SAMRIDDHI FOUNDATION

ELECTRICITY as a Viable Alternative to PETROLEUM PRODUCTS

An Analysis of its Substitutability in Terms of Private Consumption

by Anjila Shrestha, Ashesh Shrestha and Prakash Maharjan

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Anjila Shrestha
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Abbreviations and Acronyms

ADF	Augmented Dickey-Fuller
AEPC	Alternative Energy Promotion Centre
BOP	Balance of Payment
CPI	Consumer Price Index
DoED	Department of Electricity Department
ERC	Electricity Regulatory Commission
ESAP	Energy Sector Assistance Program
FDI	Foreign Direct Investment
FNCCI	Federation of Nepalese Chambers of Commerce
GDP	Gross Domestic Product
IOC	Indian Oil Corporation
kW	Kilowatt
kWh	kilowatt-hours
MH	Micro Hydro
MoEWRI	Ministry of Electricity, Water Resources, and Irrigation
MW	Megawatt
NARDL	Nonlinear Autoregressive Distributed Lag
NEA	Nepal Electricity Authority
NOC	Nepal Oil Corporation
NSWI	National Salary and Wage Rate Index
NPC	National Planning Commission
OLS	Ordinary Least Squares
PP	Phillips-Perron
PPA	Power Purchase Agreements
RET	Renewable Energy Technologies
USAID	United States Agency for International Development
VAT	Value Added Tax
KPSS	Kwiatkowski-Phillips-Schmidt, and Shin Statistics

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Executive Summary

The Government of Nepal imposed import restrictions in the fiscal year 2021/22, citing depleting foreign currency reserves and an increasing deficit in the balance of payments as reasons. However, checks on the import of petroleum products were not in place even when it accounts for 16 percent of total imports even after the Russia-Ukraine war which led to an all-time high in the prices of petroleum products.

Nepal has been working towards energy security through increasing electricity production and consumption in the past five years. As a result, imports of electrical appliances have risen, particularly in the cooking and transportation sectors.

The primary aim of this study was to understand the cross elasticity between the prices of petroleum products and electrical appliances, as well as the possibility of substituting the use of petroleum products in the country with products that require electricity consumption. We first conducted a correlation analysis to look at the relationship between different variables. Then, we analysed how the average price of petroleum products affects the import value of electric goods, while controlling for other factors, to truly understand the elasticity.

We wanted to find out if there was a trend in all the variables, keeping in mind the possibility of a random distribution of a pattern. To check this, we did tests on the variables using the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron (PP) test. The ADF test showed that there was a trend in the Price Index, but the PP test did not show any pattern. So, we used the first difference of the data because it had no pattern trend, and it was stationary.

However, a major challenge when estimating the effect of oil price on various economic variables is the endogeneity of oil price; but since Nepal's domestic factors are unlikely to have a significant effect on oil prices, we believed that oil price was exogenous in our case and conducted a regression test that produced consistent estimates.

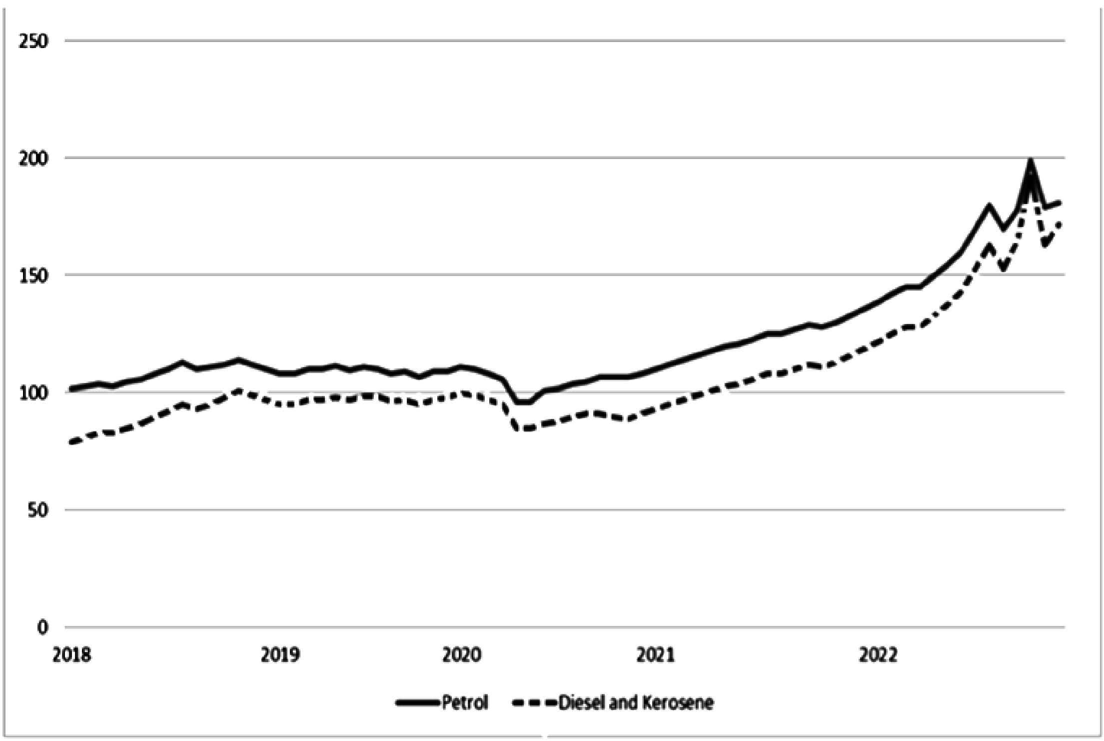
The regression estimate showed that there is a positive relationship between the change in average prices of oil and the change in the total value of imports of electric goods. Therefore, we conducted a simple linear regression between the change in average oil price and the change in import value of electric items and found that our estimates were significant at a 1 percent level. We also controlled for other covariates and found a drop in the level of significance, but the estimates were still statistically significant at a 10 percent level. Therefore, from the correlation and regression analysis, we conclude that oil price has a positive effect on imports of electric items.

To address this, we recommend that the government take measures such as formulation of a new legislation that addresses the contemporary problems of the energy sector as well as implementing energy efficient measures and promoting institutional efficiency to increase access and consumption of electricity in the country.

Introduction

Nepal, being a country that is utterly and unequivocally reliant on import of refined oil (with no domestic oil extraction plants or refineries), does not have the luxury of setting oil prices according to the production costs incurred. The Nepal Oil Corporation (NOC) sets the retail prices in Nepal after adjusting for the price set by the Indian Oil Corporation (IOC).

Figure 1 Price of Petroleum products in Nepal (2018-2022) in Nepalese Currency



Source: Nepal Oil Corporation

Recently, petroleum prices have soared as high as Rs 199 for a litre of petrol and Rs. 192 for a litre of diesel (June 19th, 2022) which currently (January 8th, 2023), has come down to Rs 175 per litre of petrol and Rs. 172 per litre of diesel. The prices of petroleum products since the year 2018 till 2022 indicate a steep increment in prices. If we assume the prices on the first day of the year 2018 to be the base price, till date, the petrol price has increased as high as 95 percent while that of diesel and kerosene have increased as high as 143 percent. Additionally, the prices of petroleum products in Nepal are also determined by the taxes that are included to compute the final prices.[1] The following table lists all the Determinants of Oil price in Nepal.

1 For detailed price structure of Petroleum Prices check Annex.

Table 1 Determinants of Oil price (as of November 2022) in Nepal

Cost Component	Petroleum Products	Product Rate
Custom duty	Petrol Diesel Kerosene Aviation Turbine Fuel Liquified Petroleum Gas (LPG)	NRs 25.20/l NRs 12/l NRs 12/l NRs 2.10/l 5% of IOC invoice amount
Custom Service Charge	For all kinds of petroleum products	NRs 565/letter of credit (with VAT)
Road Maintenance	Petrol Diesel	NRs 4/l NRs 2/l
Infrastructure Development Tax	Petrol Diesel	NRs 10/l NRs10 /l
Pollution Charge	Petrol Diesel	NRs 1.5/l NRs 1.5/l
PSF Transfer	For all kinds of petroleum products	1% of total sales (without VAT)
Fuel through-put Charge	Aviation Turbine Fuel	0.3 % of sales (without VAT)
Insurance Premium	Liquified Petroleum Gas All petroleum products other than LPG	0.105% of IOC invoice amount 0.06% of IOC invoice amount

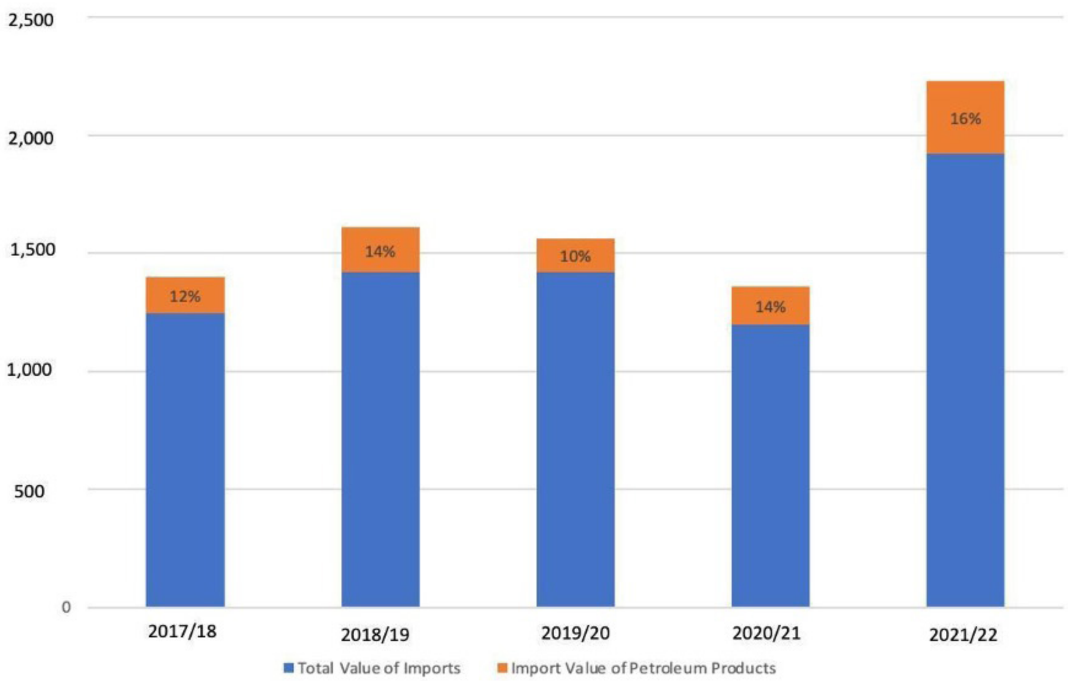
Source: Nepal Oil Corporation

Besides these, the NOC also takes into consideration the transportation charges, technical loss and administrative charges while computing the last price of the petroleum products. Various studies have shown that the rise in the prices of petroleum have significant effects on the economy. Choi et al. (2018) found that a 10% increase in global oil prices resulted in average domestic inflation of 0.4 percentage points in 72 advanced and developing economies. Similarly, Bacon (2005) discussed the direct effect of rising oil prices on the economies of low-income nations, citing the deterioration of the balance of payments. He argued that low-income countries with a high dependence on oil imports can experience significant declines in GDP because of rising oil prices. However, Sek et al. (2015) argued that in countries with high oil dependency, the impact on inflation is indirect, as the major determinants of domestic price levels are real exchange rates and exporter production costs. The authors claim that higher production cost will pass-through into domestic price levels which in return increases the domestic inflation.

For a country, solely dependent on import of petroleum products, the increase of its price has a high impact on the economy. Bhusal (2010) concluded that for Nepal, oil acts as an important ingredient for economic development. Thus, reducing its consumption could lead to a fall in income and employment. Likewise, Karki & Risal (2018) established a presence of asymmetric adjustment of refined petroleum products on the Consumer Price Index (CPI) in the long run in Nepal. Their study identified that a unit rise in price of diesel accompanied small contraction in the consumer price index by -0.048 units in the long run while the unit fall in price of diesel shows an increase in the consumer price index by 0.431 units when adjusted for monetary impact and price level of India. Karki & Risal have found that in the short run, the size of increment on the price of petroleum products had a significant impact on inflation while in the long run only the price of diesel impacted inflation.

The Russia-Ukraine conflict had a severe effect on the Nepalese economy as the prices of petroleum products rose significantly. Nepal Rastra Bank, the central bank of the country in their annual Macro-Economic and Financial Situation Report (2021/22) stated that the foreign exchange reserves of the country decreased by 13.1 percent. The decreasing foreign reserves and balance of payment resulted in the government taking measures such as banning the imports of certain goods and providing additional holiday for their staff. However, popular belief is that with the development of technologies and substitutes, Nepal could substitute the use of petroleum products.

