The impact of quick fixes, policies and regulation on the energy crises in Pakistan

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ABSTRACT The electrical power demand in Pakistan is tremendously increasing due to fast increase in population, industrialization and construction sectors. This leads to various solutions and quick fixes. In this paper a retrospective study and analysis has been done for the quick fixes to cope with the electrical load shedding by various means such as installations of Uninterruptible Power Supply (UPS) at the main utility connection with backup batteries, generators which were powered by the utility gas connection to produce electricity and gas extractor / concentrator to increase the gas pressure. The severity of the electrical energy crises increased several folds with tremendous loss of capital / investment and foreign exchange. The energy efficient devises and appliances in combination with renewable resources, mainly solar photovoltaic and energy efficient products, are discussed in order to optimize the solutions and policies to benefit the end-user at the retail level rather than favoring big investors, importers and Independent Power Producers (IPPs).

KEYWORDS: Energy crises; Policies; Renewable; UPS; Direct Current; Batteries
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Review Article

INTRODUCTION

The energy crises in Pakistan have strongly affected both the industrial and domestic sectors leading to severe crises in all disciplines of life including social, services and manufacturing sectors. The prolonged hours of load-shedding / blackout delayed the production / manufacturing activities resulting in delayed / uncompleted consignments / orders. Several alternatives such as diesel, petrol or natural gas were used in order to cope with load shedding hours which resulted in a considerable increase in production cost (Faheem, 2016; Ichord, 2020).

In addition, the lack of price control over various accessories and products that directly influence power production further increases the energy prices leading to higher production cost. All these factors have summed up to make the Pakistani industrialist and exporter as untrustworthy in the international market who are not able to fulfill their commitments and promises. International market is aggressive and volatile in this case, and there are many competitors to replace Pakistani products with lower price, better quality and timely delivery. Bangladesh is a famous example which replaced Pakistan for most of its products especially in the textile sector (Khan *at al*., 2011; Jenkins, 2018; Kanwal *at al*., 2018).

Several Pakistani investors and industrialist have shifted to other countries where Bangladesh a developing country having similar crises as Pakistan, but offers lucrative incentives to foreign investors or industrialists, such as tax-free status for the first ten years with the additional benefit of "tariff free" entrance to the market of the European Union countries. In addition, they offer to provide the energy resources with Uninterruptible Power Supply (UPS) at cheaper rates than Pakistan. Several billions of dollars investments, including shifting of complete industrial units have been made by the Pakistani industrialist to Bangladesh (Anthony & Paul, 2011; Rana, 2011; Jafri, 2012).

TRANSACTIONS ON SCIENCE AND TECHNOLOGY

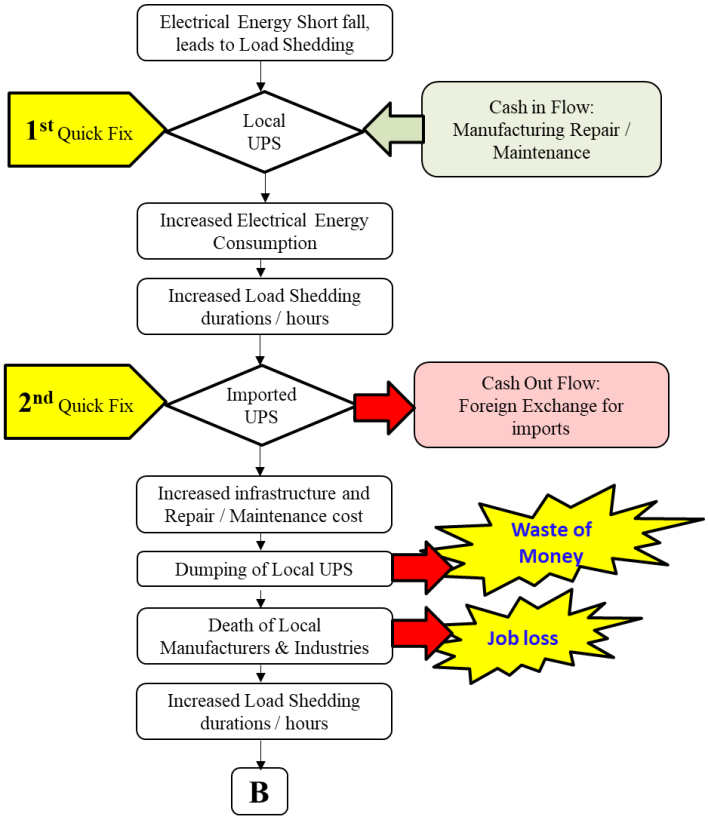

Figure 1. Illustration of the quick fixes and their outcomes. Legend B is further illustrated in Figure 2.

