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Trend and Cluster Analyses of Electrical Energy Demand, Supply, and Consumption in Masbate Province

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A B S T R A C T

This study investigated the electrical energy demand, supply, and consumption patterns across twenty-one (21) municipalities in the Masbate province from January 2019 to August 2024, on a monthly basis. Through the utilization of the eleven (11) time series model, the cubic model was found to be the best fit for demand achieving 31.49% accuracy and for supply with 31.39% predictions, while the quartic model with 32.60% accuracy for consumption, with R^2 used to evaluate the model performance. Through the application of the best fit time series models this study identified the nearly co-linear trend lines of the electrical demand and consumption which showed a clear difference with the trend lines of the electrical energy supply. It also developed predictive models for a whole year of September 2024 to August 2025. Furthermore, the utilization of cluster analysis showed that Masbate City has the highest electricity demand, supply, and consumption, contrasting with municipalities such as Esperanza which exhibit consistent low electricity use. This study provided insights that aimed to inform policymakers on enhancing energy management, that addresses ongoing power challenges while supporting sustainable development goals (SDGs) of Masbate province. Meanwhile, the limitations included a reliance on raw historical data which might affect the reliability of the results; misleading the predictions if significant changes occur, along with findings specifically focused to the province of Masbate, which may not be applicable and relevant to the other regions with different geographical conditions and infrastructural developments.

Keywords: Electrical Energy, Demand, Supply, Consumption, Trend and Cluster analyses, Time-Series Models, Masbate

1. INRODUCTION

Conducting a study that accomplishes a deep understanding on the electrical sector in the province of Masbate with the islands of Ticao and Burias, is deemed crucial not only for future sustainability and effective policy- and decision-making but is also strongly emphasized due to the ongoing problems with brownouts experienced by the residents for the longest time. Hence, the proponent along with the project team constructed quantitative research—studying the electrical energy demand, supply and consumption with the aim to forecast future energy values of the province as a whole in the time frame of September 2024 to august 2025, using the identified best fit model, and with another objective to determine each electrical energy demand, supply and consumption of its twenty-one (21) municipalities. This research was created with the foundations made by an extensive literature review, accompanied with the statistical instruments according to the basis recommended by the academic contributions of Pelka (2020) of time series models and cluster analysis supported by the studies of Kaur and Gabrijelčič (2022) in the field of mathematics predictions. The historical data analyzed from the given dates of January 2019 to August 2023 provided by the respective electrical energy cooperative of each island. The results of this study presented valuable insights into the energy needs, enabling more informed policy decisions and infrastructure planning, addressing the issues with electricity, and serving as groundwork into guiding future researchers planning to delve and examine the electrical energy industry in the province of Masbate.

1.1 Statement of the Problem

The general aim of the study is to understand and analyze the electrical energy demand, supply, and consumption in Masbate Province. There are five specific objectives in this research which are: (1) Determine the electrical energy supply, demand, and consumption trend line in the Province of Masbate from January 2019 to August 2024. (2) Compare the supply, demand and consumption of electrical energy in the year January 2019 to August 2024 monthly. (3) Construct a time series model that predict the demand, supply, and consumption of electrical energy in Masbate Province from September 2024 to August 2025 using the following time Series models: Linear, Quadratic, Cubic, Quartic, Quintic, Exponential, Logarithmic, Power, Moving Average, Exponential Smoothing, First Auto-regression (4) Identify the best fit time series model on the electrical energy demand, supply, and consumption in Masbate Province from September 2024 to August 2025. (5) Determine the highest, average and lowest electrical energy demand, supply, and consumption of each municipality of Masbate Province after conducting cluster analysis.

2. METHODS

2.1 Research Design

This study employed a descriptive-predictive design to understand the trends in consumption and production, as well as to determine their value using the best-fit time-series model.

2.2 Data Sources

In this study, data was obtained from Bureau of Fisheries and Aquatic Resources and Philippine Statistics Authority.

