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Editorial Policy

The Energy and Value Letter brings together academics and practitioners worldwide to discuss timely valuation issues in the energy sector. It publishes news from the Centre for Energy and Value Issues (CEVI), its linked organizations and others (including calls for papers), columns on topical issues, practitioners' papers: short articles from institutions, firms, consultants, etcetera, as well as peer-reviewed academic papers: short articles on theoretical, qualitative or modeling issues, empirical results and the like. Specific topics will refer to energy economics and finance in a broad sense. The journal welcomes unsolicited contributions. Please e-mail to **w.westerman@rug.nl** (Wim Westerman), a copy of a news item, column or a completed paper. Include the affiliation, address, phone, and e-mail of each author with your contribution. A column or news item should not have more than 600 words and a paper should not exceed 5,000 words, albeit that occasionally larger pieces can be accepted.

Center for Energy and Value Issues
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Celebrating and looking ahead

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Firstly, we can as CEVI be happy about a conference that went so well. James Thewissen and others have done much to make a success of the 8th CEVI Conference in Louvain-La-Neuve, Belgium. The opening session was much motivating, as were the 21 paper presentations, including one ISINI session with five papers. With the conference being held virtually, the fee was waived. CEVI is grateful that UCL has been such a good host, who created a friendly atmosphere. We were able to learn a lot from each other and there were many nice personal interactions. We look forward to hold our next conference at their Louvain-La-Neuve campus physically. So do make a mental note for May 2023!

Secondly, at the time of writing, we are finishing the editing of the 8th CEVI book in the Springer series. It is set up in cooperation with Hacettepe University's Energy Markets Research and Application Center. André Dorsman, Kazim Atici, Aydin Ulucan and Mehmet Baha Karan are editors of the 8th CEVI book, focusing on energy and value issues related to operations research and financial modelling, in which 12 chapters are foreseen. The publication date is set at January 2022. James Thewissen has offered to come up with a new book idea. Key themes may center around economics and finance in relation to decarbonisation, ESG, big data, energy intensity and beyond, but any of your suggestions are most welcome.

Thirdly, we like to point at our other activities. For instance, CEVI contributes to the CAPRC in the USA (energy seminar on September 13; annual conference also in September) and to ISINI (next conference planned in September 2022). We should not forget to recall that many of our members contribute paid and unpaid to projects with firms and other bodies. The society benefits from it and so do we at CEVI. The profile that has bene built up by Hacettepe University in Turkey is especially very strong and so it is no wonder that this university is recognised as a founding sponsor. Next to Mehmet Baha Karan, also Kazim Baris Atici has been appointed as a new member of the Board.

Fourthly, we like to point you at the contribution by Nooriya Mohammed to this issue. Her paper on electricity demand forecasting in Iraq offers much insight on an important topic in a developing country. Next to this, we are also happy to publish a few abstracts from paper presentations at the CEVI conference. We also have an interesting Call for Papers in *Energies*, do take a look at it.

Lastly, we should not forget that the global pandemic is still going on and that in many countries the economic circumstances are very hard these days. However, even under such circumstances, it is good to relax at times. For many of us, such a period has started or is about to start. If possible, we wish you a good time and a happy return after the mid-year break!

8th Multinational Energy and Value Conference, Louvain-La-Neuve, May 6-7, 2021: Abstracts of selected paper contributions

Below, you will find a sample of abstracts of papers presented at the 8th CEVI conference *(editor)*.

Resource Efficiency Awareness of the Companies

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Abstract
The aim of this paper is to analyse the resource efficiency awareness of the companies. The analysis is based on the survey outcomes of GESIS Data Archive, Flash Eurobarometer which was conducted in 2017 for 36 European countries and the United States of America. We focus on the employment type, establishment time and turnover characteristics of the companies and analyse whether differences in these characteristics effect the degree of resource efficiency awareness of the companies. Six variables measure awareness. We used a two-step methodology based on statistics and data mining/machine learning tools. In the first step we applied a Chi-2 dependence test between each characteristic variable and each awareness variable. We found that turnover performance for the past 2 years and last year's turnover are effective on the resource efficiency awareness of the companies. In the second step we used the results of the dependence test as input to partition countries into overlapping clusters, each cluster containing countries having frequent common characteristics in terms on dependence/independence between characteristic variables and awareness variables. For the clustering we first tried the well-known algorithm Kmeans, but the results were poor, and we concluded that there is no natural partition of the countries a small number of disjoint groups. Then we applied another method based on the Apriori algorithm, which generates frequent sets of dependence/independence between pairs of variables. Next, we used these frequent sets to define overlapping clusters, each cluster corresponding to a different profile from the variable dependence point of view.