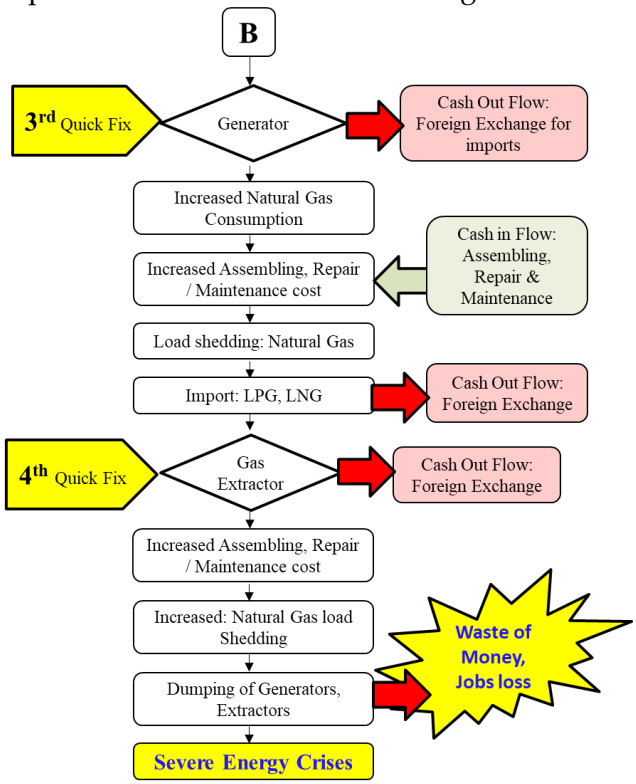

Figure 2. Illustration of third and fourth Quick Fixes in continuation of the previous diagram.

In fact, the energy policies and infrastructure development should be addressed on a broader or at national level in order to find concrete and futuristic solutions rather than seeking some "Quick Fixes" (see Figure 1 and Figure 2) for "temporary relief". Since, in cities, people are living in flats and small houses, proper ventilation and natural cooling systems were not incorporated during town planning according to the longer durations of load shedding hours. Unlike rural areas, where open and big

houses are not as vulnerable as urban residents, they are unable to sleep at night in the hot summer. This results in a considerable drop in their performance at workplaces along with damage to their health and finances as reported in several studies as cited in the references (Jamil *at al*., 2018; Sohail & Khalid, 2020).

PROBLEM AND POLICIES ANALYSIS

The severity and dependence on electrical energy create panic in people living in big cities, such as Karachi, Lahore and Peshawar, where extreme temperatures are observed in hot summers, pushing general public to find a "quick fix" to ease their discomfort. Most of the publics are not fluent in English and hardly can access to high-quality authentic research and technological literature and international standards.

Also, typical research publications and standards are written in highly technical or scientific English with excessive use of alternative and novel vocabulary, legal notes and styles to avoid plagiarism, copywrite and legal issues. This makes the document extremely difficult to understand even for people who have good English language and technological skills. In addition, the mental heuristic led them to avoid the discomfort in reading a dry technical document in non-native language especially English and take shortcuts and quick fixes. Social media is full of videos and materials in the local language, claiming extraordinary results for their offered solutions and remedies in order to sell out their products and accessories and / or with the intent to increase their online channel rating by posting "contents", with lucrative benefits for their proposed solutions (Srikrai *at al*., 2016; Rahman & Hasan, 2019).

Therefore, tremendous chaos is found in the market following a herd mentality with short-term solutions and quick fixes. In fact, more than 50 % (NTDC, 2013; NTDC, 2022) of total energy is used by the domestic sector, which pushes them to find solutions at their own level. So, the first quick fix (see Figure 1) was UPS for backup during blackout or load-shedding hours (Ahmad *at al*., 2016) which was observed as large scale installation from 2007 to 2012 as depicted in Figure 3.

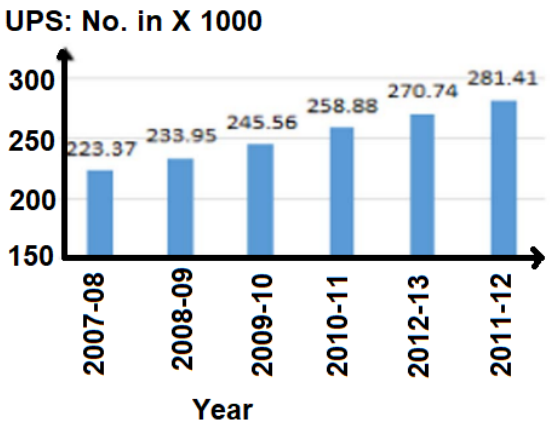

Figure 3. Number of installed UPS in the domestic sector of Pakistan as depicted from the reference (Ahmad *at al*., 2016)**.**

UNINTERRUPTIBLE POWER SUPPLY (UPS) AND STORAGE BATTERIES

Typically, UPSs were installed at the mains electrical supply (see Figure 4) where their batteries were charged from the mains supply (Bekiarov & Emadi, 2002). In case of power failure, they provided

electricity to the end users from the energy stored in the batteries with conventional automobile, flooded Lead-acid (distilled water filled) batteries.