Figure 2 Share of Import value of Petroleum Products on total value of imports in millions (NRs.) (FY 2017/18 to FY 2021/22)



Source: Nepal Oil Corporation

This study intends to check the viability of moving away from petroleum products to electricity as the generation of electricity in the country has increased tremendously. The study attempts to understand the effects of oil price spikes on the import of substitute goods using electricity and to identify better policy alternatives to reduce the Balance of Payments deficit, building on the work of Gunatilake, Wijayatunga, and Rolad-Holst (2020), which established that hydropower expansion can substantially compensate for the negative effects of oil price hikes, and that lower oil prices provide higher growth benefits for any level of hydropower expansion.

Nepal being a country that was forced to face acute power shortages and interrupted energy supply, as of 2022, has the installed capacity in the country of 2200 MW. However, because of the dominance of Run-of-the-River projects in the system, Nepal still needs to wait for a few more years to become self-reliant in electricity (Nepal Electricity Authority, 2022).

We selected a period of five years, 2017/18 to 2021/22 as there was an acute power shortage prior to the year 2017/18 due to low electricity production in the country. Similarly, nearing the end of the fiscal year 2021/22 the government implemented import restrictions in the country affecting the country's ability to import freely.

Literature Review

The relationship between oil prices and its impact on the consumption of renewable energy, mainly focusing on electricity in context to Nepal (being a net oil importing country is vital) as the results derived from this establishment will help the policymakers make a more informed decision. Murshed (2018) established a non-linear association between renewable energy consumption and crude oil prices in South Asian countries by providing ample evidence using data from 1990 to 2018. The estimates of long run elasticity confirm nonlinear nexus, further suggesting even if rising crude oil prices do not initially increase renewable energy consumption; after they reach a certain threshold level of crude oil price. They expected subsequent increases in oil prices to boost renewable energy consumption numbers. Their study established an identical relation in terms of oil prices and the fraction of renewable energy in total final energy consumption volumes, but they limited their study to only four net oil-importing countries (Bangladesh, India, Pakistan and Sri Lanka). They conducted this study on Crude and Refined oil-importing countries. Since Nepal does not import crude oil, we cannot take the findings of the study as factually applicable in the scenario of Nepal's economy.

Zakaria et al. (2021), in their paper, mentioned that the increasing petrol prices have high policy implications for a country, especially, South Asia and South Asian countries must decrease their dependence on imported oil and focus on developing domestic energy sources. Their study conducted ADF unit root test and Pearson unit root test for their empirical analysis along with cointegration test between oil prices and inflation rates. Similarly, Bhusal (2010) employed Granger causality test to analyse the relationship between economic growth and oil consumption with the same order of integration whereas Karki & Risal (2018) investigated asymmetric oil price pass through on inflation in Nepal using time series data of 331 months from April 1987 to February 2018 and applied Nonlinear Autoregressive Distributed Lag (NARDL) model to estimate long run and short run to conclude their findings.

Murshed, 2018, mentions that trade openness in a country positively affects a country's adaptability for renewable resources in South Asia including Nepal by applying annual time series data stemming from 2000 to 2017 and employing the two-stage least squares (2SLS) panel data estimation method. In addition, the study also applied the panel Granger causality test to distinguish the long-run causal associations between the variables considered in the regression models. Murshed (2019) put forward broad results on his paper where he emphasises the effectiveness of trade openness in facilitating the transition to renewable energy in low-income countries.

Banerjee, S. G., Singh, A., & Samad, H. A. (2011) demonstrate how electrification (includes micro hydro electrification) is beneficial to rural households of Nepal, with empirical evidence indicating multidimensional welfare outcomes (health, education, women's empowerment and GHG emissions).

The literature clearly documents the role played by energy in exponentially increasing output levels, as well as the augmentation of traditional production functions by energy inputs, as described by Murshed (2018) and Ahmed and Azam (2016), and Bozoklu and Yilanci (2013), respectively. Thus, for a country like Nepal, where a major source of energy persists to be fossil fuels, the price of oil is of much concern, especially, when market mechanisms are not used to set petroleum prices. Hence, there seems to be a necessity to conduct a study on the impact of rising oil prices on the usage of electrical products in the country. There is a gap in the body of knowledge in establishing relationships between imports of substitute goods and subsequent oil price change. So, a measure of the impact on consumption of renewable energy resources, mostly, electrically operated goods because of rising oil prices in Nepal is necessary. Hence, this paper will be solely looking at the effect of rising oil prices in the usage of electrical appliances while testing for impact of other variables.

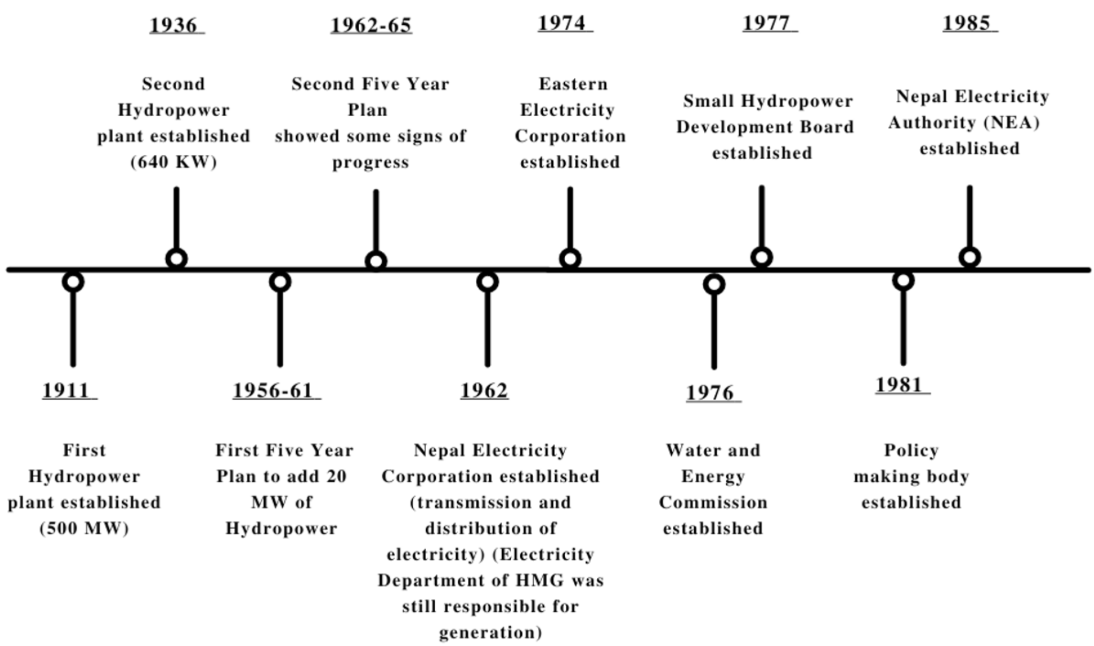
Our primary aim is to determine the relationship between oil price and consumption of electric appliances by households. We want to see how households substitute appliances that run on fossil fuel with electrical appliances with an increase in oil prices. To examine such a relationship, it would be ideal if we had data on household consumption of electric appliances or electricity. However, we do not have data on household consumption of electric appliances, and time series data on household monthly consumption of electricity is not available. Therefore, we use the import value of electric appliances used by households as a proxy for household consumption of electric goods/electricity.

The Political Economy of Electricity in Nepal

3.1 Electricity in Nepal

Nepal has about 2.27% of the world's freshwater resources (Central Bureau of Statistics, 2005) comprising 6000 rivers (including rivulets and tributaries) and covering 45,000 km (Directorate of Fisheries Development, 2004). Estimated average water run-off from these rivers is about 220 billion cubic metres annually. Nepal holds an estimated theoretical power potential of 83,000 MW (approx.) but the estimated economically workable potential to harvest hydropower is 43,000 MV (approx.). The inauguration of the Pharping Hydropower Plant in 1911 AD signifies the commencement of electrification of Nepal using hydropower. The early stages of evolution/development of hydropower are in the following timeline:

Figure 3 Timeline of important events leading to hydropower Development in Nepal



In the present scenario, Nepal has established 137 hydropower plants around the country with connection to the national grid through investments by Nepal Electricity Authority, its subsidiaries, and individual producers. According to the Department of Electricity Development, 85 hydropower projects with a total capacity of 6077 MW and three solar plants with a combined capacity of 15 MW have received building permits. In addition, the Department has issued survey permits for 207 power facilities, including hydroelectric, solar, wind, and cogeneration plants. The access to electricity has reached 93.0 percent (FNCCI 2021) currently with the increase of the electricity production. The details of percentage-wise Access to Electricity in all provinces is present in the table below:

Table 2 Percentage-wise Access to Electricity in all Provinces

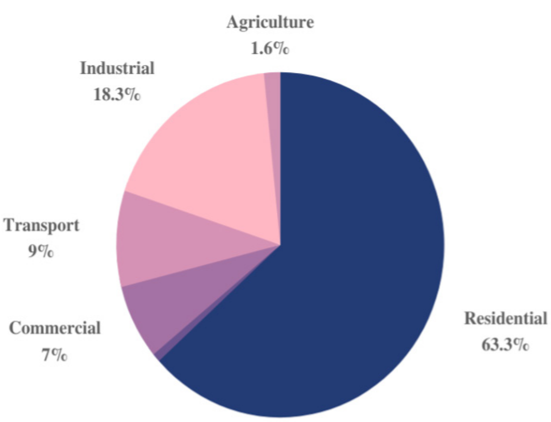
Province	2020/21
Koshi	82.43
Madhesh	99.05
Bagmati	94.44
Gandaki	92.79
Lumbini	91.00
Karnali	34.75
Sudurpaschim	64.69

Source: Nepal Electricity Authority, 2021

As of mid-March 2021, about 3.18 percent of the total population had access to electricity from renewable energy sources with 801 kilowatts of electricity coming from micro and small hydropower projects (under alternative energy) and 250 kilowatts of electricity coming from solar and wind energy. The total energy consumption of all sectors of the economy has made an increment of 2.04 percent increasing to 4779.64 gigawatt hours in mid-March 2021 (Economic Survey, 2020/21).

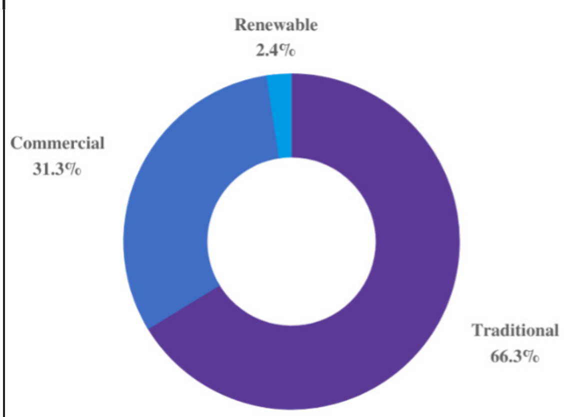
The following donut charts show the consumption of electricity in the country:

Figure 4 Sector-wise Energy Consumption in Nepal (2021)



Source: Nepal Energy Sector Synopsis Report, 2021/2022

Figure 5 Type of Energy Consumption in Nepal (2021)



Source: Nepal Energy Sector Synopsis Report, 2021/2022

Figure 4 shows the average annual energy consumption in Nepal by sector. The Industrial sector is responsible for 18.3 % of the energy consumption, while the Residential sector has the highest consumption rate of 63.3%. The Commercial sector consumes 7% of the total energy while agriculture and construction and mining accounts for only 1.6% and 0.8% respectively. The remaining 9% of energy consumption is by the Transportation sector.

Similarly, Figure 5 displays the types of energy consumption in Nepal. The chart shows that Traditional energy sources are responsible for the majority of energy consumption in Nepal, with a share of 66.26%. Traditional energy sources include Fuelwood, Agricultural Residue and Animal Waste. Commercial sector, which includes Electricity, Coal, Kerosene, Petrol, Diesel, ATF, LPG and Furnace Oil, is the second largest consumer of energy, with a share of 28.2%. Renewable sources of energy, such as Biogas, Bio-briquette, Solar, Wind, Micro/Pico Hydro, waste to energy and Geothermal energy, account for only 2.40% of the total energy consumption.

The Nepalese government has given top priority to the use of alternative sources of energy or renewable energy. The country has also introduced various subsidy policies for Renewable Energy Technologies (RET) that contribute to generating electricity. The subsidies for the technology used are based on the cost of material, equipment, and transportation for project construction and according to geographic regions. Although subsidy amount differs according to technology and region, subsidy amount covers 40% of the total costs. Similarly, subsidies to RETs are based on the least cost to energy output, best technology based on technology type, cost and capacity, geographical location, and targeted beneficiaries.