Decomposition of CO_2 emissions over 1987–2018 in Turkey

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Abstract
This paper studies the energy situation and the development of CO_2 emissions in Turkey. Official projections, namely the new economic plan for 2021–2023 (HMB, 2020), show that Turkey has a yearly GDP growth potential of around 5%. Recent projections of the Climate Action Tracker (CAT, 2021) indicate that the level of CO_2 emission is going to rise in the post Covid-19 current policies scenario with 50% until 2030 with respect to the level of emissions in 2018. It is a great challenge to both meet the growth target and keep the CO_2 under control. Thereupon, this paper tries to unfold factors that explain CO_2 emissions by undertaking a complete decomposition analysis for Turkey over the period 1987–2018.
The analysis shows, as is common to relatively fast-growing economies, that the main contributor to the rise in CO_2 emissions is the expansion of the economy (scale effect). The carbon intensity and the change in composition of the economy, also contribute to the rise in CO_2 emissions, but much less. Moreover, the carbon intensity has started to decrease in the 2010-2018 period. The energy intensity of the economy, which is decreasing at an accelerating rate after 2000, is responsible for a significant reduction in CO_2 emissions. A regression analysis with the data shows that a process of decoupling of both carbon emissions and energy consumption with respect to economic growth has started in Turkey over the period 1987–2018, indicating both an environmental and an energy Kuznets curve for Turkey.

Key words: Decomposition analysis; Turkey; energy; CO_2 emissions; economic growth.
JEL classification: Q4, Q54

Corporate liquidity in normal and crisis times: what is the best yardstick?

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Abstract
This paper investigates measures that help to assess corporate liquidity in both normal and crisis periods. An overview of relevant liquidity measures used by both professionals and academics shows that these concentrate on cash ratios, working capital ratios and in specific the cash conversion cycle (CCC). An application of regular liquidity measures on three major European electricity suppliers shows that it matters whether a company is production driven or sales driven. Three local cases show how a recent crisis affected liquidity in various types of firms and indicate that whereas priorities do change, liquidity measures should not. An overview of liquidity management on 27 electricity, oil/gas and other multinational firms supports this idea. We plea for keeping a close eye on the CCC in both good and bad times.

Key Words: cash, working capital, cash conversion cycle, crisis, liquidity measures

Evaluating Turkey’s Metropolitan Municipalities towards SDGs With Respect to Energy and Climate Change

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Abstract
The Sustainable Development Goals (SDGs), which aims to protect the planet earth and ensure all people live in peace and prosperity by 2030, was adopted by all the United Nations (UN) Member States in 2015. Since then, they were placed at the heart of the 2030 Agenda for Sustainable Development. There are 17 SDGs and 243 indicators, of which 145 are directly related to local governments/municipalities. Turkey is not one of the countries that successfully meet all SDGs targets. According to the Sustainable Development Report 2020 prepared by Sachs et al. (2020), Turkey's SDG Index is 70.3/100, ranking 70th in the world. It is obvious that metropolitan municipalities (MMs), which have more than 750,000 populations, play a significant role in meeting SDGs requirements. Therefore, this study examines the sustainable development objectives in 30 MMs in Turkey to evaluate their success between 2014 and 2020. The data used in the study is based on the strategic plans of the MMs. The keyword analysis is also used to detect how certain keywords are used in municipalities' activities. The analysis showed that MMs' activities are mostly concentrated on areas such as fighting against poverty, urbanization, industry, health, and education. Social assistance to vulnerable citizens and the number of health centers have been increased, vocational training courses have been opened, and various infrastructure works have been carried out to develop the industry. However, efforts to combat climate change, use clean energy, protect land and sea life, ensure social peace-justice and gender equality are in general inadequate. Herein, this study deepens into two SDGs like SDG 7: Affordable and Clean Energy and SDG 13: Climate Action. With respect to the goal of SDG 7, it is seen that 20 of the MMs have renewable and clean energy targets, and different renewable energy sources were emphasized for different regions: for example, biomass in Erzurum, geothermal in Aydın and Balıkesir, and solar in Diyarbakır. Besides, various initiatives were planned, such as solar bus stops and ecological buildings in Konya, clean energy in transportation in Maraş, and localized heating for self-consumption of energy in Manisa. Only Mardin and Eskişehir municipalities mention policies to decrease coal use in their strategic plans. The energy efficiency target is only mentioned in 18 MMs out of 30 MMS in their 2020 strategic plans. Concerning the goal of SDG 13, only 9 MMs out of 30 have climate action plans. In these plans, the most commonly mentioned concept is drought on agriculture and water resources. For instance, the municipality of Adana shows great effort to combat climate change with its environmental strategy. In addition, the Gaziantep, Istanbul, Muğla, and Trabzon municipalities have climate change action plans. On the other hand, only four municipalities, such as Istanbul, Eskişehir, Izmir, and Mersin, mention the SDGs in their strategic plans. In conclusion, it can be said that MMs play a crucial role in Turkey, but there is a long way to go in front of them to adopt the SDGs.

Keywords: Affordable and Clean Energy, Climate Action, Metropolitan Municipalities (MMs), Sustainable Development Goals (SDGs), Turkey

Modelling Electricity Demand Forecasting in Iraq

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Abstract
This study presents a suitable approach to forecast the demand for electricity and the related statistical issues of its prediction accuracy. An econometric method has been developed to capture and simulate different patterns in the available data. The case study predicts demand for the Iraqi power system in a convenient and robust way, reflecting the country's future economic and demographic development. The result clarifies that an optimal model should have a high-quality representation of this challenging problem, which deals with a range of uncertainties.

Keywords: Electricity demand forecasting, Iraq

1. Introduction

Electricity demand forecasting is an essential issue in the electricity planning systems. It is not a new area of research, as the last three decades have seen international growth in the power supply, which led to a blast in the number of electricity planning studies. A wide variety of models has been proposed to improve load demand forecasting accuracies. They vary in the complexity of functional forms and estimation procedures, taking into consideration the applicable time horizon. Many of these models are developed for both short-term and long-term forecasting. The models are developed using traditional methods such as time series and regression models and recently apply also new methodologies, including artificial neural networks and expert systems.