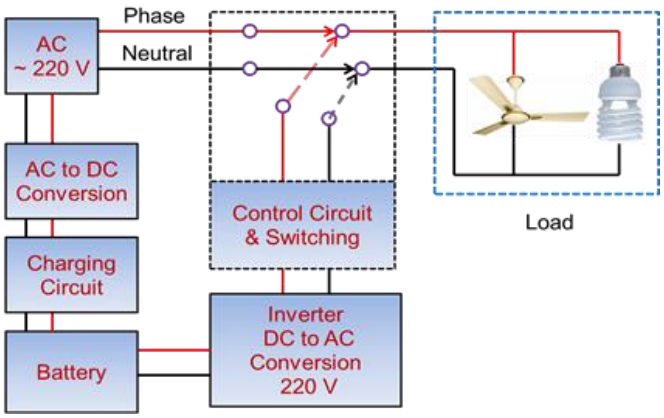

Figure 4. Block diagram of the offline Un-interrupted Power Supply (UPS) illustrating various functional units in connection with the line 220 V AC (Alternating Voltage). In online UPS the "Control Circuit & Switching" block is absent, and the load is connected directly to the inverter.

A typical UPS contains several electrical and electronic component blocks, as illustrated Figure 4, where the main utility AC (Alternating Current) electric power is rectified by an alternating current (AC) to direct current (DC) converter to charge the battery via the "Charging Circuit". The stored DC power in the battery is fed to the inverter or DC to AC converter circuit, to produce 220 V AC which is used in case of load-shedding or blackout periods. All these component blocks have their standalone energy usage and losses along with the conversion and inversion losses.

In addition, the backup batteries of UPS are charged from the main utility AC power connection which increases considerably the on-time power consumption of each UPS user and is observed as complaints from domestic users about excess billing even after prolonged load-shedding hours. This is because the stored electrical power in batteries is inverted and used during load-shedding hours. Also, a higher amount of power is drawn from the main AC utility power connection when the load shedding hours end in order to fully charge the UPS's flooded lead-acid batteries.

Indeed, the backup batteries, especially, lead-acid batteries are designed for automobile sector for surge current application without the ability to deep discharge cycles. The battery loses its performance and backup time when tried to be used for deep discharge and higher current as depicted in Figure 5. Around 40 % of the stored electrical power will be lost for the maximum discharge current (1C discharge). For instance, 100 Ah rated capacity battery will be completely discharged in one hour for the discharge current of 100 A where 40 A will be dissipated as power losses (Schiffer *at al.*, 2007; Konig *at al.*, 2021). Therefore, it becomes crucial to minimize the discharge of current as much as possible, i.e. ≤ 20% of the total battery capacity. So, for a 100 Ah battery the preferable discharge current should be 10-15 A. Hence, the efficiency of the batteries can be increased to 70 - 85%, while in such cases around 20-30% of the electrical energy is wasted in flooded Lead-acid batteries.

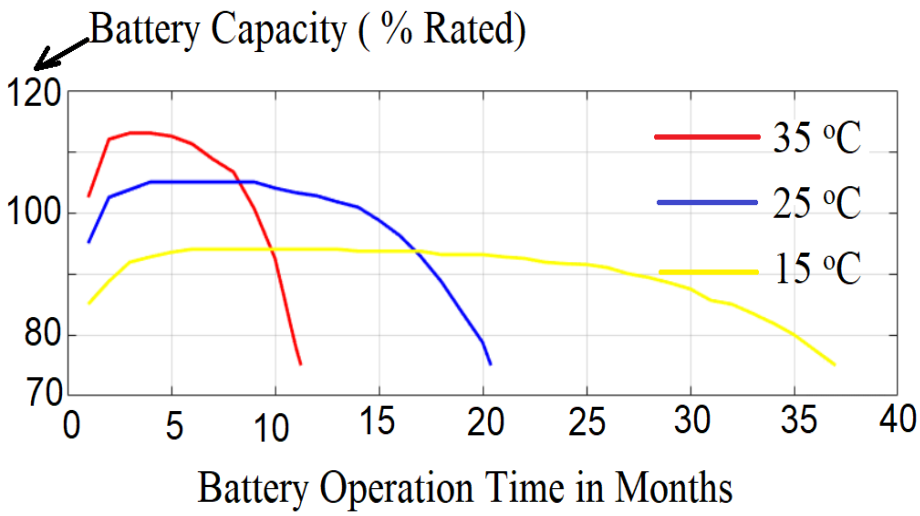

Figure 5. The degradation of Lead-acid Battery for various temperatures as depicted from (Zhang *at al*., 2017).

