors regressions on WDI data

There has been an enormous increase in the consumption of energy as a result of rapid Unplanned urbanization. Therefore, we need to improve our production capacity. Figure 1

shows inverse relationship between population density and per capita electricity consumption.

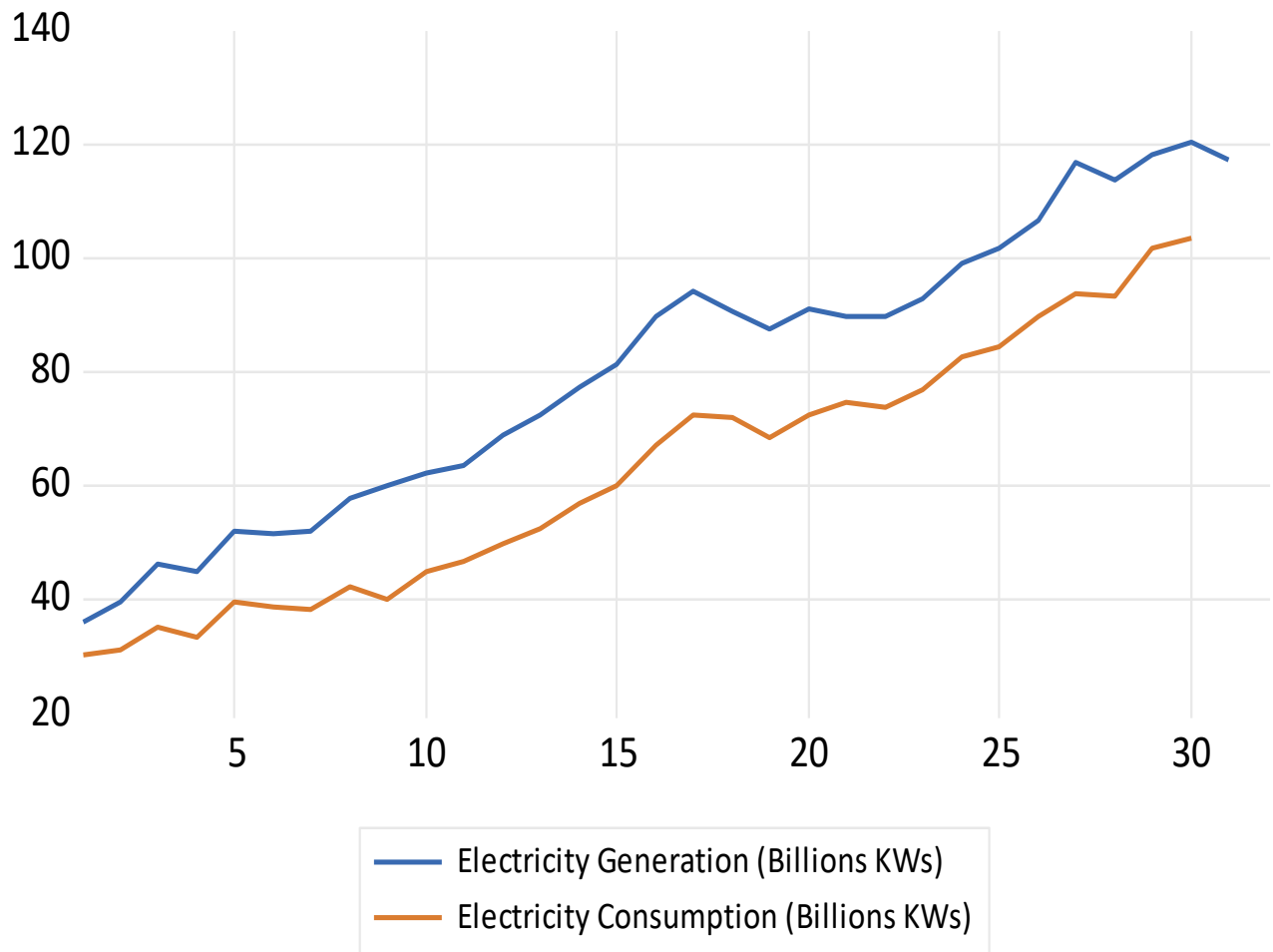
Electricity is produced by five major sources in Pakistan. Share of electricity produced by these major sources in 2014 is given in following pie chart



Source: Federation of American Scientists (FAS)