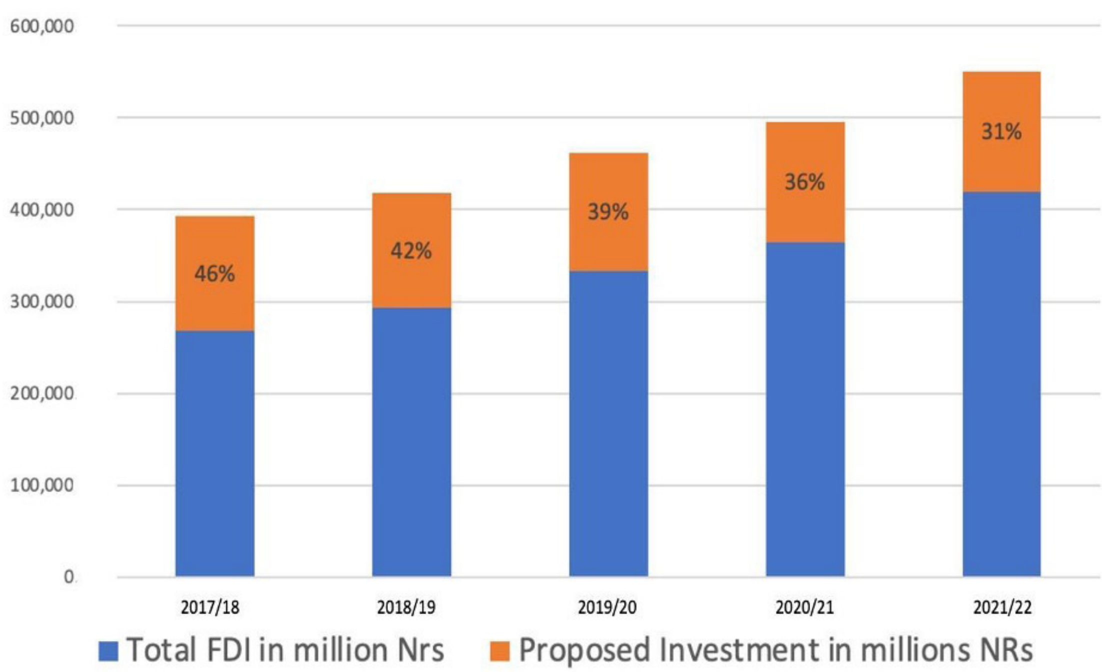
Also, intending to increase electricity use in industries, the Nepal Electricity Authority has also started promotion of cogeneration - the process of successive creation of thermal and electrical energy from a single primary source. Currently, only one industry is producing electricity through cogeneration in the country while the Department of Electricity Department (DoED) has granted construction licences to two industries. The government has also started a program of selling electricity back to Nepal Electricity Authority by the domestic, organisational and the commercial producers. The method of calculating the cost and return is based on a net-metering system. Meaning, if the amount of electricity consumed by the entity is less than the amount of electricity they sell, Nepal Electricity Authority will pay the sellers whereas if the amount of electricity consumed is more than the electricity sold, the entity will have to pay the charges for excess amount consumed.

Furthermore, in a joint session of both houses of parliament held by President Bidhya Devi Bhandari, the president presented the government's program and policies for the F/Y 2022/23, which mentions that the government will promote use of electricity in the kitchen and promote the use of Electric Vehicles (EV). The government has promised to set up electric charging stations (with the assistance of private sectors) to promote EVs. The Electricity Regulatory Commission (ERC) has also developed a Capital Investment Plan with the GoN's strategy of boosting domestic consumption of generated energy. It plans to increase the current transmission and distribution capacity and to assess the capital investment necessary (NEA, 2022).

Additionally, Nepal Government has also demonstrated strong adherence to accelerating climate action and the promotion of alternative energy sources. The country aims to achieve net zero emissions from 2020 to 2030 and a full net zero emissions by 2045 to achieve the goals set during the Paris Agreement of 1992 as well as the sustainable development goals. For this purpose, Nepal has identified sector specific goals and objectives that has painted a roadmap and identified strategies for the same. Two major documents provide a clear picture of Nepal's strategies to reduce the dependency on fossil fuels and increase the promotion of alternative energy. The first document being the "Sustainable Development Goals: Status and Roadmap: 2016-2030" prepared by the National Planning Commission while the second document being "Nepal's Long-term Strategy for Net-zero Emissions".

The country also aims to provide electricity access to 99 percent of its population by the year 2030 and increase the per capita electricity consumption to 1500 kWh but despite having made such commitments, the Industrial Statistics Report (2021/22) shows that the share of Foreign Direct Investment (FDI) in the energy-based sector has been decreasing. The share of FDI in the energy-based sector has come down to 31 percent in 2022 from 46 percent in 2018. Adhikari, 2022 mentions that the requirement of dollar-based Power Purchase Agreement (PPA) and the hedging contribution by the government one of the main reason for the decrease in foreign direct investments in the hydropower sector.

Figure 6 FDI in Energy Based Sector (FY 2017/18 to FY 2021/22)



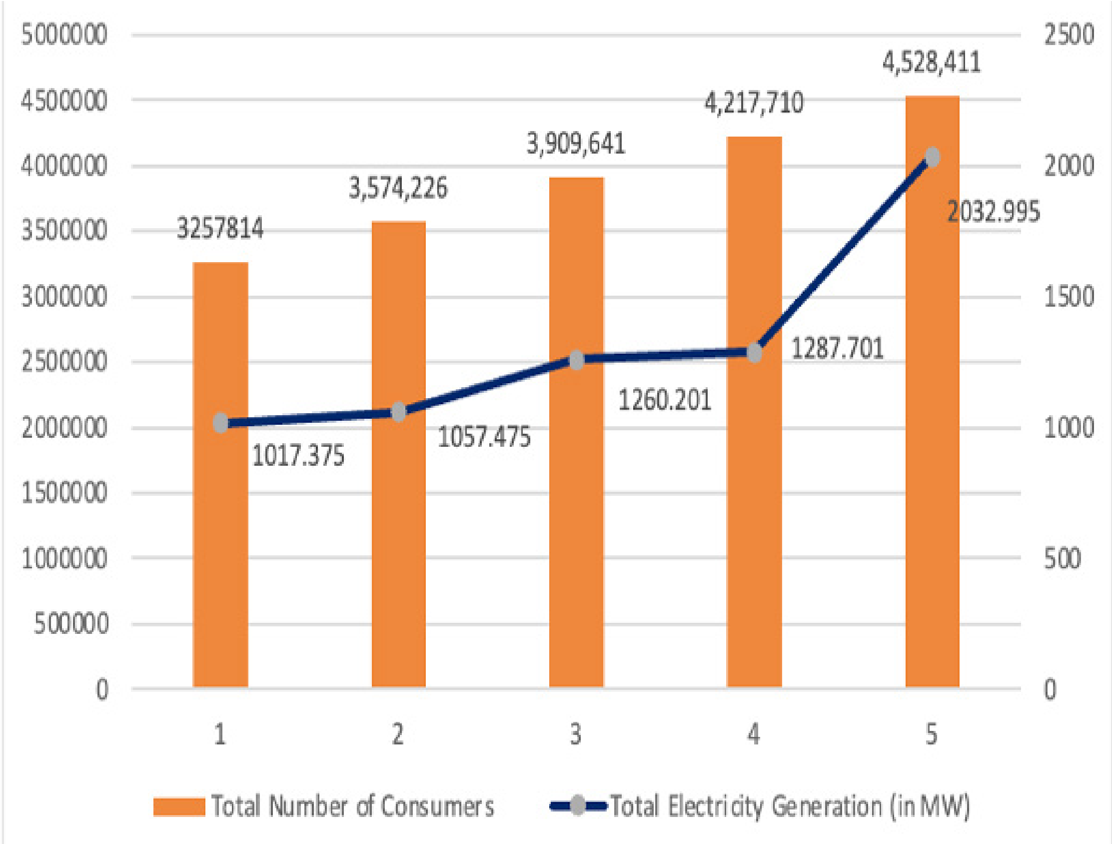
Source: Nepal Industry Statistics, 2022

Similarly, policy and infrastructure constraints have been a major issue in Nepal's electrification journey. The absence of proper policies in the sector have produced in mismanagement and failure in co-ordination between upstream and downstream projects (ibid.). Furthermore, the problems of right of way and environmental clearances along with capacity constraints in terms of cross border transmission systems have created risks for the hydropower projects in the country further decreasing the prospects of investments in the sector.

3.2 Electricity as a Substitute of Petroleum Products

After decades of chronic energy deficit, Nepal is now heading towards energy security with increasing investments in alternative energy such as hydropower, thermal, and solar. Since 2018, the number of consumers of electricity has increased by 26 percent in the country whereas electricity connectivity in the country saw an increase of 7.37 percent compared to the previous fiscal year (Nepal Electricity Authority, 2021).

Figure 7 Electricity Generation in Nepal and Total Number of Electricity Consumers since 2017



Source: Nepal Electricity Authority

The government started campaigns to encourage consumers to substitute the use of petroleum products with electricity for household activities with the increase in electricity generation and access to electricity within the country and considering the impact of rising oil prices. Nepal Electricity Authority also reduced the electricity tariffs to further promote the use of electricity. The tariffs charged per unit electricity consumption, previously classified in seven groups, are now classified into nine different groups with reduced rates.[2]

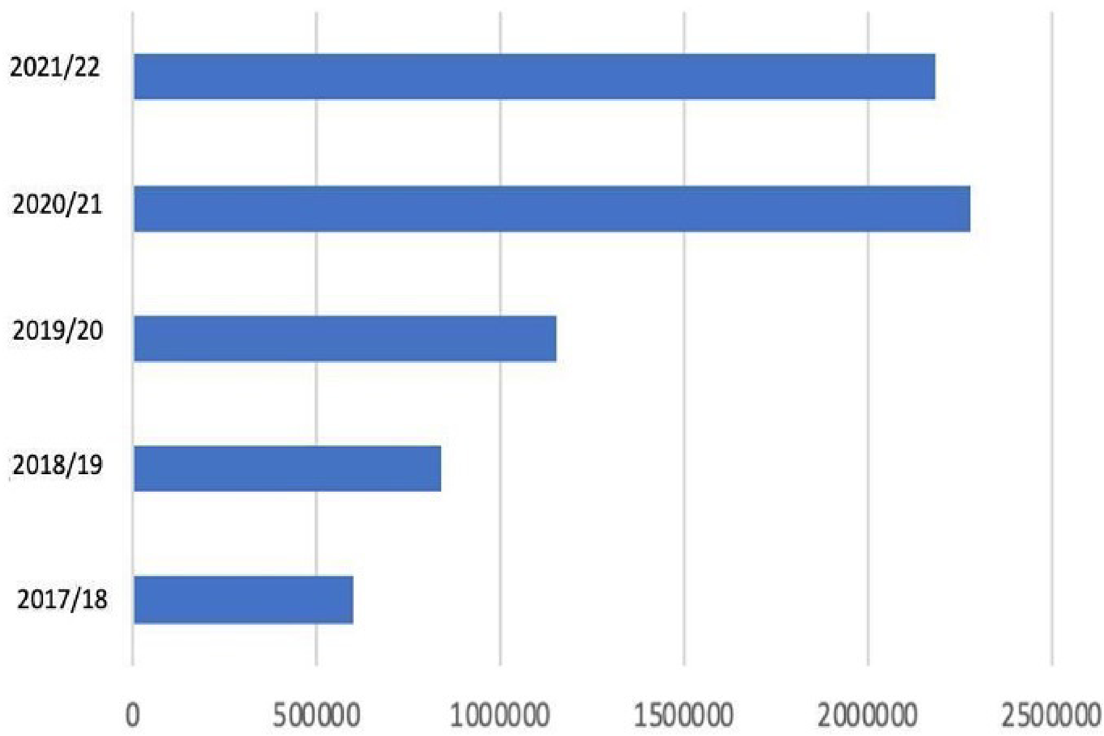
Likewise, the import of electrical appliances has been on a steady increase in the country. As per the data from Customs Department, in the FY 2020/21 alone, the import of electrical

2 For detailed price structure of Electricity Tariff rates check Annex

appliances for consumption has reached 2.18 million pieces compared to 597 thousand in the fiscal year 2017/18.

Nepal mainly uses electricity for cooking, lighting, and transportation as a substitute for petroleum products. Studies suggest that the cost of using electricity is cheaper than the traditional source of energy such as firewood, petroleum products, etc.

Figure 8 Import of Electrical Goods in Pieces



Source: Department of Customs, Nepal

For instance, Nakarmi (2019), mentions that the monthly cost of using electric induction cooktop is almost NRs. 200 cheaper than using fuelwood and almost NRs. 350 cheaper than using Liquid Petroleum Gas. He further mentions that an electric induction cooktop is 40 percent cheaper and 32 percent efficient to use for a family of four. Similarly, assuming a household comprises five members, studies conducted by Banerjee, M. et al. (2016); Narasimha Murthy & Antonette D'Ssa (2004), mentions that electric hotplates are more economic than the traditional source of fuel.