Indeed, there were several limitations and experimental errors as reported by (Ahmad *at al*., 2016), showing an estimate of energy loss of 2.20 Giga Watt (GW) from 2007 to 2013, for a typical load-shedding duration of seven (07) hours per day. This seems to have a huge impact on the national power grid due to domestic UPS, typically with a rating of 1000 watts. They estimated that the cost of electricity provided by UPS is three times mo**re** expensive than the utility power supply due to UPS circuits and battery inefficiencies.

In addition, the performance efficiencies of flooded Lead-acid batteries reduce with time and normally require complete battery replacement within 18 to 30 months as illustrated in Figure **5**. The optimal performance of the battery is achieved at around 25 °C, which is not possible in the hot summer where temperatures in most areas of Pakistan, rise above 40 °C. Several peer-reviewed publications / product literatures have reported 50% drop in the life cycles of batteries for each rise in 10 °C of temperature while the capacity increases due to faster chemical reaction rate at higher temperatures. Normally, the domestic UPS units are installed near the main input utility connection where cooling and ventilation is provided, making along with excessive exposure to the dust particles which make the situation worse for the efficiencies of UPS and batteries (Schiffer *at al*., 2007; Konig *at al*., 2021; Rajamand, 2022).

The Battery sellers and companies normally offer a warrantee of six months for used UPS, which is increased to the twelve months if used for a typical automobile application, where batteries are only used for engine ignition, stereo and lights etc. Typically, the cost of a 100 Ah battery was in the range of PKR 29,000 on May 25, 2023, which is risen from PKR 14,000in December 2022 due to the rise in prices of petroleum products, electricity and supertax. In fact, the real scenario behind battery warrantees is not easy to understand and typically public buys them due to advertisement and selling tactics. However, the problems arise when there is fault in batteries, and the warrantee are made. In most cases, the blame is placed on the user's side due to lack of proper maintenance, charge /discharge circuits, installation site and load regulations.

In addition, the faulty battery sometimes shows full charging with application of the charging power, but its power drops considerably when connected to the load. Due to lack of buying power, normally public use repaired / second-hand batteries for lighting devices (LED's etc.) which need small amount of current and can have larger backup time. However, such type of batteries becomes

excessive continuous charging load on the utility power connection, which may contribute to the excessive power wastage on the user's side.

The maintenance and operation of flooded lead-acid batteries have key importance but in most cases the damage cost is borne by the buyer with excessive fear of handling new battery. Therefore, the customer satisfaction rate has tremendously reduced after large scale implementation of UPS as depicted in Figure 3. However, it needs to be re-investigated and updated for the recent years (Ahmad *at al*., 2016), because such kind of study needs financial and institutional support. In addition, domestic users are reluctant to share their installed instrument and data with the billing or regulatory authority in order to avoid threats of penalties and / or over billing.

In the early 2000s, due to the shortage of UPS units, several brands were assembled locally and sold out in huge amount in the local market, but it was realized later that the indigenous technology was not good to get the desired results and on the other hand, it worsened the problem. The survey and experimental work were carried out by (Ahmad *at al*.; 2016) on various types of UPS such as square, modified sine, and pure sine wave etc. installed in the Lahore division.

Ahmad *at al*. (2016) performed various tests and analysis on various types (square, modified since, step-sine, and pure sine wave) in according to IEC 62040-3 (1999) in (IEC, 2025) order to investigate their efficiencies of charging and discharging circuits, invertor efficiencies, harmonic distortion to the utility grid and power loading. They found that the efficiency of the 90 % of installed UPSs was in the range of 50% in the domestic sector due to inefficient local technology based on the bulky transformer and circuit.

The harmonic distortion from the UPS units is also added to the system which travels to the utility power connection and transformers leads to several harms to the main grid and home appliances. Several inductive loads such as fans and motors produce humming sounds with increased power dissipation and excess heating. Furthermore, the power dissipation of the appliances increases considerably when a pure sine wave is not available from UPS. In addition, considerable damages have been observed in home appliances due to use of improper circuits and control schemes adopted in the UPS and inverters. The maintenance cost of UPS and damages to appliances puts extra financial load on the end users. Therefore, several foreign brands of UPS or inverter and chargers by spending precious foreign exchange and sale out in huge quantity in local market. This collapse caused the local manufacturing industry which was not in a condition to compete with imported products in both quality and price level (WITS, 2021; Naeem-uz-Zafar, 2023).

