



# Industry Willingness to Pay for Adequate Electricity Supply: A Discourse on Sustainable Industrial Development

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## Abstract

**Background:** Hopefully, if rest of things work as expected, the adequate supply of electricity, as one of the major industrial energy inputs, plays vital role in determining the industrial production, at large. In this paper, the present researchers assumed that the present state of scarcity of electricity may reveal their higher level of willingness to pay for higher energy efficient ratio as a pay-off of their improved industrial productivity. It is a proven fact that as one of the dominant indicators of national economic development and prosperity, effective electricity management procedures for industry increases significantly the productivity and operational efficiency.

**Objective:** The present paper attempts to explore the willingness of industrialists to pay more for adequate electricity supply for the industrial purpose in the present context of Nepal.

**Methods:** Extensive desk review was carried out with a directed intension to develop insights on effective management of energy supply-related activities in industrial sector by analyzing the advances and trends as well as synergies in different intervention areas.

**Findings:** A large number of academic and professional research works are carried out by different researchers on electricity management, with focus on identification of energy management models, corresponding to the industrial sector that shows individual attributes, social contexts, as well as participation and knowledge, which can have cumulative effect on WTP. WTP for adequate electricity is one of the key measures for sustainable economic growth for reliable and sensible management of forecasted energy demand.

**Conclusions:** In spite of plethora of literature on electricity management and WTP, the solutions presented by different researchers are limited in scope. Still many researchers are working on tool contributions, but most of them are only providing solutions for specific regions and communities. There is a need to develop a generic electricity management system with tracing the industrialists' willingness to pay for adequate electricity supply in a customized manner as a generic solution. The present researcher is hopeful that this work accomplishes this need.

**Implications:** Required strict policy regulations at governing level and effective programming at implementation at industry level.

**Keywords:** electricity management, willingness to pay, electricity demand and supply, adequate electricity supply, industrial productivity.

**Paper Type:** Research paper

**JEL Classification:** D24, L6, L94, Q41

## Introduction

The price mechanism from supply side and productivity of the industries from demand side could be considered as powerful tools for decision making, managing and controlling the demand of the electricity consumption in industries (Yevdokimov et al., 2019). Similarly, electricity prices critically affect electricity consumption in industrial sectors and lower price and production elasticity are the factors for estimates of electricity demand where companies with a high intensity of electricity have own-price elasticity (Shin & Hwang, 2017). At the same time, the industries can implement the load shifting techniques which is better method for load management programs in industries because they do not change the total production (Adom, 2016). Electricity supply problems put severe pressure on the country's economic growth, with commerce and industry suffering substantial losses due to reduced production capacity that is many manufacturers claimed to be running at only 30–40% of production capacity during the worst parts of the electricity crisis (World Bank, 2015).

The economic, security, financing mechanisms and environmental have been recognized for energy efficiency projects and technologies often facilitate investments in profitable projects that enhance industry's productivity and economic performance (Alcorta et al., 2014). Bad governance and poor resource management of electricity consumption in industrial sector (Hali et al., 2017). Through rationalizing the tariff structure, efficiency improvement and demand side management of electricity in industry, it helps in curtailment the wastage of electricity and thereby reduce the consumption of electricity without affecting the end-use benefits (Ghosh, 2002).

Ghaderi et al. (2006) found that the number of factories and level of economy activity have greater impact in energy consumption by the industry than the price changes of electricity but (Bjørner et al., 2001) say that considerably lower price and production elasticity are the estimators of electricity demand where industry with a high intensity of electricity have own-price elasticity. On the other hand, Alcorta et al. (2013) point out that energy efficiency (EE) has become the new topic of interest for the manufacturing industry as it can reduce both economic and environmental impacts related to the energy consumption whereas Liu et al. (2012) identified that industry's involvement level of electricity saving activities (ESAs) in significant and positive influences by energy management level of competitors and internal training on energy saving. Blankenship et al. (2019) stated that in areas where electricity is heavily underpriced and where governance is weak implement useful input for effective strategies to reform electricity pricing for better service and which ultimately help in industrial growth. Industries are willing to pay more amounts on the electricity with higher energy efficient ratio or with the energy efficiency label (Liu et al., 2012). Further, Cagno & Trianni (2014) found that industrial energy efficiency has raised to energy policy agenda, and particular efforts should be placed to tackle the barriers to energy efficiency of small and non-energy intensive industrial users.