In this study, differences in modelling aspects are investigated and the high degree of dependence on exogenous factors is explained, especially relating to economic growth-related varieties in the long term. An optimal model for long-term forecasting has been investigated to predict the Iraqi electricity demand accurately. This resulting forecasting is convenient and robust in that it reflects the country's future economic and demographic development. The study develops a forecasting model and presents a detailed explanation of the faced expectations and required transformations. The prediction accuracy of the model, alongside its modelling compatibility to the data, is also discussed.

Many studies are dedicated to the models of electricity demand forecasting and will be reviewed in the next section. Section 3 deals with the problem definition and the data analysis using econometric analysis, whereas improving the long-term load forecasting is presented in section 4. Section 5 concludes.

2. Models for Electrical Load Demand Forecasting

During the past few decades, various methods for electricity demand forecasting have been developed and implemented. All of them have witnessed varying degrees of success (Hahn et al., 2009). Statistical models are widely used to yield accurate predictions for the evolution of electricity demand in most developing countries. The influences drawn from economic time series tend to be highly correlated with electricity consumption. The electricity unit prices also have a high correlation, so using econometric and multivariate regression models is conventional to study electric demand prediction (Wolfram et al., 2012).

A review of the most common approaches and categorisation of electricity demand forecasting methods is presented by Singh et al. (2013), who classify these methods into three major groups: traditional forecasting, modified traditional and soft computing methods respectively. The study of Soliman et al. (2010) explains and confirms that econometric testing and extrapolation are the main methods used to forecast, by modelling the relationship between the load demand and the GDP, population, cost of electricity, as well as many other factors. Ghods et al. (2011) present an overview of practice methods by defining different models and methods of long-term load demand forecasting. However, electricity demand can be forecasted by all these methods. The amount of historical data and the variables they require for forecasting make them different in terms of accuracy from one case to another.

In an overview of long-term electricity demand forecasting methods by Feinberg and Genethliou (2012), it was shown that econometric modelling, end-use modelling and their combinations are among the most used methods. These approaches depend on economic factors, such as per capita incomes, employment levels, electricity prices, etc. In the long term, many conventional methods cannot correctly present complex non-linear relationships between the electric load demand and the combination of factors that influence it.

The so-called ANN approach can provide good performance when dealing with complex non-linear problems (Hernández et al., 2014). Some types of these models are based on artificial intelligence, which draws upon the neural networks approach. The results show that their successful application will depend on the nature and quality of the data and the development of knowledge and validation (Saravanan et al., 2012). The ANNs can learn to approximate any function, just by using example data, representing the desired task and representing a good approach that is potentially robust and fault-tolerant (Badran et al., 2017).

Moral et al. (2017) introduced a new prediction procedure to improve and develop the methods meant above by combining long and short-term features that are incorporated by adopting chronological models. In addition, Hong (2013) classified the models and create a new model with more accurate forecasting after conducting their data analysis.

The explanatory forecasting approach is another method with a wide variety of forecasting applications that comes with scenario analysis. Scenario planning depends on studying uncertainties that are differ from the conventional method to forecast. Bazilian et al. (2012) construct a basic scenario depending on historical trends and various factors for planning energy access in the African Sahara. The result shows that a threefold increase in an installed generation capacity is being required until 2030.

For the Iraqi electricity demand forecasting, the Ministry of Electricity (MOE), in cooperation with consulting firms and experts, has constructed three scenarios for the long-term (MOE, 2010). These scenario-based forecasts include the expected economic growth and the change in the price of electricity. Then load forecasting was updated in 2012 comprising again multiple scenarios, including the expected values of the GDP growth, which reflected the predominant role of revenues from the oil sector in the Iraqi economy (Energy Agency, 2012).

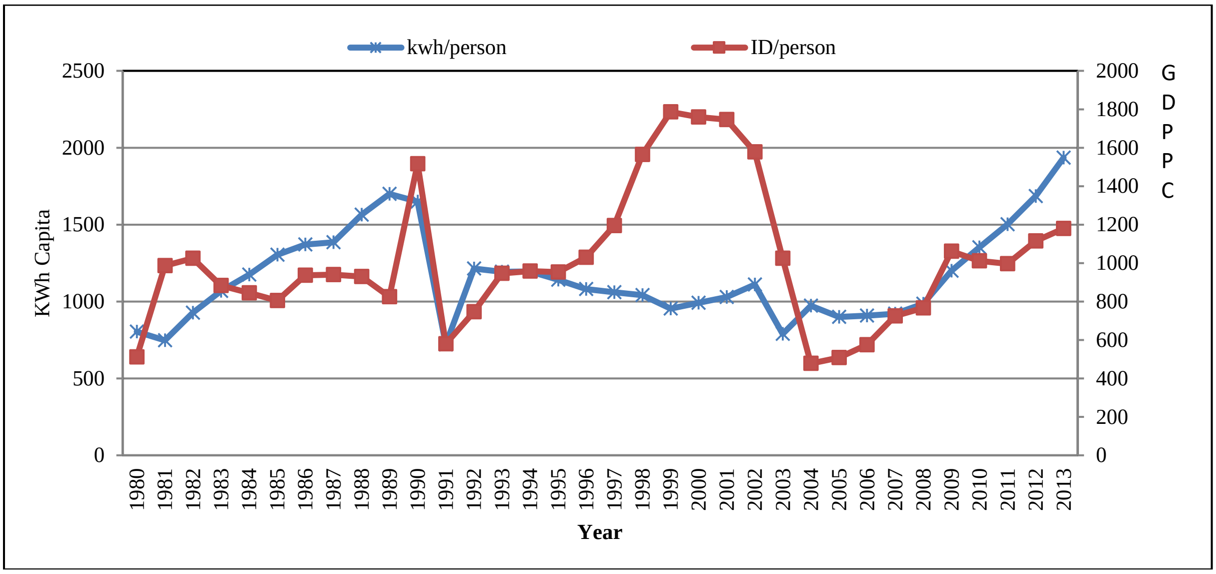
From this review, most research has adopted traditional methods such as the econometric regression approach and clarified that accuracy in electric demand forecasting varies significantly across the electricity consumption in each country. Therefore, this study provides a suitable forecast of long-term electricity demand by investigating multiple econometric method models.