ELECTRICAL POWER GENERATORS

As a consequence, huge installation of UPS or inverters with batteries from several years resulted in further increase in electrical power demand which has increased the load shedding hours (refer to Figure 6 for clarity). To rectify this problem, a third Quick-Fix (see Figure 2) was implemented by installing electrical generators for domestic and industrial users. This led to a substantial increase in the import bill for the "Power Generating Machinery", as reported by Pakistan Bureau of Statistics (PBS) (Naeem-uz-Zafar, 2023), which is from 18.86% in 2020 to 39.38% in 2021, which is worth US$ 1,913.6 million. The industrial sector installed huge generators ranging in megawatts and therefore they suffered less trouble compared to the domestic users. For domestic users, small generators of few kilowatts were imported as a whole or in parts but without regulating the quality standards and control parameters (WITS, 2021; Naeem-uz-Zafar, 2023).

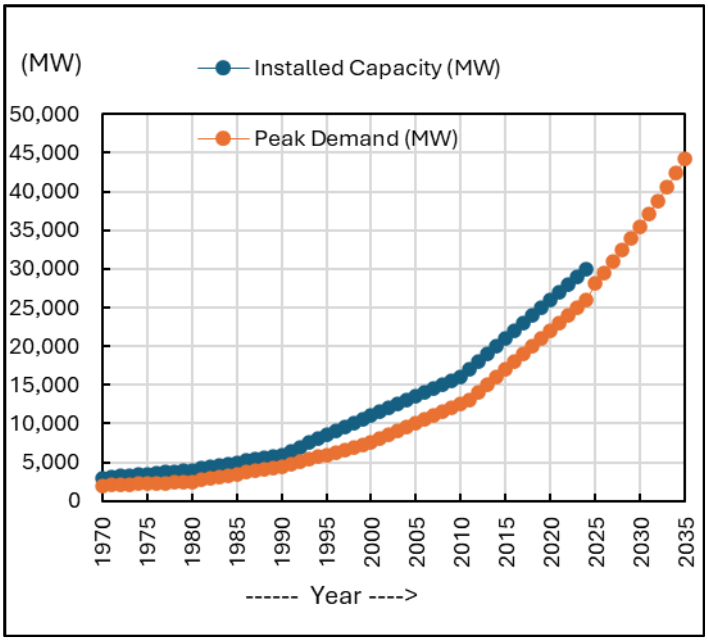

Figure 6. Peak demand Vs the installed capacity of Pakistan's Electrical energy from 1970 to 2024. The installed capacity grows sufficiently with the addition of thermal energy generation which becomes expensive to produce (Arshad & Shamshad, 2022; NEPRA, 2024, WAPDA, 2024).

The recurring cost of electrical power generators is high when fueled with diesel and petrol, therefore, are fueled by natural gas provided as domestic household utility. Thus, the efficiency of these generators drops considerably when operated with natural gas leading to several problems such as, increase in maintenance cost, noise and heat and needed to shut down after operation for more than two to four hours in order to cool down before restart. Indeed, the electrical power generators resolved the problem for several years, until the automobile and transport vehicle started to use natural gas aggressively in the form of Compress Natural Gas (CNG) as primary fuel. This provided much higher average fuel over mileage compared to petrol or diesel. Therefore, there was a tremendous increase in opening and operation of CNG pumping station to fill the vehicle on the road. This increase in the consumption of natural gas in the form of CNG led to severe "Natural Gas load shedding" in Pakistan (Zaman *at al*., 2015; Sohail & Khalid, 2020).

In addition, during electricity load shedding, several areas faced low pressure in utility connection of Natural Gas, which prevented them from running Generators for electricity during load shedding hours and periods. Therefore, a "fourth Quick Fix" was implemented by installing "Gas Extractors" at the utility input connection to suck an excessive amount of gas and compress it to increase the operating pressures to run the electricity generators (Azeem *at al*., 2017).

Even though gas companies issue warnings and punishment treats, the huge amount of gas compressors were sold and installed at the input connection of utility gas, which caused complete loss of gas during peak hours. This led to severe shortage of natural gas for the basic cooking and heating activities. Most of the automobile vehicles and electrical generators were switched to petrol, diesel or Liquid Natural Gas (LNG) to cope with the problem. The effect was observed in considerable increase of LNG imports ranging from 60 to 70% in the fiscal year 2021 as reported (Arshad & Shamshad, 2022; Naeem-uz-Zafar, 2023).

Several taxes, surcharges, fuel adjustment were enforced on the electricity and gas producers, distributors and retailers which uplift their prices i.e. the electrical energy price for one kWh was PKR

21 in 2016 which rose to PKR 38 per kWh in 2023. This put excessive pressure on the manufacturing sector, leading to closure of several mature and giant industrial and business units thus severe unemployment and economic crises. In addition, these expensive products such as UPS, imported generators and CNG kit and cylinders became useless, and sold as scrape prices or dumped to the landfills. For instance, CNG kit and cylinder cost for an average 800 cc car was around 30,000 to 50,000 PKR, when CNG pumps were even partially operational since 2020. Now it costs only a few thousand on the basis of total weight as a scrap.