2.3 Research Procedure

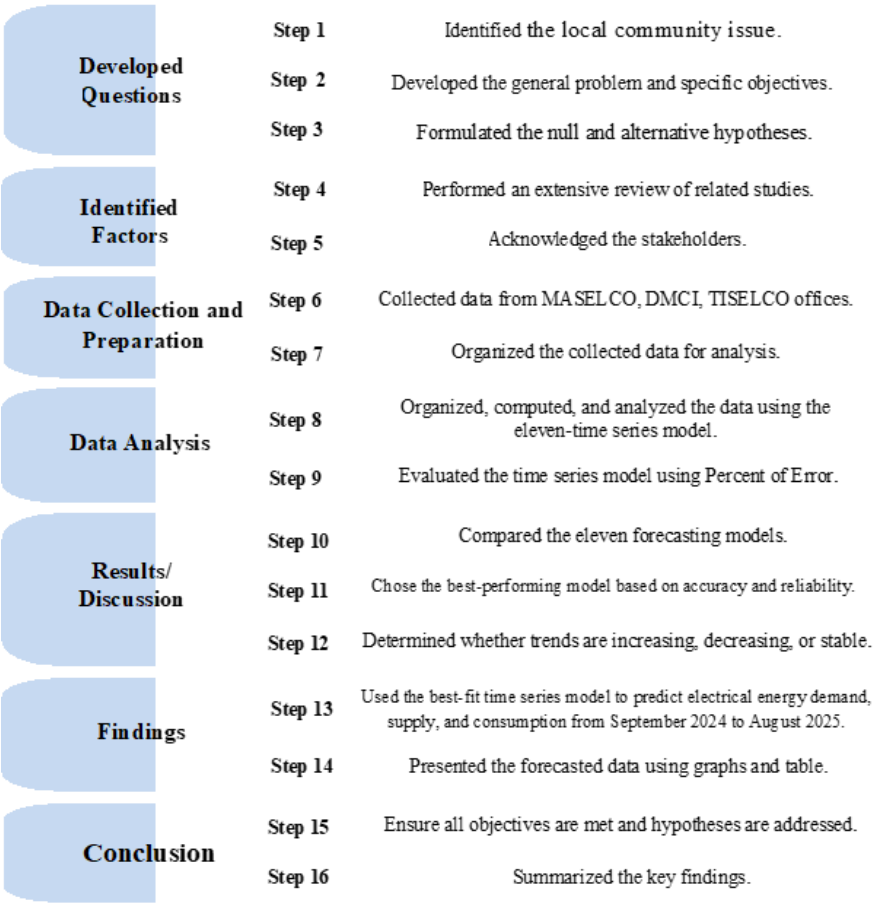

Figure 1. Flowchart of the Research

To address the general problem statement—predicting the future forecast of electrical energy demand, supply, and consumption in the province of Masbate using the best-fit time series model—a systematic process consisting of sixteen (16) steps further grouped into seven (7) categories was followed. Each step is to be finished before advancing to the next task. The process was completed as follows:

First, the research problem was defined. By examining the current issues affecting the local community. The general problems and specific objectives were subsequently formulated. This was followed by the development of both the null and alternative hypotheses.

Second, components such as the review of related literature and the research design were devised. This process included extensive reviews of related studies and mapping out the overall research framework. While working in this phase, the stakeholders and individuals who are impacted by the research are considered.

Third, in data collection the researcher gathered the information needed, through meetings at the offices of MASELCO, DMCI, and TISELCO in Mobo and San Jacinto, Masbate. These meetings included discussions on causes of brownouts and imbalances of electrical energy with the personnel on managerial or with supervisory roles.

Fourth, organization, computation, analysis and interpretation took place. These time series models were next used to display patterns starting from January 2019 to August 2024. The researcher used Percent of Error to evaluate which of the eleven-time series forecasting models—linear, quadratic, cubic, quartic, quintic, exponential, logarithmic, power, moving average, exponential smoothing, first auto-regression—proved to best fit.

Fifth, the results derived from the analysis were thoroughly examined. After analysis, the most accurate model was identified, cubic for demand and supply; quartic for consumption. The discussions that followed clarified what the results of the data represented, whether it indicated an increasing, decreasing, or a stable trend.

Sixth, the aforementioned best-performing models was then employed to forecast electrical energy demand, supply and consumption from September 2024 to August 2025. The computed data were next presented in visual graphs and tables, supplemented with detailed discussions of implications and explanations.

Seventh, in this phase, conclusions have been drawn, making sure to address all of the five (5) objectives made and provide recommendations for future researchers. The findings proved to be valuable in providing insights for future planning and decision-making by stakeholders and law-makers regarding the electrical energy of the province. At this final stage, the research was completed and prepared for publication.

3. RESULTS AND DISCUSSION

Section 1. Trend Lines of Electrical Energy Demand, Supply and Consumption in the Province of Masbate.

3.1A Trend Lines of Electrical Energy Demand

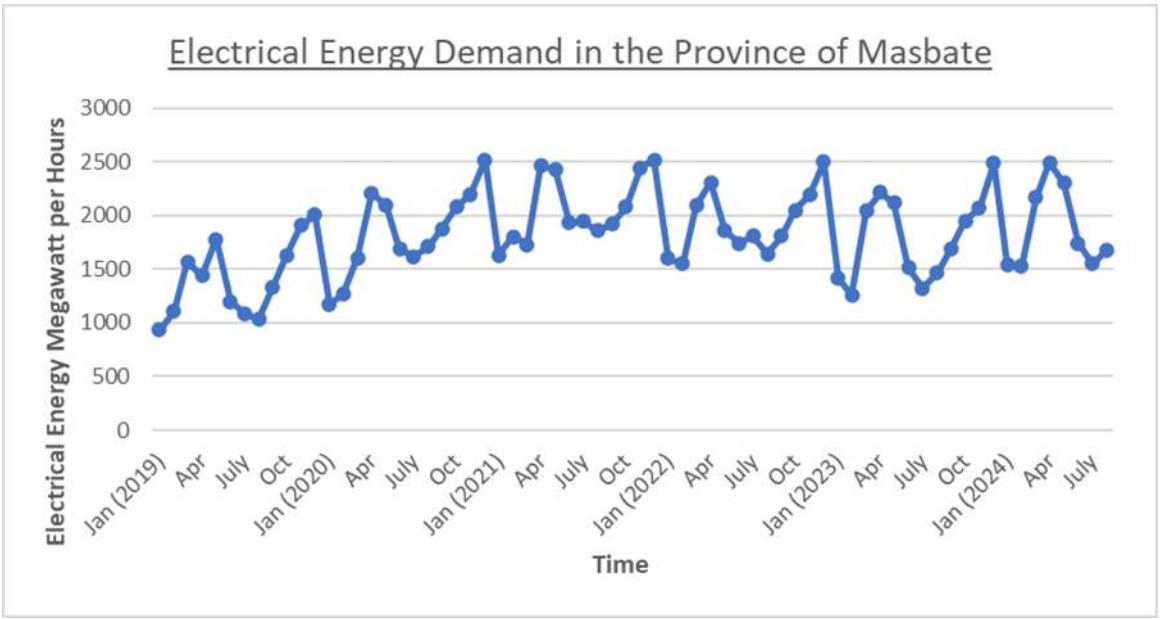

Figure 1. *Electrical Energy Demand in the Province of Masbate*

Figure 1 illustrates the demand of electrical energy in all municipalities in Masbate. The demand for electrical energy from January 2020 to August 2024 has fluctuated over time. There was a significant decrease in energy demand during two specific periods: from December to January and from April to July. The lowest recorded electrical energy demand was 932 megawatt/hour in January 2019, while the highest demand peaked at 2,518 megawatt/hour in December 2021.