3. Problem Definition and Methodologies of the Empirical Analysis

The electricity supply in Iraq increased rapidly between 1967 and 1979 due to the fast-growing economy that brought prosperity and stability. The GDP growth was one of the most significant drivers of the rise in electricity demand. Meanwhile, the generating capacity and electricity network were expanded to satisfy the increased demand (MOE, 1990). The current situation of the electricity system is in a crisis mode as the supply had fallen short of demand starting from the early 1991s, and the gap expanded then due to three decades of war and the lack of investment.

After the US-led invasion in 2003, the power system has witnessed significant damages. The economic stability situation of Iraq has remained below expectations, although its GDP has almost doubled ten times since 2003. The production of electricity becomes bigger than before. However, supply is still insufficient to meet demand; power cuts are a daily occurrence and the use of private diesel local generators is widespread. Figure 1 plots the electricity consumption and the GDP per capita.

Figure 1. Electricity consumption and GDP (1980-2013).



Data source: *The MOE of the Republic of Iraq.*

As there are multiple varying influencing factors, some of which impact the electricity demand for the short term and others in the long term, electricity demand prediction is a highly complex mission. One of the difficulties in building an accurate forecasting model is determining adequate inputs and predicting future developments. In this case, the most critical step is to look for the data pattern and quality to develop specific methodologies, models and rules to forecast. Weron (2006) discusses forecasting with precision and argues that this can be done successfully when not employing comprehensive algorithms and processing quality data that are astutely analysed and implemented.

4. Econometric Regression Method

Multiple regression models measure the simultaneous influences of many independent variables upon one dependent variable. An attempt has been taken in the present section to forecast the electricity's long-term demand consumption per capita by employing the well-established multiple linear regression econometric models after testing economic hypotheses with rather basic statistical models.

The statistical approach, such as matrix correlation, was used to analyse and construct a suitable relationship between the variables in Table 1. As a result, qualitative variables are incorporated into the model by using dummy variables. After that, the models' building of a causal relationship between the dependent and independent variables is established.

The Ordinary Least Square (OLS) method is used to estimate the regression model. The general form of the linear relationship between the dependent and independent variable can be expressed as follows (Rawlings et al., 1998):

$$Y = \beta_0 + \sum_{i=1}^{I} \beta_i X_i + \varepsilon \tag{1}$$

where β_0 is the intercept which is the value of $E(Y_i)$ when $X_i = 0$, β_i are the model parameters that represent the rate of change of $E(Y_t)$ per unit change in X_i. Then, the residual (ε) assumed to be a randomly distributed variable with mean zero and variance σ^2. Then, the OLS method is used to generate the coefficients.

4.1 Determining Explanatory Variables

In the Iraqi electricity system analysis, we examined the economic and demographic growth and the electricity price as explanatory variables, identified in Table 1 below. It has been figured out that the shortage in electricity supply is interesting to be addressed. This requires adding a dummy variable to represent the effect of the load shedding.

Table 1. Dependent and independent variables.

Y: Electricity consumption per capita
X_1: GDP per capita
X_2: Electricity price
X_3: Load demand
X_4: % shortage of electricity (dummy)

The developed demand forecasting models are used to examine the linear correlations between candidate variables that are thought to be essential factors. This is based on economic and statistical theories by Montgomery et al. (2012). The variables explain the fluctuation of electricity consumption, and the matrix of correlation coefficients between these variables is presented in Table 2 below.

Table 2. The correlation between the forecast and explanatory variables.

	X_1 (ID/person)	X_2(ID/kWh)	X_3(LD)
Y (kWh / person)	0.158	0.382	0.351
P-Value	0.372	0.026	0.042

The relationship between explanatory variables and electricity consumption (kWh/person) is statistically significant for x_2 and x_3.

4.2 Expectations of Explanatory Variables

GDP Expectations and Population

The GDP growth reflects the predominant role of revenues from the Iraqi oil economy, and the different forecasts for oil supply correspond, thus producing different results for the national economy. However, the global oil market price has recently seen a noticeable decline. GDP assumptions for the worst-case scenario are determined at a level of 3%. This level is less than the general expectation. In the case of the optimistic scenario, the assumption is based on Iraq going back to a path closer to an average non-OECD growth since 1980, and then maybe arriving at a growth level of 6%.