HISTORICAL PRODUCTION VS DEMAND OF ENERGY

The energy peak-demand vs installed capacity is shown in Figure 7 for the period from 1970 to 2024 with possible projection in rise until the year 2035. The projected increase in peak-demand for next 10 years shows 44,300 MW, which will exceed the installed capacity. Although there is sufficient increase in the installed capacity till last year (2024), with tremendous increase by using the thermal power plants which was around 10% of total generation of 90% hydropower before 1970 shows considerable increase from 1981 to 15% reaching to 60% in the year 1990 (see Figure 8) with 40% from hydropower which stay the same until 2013 with the addition of renewable energy of contributions, i.e. Hydropower 35%; Thermal 50% and Renewable 10% in the year 2014. The data were compiled and organized with the help of ChatGPT web application from the various references (IEA, 2024; NEPRA, 2024; NTDC, 1998; World Bank, 2024).

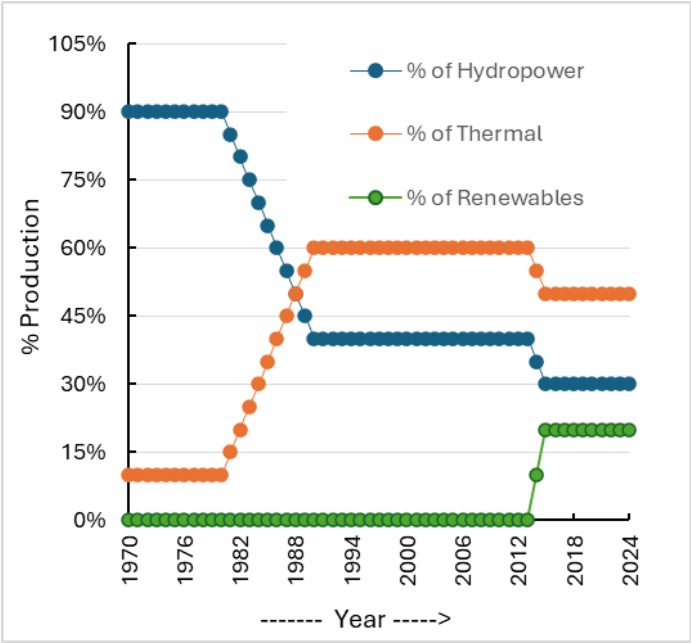

Figure 7. Distribution in percentage for various sectors for the year 1970 to 2024, i.e. Hydropower, Thermal and Renewable energies (Arshad & Shamshad, 2022).

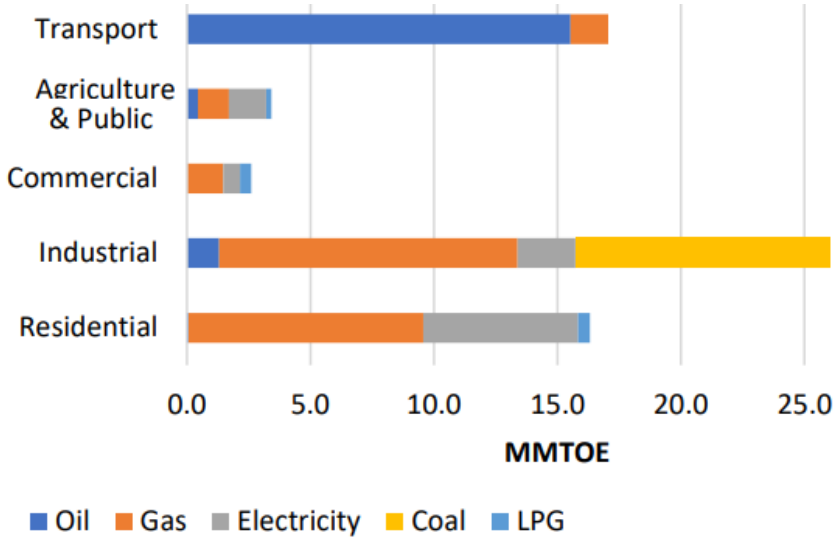

Figure 8. Sectoral demand in connection with the energy type (oil, gas, coal and LPG) as depicted by (Khan *at al*., 2023) in MMTOE (Million Ton of Oil Equivalent).

The sectoral demand in connection with energy type is reported by Khan *at al*. (2023) as shown in Figure 8. The shortage of electrical energy leads to the adoption of gas, oil and other alternatives. Therefore, electrical energy cannot be taken explicitly to understand the whole picture. Indeed, the industrial sector electrical demand has decreased from the domestic sector (more than 52%), but it draws a big share of gas and coal to full fill its energy demand. In fact, the gas sector is in extensive use as a substitute for electrical energy in both residential and industrial sectors. The easy and quick solution is running gas electrical generators for producing electrical energy.