3.1B Trend Lines of Electrical Energy Supply

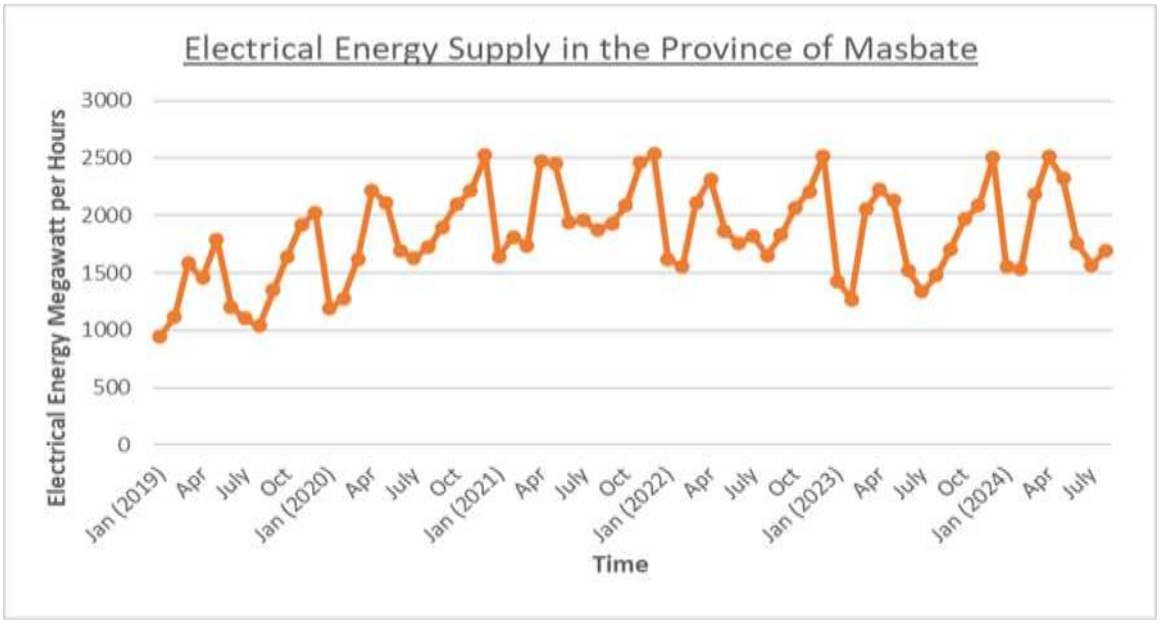

Figure 2. Electrical Energy Supply in the Province of Masbate

Figure 2 shows the electrical energy supply in all municipalities in Masbate. The demand for electrical energy from January 2020 to August 2024 has also fluctuated over time. There was a significant decrease in energy demand during two specific periods: from December to January and from May to August. The lowest recorded electrical energy demand was 947 megawatt/hour in January 2019, while the highest demand peaked at 2,535 megawatt/hour in December 2021.

3.1C Trend Lines of Electrical Energy Consumption

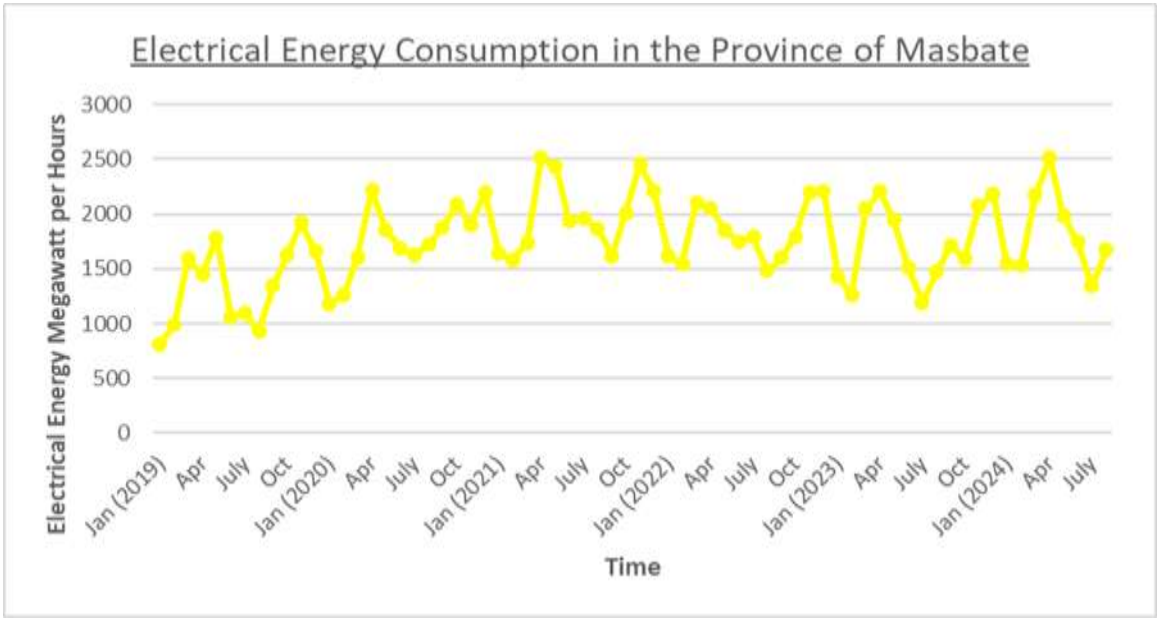

Figure 3. Electrical Energy Consumption in the Province of Masbate

Figure 3 shows the electrical energy consumption in all municipalities in Masbate. The demand for electrical energy from January 2020 to August 2024 has also fluctuated over time. There was a significant decrease in energy demand during two specific periods: from December to January and from May to August. The lowest recorded electrical energy demand was 813 megawatt/hour in January 2019, while the highest demand peaked at 2,512 megawatt/hour in April 2024.