The two main scenarios are adopted to analyse the economic impact of using GDP to forecast electricity demand. Iraq's population growth expectation is in the range of 2.8-3%, as is extracted from the statistical data, and the stability of this range reflects the impact of security and immigration.

Electricity Prices Expectations

In 2008, the electricity price rose ten times and it has risen again since 2014. It is expected that the electricity price may rise to cover the variable costs of the supply. This is based on the strategy of the MOE for future reference. In order to address the assumed reduction of the rate of electricity price subsidies, it was assumed that the price rises more than 2% each year to cover the operation cost.

Percentage of Electricity Shortage Expectation

As a result of the challenges in economic and security issues, a delay in completing new projects and the shortage in the existing electricity supply could be caused. Two scenarios are proposed to expect the percentage of the shortage in supply. It is assumed that in 2017 the demand meets the supply. The percentage of the current shortage situation gradually declines each year until it reaches a zero value.

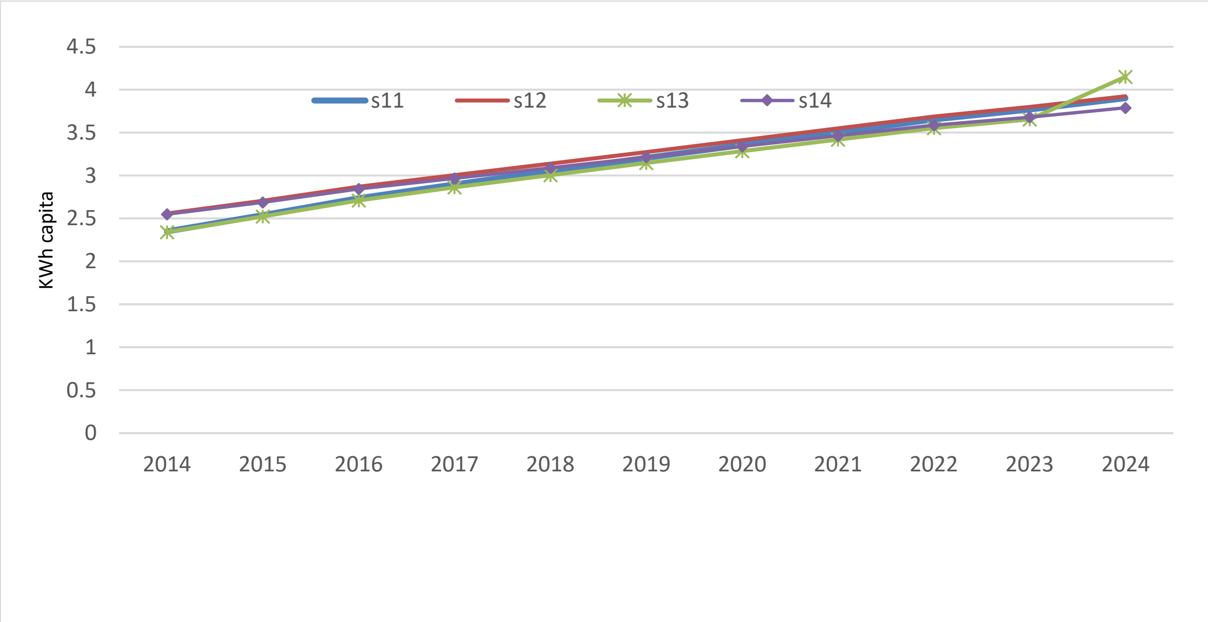
Peak Load Demand Expectations

This variable has been critical in formulating the model to obtain an accurate forecast from the analysis and interpretation of the results. The linear regression procedure is used to obtain a future value of this variable based on the historical time series. The below formulation is used to compute the expected load demand:

$$LD = \frac{\sum_{i=1}^{8760} MW_i}{8760 * LF} \tag{2}$$

The average Load Factor (LF) was 63% for the period (1980-1990), which is more stable. Based on these analysis results, the value of LF is adopted, together with the prediction value for consumption, to forecast the maximum(Peak) load demand. Observing the results presented in Figure 2, the curve of s_{11} and s_{12} scenarios have an annual GDP growth of 6% with a X_4 variable non-zero and zero, while the s_{13} and s_{14} curves assume an annual GDP growth of 3%.