Arshad & Shamshad (2022) reported the distribution of energy-input sources are as oil (38%), hydro (29%) and gas (29%). The share of the "Petroleum Group" in the Pakistan total imports bill is 20.15%, which worth of 11,357.9 million in FY 2021 (Naeem-uz-Zafar, 2023), put excessive pressure on the production of energy due to the sharp increase in the prices of petroleum products in international market. Therefore, it becomes expensive in current world's scenario to operate the IPPs from expensive petroleum products and need way out to other cheaper of renewable energy resources.

Since the installed capacity of IPPs was expensive to produce electricity, thus government subsidized the cost by paying to IPPs and providing discount in fuel prices which cost huge sum of money to be paid to IPPs and accumulated as "Circular Debt" on the Government. This made them to decrease their power production for their unpaid bills, for their installed capacities irrespective whether they are producing or not, but they are still paid for their installed capacity with Private Purchase Agreement (PPA) agreement with the regulators and distributors as a "Single Buyer Model", which means only Government can buy their electricity and they are not allowed to sell it directly to the consumers. The "Single Buyer Model" also limits the price competition and efficiencies among the IPPs. Even though IPPs are not allowed to sell directly the electricity to their neighboring industries and consumers where they could eliminate the grid transmission inefficiencies (more than 15%), distribution and middle-man commission can be eliminated in order to make the production (per-kilowatt) cost more feasible for their neighboring industries and consumers.

Recently, few IPPs started to convert their input expensive or imported fuel (imported coal, gas and oil) into renewable resources such as local coal, wind and solar system installations (see Figure 9) which increased the portion of renewable resources to around 10% of total production. However,

they are still several times more expensive than hydropower generation and need huge upfront investment capital with import bill payment in specially for wind and solar systems.

An average middle and lower middle class domestic user need an average of two fans and two LED lights. The advancement in ceiling fan technology has resulted in an average full size DC ceiling fan of 30-50 watts with an LED of 8-15 watts. So, two fans would consume 60 to 100 watts with the 16 - 30 watts for the LED lights. This gives an average "Emergency Power Consumption" of around 100 to 130 watts of continuous load which can be operated for more than 20 hours without a UPS, Battery storage and an air-conditioner. The refrigerators and pumping motors can be an additional load of 200 to 500 watts, but it might not be power-on for more than few hours. So, in principle the average instantaneous load might be well below 500 watts.

LOW VOLTAGE DC DEVICES AND POWER SAVING

The depletion of energy resources led to the fifth Quick Fix, which is to buy low voltage DC devices and accessories, which can be directly operated on DC power supply. This quick fix should be adopted as a First Quick Fix in the earlier phase of load-shedding, where tremendous amount of electrical energy was wasted in UPS, inverters, converters and generators. Billions of dollars and foreign exchanges are invested for importing, assembling and fabrication of low voltage DC devices and appliances which is lucrative option for middle- and lower-class public who are burned out from several monetary losses along with discomfort. Indeed, it gives better backup time with minimal maintenance cost in a current situation of severe electrical and gas load shedding which span a schedule of 6 to 15 hours in a day excluding the fault status where the breakout can be longer than a day.

Thus, energy efficient devices and accessories have the key importance to be controlled and regulated, which is already adopted several decades ago in the developed countries. Even though they had surplus energy, they strictly regulate the devices and home appliances for their energy efficiencies which are sold to their public. In addition, the extra devices and accessories are scheduled or programed to switch off when not in use. For example, the corridors lights in buildings and offices which are only used as a passage when someone is passing or changing the rooms or halls, are turn-on for few minutes and turn-off automatically when the person passed by. This is very common practice in developed countries such as Germany, where the evening darkness starts around 5:00PM but the corridor lights in busy places (offices and universities) are turn-off automatically after few minutes and need to turn-on manually by person who want to pass by or use the corridor.

Contrary to this, in Pakistan which faces extreme shortage of electricity, this practice is not adopted and several high-power lights in corridors of offices, universities and factories are powered on throughout the day. Most people or owners resist adopting this scheme because they want to show or impress their customers as well as employees the luxurious interior design including furniture, and to avoid them from the discomfort to manually pressing the button to switch on the corridor lights when it is needed. It is therefore, recommended to implement forcefully such "energy saving procedures" in government as well as in private buildings with warnings and penalties, because saving a watt (energy) is like producing a watt (energy).