Table 3 Prices of Kerosene Stoves, LPG stoves and Electric hotplates over the course of following respective years

Year	Kerosene Stoves	LPG Stoves	Electric hotplates
2000	270	430	680
2003	340	535	790
2014	1760	1082	960
2019	1240	1453 (Household has 2 cylinders in use and it includes capital cost of them 10/11/2019, NOC)	1144 (For Induction heater : NPR 990)

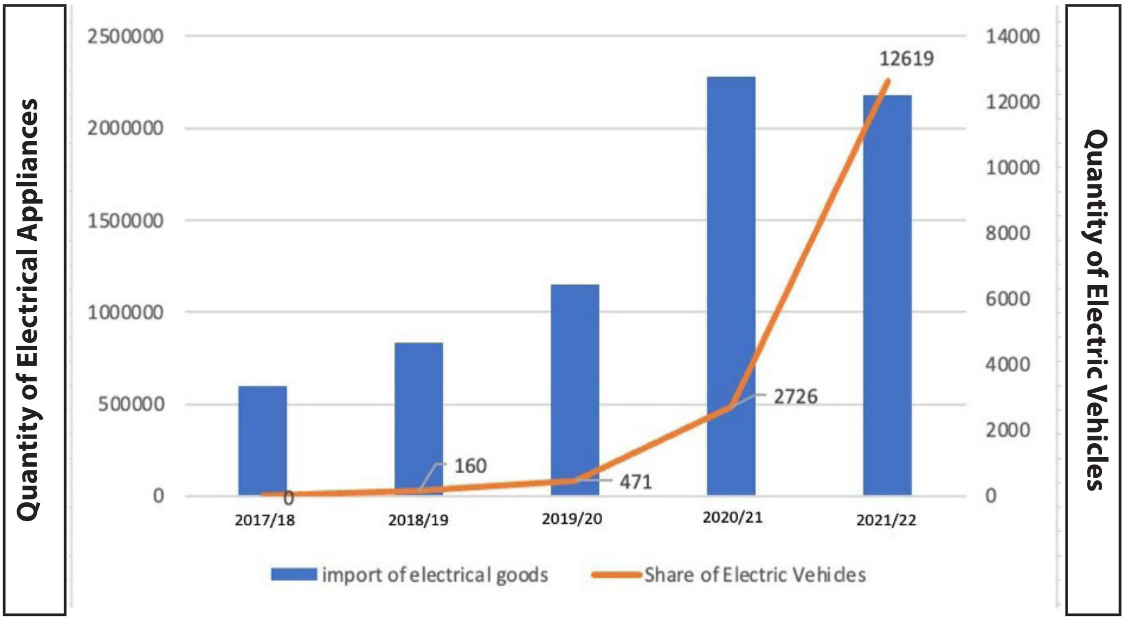
Source: Prof. Amrit M. Nakarmi PhD, 2019

1 kg of LPG combustion produces 45.7 megajoules of energy (heat). But since we measure electricity consumption in kilowatt-hours (kWh), it is necessary to convert both forms of energy in one measuring unit. Mathematically, 1,000 joules of energy is equal to 0.2778 watt-hours, every cylinder with 14.2 kg of cooking gas gives 181.9 kWh, or 181.9 units, of energy. (Dahal, G.R, 2020). As per the 2022, 181.9 units of electricity would cost around Rs 1,800 whereas a cylinder of gas also costs Rs 1,800. But the efficiency of electric stoves makes a significant difference. Research conducted emphasises that electrical cooking appliances provide 74 percent efficiency whereas gas stoves have an efficiency of 40 percent only. Efficiency rate of cooking increases to 90 percent as the users switch to induction stoves (Sweeney et al., 2014). Factoring usage of energy for the required task, using LPG for cooking will cost Rs 13.5 per unit while using an induction appliance will bring the cost to about Rs 11.5 per unit (Koirala, 2019).

Likewise, the use of electric vehicles, four wheelers and two wheelers, has seen a surge in imports since 2018. From 2018 till 2022, import of electric four wheelers were worth NRs. 5.3 billion whereas the import of electric two wheelers was worth NRs. 393 million. The increasing adaptability of electric vehicles in Nepal is because of its benefits over vehicles operated through traditional fuels (not accommodating the price of fuel).

As per a recent study conducted by Pathak & Subedi (2021), electric vehicles had a lower average operational cost than the petrol/diesel operated vehicles because of their lower maintenance costs. Their study mentions that electric vehicles seem to be economical during the operational phase while petrol/diesel field vehicles seem economical during the time of purchase given the same years of ownership, same annual kilometre travel and same factor of residual value of vehicles.

Figure 9 Share of Electric Vehicles in Total Imports of Electric Goods (in pieces) (FY 2017/18 to FY 2021/22)



Source: Department of Customs, Nepal

Despite fossil fuels being a dominant source of power for household activities in Nepal, the concerns of inflation and price fluctuations among others has shifted the consumption pattern in the country. The Government of Nepal has also shifted its priority to the alternative sources of energy such as hydropower, solar, thermal aspiring to achieve universal access to clean cooking by 2030 by tapping into the colossal potential Nepal has for hydroelectricity generation.

This study focuses solely on the cross elasticity of oil prices and electrical appliances meaning it will be looking at the effect of rising oil prices in the usage of electrical appliances while testing for impact of other variables. The increase in consumption of electrical goods may be subject to an increase in electricity production, government incentives, consumers' salaries, etc. as well as availability of the products along with the rising oil prices. Also, electric appliances prove to be a more viable option for substituting petroleum products, given its cost effectiveness leading to an increment of disposable income of the household. Present literature provides various empirical evidence that suggests economic benefits of using electrical appliances. However, they do not measure the impact of increasing prices of traditional fuels on consumption of renewable energy resources.

Variable Description

As we seek to study the impact of oil prices on import of electrical goods, our primary independent variable is oil price. We control for various other factors. Our control variables include prices of petroleum products, prices of electrical appliances, electricity supply, salary and wage rate index, and consumer price index. The reason for selecting these variables is that of their effect in the consumption of electrical appliances. The prices of petroleum products have a direct impact on the consumption of electrical appliances as prices of petroleum products increase. People will substitute the use of fuel products with electrical products. Similarly, the consumption of electrical appliances will increase only if there is a possibility of uninterrupted power supply and vice versa regardless of the price of petroleum products and as the prices of electrical appliances increase, its consumption will decrease. Likewise, the increase in the consumer price index along with salary and wage rate is highly likely to affect the purchasing power of the consumers.

The values of each variable are monthly data for the past five years i.e., data for the study period extends from the fiscal year 2017/18 to 2021/22. During the study, we used the value of the quantity imported instead of the number of imports, and we assigned weightage to each based on their share in the total value of electrical appliances imported because of the wide range in prices of these goods. For instance, Nepal imports goods worth NRs. 2000 (induction stoves) compared to goods worth NRs. 12 million (electric vehicles having power over 300 KW).

Analysis and Findings

5.1 Pairwise correlations

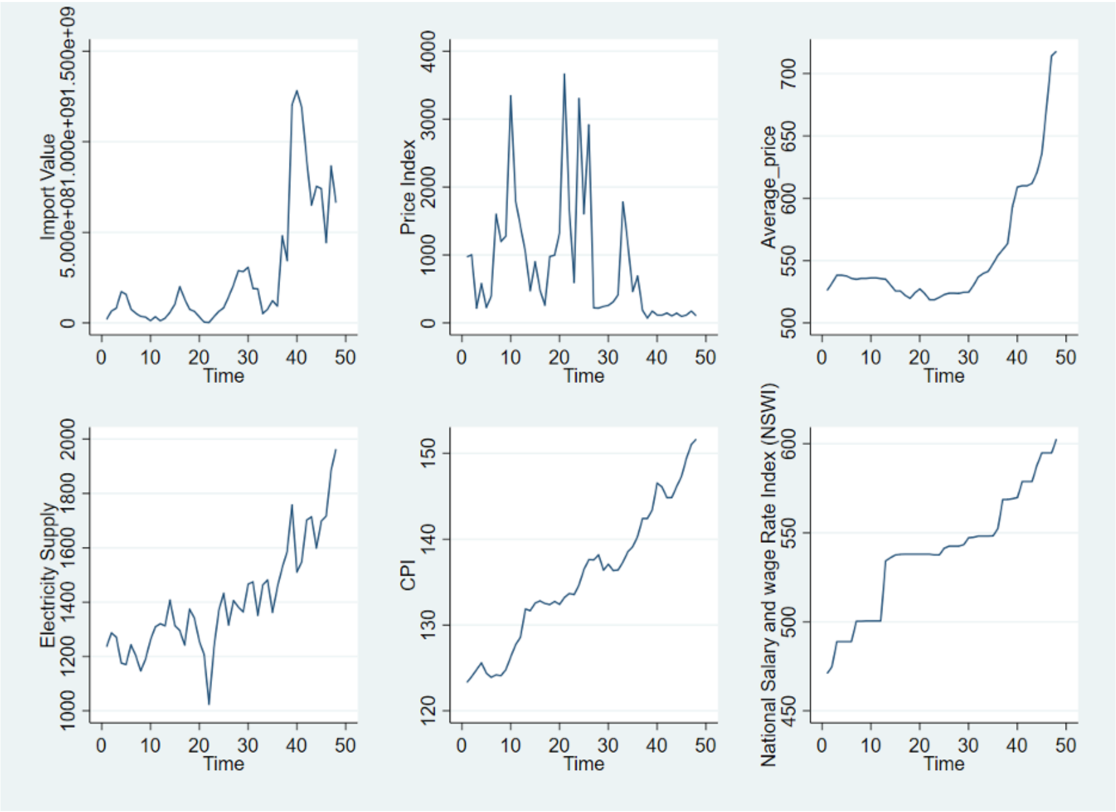
Table 4 Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) ImportValueinT~s	1.000						
(2) Petrol	0.682***	1.000					
(3) Diesel	0.657***	0.987***	1.000				
(4) LPG	0.758***	0.959***	0.960***	1.000			
(5) Price Index	-0.510***	-0.452***	-0.426***	-0.407***	1.000		
(6) ElectricitySup~y	0.745***	0.852***	0.831***	0.839***	-0.454***	1.000	
(7) CPI	0.751***	0.754***	0.720***	0.755***	-0.393***	0.872***	1.000
*** p<0.01, ** p<0.05, * p<0.1							

The above table illustrates Pairwise correlation between various variables which we will use in our analysis. We can see that the import value of electric goods possesses significant correlation with the price of all kinds of petroleum.

Likewise, the covariation among our covariates is also significant at 1% level. We will now conduct regression analysis to further explore the effects of various petroleum products on import of electric goods. We take a simple average of their prices as the prices of petroleum products highly correlate. First, we will regress the import value of electric goods with average prices of petroleum products and subsequently we will control for other covariates to see how the relationship between import of electronic goods and prices of petroleum products changes when controls are in place.

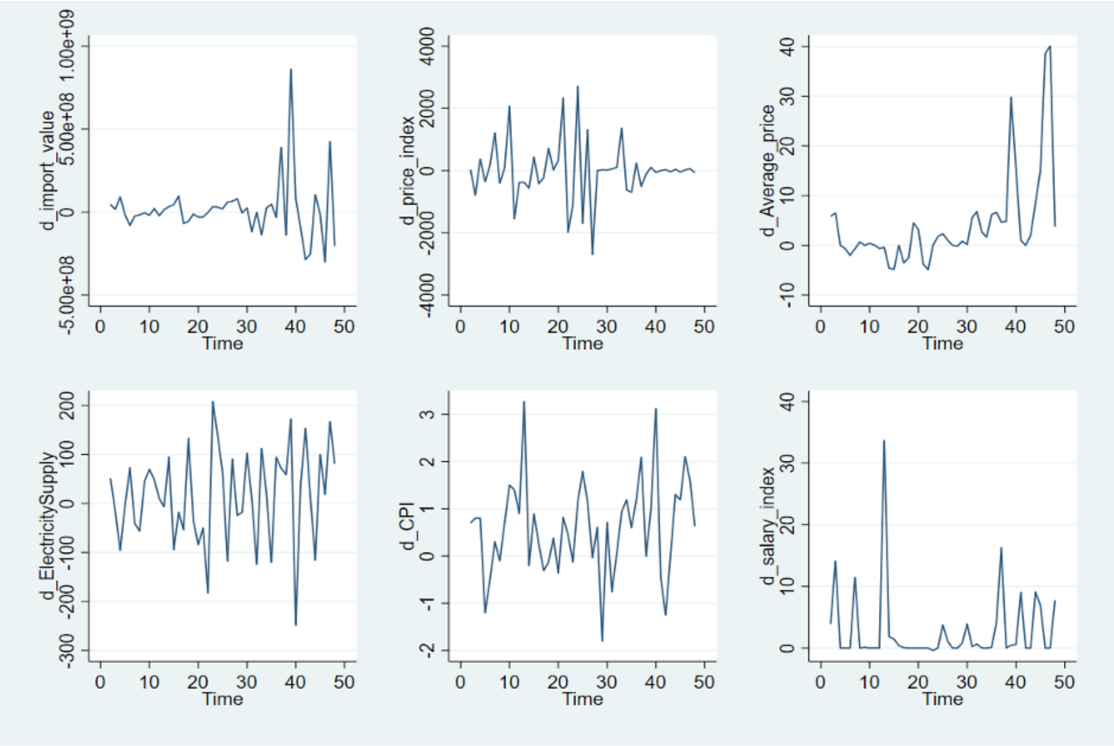
Figure 10 Time series graph of variables used in analysis



The graph depicts a time series of variables which is being used for our analysis. All the variables except value of imports and Price Index are upward trending hinting towards the existence of a deterministic trend in these variables. A direct regression without treating the trend would give us a spurious relationship. There is a possibility of presence of stochastic trend in all our variables which would mean that our variables are non-stationary and there is a presence of unit root. Again, when there is a presence of unit root, the relationship from Ordinary Least Square regression would be spurious. Therefore, we will perform unit-root tests on our series to determine if our series is stationary or not. One of the most common methods to perform unit root tests is Augmented Dickey-Fuller (ADF) test (see Dickey & Fuller, 1979; Brooks, 2014). Other methods to test presence of unit tests are Phillips-Perron (PP) test (see Phillips & Perron, 1988) and Kwiatkowski-Phillips-Schmidt, and Shin Statistics (KPSS) test.