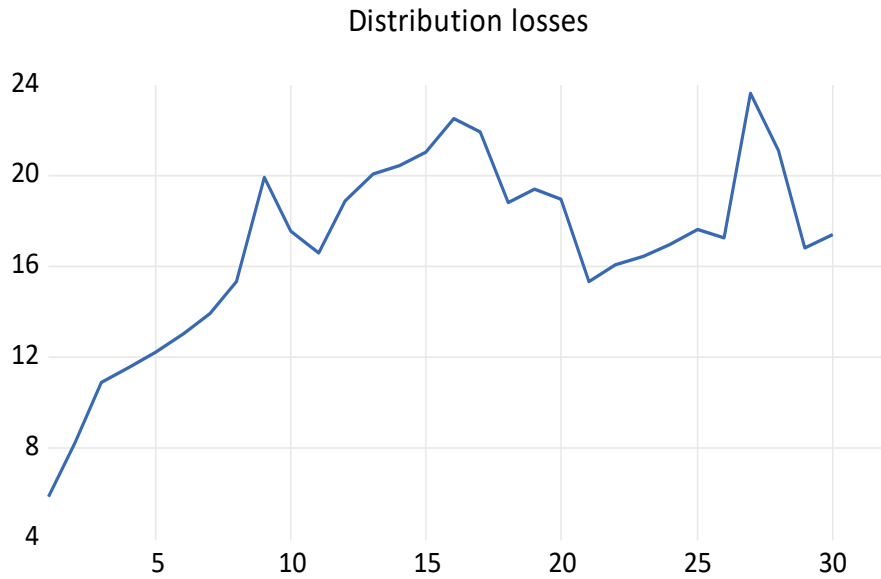
Petroleum, hydro and natural gas are major sources of electricity generation in Pakistan, these counts 64 percent and 34 percent of total electricity generation respectively. Where, estimated reserves of crude oil are 303.63 million barrels per unkm and extracting approximately 24 million barrels per unkm. Hence, if Pakistan does not explore new wells, current crude oil reserves will exhaust within next two decades. Pakistan is rich in renewable energy sources such as a hydro power but it contributes only 34 percent in total electricity generation. Electricity generation from hydro is 6555 MW against the potential of 41000 to 45000 MW.

The gap between electricity Generation and consumption is getting narrow. Theoretically there might be two reasons, first reason could be improvement in distribution loss and second reason which highly relevant in Pakistan's case could be high electricity demand. In this study we consider this gap as proxy for energy security, bigger gap between electricity production and consumption is an indication of energy security and narrow gap indicates energy insecurity.



*Figure 2: Electricity consumption and electricity generation in last 30 years*  
*x-axis years and y-axis electricity consumption and generation (unit: Billions KWs)*  
 Source: Author's calculation based on EIA data set

Government of Pakistan has taken different measures to improve the distribution loss in last one and half decade. following Figure 3 shows distribution losses in last three decades. We can observe slight improvement from last one and half decade.