Section 2. Comparison of Electrical Energy Demand, Supply and Consumption in the Province of Masbate.

3.2. Trend Lines of Comparison Between the Electrical Energy Demand, Supply and Consumption.

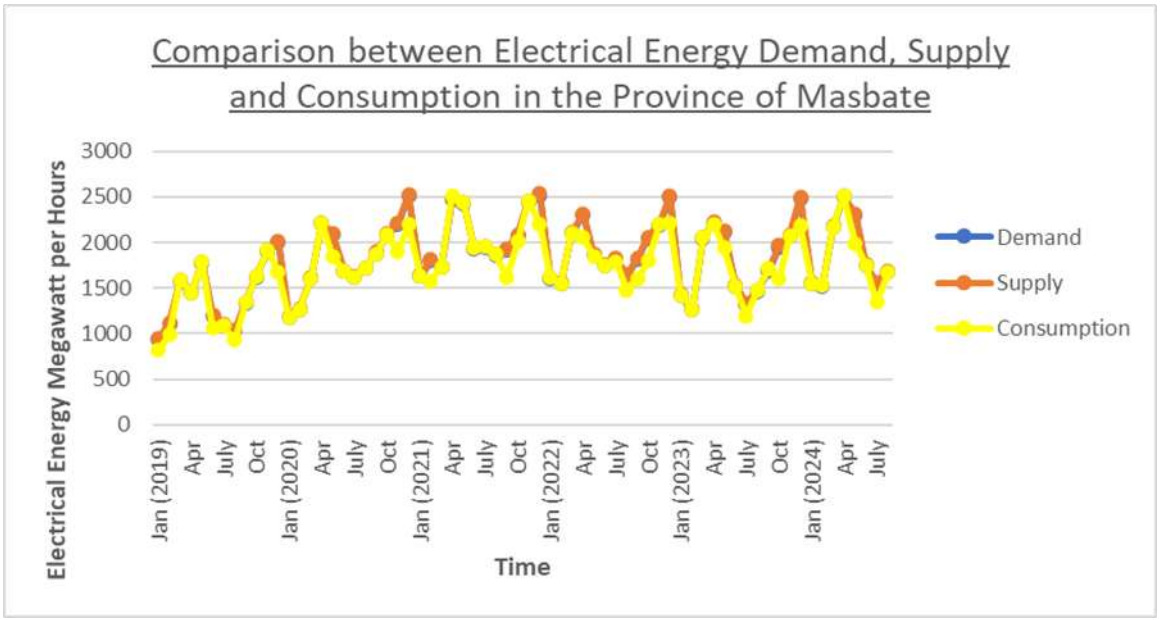

Figure 4. Comparison between Electrical Energy Demand, Supply and Consumption in the Province of Masbate

Figure 4 shows the trend lines of electrical energy demand, supply and consumption in Masbate. As shown in the figure, the demand and consumption of electrical energy are nearly collinear, with only slight variations between them. However, when it comes to supply, there is a difference between demand and consumption.

Section 3. Best Fit Model and Prediction of Electrical Energy Demand, Supply and Consumption for Sep 2024 – August 2025.

3.3A Demand

Table 1 demonstrate the accuracy of each model of the electrical energy demand. The best fit model for the electrical energy demand is the cubic time series model having an equation of $y = 0.0144x^3 - 1.9547x^2 + 80.263x + 960.83$ with 31.49% accuracy.

Appendix A. Model	**Appendix B. Equation**	**Appendix C. R^2**
Appendix D. Linear	**Appendix E. $y = 6.8019x + 1594.9$**	**Appendix F. 11.05%**
Appendix G. Quadratic	**Appendix H. $y = -0.4635x^2 + 38.78x + 1221.8$**	**Appendix I. 26.08%**
Appendix J. Cubic	**Appendix K. $y = 0.0144x^3 - 1.9562x^2 + 80.281x + 974.53$**	**Appendix L. 31.39%**
Appendix M. Quartic	**Appendix N. $y = 0.0002x^4 - 0.0195x^3 - 0.4457x^2 + 56.722x + 1061.1$**	**Appendix O. 8.84%**
Appendix P. Quintic	**Appendix Q. $y = -0.00003x^5 + 0.0056x^4 - 0.3517x^3 + 8.2488x^2 - 31.541x + 1284.9$**	**Appendix R. 1.61%**
Appendix S. Exponential	**Appendix T. $y = 1538.4e^{0.0043x}$**	**Appendix U. 10.08%**
Appendix V. Logarithmic	**Appendix W. $y = 211.49 \ln x + 1139.2$**	**Appendix X. 22.54%**
Appendix Y. Power	**Appendix Z. $y = 1149.1x^{0.1346}$**	**Appendix AA. 21.09 %**
Appendix BB. Moving Average	**Appendix CC. $y = (Y_1 + Y_2 + Y_3)/3$**	**Appendix DD. --**
Appendix EE. Exponential Smoothing	**Appendix FF. $y = O.5Y + 0.5Y_i$**	**Appendix GG. --**
Appendix HH. First-auto Regression	**Appendix II. $y = O.5Y + 0.5Y_i$**	**Appendix JJ. 25.74%**