Dilaver and Hunt (2011) investigated the relationship between industrial electricity consumption, electricity prices and industrial value added to estimate future electricity demand by Turkish industry. Still further research requires to provide evidence for better managerial implication. At the same time, Inglesi-Lotz & Pouris (2016) found in Ghana that pricing mech-

anism is an important tool to discourage electricity consumption but the low elasticity values recommend for inadequate to discourage in consumption of electricity but still the willingness to pay for the electricity for the regulated electricity is not explored in the industrial sector. The present paper aims to explore the willingness of industrialists to pay more for adequate electricity supply for the industrial purpose in the present context of Nepal.

The paper proceeds as follows. Section 2 reviews the literature more closely related to this article. Section 3 discusses the results and Section 4 concludes the study.

## **Review of Literature**

### ***Electricity, Industrial Production and willingness to pay for electricity: A linkage***

Electricity has an enormous effect on the modern world (Forrester, 2016). Also, Bjørner (2001) stated that electricity is the most flexible and clean source of energy that constitutes one of the vital infra-structural and regarded as input in production in the same way as labor, capital etc. in industrial sector. Similarly, electricity management is used to refer to a group of actions designed to efficiently manage a site's electricity consumption with the aim of cutting the costs incurred for the supply of electrical energy, from grid charges and general system charges, including taxes. (Shrestha & Nakarmi, 2015). Electricity management is defined as the judicious and effective use of electricity to maximize profits and minimize the costs and enhance competitive advantage was defined by (Liu & McKane, 2017). Energy management comprises the total of planned and executed actions in order to ensure a minimum of energy input for a predefined performance by (Schulze et al., 2016).

Mpatane (2015) explained that the main problems of industrial development in the country are political instability, industrial insecurity, unfavorable labor relation, minimal availability of energy, weak industrial infrastructures, lack of productivity, lack of capacity to adopt new technology, low competent human resources, weak supply management and lack of diversification of exportable items. Similarly, Abid and Mraih (2014) explicated that expansion in GDP and increase in the energy usage are happening simultaneously, and it implies that productive activities in most of the industrial sectors need energy as an input and energy acts as an engine for economic growth. Therefore, industrial real GDP depends highly on energy supply. However, as electricity consumption causes industrial output, the growth hypothesis concerning energy consumption and economic growth holds in manufacturing sector and policies that restrict electricity production (Sun & Anwar 2015). Therefore, this study provides the electricity management procedure for industry to increase industry related productivity and contribute to national economy.

Willingness to Pay (WTP) is defined as the highest price a consumer is willing to pay for one unit of good or service and it is the key component of consumer demand and is critical knowledge for a business in the process of pricing their product (Ozbaflı & Jenkins, 2016). Similarly, pricing of electricity and the demand for the electricity efficiency characteristics provide the evidence to industry for decision making and offer useful measures for policy makers (Liu et al., 2012). Further, WTP can be measured by the extent to which utility to the

individual changes via the electricity consumption choice of industry (Twerefou, 2014).

Therefore, electricity management is the optimum utilization of the electricity by balancing demand and supply of the electricity and industries are willing to pay for electricity supply as the consumption choice of industry. That is, higher the utility derived from a service or good, more the amount a consumer would be willing to pay.

### ***Theories on Electricity management for Industries***

This review is multidisciplinary and, as such, it combines theories and frameworks from diverse but related fields of energy management and industrial enterprises. The Holistic Energy Management Model developed by Posch (2011) allows industrial enterprises the implementation of a customized and holistic energy management system. Similarly, Energy Management System (EnMS) standard is a globally accepted framework for managing energy, providing technical and management strategies for enterprises to increase energy efficiency, reduce costs, and improve their environmental performance developed by International Organization of Standardization; mentioned by Koppell (2011). This model helps to integrate energy management in organizations into their overall efforts, improve quality and environmental management of organizations and provide a framework for requirements of organizations. Also, Energy Management Maturity Model is to assess the level of maturity of an organization, providing a systematic framework for carrying out benchmarking and performance improvement, Maturity Models are tools that are used (Introna, 2014).

Energy saving activities model admits the importance of externally coercive, normative and mimetic pressures as well as internal factors, a company's energy saving strategy orientation, top support and learning capacity which jointly explain a company's Energy Saving Activities (ESAs). To analyze the differences in ESAs of the companies with various characteristics, the company's size, ownerships, sector belongings and the pressure of energy price are selected as control variables. The individual attributes, social context, as well as participation and knowledge can have a positive effect on WTP. It also illustrates that there are possible correlations between sets of independent variables; more specifically, that individual attributes and social context can influence participation, while social context can influence attributes.

