

## Intermittent Power Supply and Its Effects on GDP of Developing Nations Nicholas Attamah

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### ABSTRACT

Much progress has been made in recent decades in connecting the people of the world to reliable supplies of electricity, but some regions remain particularly under-served. Intermittent electricity is electrical energy that is not continuously available due to external factors that cannot be controlled, produced by electricity generating sources that vary in their conditions on a fairly short time scale. The shortage of power supply will seriously affect the healthy development of the economy and can cause large economic losses. To justify intervention by development agencies and governments to improve electricity access and reliability, it is desirable to know that this intervention would have a causal effect on economic growth, poverty, and other development indicators of interest.

Keywords: Intermittent, Power Supply and GDP.

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### INTRODUCTION

Intermittent electricity is electrical energy that is not continuously available due to external factors that cannot be controlled, produced by electricity generating sources that vary in their conditions on a fairly short time scale. Sources of intermittent electricity include solar power, wind power, tidal power, and wave power [1]. Although solar and tidal power are fairly predictable (length of days, weather patterns, tidal cycles), they are still intermittent because the time period that electricity can be created is limited. Because of this varying electrical generation these sources are considered non-dispatchable, meaning that their electrical output cannot be used at any given time to meet societies fluctuating electricity demands. Power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load [2]. As a result, power supplies are sometimes referred to as electric power converters [3]. Some power supplies are separate standalone pieces of equipment, while others are built into the load appliances that they power. Examples of the latter

include power supplies found in desktop computers and consumer electronics devices. Other functions that power supplies may perform include limiting the current drawn by the load to safe levels, shutting off the current in the event of an electrical fault, power conditioning to prevent electronic noise or voltage surges on the input from reaching the load, power-factor correction, and storing energy so it can continue to power the load in the event of a temporary interruption in the source power (uninterruptible power supply) [4]. All power supplies have a *power input* connection, which receives energy in the form of electric current from a source, and one or more *power output* connections that deliver current to the load. The source power may come from the electric power grid, such as an electrical outlet, energy storage devices such as batteries or fuel cells, generators or alternators, solar power converters, or another power supply [5]. The electricity industry is a basic and significant industry of the national economy, which is closely related to economic development. On the one hand, electricity is a driving force of economic development [6]. The shortage of power supply will seriously affect the

healthy development of the economy and can cause large economic losses [7]. On the other hand, the level and speed of macroeconomic development play a decisive role in determining electricity demand [8]. The process of electric power construction normally, from planning to completion and commission, will take three or even five years. The fluctuation of the economic situation, as well as the delay of electric power investment will unavoidably lead to an unbalance between electricity supply and demand. Therefore, advance planning for electric power investment to match the economic demand becomes a vital issue in electric power development. In economics, shortage means that the effective demand of the product is greater than the actual supply. In an effective market, the equilibrium price will automatically smooth out the imbalance between demand and supply, and there should be no power shortage in an equilibrium status [9].

In 2011, China's power shortage showed new characteristic, namely widespread power shortage in the case of sufficient Electricity and Development

Electricity is a high quality energy carrier - more productive and flexible than other energy vectors, with zero pollution at the end use point. Electricity is far more thermodynamically efficient than any alternative technology in applications such as lighting. There are many high-value applications such as computing and telecommunications for which electricity has no substitutes. Where there are alternatives, the high cost of electricity limits its use to quite high-value applications [12] but where electricity is subsidized it will also be used in low-value applications. In the 19th Century, electric motors proved much more flexible than steam engines and allowed the reorganization of work in factories, providing productivity gains [13]. Other early applications were lighting and telecommunications, first the telegraph and then telephones. Communications, lighting, and industrial power are likely to still be the first applications when electricity is introduced in previously

capacity, where the growth of capacity supply exceeds the power demand [10]. The reason for the electricity shortage before is insufficient capacity, resulting from an imbalance between electricity demand and electric power construction. However, in 2011, the new characteristic was large-scale power shortage coupled with sufficient electricity capacity, known as "soft electricity shortage". The electricity shortages can be divided into two cases: hard electricity shortage and soft electricity shortage. Hard electricity shortage refers to insufficient capacity. The market demand for electricity cannot be met even with high utilization hours of power generating units. Soft electricity shortage is the result of low utilization hours of power generating units with sufficient capacity, since the existing installed capacity is underutilized [11]. The general reasons for hard electricity shortage and soft hard electricity shortage are different, but the profound reason for both lies in the monopoly of the power industry and its administrative pricing.

unsupplied regions today. Traditional fuels are polluting and often require significant inputs of household labour in collection, processing, and use. Development provides market opportunities for employment and the means to avoid the negative effects of traditional fuels. Therefore, as incomes increase, households gradually ascend an "energy ladder" by consuming higher quality fuels such as electricity, although this does not mean giving up traditional fuels altogether or that incomes are the only factor relevant for household energy transitions [14]. At the national level, there is also a shift to a higher share of electricity in energy use as income per capita increases. The close connection between electricity and economic activity has led some scholars to use night light data to improve the measurement of economic growth [15]. All high-income OECD countries have near-universal access to electricity. [16] outline some of the ways in which increased energy availability could disproportionately affect