Therefore, continuous supply of 500 watts of electrical energy to the domestic users without load shedding is more crucial to make them confident not to use the additional extra load of UPS and batteries, because the UPS with backup batteries (flooded lead-acid normally) increase the instantaneous load almost double and the load continue to increase with the passage of time due to

depreciation in the life cycle of these batteries. In most cases, domestic users try to use these batteries for longer than 18 months, which further increases their instantaneous load with reduced backup time. Therefore, it is important to regulate and control the wide scale installation of UPS and battery and can only be allowed with exceptions of sophisticated machines or instruments required in emergency basis for hospitals and data centers, and sophisticated industries. They should be charged from solar panels and any alternative energy source rather than line electricity. They should only be used for shorter time (10 to 30 minutes) when shifting load from line-connection to the generators, solar or other resources. In addition, government should offer incentives, bank loans or subsidies to encourage the replacement, development and regulation of energy efficient devices and appliances which can be much more fruitful to put money in other quick fixes.

Other alternative is that the small-scale solar PV panels units of 100 to 300 watts can be subsidize or lease out to the middle and lower middle class domestic users in order to full-fill their demand of "Emergency Power Consumption" during the load shedding hours and encourage them to charge their batteries from solar energy and used directly to drive the DC fans and LED light to avoid the losses due to inversion and conversion from DC to AC. However, the large-scale solar PV installation faces several problems due to import regulation, policies, invertor prices, power consumption and implementation schemes related to their efficiencies, life span and net metering as discussed in detail by Karim *at al*. (2022).

Similarly, air conditioning is excessively in use from last few decades, even by the middle and lower middle class domestic user, which increase their power consumption more than double, because an average one tone air conditioner (invertor type) put an extra load of around 1000 watt to cool down properly a room size of 144 square-feet with an average height 12 feet. Although this issue could be avoided by sealing the room perfectly to avoid the cooling losses, this resulted in lack of fresh-air ventilation in the room and making it hazardous for the health. The air conditioner uses hazardous coolant gases and generates excessive heat during operation which radiates to its surrounding environment, results in further rise in the temperature. Therefore, it would be helpful to regulate and limit the excessive use of air-conditioners by forcing environmentally friendly procedures and efficient cooling as well as ventilation systems.

CONCLUSION AND OUTLOOK

The shortage of electrical energy in Pakistan which began few decades ago has worsen significantly even after substantial investment in multiple heads by "Quick Fixes" such as UPSs, gas and petrol generators, as well as gas extractors. This has also led to capital losses due to purchasing and subsequent dumping of such expensive devices which primarily benefit importers and traders or sellers who earn exceptionally high profits margins by exploiting the general public.

In addition, the widespread installation of UPS and Batteries (normally flooded Lead-acid) increases the instantaneous load tremendously, therefore, needed to be strictly regulated and restricted for being charged from the utility electrical connection. The government should offer incentives, bank loans and subsidies to encourage the battery charging through solar panels integration along with the deployment of energy efficient devises and appliances which can be more effective investments than other quick-fix solutions.

Due to this, saving electrical energy from the domestic sector (consumes more than 52%) can be redirected towards the industrial and manufacturing sector, which plays a vital role in lowering the

production cost to compete with international market. This would result in more foreign exchange and earnings with stronger competitive edge which helps to reduce the trade deficits.

Several manufacturers stopped their manufacturing, operations and activities, instead became seasonal importers and traders of the depleted energy products such as imported UPS, inverters, generators and related kits which were claimed to be better than local products and sold for huge profit margin which led to the shut-down of local manufacturing and industries subsequently increased unemployment. At this point, the local industry needed support, strengthen and subsidized for R&D and upgrading rather than giving an open hand to importers and traders to damage the local market with unregulated imported products with cheaper prices and exceptional lucrative claims. Initially, the prices and quality were better than the local manufacturers but now after a decade the imported products have taken advantage of monopoly with much higher prices but low in quality as well as services and warrantees. This tremendously imbalanced the import-export deficits and needed extensive foreign exchange to import the essential products (UPSs, inverters, etc.).

NEPRA, issues in 2015 the guidelines for the power production within 1 KW to 1 MW for the Net –Metering and distributed generation, but the growth seems slow due to several factors. This means it needed to be forcefully rectified to harness the potential output from the grid-tied PV panels and wind turbines. Also, the small-scale solar PV from 100 to 500-watt DC-based units can be easily subsidized or leased out due to its minimal investment capital and will cater majority of domestic middle and lower-middle class users. This action will help the end-users at retail level, which is much better option than favoring IPPs having large circular depths and facing extreme pressure due to several factors such as fuel, operation prices, Return of Investment (ROI), bidding process and environmental concerns.

It may be worthwhile to perform a complete and comprehensive study to gather authentic and reliable data in order to analyze and interpret the results, including the exact initial investments, the ROI, capital loss and gain, to find a concrete futuristic solution. Such failures and mistakes needed to be properly investigated to learn from the past, trouble shoot the problem and punish the culprits which could be the IPPs, regulators and distributors. Strong and severe punishments or penalties are needed explicitly in order to close the door completely for the future manipulators and players as well as the irresponsible regulators or the policy makers.

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