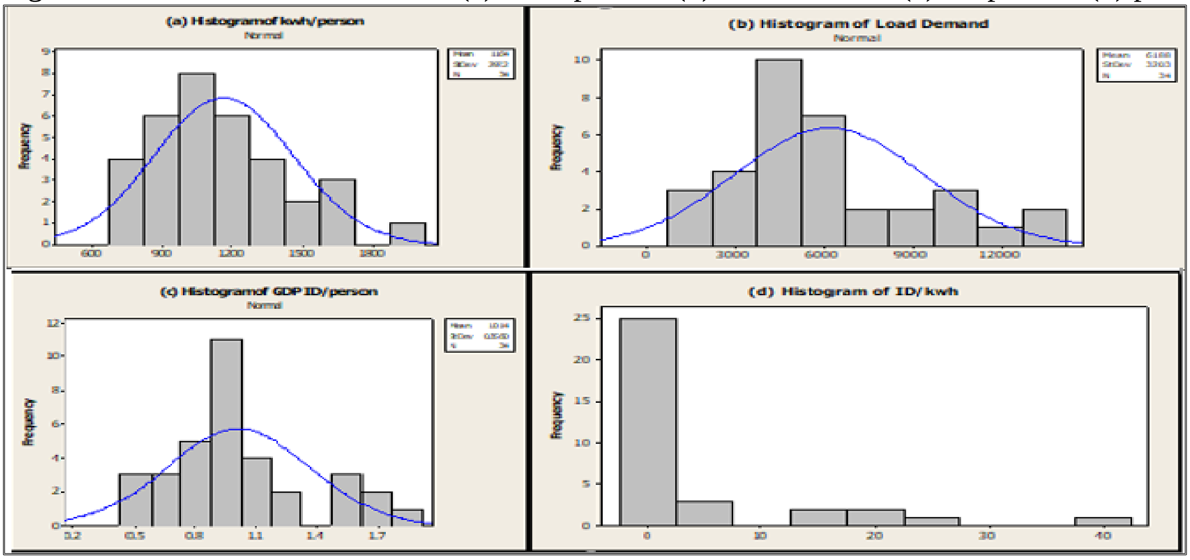
Figure 2. The LF with multiple scenarios.



4.3 Linearity of variables (logarithmic transformations)

Using the logarithm of one or more variables instead of the unlogged form makes the non-linear relationship more effective while still preserving the linear model. Moreover, these transformations are a convenient means of transforming a highly skewed variable into a more approximately normal one. The histogram in Figure 3 illustrates a normal distribution pattern for each variable under study, except the variable of electricity price that has a significant right skew, which means that most data of the variable clusters have low values. Therefore, the natural logarithm of this variable is required to convert it to normal.

Figure 3. Pattern of the actual data: (a) kWh/person, (b) load demand, (c) ID/person, (d) price.



4.4 Estimating the Econometric Regression Model

The least-square method was used to estimate the regression coefficients of the linear relationship between the dependent variable (Y), which denotes the sequenced values of electricity consumption per capita, and independent variables (X_i), where i=1 to 4 represent GDP per capita, an average electricity price, one lag of load demand and the dummy variables, respectively. This procedure is used to determine the best-fitted line of the data by minimising the sum error squares, as shown in the following equation:

$$RSS(\beta) = \sum_{i=1}^{n} (Y_i - f_\beta(X_{i,.}))^2 = \|Y - \hat{X}\beta\|_2^2 = min_\beta!, \tag{4}$$

with $\hat{X} = (1X)$. The minimising problem has one optimal solution in equation (4) under the condition that $\hat{X}$ is invertible, as shown in equation (5):

$$\hat{\beta} = min_\beta\left(RSS(\beta)\right) = \left(\hat{X}^T\hat{X}\right)^{-1}\hat{X}Y \tag{5}$$

where $\hat{\beta}$ represents the least-squares estimator.

The residual term is checked for stationarity after the empirical model is estimated. In the case of the non-stationarity of the residual, the dependent and independent variables are adequately transformed. The models are modified according to the behaviour of the residuals of the forecasting. The statistical attributes measure the goodness-of-fit of the regression model estimation like the coefficient of determination R^2. The latter interprets the total proportion variation in Y, which is explained by all explanatory Xi variables taken together; the F-test is used to measure the overall model significance.

The T-test is used for individual variable slopes to show whether there is a linear relationship between Xi and Y variables. The test statistic for each variable should fall in the rejection region (p-values < .05) and the Durbin-Watson (DW) test, which is a statistical approach that tests the null hypothesis and that the errors from an OLS estimation are not autocorrelated against the alternative that the errors follow an AR process, ranges from 0 to 4. A value close to 2 indicates non-autocorrelation. More information is available with the author upon request.