We use ADF test and PP test to see if our variables are stationary or not. The unit root test performed using ADF test and PP test without lags showed that there is a presence of unit root in all our series except for Price Index. The ADF test with lags revealed unit root in Price Index as well, but there was no evidence of presence of unit root when we performed PP test even with lags. Hence, it would be fair to conclude that all our series excluding Price Index are non-stationary. A widely used technique is to take the first difference of the variables to treat non-stationarity, among several techniques.

Figure 11 Time series graph of variables(first- difference) used in analysis



The figure exhibits the time series of our variables after we have taken the first difference. The first differenced series seem to be free of trends and are stationary. We will use ADF test and PP test to confirm if there is a presence of unit root in any of the differenced series.

5.2 Unit Root Test Analysis

Table 5 ADF Unit Root Test

Variables	ADF test statistics Z(t)	p-value	Critical Values		
			1%	5%	10%
Import value	-1.693	0.4348	-3.600	-2.938	-2.604
Δ Import value	-7.834	0.0000	-3.607	-2.941	-2.605
Average price of petroleum products	4.778	1.0000	-3.600	-2.938	-2.604
Δ Average price of petroleum products	-3.294	0.0151	-3.607	-2.941	-2.605
Price Index	-4.137	0.0008	-3.600	-2.938	-2.604
Δ Price Index	-10.545	0.0000	-3.607	-2.941	-2.605
Electricity supply	-0.594	0.8724	-3.600	-2.938	-2.604
Δ Electricity supply	-7.839	0.0000	-3.607	-2.941	-2.605
CPI	0.650	0.9888	-3.600	-2.938	-2.604

Δ CPI	-5.687	0.0000	-3.607	2.941	-2.605
National Salary and Wage Rate Index (NSWI)	-0.900	0.7880	-3.600	-2.938	-2.604

Table 6 Phillips-Perron Unit Root Test

Variables	PPerron test statistics Z(t)	p-value	Critical Values		
			1%	5%	10%
Import value	-1.745	0.4080	-3.600	-2.938	-2.604
Δ Import value	-7.782	0.0000	-3.607	-2.941	-2.605
Average price of petroleum products	4.819	1.0000	-3.600	-2.938	-2.604
Δ Average price of petroleum products	-3.271	0.0162	-3.607	-2.941	-2.605
Price Index	-4.244	0.0006	-3.600	-2.938	-2.604
Δ Price Index	-11.375	0.0000	-3.607	-2.941	-2.605
Electricity supply	0.175	0.9704	-3.600	-2.938	-2.604
Δ Electricity supply	-8.356	0.0000	-3.607	-2.941	-2.605
CPI	0.491	0.9846	-3.600	-2.938	-2.604
Δ CPI	-5.707	0.0000	-3.607	2.941	-2.605
National Salary and Wage Rate Index (NSWI)	-0.900	0.7880	-3.600	-2.938	-2.604
Δ NSWI	-6.895	0.0000	-3.607	2.941	-2.605

We conducted unit root test using ADF test and PP test with and without trend on the first-differenced variables. The test statistics show that there is no presence of unit root in all first-difference variables at 5 percent level. Thus, we can conclude that our series is stationary at 5 percent level and relation derived from Ordinary Least Squares (OLS) on the first-difference series would not be spurious. However, one of the major challenges while estimating the effect of oil price on various economic variables is the endogeneity of oil price (see Barsky & Kilian, 2002; Kilian, 2009). Oil price is not exogenously determined as other domestic factors such as demand for oil, supply of alternative sources of energy among others can cause a change in oil price. However, we believe that Nepal's domestic factors are unlikely to have a significant effect on oil prices. Our domestic oil demand as a proportion of global oil demand is minuscule and therefore our domestic market for oil possibly cannot cause fluctuation in oil price. Therefore, we believe that oil price is exogenous in our case and our regression does not produce inconsistent estimates.

5.3 Results

Table 7 Results from regression analysis

	(1)	(2)	(3)	(4)	(5)
	d_import_ value	d_import_ value	d_import_ value	d_import_ value	d_import_ value
d_Average_price	7141058.5***	7158104.7***	6962941.2**	5411695.8*	5437479.0*
	(2.76)	(2.74)	(2.60)	(1.86)	(1.78)
d_price_index		-14471.6	-14833.0	-17092.6	-16988.9
		(-0.57)	(-0.57)	(-0.67)	(-0.65)
d_ElectricitySupply			109226.8	180194.7	179195.2
			(0.42)	(0.68)	(0.66)
d_CPI				35363513.8	34853594.4
				(1.29)	(1.09)
d_salary_index					154588.3
					(0.03)
_cons	-15483728.5	-15820966.5	-16723911.9	-32875046.7	-33088436.9
	(-0.58)	(-0.59)	(-0.61)	(-1.10)	(-1.07)
N	47	47	47	47	47

t statistics in parentheses
** $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$*
**where d is the yearly change*

The regression estimates show that there is a positive relationship between change in average price of oil and change in total value of imports of electric items. First, we conducted a simple linear regression between change in average oil price and change in import value of electric items. Our estimate is significant at 1 percent level. Then, we subsequently control for other covariates. After controlling for several covariates as seen in the above table, there is a drop in the level of significance, but the estimate remains statistically significant at 10 percent level. Therefore, from the correlation and regression analysis, it would be fair to conclude that oil price has a positive effect in import of electric items.

Observations and Recommendations

Nepal Oil Corporation (NOC) and Nepal Electricity Authority (NEA), both, are state-owned enterprises that enjoy monopoly power in their respective markets. NOC is responsible for the import, storage, and distribution of petroleum products while Nepal Electricity Authority bears sole responsibility of transmission, distribution, and cross border trade of electricity.

However, even when these two state owned enterprises enjoy such beneficial positions, both the petroleum and electricity sector have been plagued with issues ultimately burdening the consumers with added costs. A case in point being the NOC not reducing the prices of petroleum products even when the international prices are decreasing. The consumers are devoid of choice but to purchase petroleum products sold by the NOC even though they are being charged higher prices. Similarly, in the case of NEA, the monopsony power of the NEA has provided it with an unfair advantage in setting the terms and conditions of Power Purchase Agreements (PPAs) with power producers resulting in the standard price of electricity, cutting off all and any chance of competitive pricing as well as an alternative market. For instance, the power purchase rate for solar generated electricity is very low compared to that generated by hydropower projects. A rate decided by the NEA for solar energy is Rs. 5.94 which is below the price of Rs. 7.10 paid to hydro developers during the wet season.

However, the Nepali energy sector has fared well over the last few years with the installed power generation reaching around 2000 MW in 2021 from 1000 MW in the span of four years with the involvement of the private sector in electricity generation. This has also led to an increase in electricity consumption in the country by 16 percent.

6.1 Increasing Institutional Efficiency of NEA

Nepal Electricity Authority, being a vertically integrated SOE, performs multiple functions that includes generation, transmission, distribution, and maintenance of the electricity sector. The authority has conflicting roles as a buyer and as a joint venture in power generation along with monopoly over distribution (Dhungel & Rijal, 2012) and sale of electricity. Even if NEA has complete dominance over the electricity sector, it has been facing various challenges in its operations, including inefficiencies in organizational structure, governance, and management practices.

In February of 2022, NEA had delayed the signing of PPAs of 215 power projects having a combined capacity of (9000 MW). The power companies in question paid annual fees for the survey licenses for four consecutive years without the PPAs not even being finalized

("PPA opened for ROR", 2023) while others had to bear an increased overall costs for their project despite having a power generation license. ("IPPAN demands resumption of signing PPAs", 2022) Similarly, in December of 2022, 11 private hydropower projects were forced to incur losses of Rs 1 billion because of the reluctance of NEA to purchase electricity. ("NEA's Apathy", 2022) The hydropower developers are not only forced to incur losses because of NEA's reluctance in procuring electricity but also due to the inefficiency of NEA in developing electricity infrastructure. For example, hydropower developers situated at Lamjung were forced to delay their operation and incur losses as NEA was not able to develop transmission lines within the committed timeline (Gurung, 2022).

NEA's service inefficiency has resulted in frequent power cuts and high cost of electricity which have affected consumers and the general public. Frequent power cuts have disrupted daily life activities, harmed business productivity, compelling institutions to increase the use of diesel generators which is costly and environmentally harmful. Furthermore, high cost of electricity has affected low-income households' ability to access electricity, limiting their opportunities for education, health, and income-generating activities. As a result, the private sector is discouraged from making investment in the energy sector, hindering Nepal's economic growth.

In a SWOT-AHP analysis done by the Manager and Deputy Manager of the NEA (Shiwakoti and Regmi 2022), the authors have reflected that NEA's strengths are heavily reliant on its status as a state-owned monopoly and monopsony, as the features that make it successful would not be possible without these advantages. Further strengths that were included were huge domestic demand, ability to get cheaper sources of capital, nationwide distribution channel, good brand will and public image shows. These strengths display how being a dominating SOE has been the scapegoat of NEA to stop innovating and providing best services to the public.

Likewise, the weakness highlighted in the paper suggests that NEA is not currently operating at its highest level of efficiency, as it has been avoiding accountability and innovation. The paper further suggests that NEA has been failing to provide high-quality services to its customers due to a lack of focus on customer service, weak project management, and inefficient transmission and distribution network. Furthermore, the weakness points out NEA's limited transmission interconnection capacity with neighboring countries and rural electrification expenses to expand the network into remote, distant, and dispersed locations. These weaknesses show that NEA is not efficiently serving its entire customer base, particularly in rural areas.

These inefficiencies of the NEA can be addressed by unbundling the state-owned enterprise. The corporatization and commercialization of the distribution segment will improve reliability and quality of supply as a result of efficient procurement of modern technologies required and implementation of cost-reflective tariffs. Modernization of the electricity grid will increase flexibility, resilience, and efficiency of electricity distribution whereas implementing cost-reflective tariffs will induce efficient use and improve the sector's financial position. These reforms have achieved significant successes elsewhere and Nepal could benefit from studying these policies in depth and applying them to their own legislation to increase efficiency and ensure reliable power supply.

6.2 Privatization of Electricity sector

Kikeri and Nellis (2002) reviewed 60 studies of privatization in competitive sectors and showed a strong positive relationship between financial and operating performance improvements and privatization. Megginson and Neter (2001) conducted a study in different countries where they found that in almost all countries privatizations improved performance measures. Lenz (2011) analyzed Southeast European countries that had privatized their electricity sector in various ways to attract foreign investment, liberalize the market, and increase competition. The lack of previous investments has resulted in an inefficient electricity industry, inadequate supply, and non-compliance with EU environmental standards. Successful privatization is dependent on sector restructuring, effective regulation, and appropriate market conditions and privatizing the distribution sector before generation is considered optimal.

Gupta (2008) showed that between 1991-1999 the Government of India (GoI) had invested Rs 612 billion in SOEs and earned dividends of Rs 179 billion. Almost all of the investment was financed by GoI by issuing debts at an interest rate above 10% but the rate of return only averaged around 3.4%. Gupta lists rent seeking politicians and workers, protection from competitive forces, absence of market-based incentives as some of the reasons SOEs in South Asia are extremely inefficient.

The GON has failed to enact any law to rope in the private sector in domestic and international trading and transmission, generating energy from reservoir projects, building pump-storage projects, and peaking RoR projects. NEA has a lack of competition as it has full control over the market. When there is no competition in the market, players such as NEA do not have incentive to innovate. Even when the service delivery is subpar, consumers are forced to choose the sole service provider. The intent of having such huge sectors on a monopoly and a monopsony under the state control is to negotiate lower prices and provide more affordable services to consumers. However, monopolies and monopsonies have historically had a significant influence over the market ultimately resulting in the abuse of market power and having a detrimental impact on the economy, hindering innovation and development.