### ***Empirical studies on willingness to pay for electricity management***

Electricity management literature shows the efficient and effective ways for adequate electricity supply. Willingness of business establishments to pay for improved quality of electricity supply across business types and locations (Morrison & Nalder, 2009) shows that the electricity supply quality rate is highest and experienced the least outage. At the same time, the industries can implement the load shifting techniques, a better method for load management programs in industries because they do not change the total production (Adom, 2017). Similarly, correct electricity pricing helps in balancing electricity demand and supply situation to some extent (Pokharel, 2007). Table 1 shows how this study has covered South Asian region.

**Table 1: Empirical Reviews**

Authors, Date and Country	Study	Methods	Findings	Recommendation
Ashok and Banerjee (2000), India	Load-management for the industrial sector	Load-shifting technique	Demand and load factor can be improved by using load-shifting technique	Reducing the peak demand and flattened load curve
Ghosh (2002), India	Electricity consumption and economic growth	Granger Causality	Unidirectional casual relation from growth to electricity	Rationalizing the tariff structure, efficiency improvement and demand management
Pokharel (2007), Nepal	Economic growth and energy consumption	Cobb-Douglas functions	The energy end-use patterns and their implication on the economic sector augment supply sources, reduce energy cost and increase end-use efficiency	Energy policy should gear and focus on increasing supply and demand capabilities in electricity
Nepal & Jamasb (2015), Belarus and Nepal	Government, market, and regulatory failure in electricity sector reforms	standard reform model	The development process on political, sectoral, macro-economic and financial to successful reforms of electricity.	Strong governance and proper institutional arrangement can control corruption, theft and install resistivity towards political sector to reforms electricity across the small systems in developing and transition economies
Hali et al. (2017), Pakistan	Impact of energy sources and the electricity crisis on the economic growth	GMM technique	The economy of Pakistan is damaged because of scarcity of electric power and the use of expensive energy fuels to generate electricity couples with mismanagement and the lack of political to introduce reforms within the electricity sector	Increase its electricity generation capacity and lower its dependence on oil as an electricity fuel source for the economic growth of the country.
Blankenship et al. (2019), India	Willingness to pay for pricing reforms that improve service	Tobit regression model and ordered logistic regression model	Social trust, delays in service and lack of community service and policies have impact on reducing WTP	Strong governance, effective strategies and policy focus on using energy
Nepal and Pajja (2019)	Energy security, electricity, population and economic growth: The case of a developing South Asian resource-rich economy	ARDL bounds test, Granger causality tests	There is no long-run relationship between electricity consumption and economic output for Nepal, distinguishing it at the regional level for South Asia	Large scale development improvements in energy efficiency, strengthen energy security in the long-run but also will help tackling climate change

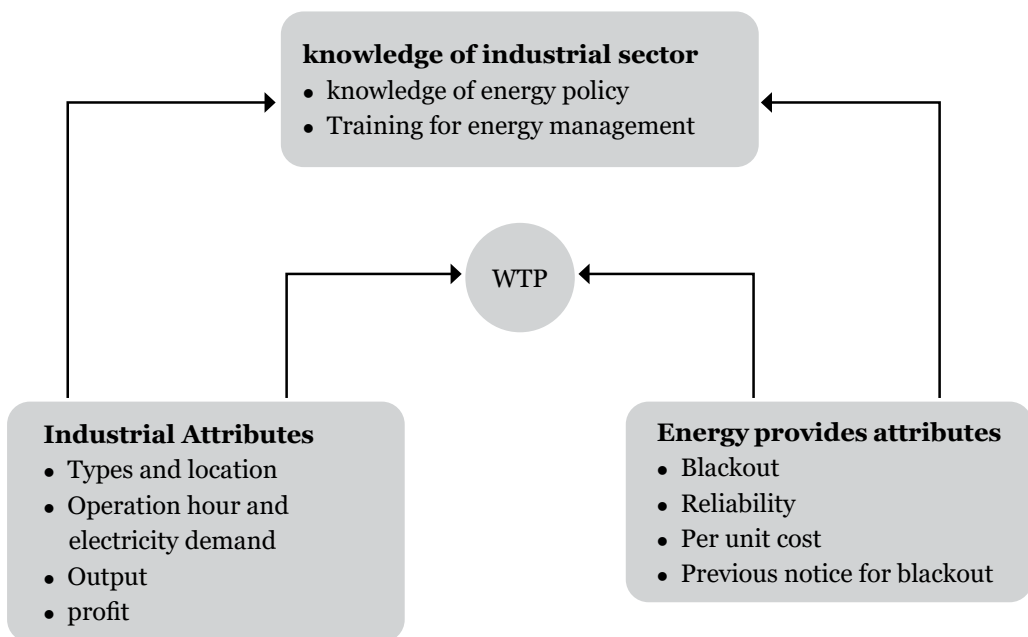
As Ghosh (2002) emphasized on rationalizing the tariff structure through willingness to pay for efficiency improvement and demand management. Hence, industry should focus on proper techniques and strategies to manage the electricity consumption.