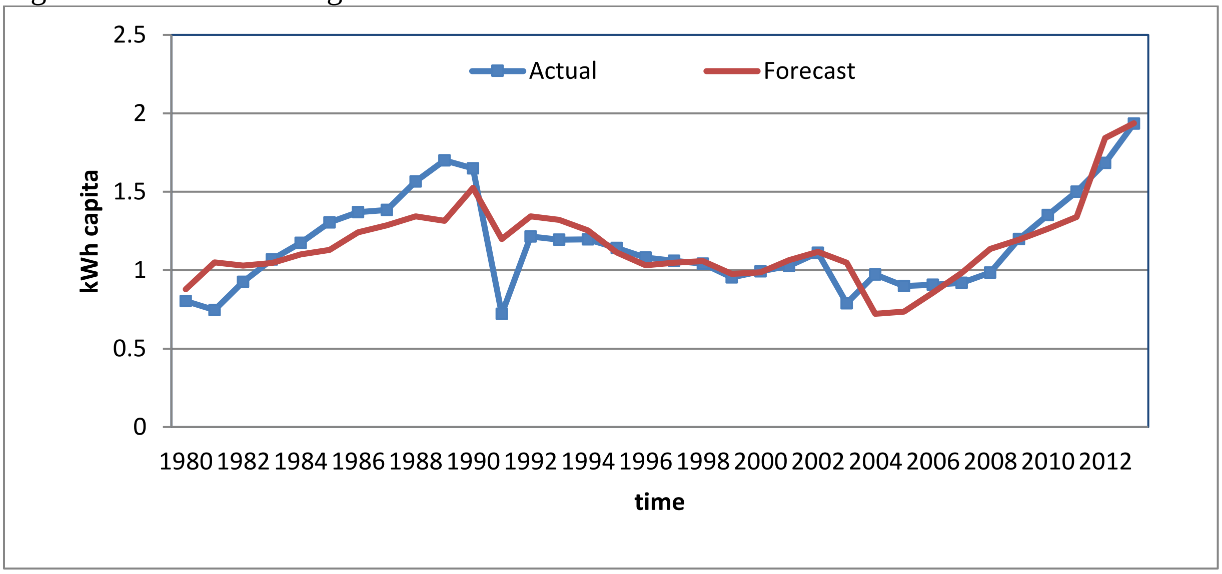
4.5 Results and Discussion

It is observed in the regression model's estimation that the electricity price and shortage in supply have a negative effect, while the GDP per capita and load demand have a positive effect on the energy demand. Four models were being examined and investigated to obtain an accurate model. In model (1), the set of independent variables (X_1, X_2, X_3, X_4) is selected based on the statistical test of the relationship between these variables in multiple regression models. The following formula can be created.

$$\hat{Y} = 0.22X_1 - 0.200\log(X_2) + 0.158X_3 - 1.286X_4 + \varepsilon \qquad (6)$$

The fitting of OLS model 1 is presented in equation 6, with the fitting curve shown in Figure 4.

Figure 4. The curve fitting of an OLS model.



It is essential to consider the different scale of the variables when interpreting the influences of the explanatory variables. The standardisation of the regression coefficients is computed in the following form:

$$\beta_i^s = \beta_i \left(\frac{S_{X_i}}{S_Y}\right) \qquad (7)$$

where β_i is the estimation value, S_{X_i} is the standard deviation of variable i, and S_Y is the standard deviation of Y.

Table 3. The standardisation regression coefficients.

β_i	GDP	Price	Shortage	Lagged load demand
β_i^s	0.265359	-0.96981	-0.65868	1.711428

It is evident from Table 3 that the 0.97 standard deviation change in Y is caused by a change in standard deviation in price. Therefore, the price and lagged load demand are essential in explaining the consumption of electricity.

Model 2 employs the same set of explanatory variables in model 1, yet excluding X_3, which represents one lag of electricity load demand because it has a significant correlation of 80% with X_2, the price of electricity. The indicators of the fitting OLS model are presented in Table 4, where the coefficient is very statistically significant, but the low statistical value of the DW statistic indicates a high autocorrelation in the OLS residual.
Model 3 suggests a form of the log-linear transformation used to predict the dependent variable Y. The estimation results are presented in Table 4 and indicate the coefficients to represent the relationship between the dependent and explanatory variables and the statistics for a T-value, with a P-value for each coefficient. With an R^2 of approximately 98%, the F-value (6.885) is significant. However, the model yields a lower value of the DW statistic approximately to zero, and this means a high serial correlation with the OLS residual.
Model 4 is significant for the second differences of the electricity price series at 10% with a P-value of .07. The series with two lags is selected to represent the explanatory variable instead of the original series. The model coefficient is estimated in Table 4. The model yields an OLS consistent solution with model 1. The results show that R^2 is equal to 97%, the t-values of the regression coefficients are significant, and the signs of these coefficients are correct. The DW statistic is up to the value of 1.24.

Table 4. The statistical attributes of four models.

T-test	Constant	X1	X2	X3	X4	DF	DW	F	P	R^2
Model (1)	NA	3.34	-7.7	11.66	-3.76	30	1.41	401.9	0	98.16%
Model (2)	NA	6.61	-3.12	NA	2.8	31	0.45	91.64	0	89.85%
Model (3)	7.45	9.26	5.04	10.69	3.10	29	0.639	6.885	0	97.7%
Model (4)	NA	2.4	-6.7	10.86	-3.9	28	1.242	329	0	97%

However, the statistical measurements of the F-value, R^2 and DW for OLS estimation model 1 are more significant and more accurate than for model 4. Based on the comparison of three periods forecasting these two models, model 1 is more accurate to represent the regression relationship to predict the electricity demand. This is shown by using the essential measures of accuracy MAPE and MSE. For model 1, the MSE is 9% better than model 4. However, the MAPE (7%) of model 4 is better than model 1.