development outcomes. Several are particularly applicable to electricity: reallocation of household time, especially for women, away from energy provision towards improved education and income generation; enhanced productivity of education investment due to children being able to study at night; the ability to use new technologies including communication technologies; and health benefits resulting from outcomes such as reduced indoor air pollution and the ability to refrigerate [17]. Providing a reliable supply of electricity requires costly investment as well as skilled control of the electricity network. Electricity supply and demand must be instantaneously balanced at all times in order to prevent network collapse. Meanwhile, electricity demand is volatile, across the course of the day and night, over the weekly cycle, and over seasonal cycles and weather events. Meeting annual peak demand requires network and generation capacity that may only be used for a few hours a year in some cases [18]. Efficient allocation of resources in electricity infrastructure is a “very challenging task” [19]. Due to the complexity and costs of electricity sector management and investment, power supply is often less reliable in developing countries than in developed countries. Electricity theft is also more common [20]. Reliability issues provide an incentive for industry and other electricity consumers to rely on captive generation (i.e. self-generation) of electricity. There are economies of scale in electricity generation [21]. Methods of providing small-scale electricity, such as diesel generators, are generally costly. Oil-fired generation is the dominant source of electricity in many small countries; particularly island developing countries [22].

#### Role of Electricity in Business

There is a symbiotic relationship between electricity and business. Energy supplies have a significant impact on economic activities [13]. This is because it is used for varied purposes ranging from production, storage, powering of office equipment and product display.

Consequently, the use of electricity serves as input for production. This makes electricity an essential commodity for all industry types- manufacturing, service and distribution. Various sectors of the economy such as manufacturing and transport use enormous amounts of electricity for operation processes including storage, production. It is a critical resource needed to make products. In this respect, electricity as a “transformed unity” serves as a commodity. Consequently, suppliers of electricity have a strong influence on the buying organisation’s ability to gain a competitive advantage and provide solutions to their clients. This is because operators of SMEs have a high dependency on electricity as a standardised input, without it they cannot produce to satisfy their customers. This dependency on suppliers therefore explains the value of electricity to SME operations along two trajectories namely: supply risk and reliability of supply [22].

#### Supply Risk

The supply risk trajectory is a critical factor along the perception of electricity as a resource for the operation of SMEs [2]. In a report by UNIDO (2009), it was revealed that, in spite of the abundant resources Africa is endowed with, it still struggles with supply challenges in electricity. According to the UNIDO 2009 finding, only 26% of households have electricity making Africa the lowest in electricity penetration in all the continents [6]. UNIDO (2009) reported that, an estimate of 547 million people in Africa lack access to electricity. Many reasons have been put forward by researchers and practitioners as the causes of such a predicament. For instance [17] have catalogued the following as the causes of poor access to electricity in Africa:

- Poor performance, resulting in poor quality of supply and service and an inability to meet growing electricity demand
- Insufficient managerial and technical skills to do the job
- Inability of the African country’s government to fund expansion or

refurbishment, or to attract private sector investment into the power sector

- Lack of maintenance of the existing facilities due to inadequate finance/technical leading to reliability problems.
- Inappropriate tariffs, often resulting from political interference, with tariffs below marginal costs
- Poor governance or unstable governments due to regional and ethnic conflicts
- Poor economic status of African states especially south of the Sahara
- Inadequate revenue collection mechanisms, and therefore credit unworthy businesses Inadequate rainfall which causes power rationing

All these have culminated in poor supply of electricity with its attendant effects on the operations and performance of SMEs [28].

#### Reliability

Reliability of electricity supply is another trajectory that is closely linked to the supply risk trajectory. Reliability was catalogued as a dimension of service quality in the work of [19]. It was then defined as the degree to which the retail service provides what was promised and when it was promised. Electricity service providers have since measured system performance using reliability as an index (that is the proportion of uninterrupted customer hours provided per year out of a total number of customer hours provided per year) [3]. The deteriorating level of quality of electricity supply has since received a lot of researchers' attention.

In Africa in general and Ghana in particular, there are problems with the quantum of electricity supplied [12]. The problems have been compounded with fluctuations in the supply of power which tends to affect business operations negatively. The New York Times in 2001 surmised that some business especially

ICT-related businesses have suffered significant losses resulting from vulnerable electricity supply. Electricity interruption frequencies, the duration of the interruptions and/or load curtailment have been known to cause a lot of difficulties for specific industries particularly those that use electricity as a resource [4]. The electricity interruptions or fluctuations have had varying effects on businesses including but not limited to instantaneous damage to semi-finished goods, associated costs incurred in repairing equipment's and losses accrued from delayed or cancelled orders. Two types of interruptions have been identified. They are planned interruptions and unplanned interruptions [17].

- Planned interruptions have a mitigating effect on business operations because potential damage to semi-finished goods or materials can be minimised through the switch to alternative sources of electrical power such as generators and solar panels. Cost incurred due to delayed or cancelled orders or equipment repairs can also be avoided because production and delivery schedules can be adjusted ahead of time. However, the costs of alternate power sources such as power generators, as well as expenditure on overtime pay to staff and outsourcing service cannot be avoided [15].
- Unplanned interruptions, however, have unmitigated and sometimes unforeseeable effects on business operations. Often, there are damages that tend to affect product quality, semi finished goods and costs incurred in repairing, and in delays in the delivery of orders. The cancelations in delivery are borne by businesses and that increases the operation and maintenance costs [17].

#### CONCLUSION

When electricity supply is disrupted, the costs can be severe. Households incur costs as their economic activity is hurt and they have to invest in alternative electricity options. In addition, household welfare also decreases as the hours after dusk cannot be spent on productive or recreational activities. At the societal

Attamah level, the functioning of healthcare facilities and interconnected infrastructure of water supply can be paralysed. According to [5], it is estimate that the global cost of some African country electricity outages in 2011 could be as high as \$190 billion or 0.15% of global GDP.

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