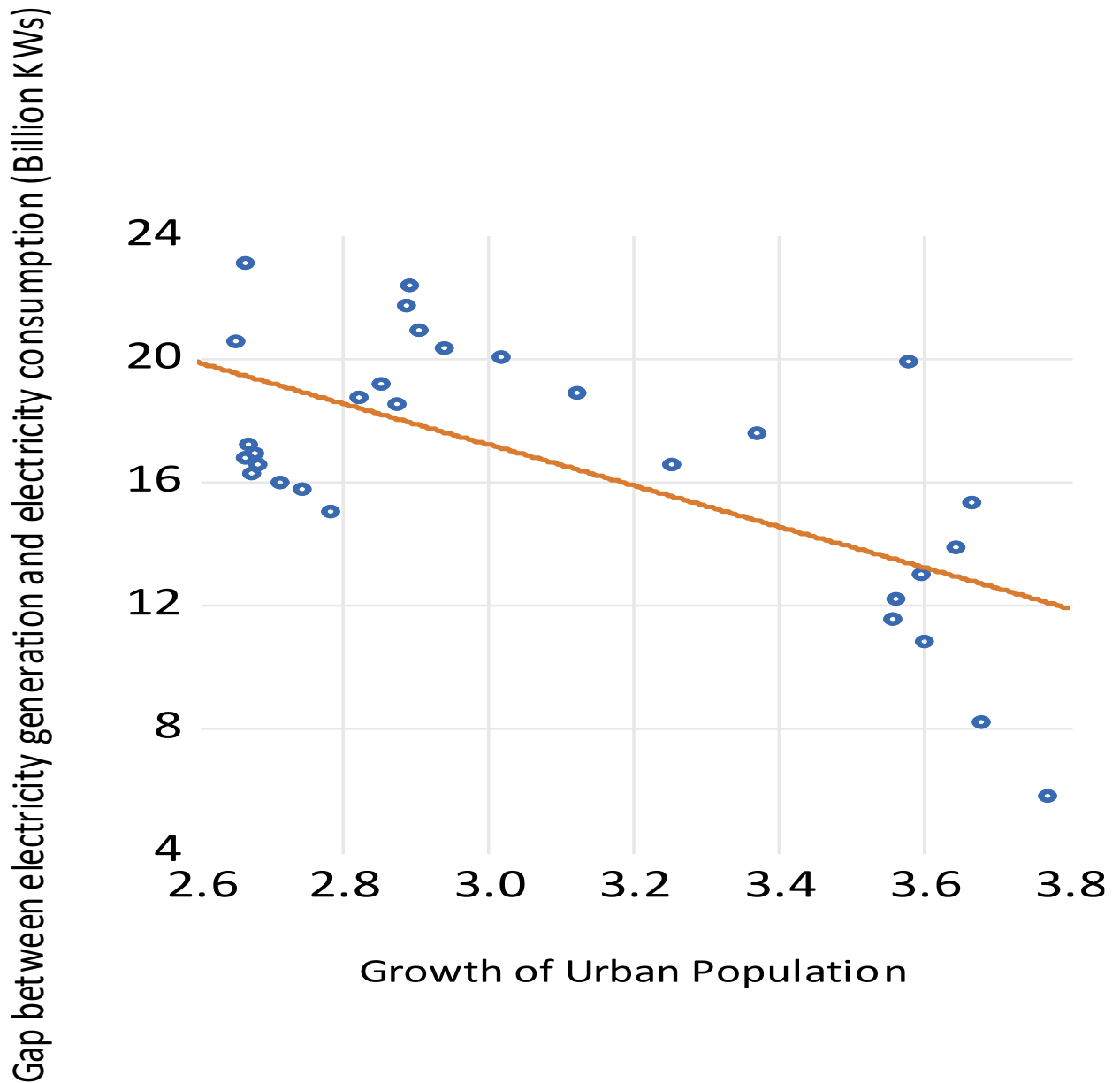


*Figure 3: Distribution losses in last 30 years*

*x-axis years and y-axis distribution losses of electricity (unit: Billions KWs)*

Source: Author's calculations on EIA data

Unplanned urbanization could be potential reason of energy insecurity in Pakistan. Following graph shows relationship between urban population growth rate and electricity production & consumption gap.



*Figure 4: Relationship between growth of urban population and gap between electricity generation and consumption*

Source: Author's regression on data taken from WDI and EIA

This Figure 4 shows inverse relationship between growth rate of urban population and gap of electricity generation and consumption. Rapid demand for electricity and reductions in the availability of hydropower in winter worsened supply of electricity. As a result, the gap between generation and consumption is getting narrow. Pakistan needs around 15,000 to 20000 MW electricity per day, however, currently it is able to produce about 11,500 MW per day hence there is a shortfall.

## Conclusion and Future Expectations

Worries for energy security was first started after the 1970s oil price shock. Whereas, some energy economist belief that issue related to energy sector has been solved through market. But, persistent high oil price period came back and now disequilibrium of energy demand and supply exist, the attention towards energy security increases (see, Cherp and Jewell 2014 ). Many energy economist and government believe that the energy insecurity problem was not solved without the demand side management (Bhattacharyya, 2011).

It is really essential for Pakistan to manage the energy demand and energy supply chain in order to overcome expected energy crisis. Energy is essential for capital intensive industrial, modern agriculture and ICT based services sectors. There has been significant rise in the demand of energy as a result of industrial development and urban population growth, in comparison to enhancement in energy production. For example, this study highlights that gap between electricity generation and its demand is getting narrow since last ten years, even distribution losses decreased in this period. This implies electricity generation did not improve but consumption increased due to rapid urbanization.

We could manage the expected energy crisis through adopting efficient urban management. Pakistan has not adopted planned urbanization due to lack of research and basic framework, its policies are based on approximation. We need proper guidance and collaboration in order to understand the advance and efficient urban energy systems. South Korea and other advance countries could help Pakistan through their expertise

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