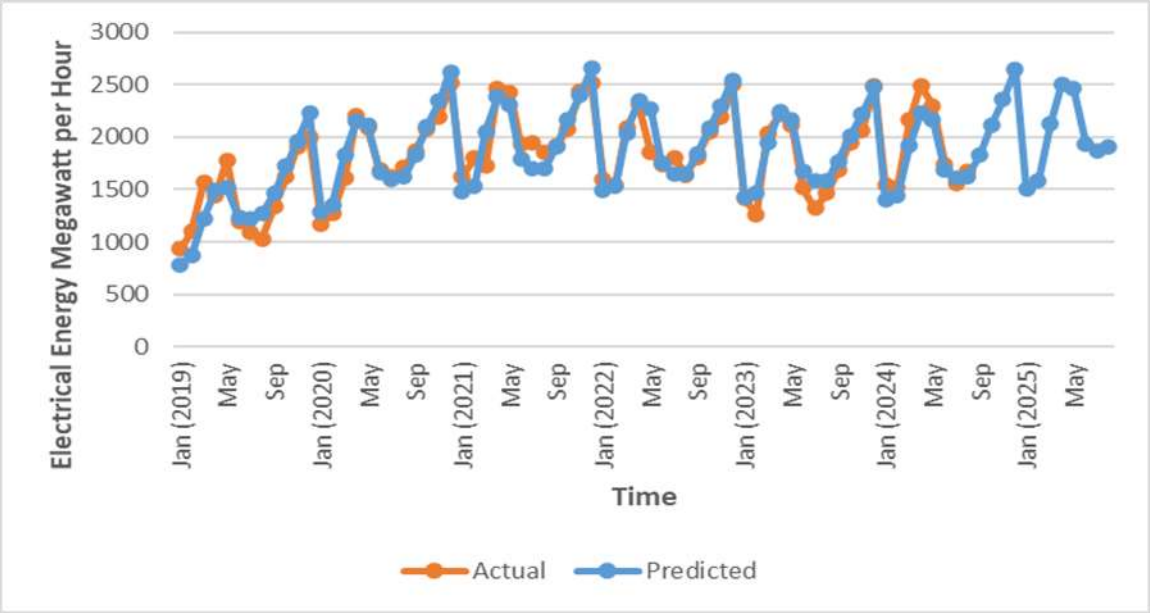

Figure 5. Prediction of Electrical Energy Demand in Masbate Province from September 2024 – August 2025 using Cubic Model

3.3B Supply

Table 2 demonstrate the accuracy of each model by subtracting the R square of the electrical energy supply. The best fit model for the electrical energy demand is the cubic time series model having an equation of $y = 0.0144x^3 - 1.9562x^2 + 80.281x + 974.53$ with 31.39% accuracy.

Appendix KK. Model	**Appendix LL. Equation**	**Appendix MM. R^2**
Appendix NN. Linear	**Appendix OO. $y = 6.8019x + 1594.9$**	**Appendix PP. 11.05%**
Appendix QQ. Quadratic	**Appendix RR. $y = -0.4635x^2 + 38.78x + 1221.8$**	**Appendix SS. 26.08%**
Appendix TT. Cubic	**Appendix UU. $y = 0.0144x^3 - 1.9562x^2 + 80.281x + 974.53$**	**Appendix VV. 31.39%**
Appendix WW. Quartic	**Appendix XX. $y = 0.0002x^4 - 0.0195x^3 - 0.4457x^2 + 56.722x + 1061.1$**	**Appendix YY. 8.84%**
Appendix ZZ. Quintic	**Appendix AAA. $y = -0.00003x^5 + 0.0056x^4 - 0.3517x^3 + 8.2488x^2 - 31.541x + 1284.9$**	**Appendix BBB. 1.61%**
Appendix CCC. Exponential	**Appendix DDD. $y = 1538.4e^{0.0043x}$**	**Appendix EEE. 10.08 %**
Appendix FFF. Logarithmic	**Appendix GGG. $y = 211.49 \ln x + 1139.2$**	**Appendix HHH. 22.54 %**
Appendix III. Power	**Appendix JJJ. $y = 1149.1x^{0.1346}$**	**Appendix KKK. 21.09 %**
Appendix LLL. Moving Average	**Appendix MMM. $y = (Y_1 + Y_2 + Y_3)/3$**	**Appendix NNN. --**
Appendix OOO. Exponential Smoothing	**Appendix PPP. $y = O.5Y + 0.5Y_i$**	**Appendix QQQ. --**
Appendix RRR. First-auto Regression	**Appendix SSS. $y = O.5Y + 0.5Y_i$**	**Appendix TTT. 25.74 %**

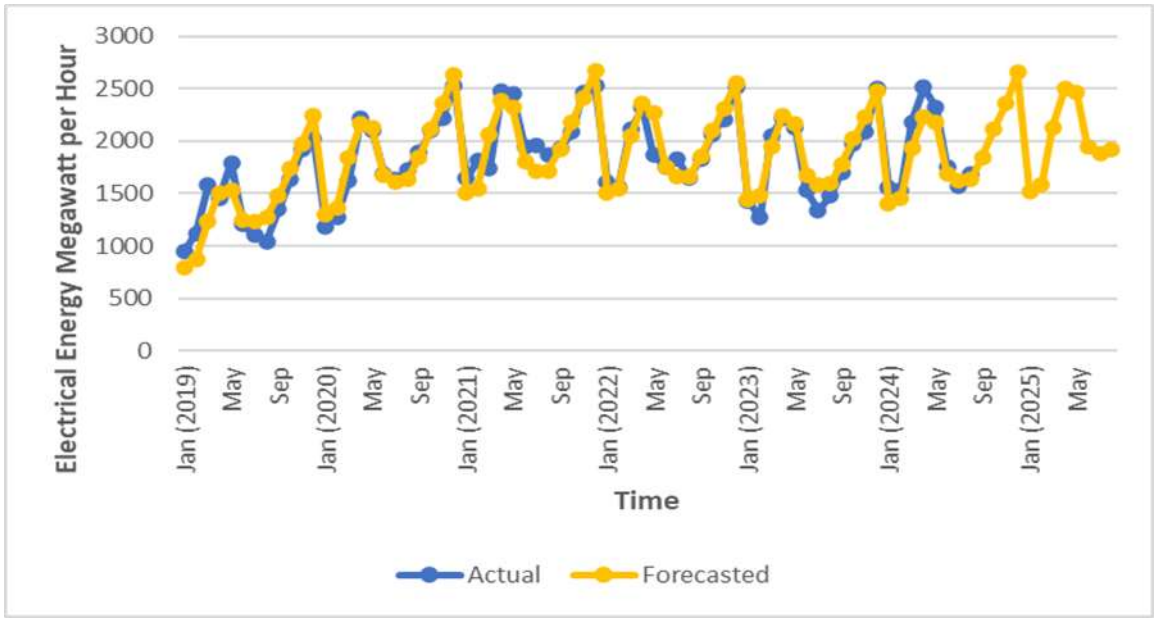

Figure 6. Prediction of Electrical Energy Supply in Masbate Province from September 2024 – August 2025 using Cubic Model