The Government of Nepal should allow competition in these sectors to further develop the energy sector in the country. Allowing the private sector to engage in development of transmission and distribution infrastructure along with cross-border trade will further strengthen Nepal's energy sector. The presence of new players in the market will increase the pace of infrastructure development, hence, increasing the electricity access to consumers. Similarly, giving private sector approval for cross-border trade will help make the power purchase rate more competitive as the producers will be able to choose between two markets, further increasing investment incentives.

Taking India as an example, back in 1991, The Industrial Policy of Resolution, 1991 mentioned that SOEs had become "a burden rather than being an asset to the government". In 2003, India introduced a series of reforms to privatize the electricity sector. After years of the Electricity Amendment Bill being due to be sent in the parliament, finally in August 2022, the Union Government sent the bill to the Parliamentary Standing Committee on Energy. GoI has now privatized Power departments and utilities, the motives being to provide better services to consumers with improvement in operational and financial efficiencies. (Press Information

Bureau, 2022). The Standard Bidding Document (SBD) also envisaged making privatization an irreversible process. (Rao, 2020)

Like Nepal, the Federal Electricity Commission (CFE) had monopolized generation, transmission and distribution of electricity throughout the country in Mexico. (Jaramillo, 2021) Mexico started the process of privatization of the electricity sector in 2013 by liberalizing the national energy industry through a constitutional reform, which aimed to promote competition in the electricity market and simultaneously increase private investment. The reform allowed private companies to participate in electricity generation, transmission and distribution in all segments of the energy sector resulting in increased investments from the private sector in transmission lines. As a result, there has been significant improvements in the electricity infrastructure and a decrease in price for the consumers due to an increase of competition in the market.

In situations of natural monopoly, such as electricity, regulation is crucial to prevent excessive accumulation of monopolistic power and induce firms to act in a way compatible with social goals.

The success of conducting electricity reforms depends on the regulatory framework, which requires an efficient regulatory institution and a quality regulatory framework. The impact of regulatory quality on electricity outcomes has been confirmed by theory, but there is limited empirical evidence. Regulatory reform, when not accompanied by other reforms, may actually reduce electricity output. Increased competition is the most important factor in improving performance in electricity generation. The regulatory quality index from the World Bank represents a useful tool for evaluating broad trends over time, and the appropriate level of institutional and regulatory quality is crucial for transition countries, such as Nepal, to benefit from the reforms in the electricity sector. However, implementing the EU reform model in the electricity sector may not be appropriate for countries lacking institutional resources, institutional capacity, or economic development. (USAID White Paper, 2021)

Similarly, like Bangladesh, Nepal is also set to become a middle-income country by 2030. Also, like Bangladesh, Nepal has suffered from price volatility of oil and has been dealing with the increase in national demand for electricity as a result of population and economic growth. Bangladesh, from having one of the lowest electricity access rates in the world in 2000; 20 percent access rate to having a 97 percent access rate in 2020, it has made incredible progress. This came from the introduction of "Vision Statement and its annexed Policy Statement on Power Sector Reforms" in 2000 that aimed to provide reliable and affordable electricity to all by 2020. The statements included seven main components that the government had aimed to adopt. Those seven steps were based on a "textbook" or "reference" model to tackle obstacles in the power sector and included the following six steps from Scaling Up Renewable Energy (SURE) White Paper, 2021 which consists of:

- Corporatize and commercialize the national electric utility
- Pass legislation that creates a legal framework for electricity and establish an electricity regulator

- Introduce independent power producers
- Unbundle the supply of electricity to enable competition in generation and retail
- Divest state ownership and privatize electricity generation and retail
- Develop electricity markets to introduce wholesale and retail competition
- Set out a level playing field for all stakeholders.

In 2008, 3-Year Road Map for Power Sector Reform: 2008-2010 was released where the restructuring of the power sector, increase in transparency and governance, facilitate independent regulation, expanding competition and improving quality of services was ensured which is enlisted further reforms are listed in the following table:

Reform Measures Initiated in Bangladesh

Recently GOB initiated conversion of BPDB into a holding company including reshaping of the whole industry. A brief account of progress in the reform of the power sector is given below:

Generation:

- Licenses have been issued to several Small Power Plants under the "Policy Guidelines for Small Power Plants (SPP) in Private Sector".
- Under the "Policy Guidelines for Power Purchase from Captive Power Plant", agreements signed between utilities and captive generators for 28 MW so far and already 10 MW connected to the grid.
- Ashuganj Power Station has been converted into a corporatized entity.
- Electricity Generation Company of Bangladesh (EGCB) has been established to implement, own and operate the proposed 2x120 MW and 2x150 MW peaking power plants at Siddhirganj and 360 MW combined cycle power plant at Haripur. EGCB will also own existing generation assets of siddhirgonj and Haripur power stations of BPDB.
- North West Power Generation Company (NWPGC) has been incorporated in 2007.
- Steps have been taken to install new power plants under various modes of financing in addition to GOB funding

Transmission:

- Power Grid Company of Bangladesh Limited (PGCB) was created in 1996. All the transmission assets (100%) including Load Dispatch Center (LDC) have been transferred from BPDB to PGCB.
- Government allowed PGCB to float tax free bonds to raise fund from local market.
- PGCB offloaded it's 25% share to public through Capital Market in 2006. The process of offloading another 15% of shares has been initiated.

Distribution:

- DESCO was established in 1996 and is now functioning in Mirpur, Gulshan, Baridhara, Tongi and Uttara area of Dhaka by taking over assets from DESA
- West Zone Power Distribution System of BPDB has been corporatized as WZPDC.
- North West Zone Power Distribution system of BPDB has been corporatized as NWZPDC.
- DPDC was incorporated in October 2006.
- Corporatization of South Zone and Central Zone Power Distribution system of BPDB is under process
- Steps have been taken to bring the people of remote areas of the country under electricity system through Remote Area Power Supply System (RAPSS)" programme Distributed generation with distribution franchise for a certain period Program to be implemented by the private sector
- SBU activities adopted in 24 distribution circles of BPDB and DESA
- For introduction of Performance Target Agreement (PTA) scheme, contract has been signed with 24 distribution circles of BPDB and DESA.
- DESCO offloaded it's 25% share to public through Capital Market in 2006. The process of offloading another 15% of shares has been initiated.

Sector Regulation:

- Bangladesh Energy Regulatory Commission Act was enacted in 2003. Bangladesh Energy Regulatory Commission (BERC) has been established and made functional to regulate the Electricity, Gas and Petroleum sector Licensing regulation for generation has been made by the BERC in 2006. BERC is in the process of preparing Electricity Transmission Regulation, 2008 and Electricity Distribution Regulation, 2008.

Tariff:

- Power Pricing Framework has been approved by the Government.
- Rationalization of tariff (partial) has been made in 2006 and effective from March 2007.

Source: Bangladesh, 3-Year Road Map for Power Sector Reform: 2008-2010

The flip from deficit to overcapacity, reduction of electricity system loss to about 8 percent and improvement of system reliability shows how Bangladesh has improved over the years. This was possible only due to the acceptance and implementation of reforms in the Electricity Sector. Nepal can follow the example set by Bangladesh to create its own policy reforms.

6.3 Legislative Reforms

The National Planning Commission (NPC) had proposed to generate 383 MW of electricity from 277 hydropower plants, which are dispersed among all federal states (National Planning Commission, 2017) but as seen from the date of the inception, the major three legislation guiding hydropower development; the Electricity Act, 1992, Water Resources Act, 1984 and Hydropower Development Policy, 2003 in Nepal are not timely. Besides the three major legislations, an investor seeking to invest in the energy sector is required to have knowledge on other legislations such as:

- Land Act, 1964
- Land Acquisition Act, 1977
- Nepal Electricity Authority Act, 1984
- Electricity Regulations, 1993
- Water Resource Strategy, 2002
- Rural Energy Policy, 2006
- Scaling Up Renewable Energy Program, 2011
- National Energy Strategy of Nepal, 2013
- Nepal Electricity Regulatory Commission Act, 2017
- Environment Protection Act, 2019
- Environment Protection Regulation, 2019
- Forest Act, 2019
- Public Private Partnership and Investment Act, 2019
- Public Private Partnership and Investment Rule, 2021.

Having many different legislations to regulate on the same sector can result in overlapping jurisdictions and conflicting provisions, which can lead to ambiguity and make it difficult for individuals and organizations to comply with the laws. Additionally, it also creates the possibility of finding loopholes in the laws which can lead to a situation where individuals or entities take advantage of the lack of clarity and exploit the gaps in the legislation to further their own interests. For instance, Land Acquisition Act, 1977 gives the government the sole right to acquire land (if it deems necessary) for any public purpose, in case of electricity development it refers to infrastructure development projects, with a subsequent valuation of the land for compensation, relocation and rehabilitation of the affected people. The provisions of land acquisition have faced the reluctance/protests of the private landowners/locals of the area because of their dissatisfaction with the acquisition process citing lack of sufficient compensation for their lands as their reasons thus, hampering the efficiency in developing the hydropower projects. Despite being a federal republic, the sole authority to acquire land remains with the federal government in Nepal. The government of Nepal should work towards devolving the power of land acquisition, project development to the provincial government as well so that the issues with acquisition of land can be solved as quickly as possible, making the process efficient.

Thus, it is of great importance to have flexible and timely legislation to address the contemporary issues of the energy sector. While the government registered the Electricity Bill, 2020 in the lower house, it was withdrawn by the National Assembly under the proposal of the Ministry of Energy, Water Resources, and Irrigation. The bill, though in need of amendments, had proposed to unbundle Nepal Electricity Authority by incorporating provisions for deregulation and delicensing, corporatization/privatisation/restructuring (of distribution) functions of NEA, integration of renewable energy, and provide licence to power trade and electricity supply to private sector.

6.4 Net-Metering Services

Net metering enables people or companies to sell extra electricity they create from renewable energy sources back to the power grid. Configuration of customers' electricity metres runs in both directions and when a customer generates more electricity than they consume, the surplus goes back to the grid. As a result, the customer's metre "spins backwards." This extra energy then adds to the customer's account and credit will apply to further energy purchases. In Nepal, net-metering aligns with the roof-top installation of solar panels around residential houses and industrial buildings but the services have been halted from July 2022 with no sign of its reinstatement. The halting of the said services has caused businesses involved in installation services to face losses as the industries that have installed solar panels on their rooftops are reluctant to pay for the charges because of the failure to be connected to the national grid. Similarly, the residential consumers are also forced to incur additional economic costs for the electricity used because the excess electricity produced cannot be sold to the NEA. Nepal Electricity Authority must reinstate the services in the country as this will allow the consumers an opportunity to decrease their electricity charges and also contribute to reducing the electricity shortages faced by Nepal during the dry season.

6.5 Long run measures

It is evident that Nepal Electricity Authority has been one of the best performing and profitable public enterprises in Nepal as of present. This credit mostly goes to the monopoly in generation and monopsony in transmission of NEA in the energy sector of Nepal along with its management changes as well as alignment of long-term goals of the government in developing the energy sector.

In 2018, the energy ministry issued a white paper on the status of energy, water resources and irrigation and the future roadmap, setting the target of producing 1,500MW electricity in 10 years to become self-reliant on electricity. As per the target mentioned in the white paper, share of the storage and pump storage hydropower projects will be 30–35 percent of total available power, share of peaking run-of-the-river type project and run of the river type project will be 25–30 percent will be 30–35 percent respectively and alternative energy will have a share of 5-10 percent. But a Cabinet meeting on July 8, 2022 decided to amend this composition by increasing the share of run of the river type projects by 10 percent while reducing the equivalent share of reservoir projects. The reduced share of reservoir type projects to 20-25 percent shows the lack of prudent approach from the government in the hydropower sector. This might have something to do with a shorter span of reduced demand and power wastage in the past but as a state, there should always be initiatives for increasing energy consumption demands. In the long run, storage or peaking run off river projects should be prioritised for energy security in Nepal.

Currently, the surplus electricity in Nepal has found Indian markets with prospects of a market in Bangladesh as well. As per the NEA annual reports, the authority has been exporting an average of 7 million MWh for the past two fiscal years but the import statistics for the same period are an average of 6.7 million MWh which shows the country is yet to enjoy energy surplus. As per Nepal Energy Outlook 2022, per capita electricity consumption in 2000 was 63 kWh which currently has reached 260 kWh in 2021. The improved per capita electric consumption shows the reduced dependence on petroleum as a prime energy source to a certain degree but still, the consumption is very low compared to the world average.

