### **Final Report: Power Consumption Prediction**

#### **1. Introduction**

* **Project Overview**: Provide a brief introduction to the goal of the project. Explain the importance of accurately predicting power consumption in Zone 3.
* **Objectives**: Clearly define the primary objective—developing a machine learning model to predict power consumption in Zone 3.
* **Scope**: Mention the dataset (singular year, weather, historical consumption, emission diffusion) and constraints, such as the confidentiality of the data.

#### **2. Data Collection and Preprocessing**

* **Dataset Description**: Describe the data you were given, including the features (e.g., power consumption, weather conditions, emission diffusion metrics) and the data format.
* **Data Cleaning**: Outline the preprocessing steps taken to prepare the data, such as handling missing values, removing outliers, and converting data types.
* **Feature Engineering**: Describe how you derived new features from the existing ones (e.g., seasonality, time of day, weather-related features).
* **Data Splitting**: Explain how you split the dataset into training and testing sets, and the reason behind this split (e.g., 80% training, 20% testing).

#### **3. Methodology**

* **Model Selection**: Explain the process of selecting the machine learning model(s). Discuss various algorithms you considered (e.g., linear regression, decision trees, neural networks), and justify why you chose the final model.
* **Model Training**: Describe how you trained the model(s), including hyperparameter tuning, validation techniques (e.g., cross-validation), and performance evaluation metrics.
* **Seasonality Focus**: Explain how you handled the seasonal patterns in the dataset, especially given that the data spans only one year.

#### **4. Results and Evaluation**

* **Model Performance**: Provide key performance metrics (e.g., Mean Absolute Error, Root Mean Squared Error, R-squared) for your trained model on the test set.
* **Visualizations**: Include plots to visualize the model’s predictions versus actual values (e.g., line charts, residual plots, or bar charts).
* **Comparison**: If applicable, compare the performance of different models and highlight which one performed best.
* **Generalization**: Discuss how well the model performs on unseen data and if it maintains predictive power across different seasons (if relevant).

#### **5. Discussion**

* **Model Insights**: Discuss any patterns you observed in the data. For example, did weather conditions correlate strongly with power consumption? What features were most important for the model’s predictions?
* **Challenges**: Highlight any challenges you encountered during the project, such as data quality issues, model overfitting, or difficulty in capturing seasonality.
* **Limitations**: Discuss the limitations of the current model (e.g., reliance on one year of data, inability to capture long-term trends).
* **Actionable Recommendations**: Based on your findings, provide strategic recommendations, such as areas for improving prediction accuracy, additional data collection needs, or integration of renewable energy sources into Zone 3.

#### **6. Conclusion**

* **Summary of Key Findings**: Summarize the most important takeaways from your analysis and modeling.
* **Future Work**: Offer suggestions for future improvements, such as using additional years of data or trying other advanced machine learning algorithms (e.g., ensemble methods, deep learning).

#### **7. References**

* **Citations**: Include references to any papers, articles, or books that were used to inform your methodology and approach.
* **Tools and Libraries**: List any programming languages, tools, and libraries you used (e.g., Python, scikit-learn, pandas, matplotlib).

#### **8. Appendices (if needed)**

* **Code**: Include the full code or relevant parts (with comments) that were used to preprocess the data and train the model.
* **Additional Figures**: If you have any other visualizations that support your report, include them here.

### **Additional Tips:**

* **Clarity**: Use clear and concise language throughout the report. Aim for professional formatting, ensuring consistency in headings, subheadings, and citation style.
* **Visualization**: Ensure your visualizations are well-labeled, easy to interpret, and directly linked to your analysis. Graphs should be accompanied by a brief explanation.
* **Professionalism**: Double-check for any grammatical errors and maintain a consistent, formal tone throughout the document.