3.3C Consumption

Table 3 demonstrate the accuracy of each model by subtracting the R square and standard error of the electrical energy consumption. The best fit model for the electrical energy demand is the quartic time series model having an equation of $y = 0.0002x^4 - 0.0128x^3 - 0.7603x^2 + 61.065x + 981.82$ with 32.60% accuracy.

A.1. ***Model***	*A.2.* ***Equation***	*A.3.* $\boldsymbol{R^2}$
A.4. Linear	*A.5.* $y = 6.1517x + 1531.6$	*A.6. 10.07%*
A.7. Quadratic	*A.8.* $y = -0.4532x^2 + 37.425x + 1166.7$	*A.9. 26.90%*
A.10. Cubic	*A.11.* $y = 0.0149x^3 - 1.9977x^2 + 80.365x + 910.87$	*A.12. 32.32%*
A.13. Quartic	*A.14.* $y = 0.0002x^4 - 0.0128x^3 - 0.7603x^2 + 61.065x + 981.82$	*A.15. 32.60%*
A.16. Quintic	*A.17.* $y = -0.00003x^5 + 0.0053x^4 - 0.3289x^3 + 7.5093x^2 - 22.885x + 1194.7$	*A.18. 8.63%*
A.19. Exponential	*A.20.* $y = 1469.8e^{0.0042x}$	*A.21. 9.13%*
A.22. Logarithmic	*A.23.* $y = 199.56\,ln(x) + 1092.4$	*A.24. 22.35%*
A.25. Power	*A.26.* $y = 1082x^{0.1382}$	*A.27. 20.60%*
A.28. Moving Average	*A.29.* $y = (Y_1 + Y_2 + Y_3)/3$	*A.30. --*
A.31. Exponential Smoothing	*A.32.* $y = 0.5Y + 0.5Y_i$	*A.33. --*
A.34. First-auto Regression	*A.35.* $y = 768.8868 + 0.5553y_{n-1}$	*A.36. 28.09%*

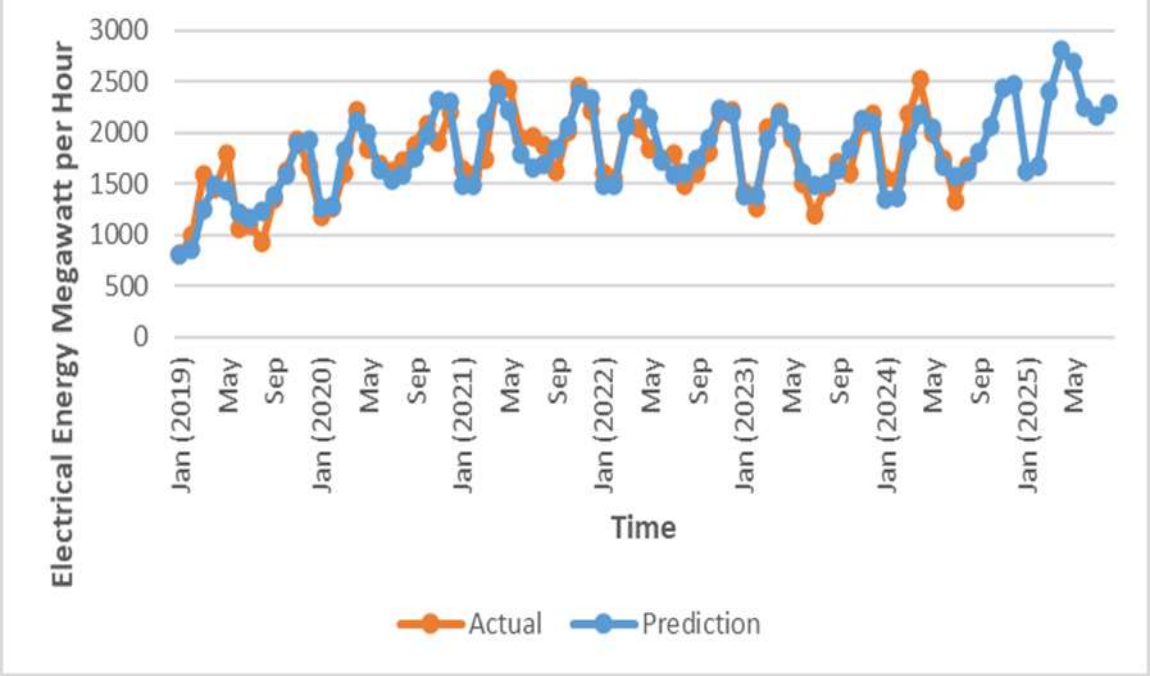

Figure 7. Prediction of Electrical Energy Consumption in Masbate Province from September 2024 – August 2025 using Cubic Model

Section 5. Cluster Analysis of the Electrical Energy Demand, Supply and Consumption by Municipalities of Masbate

a. Demand

Table 4. Cluster Analysis Result of Electrical Energy Demand of each Municipalities in Masbate