### **Conceptual Framework**

The increasing concern about climate change, scarcity of resources and energy supply has increasingly changed the attitudes of society and industry towards the environment (May et al. 2016). Further, industrial firms have been affected by growing energy prices, strict environmental regulations, customer demand and environmental awareness. As a consequence of this, energy efficiency (EE) has become a new area of interest for the industry and academia as it can reduce both economic and environmental impacts related to the consumption of energy.

We have designed the conceptual framework to describe industrial attributes, social context, as well as participation and knowledge on WTP that has positive effect. (Nakano et al. 2018). Although previous studies examined the effects of energy efficiency label, there are no consistent results about the issue. In addition, to our knowledge, only a few studies devoted to Willingness to Pay (WTP) in studying the reliable energy. Furthermore, we use the WTP to find how much the industry reveal their preference on the energy management through willingness to pay for electricity.

*Figure 1: Conceptual Framework on Industrial Willingness to Pay*



Industrial attributes, the attributes of energy providers and the knowledge about the energy policy of industry are independent variables and they determine the willingness to pay for the electricity which is a dependent variable for this study. By empirical review it was revealed that industrial attributes or characteristics like industry type, their location, its

operating hour, amount of output and their annual revenue have significant impact on the willingness to pay for the electricity. Similarly, frequency and duration of blackout, supply reliability of the electricity, per unit cost of electricity are the attributes of energy providers and the knowledge and perception about the energy policy of the country helps in determining the willingness to pay and ultimately helps in managing and optimum utilization of electricity in the industry.

## **Discussion**

Electricity management is the judicious and effective use of energy to maximize profits and to enhance competitive positions through organizational measures and optimization of energy efficiency in the process (Liu & McKane, 2017). Further, Eid et al. (2016) explained that electricity management is the efficient and effective use of energy to maximize profits (minimize costs) and enhance competitive positions. Dilaver & Hunt (2011) found that predicted energy demand to be incorporated and considered in future energy policy decisions concerning electricity industry can be necessary measures for sustainable, reliable and sensible economic growth. The productive activities in most of the industrial sectors need energy as an input and energy acts as an engine for economic growth. Therefore, real industrial GDP depends reliable and effective energy supply (Abid & Mraihi, 2014). Further, electricity supply quality rate is highest for the manufacturing firms and experienced the least outage but sufficient electricity is not supply to the industry (Morrison & Nalder, 2009). Pricing of electricity and the demand for the electricity efficiency characteristics provide the evidence to industry for decision making and offer useful measure for policy makers. Liu et al.(2012) stated that industries are willing to pay more amounts on electricity with higher energy efficiency label. However, Ozbafli and Jenkins (2016) showed that short-sighted electricity pricing policies led to a deterioration of both the reliability of the service and efficiency of electricity generation. Electricity management refers to the optimum utilization of electricity by balancing demand and supply and industries' willingness to pay as the consumption choice of industries.

## **Conclusion**

This literature review reveals that there is a need to test the willingness to pay for adequate electricity supply for the electricity management in the industrial sector. This is most applicable to policy makers as they need to know to what extent there exist any differences in WTP estimations. Moreover, this paper provides an overview of the antecedents, which can be used to test the theoretical validity in future studies by including these antecedents in the WTP estimation models. This may result in a more accurate WTP estimation to provide a better index of industries' relative preferences.

In the same attribute, several issues such as willingness to pay for electricity by industries, management of electricity in industrial sector and determinants of the barriers for balancing demand and supply of electricity are least explored areas. Therefore, further study should incorporate the improved understanding of management and challenges of electricity in industrial sector and willingness to pay for electricity by industrial sector.

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## Conflict of Interest

No conflict of interest existed while preparing this paper.

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