Current scenario of the electricity sector depicts the need for an efficient technology in all the infrastructures related to generation, transmission, distribution, wiring and metering. The emphasis on export for a short run seems plausible to meet the current dry season peak load demands and settle the surplus electricity in the wet season but the focus should be on the bigger picture of increasing domestic demands and consumption within the country in the long run. The government can do so by reducing the electricity tariffs charged as electricity tariffs in Nepal are comparatively higher than other South Asian countries. Unless the cost of using electricity is cheaper than using traditional fuels, consumers will be reluctant to substitute petroleum products with electricity due to the complex nature of electrical goods.

Once the tariffs are reduced, the government can then work on promoting energy efficient technologies that help in reducing costs for the consumers. Energy efficient technologies provide high or similar output at a low cost for the consumers. Doing so, will not only help the government in advancing the use of electricity as a major source of energy but will also decrease costs for the consumers in the long run as energy efficient technologies cost more than the non efficient technologies currently in use. The government can do so by providing tax rebates in import of electric appliances so that the prices of appliances are cheaper and easily accessible to the consumers. For instance, the government charges a total of 21.19 percent taxes (Import duty and Vat) on electric microwave ovens imported from South Asian countries and a total of 24.30 percent taxes if the microwave ovens are imported from other countries. A decrease in the import taxes will further help decrease the cost of such ovens and increase its demand. Similar measures can be taken to reduce the taxes of other electrical appliances to increase their demand. In India, the impact of citizens utilizing a large number of efficient items has resulted in a projected power savings of 56 billion units during 2020-21, valued more than Rs. 30000 crore (Ministry of Power, 2021).

Likewise, the government can initiate a nation-wide energy audits for businesses. While the government has initiated Nepal Energy Efficiency Program, the program is yet to make significant changes as only a handful of organisations conduct energy audits in the present context. As per the Alternative Energy Promotion Centre, only 15 institutions have conducted their energy audit in the year 2021. The MoEWRI can conduct audits based on provinces and the nature of businesses to start a nation-wide energy audit and reward highly energy-efficient entities. Rewards in this sense could be tax rebates or tax credits and funding opportunities to businesses to further promote the use of electricity and incentivize the use of energy-efficient technologies. For example, in India, through special credit lines and risk-sharing systems for small and medium-sized enterprises (SMEs), special emphasis has been placed on facilitating access to finance for Energy Efficiency projects and in China, awards based on the quantity of energy saved are provided by the nation. Since 2016, a fund has been in place to support projects in smart manufacturing, consumer goods, and green manufacturing, which is overseen by the Ministries of Finance and Industry and Information Technology (IEA 2019) and provides loans, credit guarantees, insurance, and subsidies to eligible projects (Sarker et al., 2020).

Table 8 Summary of Policy Instruments used to Promote Energy Efficiency in Different Countries

Measures initiated	Type	Advantage	Disadvantage	Countries/ Examples
Subsidies	Policy incentive	• Efficient when well targeted	• Costly • Implementation issues (proper amount of subsidies) • Lack of fairness as taxpayers bear the burden of the subsidies	Indonesia
Tax exemptions and rebates	Policy incentive	• Efficient when well implemented	• Implementation issues (proper pricing and amount of rebate) • Lack of fairness as taxpayers bear the burden of the subsidies	Sweden, Denmark
Voluntary Agreement	Policy incentive	• Efficient	•Success relies on the stringency of targets, without endangering the firms' competitiveness	UK Climate Change Agreements (CCAs)
Emission Trading Scheme	Policy incentive	• Efficient in reducing GHG emissions • Cost-efficient	• Not necessarily resulting in EE improvements	EU ETS
Cooperative and supportive policies	Policy incentive	• Cheap • Awareness spreading and long-term effect	• Not necessarily resulting in EE improvements in the short term	Canada, EU, US, Australia

Energy Efficiency Obligations	MarketBased Incentive	• Cost-efficient • Improvements in EE	• Unexpected costs may arise • Need for proper monitoring	White Certificates in France
Tendering Schemes	MarketBased Incentive	• Cost-efficient • Improvements in EE	• No overall saving target specified	Switzerland, Germany, Portugal, UK
Special credit lines	EE finance	• Relatively cost efficient • Awareness spreading and long-term effect • Works best under financial markets at a low maturity	• Indirect improvements of EE • May be terminated due to lack of funds • - Efficient program design is crucial	PRC, Thailand, India
Risk-sharing schemes	EE finance	• Relatively cost efficient • Awareness spreading and long-term effect	• Indirect improvements of EE • Requires a mature financial system	CEEF (Hungary, Czech Republic, Slovak Republic, Latvia, Lithuania, and Estonia)

Source: Sarker et al., 2020

Conclusion

Electricity is a promising alternative to oil due to its low environmental impact, cost-effectiveness, and versatility. With the rapid advancements in technology, electric vehicles and electrical appliances are becoming increasingly popular, which can drastically reduce the use of oil for transportation, cooking, and lighting. In addition, renewable sources of electricity, such as solar and wind, are rapidly expanding and becoming more affordable, making them a viable option for power generation. The increased consumption capacity will reduce the import of petroleum products and ultimately reduce the Balance of Payment (BOP) deficit in the long run as an increase in consumption within the country will have a multiplier effect in the other indicators of economic growth as GDP.

However, the transition from oil to electricity is not without its challenges. One of the major obstacles is the high upfront cost of electric goods and setting up energy infrastructure. This can be a significant financial burden for individuals and businesses, especially in developing countries. Furthermore, the reliability of electricity supply and the need for energy storage systems are also issues that need to be addressed. The substitutability of oil with electricity is a complex issue that has been widely debated by policymakers, economists, and energy experts thus, needs proper consideration and right policy interventions.

In conclusion, the substitutability of oil by using electricity is a promising alternative specially for Nepal where it can significantly reduce its increasing trade deficit and transition towards cleaner energy sources. While there are challenges to be overcome, the benefits of this transition far outweigh the barriers because it is economical and has the potential to drastically lower Nepal's trade deficit.

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Annex

Annex I

Petroleum Products Prices

Estimated Profit and Loss statement of Nepal Oil Corporation including infrastructure taxes						
As per the prices received and implemented as of November 1st 2022						
S.N.	**Particulars**		**Petrol per litre**	**Diesel per litre**	**Kerosene per litre**	**LP Gas per cylinder**
1	Purchase cost till Kathmandu as per November 1st 2022		162.89	167.40	131.10	2159.50
2	Retail selling price from September 1st 2022		175.00	172.00	172.00	1800.00
3	Per litre/cylinder loss faced by NOC		12.11	4.60	40.90	-359.50
4	15 days sales estimate in (KL/Cylinder)		27,029	60,279	530	1291,890
5	Profit and loss of the corporation in crore		32.74	27.75	2.17	-46.44
6	15 days loss estimate in 10 millions Nrs.		58.12			
7	Purchase cost details					
i	Price received from IOC as per the prices in international market		85.35	110.30	103.94	1495.99
	1	Government customs and advertisement fee/tax	25.23	12.03	12.03	80.43
	2	Road improvement tax	4	2	-	-
	3	Pollution Tax	1.5	1.5	-	-
	4	Infrastructure Tax	10	10	-	-
	5	VAT	20.13	19.79	-	201.54
	6	Fuel Throughput	-	-	-	-
	7	Price Stabilization Fund	1.75	1.72	1.72	18.00
	8	Interest Amount	0.52	0.52	0.52	7.36
ii	Total government revenue		63.13	47.55	14.327	307.33
iii	Total transportation cost		6.58	3.19	6.58	-
iv	Corporations' administrative and sales expenses		0.60	0.60	0.60	8.52

v	Insurance cost	0.05	0.07	0.06	1.57
vi	Technical Losses	1.10	0.79	0.76	-
vii	Dealers expenses and profit	6.09	4.89	4.89	346.09
	Total Additional Expenses	**77.55**	**57.09**	**27.16**	**663.51**

Annex II

Tariff Rates
2017/18

Domestic Consumers: Service and Energy Charge

Single Phase

kWh (Monthly) Units	5 Ampere		15 Ampere		30 Ampere		60 Ampere	
	Service Charge	Energy Charge	Service Charge	Energy Charge	Service Charge	Energy Charge	Service Charge	Energy Charge
0-20	30.00	3.00	50.00	4.00	75.00	5.00	125.00	6.00
21-30	50.00	7.00	75.00	7.00	100.00	7.00	150.00	7.00
31-50	75.00	8.50	100.00	8.50	125.00	8.50	175.00	8.50
51-150	100.00	10.00	125.00	10.00	150.00	10.00	200.00	10.00
151-250	125.00	11.00	150.00	11.00	175.00	11.00	225.00	11.00
251-400	150.00	12.00	175.00	12.00	200.00	12.00	250.00	12.00
Above 400	175.00	13.00	200.00	13.00	225.00	13.00	275.00	13.00

Three Phase Low Voltage (230/400 V)

kWh	Up to 10KVA		Above 10 KVA	
	Service Charge	Energy Charge	Service Charge	Energy Charge
Up to 400	1100	12.5	1800.00	12.50
Above 400		13.5		13.50

Three Phase Medium Voltage (33/11 KV)

kWh	Up to 10 KVA	Service Charge	Energy Charge
Up to 1000		1100	11
1001-2000			12
Above 2001			13

Electricity Consumer Block	Rate Rs. Per Unit	Billing Method
Up to 20 units	3	Minimum Monthly Service Charge Rs. 30.00 for up to 20 units and Energy Charge Rs. 3.00 per unit
21 to 30 units	7	Minimum Monthly Service Charge Rs. 50.00 and Energy Charge per unit Rs. 3.00 for per unit up to 20 units and Rs. 7.00 per unit for 21 units to 30 units
31 to 50 units	8.5	Minimum Monthly Service Charge Rs. 75.00 and Energy Charge per unit Rs. 3.00 for per unit up to 20 units and Rs. 7.00 per unit for 21 units to 30 units and Rs. 8.50 per unit for 31 units to 50 units
51 to 150 units	10	Minimum Monthly Service Charge Rs. 100.00 and Energy Charge per unit Rs. 3.00 for per unit up to 20 units and Rs. 7.00 per unit for 21 units to 30 units and Rs. 8.50 per unit for 31 units to 50 units and Rs. 10.00 per unit for 51 units to 150 units
151 to 250 units	11	Minimum Monthly Service Charge Rs. 125.00 and Energy Charge per unit Rs. 3.00 for per unit up to 20 units and Rs. 7.00 per unit for 21 units to 30 units and Rs. 8.50 per unit for 31 units to 50 units and Rs. 10.00 per unit for 51 units to 150 units and Rs. 11 .00 per unit for 151 units to 250 units
251 to 400 units	12	Minimum Monthly Service Charge Rs. 150.00 and Energy Charge per unit Rs. 3.00 for per unit up to 20 units and Rs. 7.00 per unit for 21 units to 30 units and Rs. 8.50 per unit for 31 units to 50 units and Rs. 10.00 per unit for 51 units to 150 units and Rs. 11.00 per unit for 151 units to 250 units and Rs. 12.00 per unit for 251 units to 400 units
Above 400	13	Minimum Monthly Service Charge Rs. 175.00 minimum charge and Energy Charge per unit Rs. 3.00 for per unit up to 20 units and Rs. 7.00 per unit for 21 units to 30 units and Rs. 8.50 per unit for 31 units to 50 units and Rs. 10.00 per unit for 51 units to 150 units and Rs. 11.00 per unit for 151 units to 250 units and Rs. 12.00 per unit for 251 units to 400 units and Rs. 13.00 per unit for above 400 units

Similarly, billing will be made for 15, 30 and 60 Ampere.

2018/19 and 2019/20

Domestic Consumers
Minimum and Energy Charge (Single Phase)

kWh (Monthly) Units	5 Ampere		15 Ampere		30 Ampere		60 Ampere	
	Minimum Charge	Energy Charge	Minimum Charge	Energy Charge	Minimum Charge	Energy Charge	Minimum Charge	Energy Charge
0-20	30	3	50	4	75	5	125	6
21-30	50	7	75	7	100	7	150	7
31-50	75	8.5	100	8.5	125	8.5	175	8.5
51-150	100	10	125	10	150	10	200	10
151-250	125	11	150	11	175	11	225	11
251-400	150	12	175	12	200	12	250	12
Above 400	175	13	200	13	225	13	275	13

Minimum and Energy Charge (Three Phase)
Low Voltage (230/400 V)

kWh	Up to 10 KVA		Above 10 KVA	
	Minimum Charge	Energy Charge	Minimum Charge	Energy Charge
Up to 400	1100	12.5	1800	12.5
Above 400		13.5		13.5

Minimum and Energy Charge: Three Phase
Medium Voltage (33/11 KV)

kWh	Up to 10 KVA	
	Minimum Charge	Energy Charge
Up to 1000	10000	11
1001-2000		12
Above 2001		13

Billing Method (For 5 Ampere)

Electricity Consumer Block	Rate Rs. Per Unit	Billing Method
Up to 20 units	3	Minimum Monthly Service Charge Rs. 30.00 for up to 20 units and Energy Charge Rs. 3.00 per unit
21 to 30 units	7	Minimum Monthly Service Charge Rs. 50.00 and Energy Charge per unit 3.00 for per unit up to 20 units and Rs. 7.00 per unit for 21 units to 30 units.