A.37. Municipalities	*A.38. Electrical Energy Demand*	*A.39. Cluster*
A.40. Esperanza	*A.41. 2289.5*	*A.42. 1*
A.43. Batuan	*A.44. 2457.7*	*A.45. 1*
A.46. Pio V Corpus	*A.47. 3080.19*	*A.48. 1*
A.49. Dimasalang	*A.50. 3333.876*	*A.51. 1*
A.52. Baleno	*A.53. 3576.43*	*A.54. 1*
A.55. Palanas	*A.56. 3736.7*	*A.57. 1*
A.58. Monreal	*A.59. 4058.6*	*A.60. 1*
A.61. San Jacinto	*A.62. 4860.48*	*A.63. 1*
A.64. Mobo	*A.65. 4985.69*	*A.66. 1*
A.67. San Pascual	*A.68. 5485.698*	*A.69. 2*
A.70. Claveria	*A.71. 6049.64*	*A.72. 2*
A.73. Uson	*A.74. 6061.84*	*A.75. 2*
A.76. Balud	*A.77. 6187.62*	*A.78. 2*
A.79. Aroroy	*A.80. 6650.92*	*A.81. 2*
A.82. Mandaon	*A.83. 6730*	*A.84. 2*
A.85. Cataingan	*A.86. 6934.6*	*A.87. 2*
A.88. Milagros	*A.89. 7424.18*	*A.90. 2*
A.91. Placer	*A.92. 7466.12*	*A.93. 3*
A.94. San Fernando	*A.95. 7466.12*	*A.96. 3*

A.97. Cawayan	*A.98. 9480.08*	*A.99. 3*
A.100. Masbate City	*A.101. 15151.24*	*A.102. 3*

Legend: 1- Municipalities with lowest electrical energy demand

2- Municipalities with average electrical energy demand

3- Municipalities with highest electrical energy demand

Table 4 shows that eight municipalities were classified as Cluster 2, which includes municipalities with average electrical energy demand. These municipalities are San Pascual, Claveria, Uson, Balud, Aroroy, Mandaon, Cataingan, and Milagros. The next nine municipalities were categorized under Cluster 1, which includes Esperanza, Batuan, Pio V Corpus, Dimasalang, Baleno, Palanas, Monreal, San Jacinto, and Mobo, implying the group with the lowest electrical energy demand. The remaining, Placer, San Fernando, Cawayan, and Masbate City belong to Cluster 3, comprising municipalities with the highest electrical energy demand.

Figure 9. Clustered Map of Masbate Province in terms of Demand

Legend: Red – Cluster 3

Yellow – Cluster 2

Blue – Cluster 1

b. Supplys

Table 5. Cluster Analysis Result of Electrical Energy Supply of each Municipalities in Masbate

A.103. Municipalities	*A.104. Electrical Energy Supply*	*A.105. Cluster*
A.106. Esperanza	*A.107. 2300.5*	*A.108. 1*
A.109. Batuan	*A.110. 2464*	*A.111. 1*
A.112. Pio V Corpus	*A.113. 3142.08*	*A.114. 1*
A.115. Dimasalang	*A.116. 3339.976*	*A.117. 1*
A.118. Baleno	*A.119. 3572.93*	*A.120. 1*
A.121. Palanas	*A.122. 3801.3*	*A.123. 1*
A.124. Monreal	*A.125. 4154.65*	*A.126. 1*
A.127. San Jacinto	*A.128. 4956*	*A.129. 1*
A.130. Mobo	*A.131. 5065.92*	*A.132. 1*
A.133. San Pascual	*A.134. 5492.098*	*A.135. 2*
A.136. Claveria	*A.137. 6112.64*	*A.138. 2*

A.139. Uson	*A.140. 6154.76*	*A.141. 2*
A.142. Balud	*A.143. 6248.34*	*A.144. 2*
A.145. Mandaon	*A.146. 6683.08*	*A.147. 2*
A.148. Aroroy	*A.149. 6751.36*	*A.150. 2*
A.151. Cataingan	*A.152. 6945.6*	*A.153. 2*
A.154. Milagros	*A.155. 7430.48*	*A.156. 2*
A.157. Placer	*A.158. 7531.18*	*A.159. 3*
A.160. San Fernando	*A.161. 7531.18*	*A.162. 3*
A.163. Cawayan	*A.164. 9526.98*	*A.165. 3*
A.166. Masbate City	*A.167. 15205.64*	*A.168. 3*

Legend: 1- Municipalities with lowest electrical energy supply

2- Municipalities with average electrical energy supply

3- Municipalities with highest electrical energy supply

Table 5 shows that eight municipalities were placed in Cluster 2, representing municipalities with an average electrical energy demand, these include San Pascual, Claveria, Uson, Balud, Aroroy, Mandaon, Cataingan, and Milagros. The places of San Fernando, Cawayan, Placer and Masbate City were grouped in Cluster 3, consisting of four (4) municipalities with the highest electrical energy demand. Finally, nine (9) municipalities were categorized under Cluster 1, including those of Esperanza, Batuan, Pio V Corpus, Dimasalang, Baleno, Palanas, Monreal, San Jacinto, and Mobo.

Figure 12. Clustered Map of Masbate Province in terms of Supply

Legend: Red – Cluster 3

Yellow – Cluster 2

Blue – Cluster 1

c. Consumption

Table 6. Cluster Analysis Result of Electrical Energy Consumption of each municipality in Masbate

A.169. Municipalities	*A.170. Electrical Energy Consumption*	*A.171. Cluster*
A.172. Esperanza	*A.173. 2341.67*	*A.174. 1*
A.175. Batuan	*A.176. 2385.74*	*A.177. 1*
A.178. Pio V Corpus	*A.179. 2602.89*	*A.180. 1*
A.181. Palanas	*A.182. 3163.4*	*A.183. 1*