4.7 Forecast and Confidence Intervals

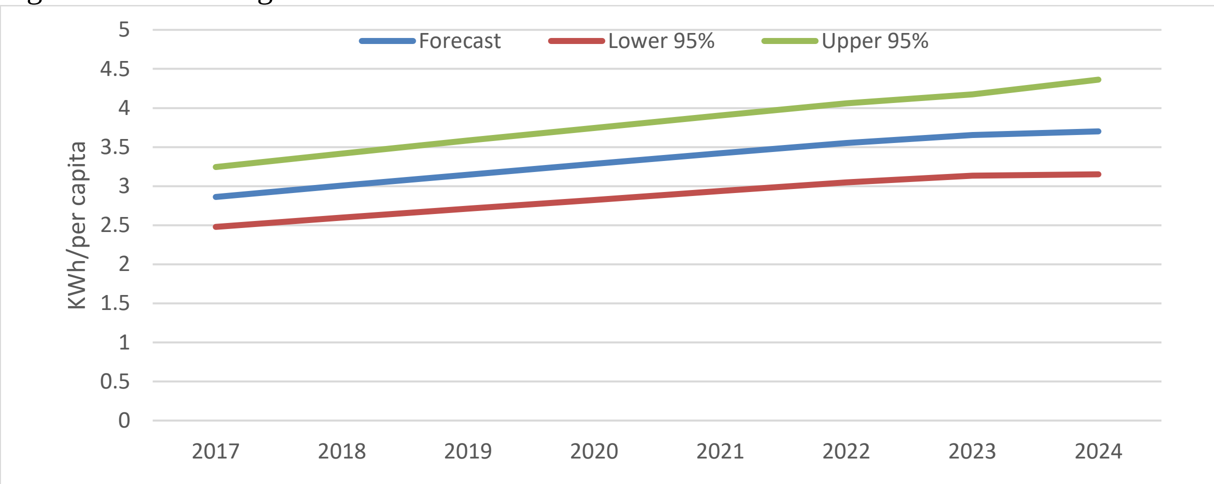
The future values of the explanatory variables have to be provided. A regression model is applied to predict the value $\hat{Y}$ and to determine the accuracy range of the forecast by evaluating the standard error of the forecast using the following equation:

$$S.e\left(\hat{Y}_0\right) = Se\sqrt{1 + \acute{c}(\acute{X}X)^{-1}c} \qquad (8)$$

Here, c is the new value for the explanatory variables represented by vector $[1\ X_1^*\ X_2^*\ \dots . X_k^*]'$. Model 1 is adopted to generate a forecast for the electricity demand per capita depending on future values of explanatory variables vectors, above which they often have to be forecasted themselves. Then, the standard error estimation is used to generate the confidence interval of the actual forecast.

The forecasts and 95% confidence intervals are illustrated in Figure 5 for the most likely scenario of the explanatory variables. In this analysis, the structure of the forecasting model has been adapted to accommodate some specific features of Iraq's electricity demand situation.

Figure 5. Forecasting and confidence interval.



5. Conclusion

It has been shown that the best forecasting model requires an understanding of all the factors that affect the phenomena of electricity demand. These factors were studied and taken into consideration when each of the models was being applied. Also, it was shown that each model has different characteristics and capability in terms of capturing and simulating different patterns of behaviour which exist in load demand.

Finally, this study, conducted in the Iraqi Ministry of Electricity, revealed that the econometric method applied here would be the best forecasting model if large fluctuations are encountered in economic factors. Whereas this has been true for Iraq in the studied period, it will no doubt also be relevant for other countries at the same time.

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Special Issue Title:

CoViD-19-Pandemic, Climate Change and Biodiversity Loss - System Crisis Events and their impact on Energy Economics and Policy in Central Europe

Special Issue Editors:

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Special Issue Information:

Dear Colleagues,

The pandemic may be a so-called "trigger event", supporting the increase in importance of sustainable energy supply, and increase the awareness of the importance to deal with so-called "exogeneous factors". X-events occur when surprising (unforseen, unforeseeable) initial events cascade through socio-technical and economical systems. CoVid-19 pandemic affects ecomies and individual lives of millions of people. For instance, the pandemic and lock-downs change beahvioral patterns and reduced industrial activities, supports digitalization and so so. While lockdowns and reduced economic activity may lead to a reduced energy demand, individual households and certain business sectors may become more dependent on stable energy supply.

However, in the mid- and long-term, other issues, such as catastrophic climate change and large-scale biodiversity loss are likely to disrupt routines and established system conditions. The unsustainable engagement with ecosystems is endangering the prosperity of current and future generations.

To this end, we are seeking for contributions of scholars in order to better understand X-events. This includes two dimensions, i.e. the probability of suprising initial events and the resilience of (nested) systems. In complexity research, three factors play the main role: feed-back, variability and robustness, but we welcome also contributions from other perspectives and theoretical framework. We invite research papers, theoretical papers, reviews, case studies, also from a multidisciplinary perspective, on the following general topics of interest:

- Stability / sustainability of energy supply.
- Incentives for development of independent energy production.
- Photovoltaics – development of the market.
- Energy policy – transnational co-operation.
- Lessons from CoViD-19 for energy supply – are we able to deal with unexpected, extreme events?
- Impact of CoViD-19 on investments and energy market.
- Impact of CoViD-19 on energy use.
- Impact of CoViD-19 on energy poverty.
- Changes in the economic structure and impact on energy markets
- Sustainable provision of energy for transport in the context of stability of energy grids as electro-mobility is expected to increase, as well as the environmental impacts.
- Social and economic paradigms, technological development and solutions for energy provisions from the point of view of sustainable energy supply
- Large-scale infrastructural, technological and economic transformations required to achieve the goal of climate neutrality by 2050.

Prof. Johannes (Joost) Platje
DI. Markus Will
Guest Editors

Keywords:
- Black Swan management.
- X-events.
- Sustainable energy supply.
- Transformations for energy sustainability.
- Transformations for climate neutrality.
- Renewable energy markets.
- Transport and energy supply.
- CoViD-19.

Planned Paper Information:

1: Title: Hydrogen as a technological saviour - A systematic analysis of possibilities and limitations for a climate-neutral energy supply
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2: Title: The impact of COVID-19 pandemic on transport behaviour and energy consumption of transport activities of households
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