31 to 50 units	8.5	Minimum Monthly Service Charge Rs. 75.00 and Energy Charge per unit Rs. 3.00 for per unit up to 20 units and Rs 7.00 per unit for 21 units to 30 units and Rs. 8.50 per unit to 50 units.
51 to 150 units	10	Minimum Monthly Service Charge Rs. 100.00 and Energy Charge per unit Rs. 3.00 for per unit up to 20 units and Rs. 7.00 per unit for 21 units to 30 units and Rs. 8.50 per unit for 31 units to 50 units and Rs. 10.00 per unit for 51 units to 150 units
151 to 250 units	11	Minimum Monthly Service Charge Rs. 125.00 and Energy Charge per unit Rs. 3.00 for per unit up to 20 units and Rs. 7.00 per unit for 21 units to 30 units and Rs. 8.50 per unit for 31 units to 50 units and Rs. 10.00 per unit for 51 units to 150 units and Rs. 11.00 per unit for 151 units to 250 units
251 to 400 units	12	Minimum Monthly Service Charge Rs. 150.00 and Energy Charge per unit Rs. 3.00 for per unit up to 20 units and Rs. 7.00 per unit for 21 units to 30 units and Rs. 8.50 per unit for 31 units to 50 units and Rs. 10.00 per unit for 51 units to 150 units and Rs. 11.00 per unit for 151 units to 250 units and Rs. 12.00 per unit for 251 units to 400 units
Above 400	13	Minimum Monthly Service Charge Rs. 175.00 minimum charge and Energy Charge per unit Rs. 3.00 for per unit up to 20 units and Rs. 7.00 per unit for 21 units to 30 units and Rs. 8.50 per unit for 31 units to 50 units and Rs. 10.00 per unit for 51 units to 150 units and Rs. 11.00 per unit for 151 units to 250 units and Rs. 12.00 per unit for 251 units to 400 units and Rs. 13.00 per unit for above 400 units

Similarly, billing will be made for 15, 30 and 60 Ampere.

2020/21

Domestic Consumers

Single Phase Low Voltage (230 Volt)

kWh (Monthly)	5 Ampere		15 Ampere		30 Ampere		60 Ampere	
	Minimum Charge (Nrs.)	Energy Charge (Nrs/ kWh)	Minimum Charge (Nrs.)	Energy Charge (Nrs/ kWh)	Minimum Charge (Nrs.)	Energy Charge (Nrs/ kWh)	Minimum Charge (Nrs.)	Energy Charge (Nrs/ kWh)
0-10	30	0	50	4	75	5	125	6
11-20	30	3	50	4	75	5	125	6
21-30	50	6.5	75	6.5	100	6.5	125	6.5
31-50	50	8	75	8	100	8	125	8
51-100	75	9.5	100	9.5	125	9.5	150	9.5
101-150	100	9.5	125	9.5	150	9.5	200	9.5
151-250	125	10	150	10	175	10	200	10
251-400	150	11	175	11	200	11	250	11
Above 400	175	12	200	12	225	12	275	12

Three phase L ow Voltage (400 Volt)

kWh (Monthly)	Up to 10 WA		Above 10 WA	
	Minimum Charge (Nrs.)	Energy Charge (Nrs/kWh)	Minimum Charge (Nrs.)	Energy Charge (Nrs/kWh)
Up to 400	1100	11.5	1800	11.5
Above 400		12		12

Three phase Medium Voltage (33/11 kV)

kWh (Monthly)	Minimum Charge (Nrs.)	Energy Charge (Nrs/kWh)
Up to 1000	10,000.00	11
Above 1001		12

Billing Method (For 5 Ampere)

S.No	kWh (Monthly)	Rate Nrs. Per Unit	Billing Method
1	Up to 10 units	0	Monthly Minimum Charge Rs. 30.00 for up to 10 units and Energy Charge Rs. 0.00 per unit
2	11 to 20 units	3	Monthly Minimum Charge Rs. 30.00 and Energy Charge Rs. 3.00 per unit for 1 unit to 20 units
3	21 to 30 units	6.5	Monthly Minimum Charge Rs. 50.00 and Energy Charge Rs. 3.00 per unit up to 20 units and Rs. 6.50 per unit for 21 units to 30 units
4	31 to 50 units	8	Monthly Minimum Charge Rs. 50.00 and Energy Charge Rs. 3.00 per unit up to 20 units and Rs. 6.50 per unit for 21 units to 30 units and Rs. 8.00 per unit for 31 units to 50 units
5	51 to 100 units	9.5	Monthly Minimum Charge Rs. 75.00 and Energy Charge Rs. 3.00 per unit up to 20 units and Rs. 6.50 per unit for 21 units to 30 units and Rs. 8.00 per unit for 31 units to 50 units and Rs. 9.50 per unit for 51 units to 100 units
6	101 to 150 units	9.5	Monthly Minimum Charge Rs. 100.00 and Energy Charge Rs. 3.00 per unit up to 20 units and Rs. 6.50 per unit for 21 units to 30 units and Rs. 8.00 per unit for 31 units to 50 units and Rs. 9.50 per unit for 51 units to 150 units
7	151 to 250 units	10	Monthly Minimum Charge Rs. 125.00 and Energy Charge Rs. 3.00 per unit up to 20 units and Rs. 6.50 per unit for 21 units to 30 units and Rs. 8.00 per unit for 31 units to 50 units and Rs. 9.50 per unit for 51 units to 150 units and Rs. 10.00 per unit for 151 units to 250 units
8	251 to 400 units	11	Monthly Minimum Charge Rs. 150.00 and Energy Charge Rs. 3.00 per unit up to 20 units and Rs. 6.50 per unit for 21 units to 30 units and Rs. 8.00 per unit for 31 units to 50 units and Rs. 9.50 per unit for 51 units to 150 units and Rs. 10.00 per unit for 151 units to 250 units and Rs. 11.00 per unit for 251 units to 400 units
9	Above 400	12	Monthly Minimum Charge Rs. 175.00 and Energy Charge Rs. 3.00 per unit up to 20 units and Rs. 6.50 per unit for 21 units to 30 units and Rs. 8.00 per unit for 31 units to 50 units and Rs. 9.50 per unit for 51 units to 150 units and Rs. 10.00 per unit for 151 units to 250 units and Rs. 11.00 per unit for 251 units to 400 units and Rs 12.00 per unit for above 400 units.

Similarly, billing will be made for 15, 30 and 60 Ampere. (Single Phase & 3 Phase Consumers)

2021/22

Domestic Consumers

1.1 Single Phase Low Voltage (203 Voltage)	5 Ampere		15 Ampere		30 Ampere		60 Ampere	
kWh (Monthly)	Monthly Minimum Charge (Nrs.)	Energy Charge (Nrs./ kWh)	Monthly Minimum Charge (Nrs.)	Energy Charge (Nrs./ kWh)	Monthly Minimum Charge (Nrs.)	Energy Charge (Nrs./ kWh)	Monthly Minimum Charge (Nrs.)	Energy Charge (Nrs./ kWh)
0-20	30	0	50	4	75	5	125	6
21-30	50	6.5	75	6.5	100	6.5	125	6.5
31-50	50	8	75	8	100	8	125	8
51-100	75	9.5	100	9.5	125	9.5	150	9.5
101-250	100	9.5	125	9.5	150	9.5	200	9.5
Above 251	150		175	11	200	11	250	11
Note: If 5 Ampere consumers use more than 20 units, they have to pay NRs. 3.00 per unit								

1.2 Three Phase Low Voltage (400 volt)

kWh (Monthly)	Up to 10 WA			Above 10 KVA		
	Monthly Minimum Charge (Nrs.)	Month	Energy Charge (Nrs./ kWh)	Monthly Minimum Charge (Nrs.)	Month	Energy Charge (Nrs./ kWh)
All Consumers	1100	Ashad -Kartik	10.5	1800	Ashad -Kartik	10.5
		Marg-Jestha	11.5		Marg-Jestha	11.5

1.3 Three Phase Medium Voltage (33/11 W)

kWh (Monthly)	Monthly Minimum Charge (Nrs.)	Month	Energy Charge (Nrs/ kWh)
All Consumers	10,000.00	Ashad-Kartik	10.5
		Marg-Jestha	11

Billing Method (For Single Phase 5 Ampere)

S. No.	kWh (Monthly)	Energy Charge (N rs./kwh)	Billing Method
1	Up to 20 units	4	Monthly Minimum Charge Rs. 30.00 for up to 20 units and Energy Charge Rs. 0.00 per unit
2	21 to 30 units	6.5	Monthly Minimum Charge Rs. 50.00 and Energy Charge per unit Rs. 3.00 for per unit up to 20 units and Rs. 6.50 per unit for 21 units to 30 units
3	31 to 50 units	8	Monthly Minimum Charge Rs. 50.00 and Energy Charge per unit Rs. 3.00 for per unit up to 20 units and Rs. 6.50 per unit for 21 units to 30 units and Rs-8.00 per unit for 31 units to 50 units
4	51 to 100 units	9.5	Monthly Minimum Charge Rs. 75.00 and Energy Charge per unit Rs. 3.00 for per unit up to 20 units and Rs. 6.50 per unit for 21 units to 30 units and Rs. 8.00 per unit for 31 units to 50 units and Rs. 9.50 per unit for 51 units to 100 units
5	101 to 250 units	9.5	Monthly Minimum Charge Rs. 100.00 and Energy Charge per unit Rs. 3.00 for per unit up to 20 units and Rs. 6.50 per unit for 21 units to 30 units and Rs. 8.00 per unit for 31 units to 50 units and Rs. 9.50 per unit for 51 units to 250 units
6	Above 251 units	11	Monthly Minimum Charge Rs. 150.00 and Energy Charge per unit Rs. 3.00 for per unit up to 20 units and Rs. 6.50 per unit for 21 units to 30 units and Rs. 8.00 per unit for 31 units to 50 units and Rs. 9.50 per unit for 51 units to 250 units and Rs. 11.00 per unit for above 251 units

Billing Method (For Single Phase 15 Ampere)

S. No.	kWh (Monthly)	Energy Charge (N rs./kwh)	Billing Method
1	Up to 20 units	4	Monthly Minimum Charge Rs. 50.00 for up to 20 units and Energy Charge Rs. 4.00 per unit (e.g.: 5 unit: Rs. 50 + 5 x 4 = Rs. 70.00)
2	21 to 30 units	6.5	Monthly Minimum Charge Rs. 75.00 and Energy Charge per unit Rs. 4.00 for per unit up to 20 units and Rs. 6.50 per unit for 21 units to 30 units (e.g.: 25 unit: Rs. 75 + 20 x 4 + 5 x 6.5 = Rs. 187.50)

3	31 to 50 units	8	Monthly Minimum Charge Rs. 75.00 and Energy Charge per unit Rs. 4.00 for per unit up to 20 units and Rs. 6.50 per unit for 21 units to 30 units and Rs. 8.00 per unit for 31 units to 50 units (e.g.: 35 unit: Rs. 75 + 20 x 4 + 10 x 6.5 + 5 x 8 = Rs. 260.00)
4	51 to 100 units	9.5	Monthly Minimum Charge Rs. 100.00 and Energy Charge per unit Rs. 4.00 for per unit up to 20 units and Rs. 6.50 per unit for 21 units to 30 units and Rs. 8.00 per unit for 31 units to 50 units and Rs. 9.50 per unit for 51 units to 100 units (e.g.: 55 unit: Rs.100 + 20 x 4 + 10 x 6.5 + 20 x8+ 5 x 9.5 = Rs. 452.50)
5	101 to 250 units	9.5	Monthly Minimum Charge Rs. 125.00 and Energy Charge per unit Rs. 4.00 for per unit up to 20 units and Rs. 6.50 per unit for 21 units to 30 units and Rs. 8.00 per unit for 31 units to 50 units and Rs. 9.50 per unit for 51 units to 250 units (e.g.: 105 unit: Rs.125 + 20 x 4 + 10 x 6.5 + 20 x 8 + (50 + 5) x 9.5 = Rs. 952.50)
6	Above 251 units	11	Monthly Minimum Charge Rs. 175.00 and Energy Charge per unit Rs. 4.00 for per unit up to 20 units and Rs. 6.50 per unit for 21 units to 30 units and Rs. 8.00 per unit for 31 units to 50 units and Rs. 9.50 per unit for 51 units to 150 units and Rs. 10.00 per unit for 151 units to above 250 units and Rs. 11.00 per unit for 251 units to 400 units. (e.g.: 255 unit: Rs. 175 + 20 x 4 + 10 x 6.5 + 20 x 8 + (50 + 150) x 9.5 + 5 x 11 = Rs. 2435.00)

Billing Methods will be similar for Single Phase 30 and 60 Ampere.