A.184. Dimasalang	*A.185. 3258.516*	*A.186. 1*
A.187. Baleno	*A.188. 3471.18*	*A.189. 1*
A.190. Monreal	*A.191. 4052.03*	*A.192. 1*
A.193. San Jacinto	*A.194. 4808.23*	*A.195. 2*
A.196. Mobo	*A.197. 4917.59*	*A.198. 2*
A.199. San Pascual	*A.200. 5295.34*	*A.201. 2*
A.202. Balud	*A.203. 5529.28*	*A.204. 2*
A.205. Claveria	*A.206. 5984.45*	*A.207. 2*
A.208. Uson	*A.209. 5999.54*	*A.210. 2*
A.211. Mandaon	*A.212. 6551.54*	*A.213. 2*
A.214. Aroroy	*A.215. 6551.64*	*A.216. 2*
A.217. Cataingan	*A.218. 6936.89*	*A.219. 3*
A.220. Milagros	*A.221. 7145.69*	*A.222. 3*
A.223. San Fernando	*A.224. 7288.19*	*A.225. 3*
A.226. Placer	*A.227. 7299.2*	*A.228. 3*
A.229. Cawayan	*A.230. 9355.72*	*A.231. 3*
A.232. Masbate City	*A.233. 13641.73*	*A.234. 3*

Legend: 1- Municipalities with lowest electrical energy consumption

2- Municipalities with average electrical energy consumption

3- Municipalities with highest electrical energy consumption

Table 6 shows that eight municipalities were classified as Cluster 1, which includes the municipalities with low electrical energy consumption. These said municipalities are Esperanza, Batuan, Pio V Corpus, Palanas, Dimasalang, Baleno, and Monreal. In contrast to that, Cataingan, Milagros, San Fernando, Placer, Cawayan, and Masbate City are part of Cluster 3, representing municipalities with the highest electrical energy consumption. Another eight municipalities were categorized under Cluster 2, which includes San Jacinto, Mobo, San Pascual, Balud, Claveria, Uson, Mandaon, and Aroroy, pertaining to municipalities with average electrical energy consumption.

Figure 13. Clustered Map of Masbate Province in terms of Consumption

Legend: Red – Cluster 3

Yellow – Cluster 2

Blue – Cluster 1

Conclusion

1. The trend lines show fluctuating electrical energy demand, supply, and consumption over time. Supply and consumption decreased significantly between December-January and May-August, with peak levels in December 202 and April 2024, and lowest in January 2019. Meanwhile, the electrical energy demand declines from December-January and April-July.

2. Between January 2019 and August 2024 in Masbate, electricity demand and consumption closely matched, with some fluctuations during peak periods like October 2020 to January 2021, driven by higher energy requirements for gatherings and events. However, supply frequently fell short of both demand and consumption due to factors such as blackouts, natural occurrences, and other disruptions, resulting in lower consumption despite the high demand.

3. The following were the predicted value of demand, supply and consumption in different time series models.

	Forecast (Equation)		
Model	Demand	Supply	Consumption
Linear	$y = 6.786x + 158.16$	$y= 6.8019 + 1594.9$	$Y= 6.1527x + 1531.6$
Quadratic	$y =-0.4644x^2 – 38.832x + 1207.7$	$y= 0.4635x^2 + 38.78x + 1221.8$	$Y= -0.4532x^2 + 37.452x + 1166.7$
Cubic	$y = 0.0144x^3 – 1.9457x^2 + 80.263x + 960.83$	$y= 0.0144x^3 – 1.9562x^2 + 80.281x + 974.53$	$Y= 0.0149x^3 – 1.9977x^2 + 80.365x + 910.87$
Quartic	$y = 0.0002x^4 – 0.0193x^3 – 0.4512x^2 + 56.812x + 1047$	$y= 0.0002x^4 – 0.0195x^3 – 0.4457x^2 + 56.722x + 1061.1$	$Y= 0.0002x^4 + 0.0128x^3 – 0.7603x^2 + 61.065x + 981.72$
Quintic	$y= -0.00003x^5 + 0.0056x^4 – 351x^3 – 8.2267x^2 – 21.282x + 1270.4$	$Y= 0.00003x^5 + 0.0056x^4 – 0.3517x^3 + 8.2488x^2 – 31.541x + 1284.9$	$Y= 0.00003x^5 + 0.00053x^4 – 0.3289x^3 + 7.5093x^2 – 22.885x + 1194.7$
Exponential	$y= 1526.6e^{0.0043x}$	$Y= 1538.4e^{0.0043x}$	$Y= 1469.8e^{0.0042x}$
Logarithmic	y= 211.33ln (x) + 1125.9	y= 211.49in (x) + 1139.2	Y= 1995.56ln (x) + 1092.4
Power	$y= 1135.5x^{0.1358}$	$Y= 1149.1x^{0.1346}$	$Y= 1082x^{0.1382}$
Moving Average	y= (Y1 + Y2 + Y3)/3	Y= (Y1 + Y2 + Y3) /3	Y= (Y1 + Y2 + Y3)/3
Exponential Smoothing	$y= 0.5Y 0.5Y_i$	$Y= 0.5Y + 0.5Y_i$	$Y= 0.5Y + 0.5Y_i$
First Auto - Regression	$y= 854.9856 + 0.5265y_{n-1}$	$Y= 0.5Y+ 0.5Y_i$	$Y= 768.8868 + 0.5553y_{n-1}$

4. The best-fit time series model for predicting the demand of electrical energy in Masbate is the cubic model with an accuracy percentage of 31.49% . Like the demand, the best-fit model for supply is also the cubic model with an accuracy percentage of 31.39%. Unlike the aforementioned models, the best – fit model for predicting electrical energy consumption is the quartic model with a slightly higher rate of 32.60%.

5. The cluster analysis of electrical energy in Masbate Province revealed differences on municipalities in terms of demand, supply, and consumption. Masbate City ranks the highest in all three categories. Municipalities like Aroroy, Mandaon, and Uson showed constant average demand, supply, and consumption. Notably, Cataingan, which has an average demand and supply, ranks among the highest in consumption. Meanwhile, Ezperanza consistently ranked the lowest across all categories.

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