1. **Summary of the Paper**

- **Title**: Electric Vehicle Charging Load Forecasting Method Based on Improved Long Short-Term Memory Model with Particle Swarm Optimization
- **Paper Name**: (Wevj_2025_Electric Vehicle Charging Load Forecasting Method Based on Improved Long Short-Term Memory Model with Particle Swarm Optimization)
- **Authors**: Xiaomeng Yang, Lidong Zhang (Corresponding Author), Xiangyun Han
- **Journal**: Wevj
- **Publisher**: MDPI
- **Published Year**: 2025
- **Workflow/Process**: The study systematically sets and validates key parameters for constructing and optimizing the electric vehicle charging load prediction model, ensuring scientific rigor and reproducibility. It includes data preprocessing, model architecture design, and optimization algorithm configuration .
- **Methodology**: A Particle Swarm Optimization (PSO) enhanced Long Short-Term Memory (LSTM) network is proposed, combining PSO's global search capability with LSTM's time-series modeling advantages .
- **Approaches**: The PSO-LSTM hybrid framework is optimized for seasonal variations, effectively capturing seasonal load variations for dynamic grid scheduling and charging infrastructure planning .
- **Source**: The research is based on traffic flow studies and time-series data analysis .
- **Dataset**: The dataset includes traffic flow data collected over various time spans to analyze long-term, medium-term, and short-term traffic patterns .
- **Dataset Availability/Public/Open-Accessible**: The dataset's availability is not explicitly mentioned in the provided context.
- **Dataset Source Link**: Not provided in the context.
- **Research Gaps**: Future research could integrate meteorological data and develop hybrid model architectures combining BiLSTM and CNN to enhance analysis of complex spatiotemporal patterns .
- **Research Key Findings**: The PSO-LSTM model significantly reduces Mean Absolute Error (MAE) compared to traditional models, indicating its effectiveness in forecasting charging loads .
- **Paper's Results/Output**:
    - During winter, the MAE is 3.896, a reduction of 6.57% compared to the LSTM model and 10.13% compared to the GRU model.

- During the winter-spring transition, the MAE is 3.806, which is 6.03% lower than that of the LSTM model and 12.81% lower than that of the GRU model .

2. **Summary of the Paper**

- **Title**: Location based Probabilistic Load Forecasting of EV Charging Sites: Deep Transfer Learning with Multi-Quantile Temporal Convolutional Network
- **Paper Name**: (arXiv_2024_Location based Probabilistic Load Forecasting of EV Charging Sites: Deep Transfer Learning with Multi-Quantile Temporal Convolutional Network)
- **Authors**: Mohammad Wazed Ali, Md Aukerul, Moin Shuvo, Bernhard Sick
- **Journal**: arXiv
- **Publisher**: None
- **Published Year**: 2024
- **Workflow/Process**: The research involved collecting data from four diverse EV charging sites, applying a deep learning model (MQ-TCN), and evaluating its performance against traditional models like XGBoost. The process included data division into training, validation, and test sets, followed by hyperparameter tuning and performance evaluation using metrics like PICP and WS.
- **Methodology**: The study utilized a Multi-Quantile Temporal Convolutional Network (MQ-TCN) for load forecasting, focusing on deep transfer learning to enhance model adaptability across different charging sites.
- **Approaches**: The research addressed challenges in load forecasting by incorporating inductive transfer learning, which allowed the model to leverage knowledge from one site to improve predictions at another, particularly with limited data.
- **Source**: arXiv:2409.11862v1[cs.LG]
- **Dataset**: Data was collected from four charging sites: Caltech, JPL, Office-1, and NREL.
- **Dataset Availability**: Open-accessible.
- **Dataset Source Link**: arXiv:2409.11862v1
- **Research Gaps**: Previous models lacked adaptability and failed to effectively model complex interactions among diverse features and irregular energy usage patterns.

- **Research Key Findings**: The MQ-TCN model achieved a PICP score of 93.62%, showing a 28.93% improvement over XGBoost for day-ahead forecasting at JPL. It also demonstrated a 96.88% PICP score using only two weeks of data at NREL.
- **Paper's Results/Output**:
    - **Format**: [Data Size-Lookback Time-Forecast Horizon]
    - **Results**:
        - MQ-TCN (Office): 91.04% for 4 hours-ahead forecasting, 87.30% for one day-ahead forecasting using 1 month of data.
        - MQ-TCN (NREL): 96.88% PICP score using 2 weeks of data.
        - XGBoost (Office): Baseline for comparison.
        - Improvement of 18.23% compared to XGBoost trained on 6 months of data without transfer learning .

3. **Summary of the Paper**

- **Title:** Machine learning optimization for hybrid electric vehicle charging in renewable microgrids
- **Paper Name:** (Scientific Reports_2024_Machine learning optimization for hybrid electric vehicle charging in renewable microgrids)
- **Author:** Marwa Hassan (Corresponding Author)
- **Journal:** Scientific Reports
- **Publisher:** Not specified
- **Published Year:** 2024
- **Workflow/Process:** The paper begins with an introduction to renewable microgrids, followed by the development of a Machine Learning-Based Energy Management Framework. It details the modeling of hybrid electric vehicle (HEV) charging demand and explores two charging scenarios: coordinated and intelligent charging. The methodology includes simulations on an IEEE microgrid to validate the proposed approach.
- **Methodology:** The study employs Gaussian Process (GP) regression for modeling HEV charging demand and introduces the Krill Herd Algorithm (KHA) for optimization.

- **Approaches:** The paper presents a novel optimization method inspired by KHA, with a self-adaptive modification to tailor solutions to specific situations, enhancing the energy management of renewable microgrids.
- **Source:** Not specified
- **Dataset:** Not specified
- **Dataset Availability/Public/Open-accessible:** Not specified
- **Dataset Source Link:** Not specified
- **Research Gaps:** The paper identifies a lack of unified approaches in existing studies for integrating renewable microgrids with the charging demands of hybrid electric vehicles.
- **Research Key Findings:** The predictive model achieved a low Mean Absolute Percentage Error (MAPE) of 1.02381 for total HEV charging demand, indicating high accuracy. The intelligent charging scenario resulted in reduced microgrid operation costs compared to coordinated charging.
- **Paper's Results/Output:** The simulation results demonstrate the efficiency of the proposed methods, highlighting the potential for improved energy management in renewable microgrids through advanced machine learning techniques .

4. **Summary of the Given Paper**

- **Title**: Multiscale Spatio-Temporal Enhanced Model for Load Forecasting at Electric Vehicle Charging Stations
- **Paper Name**: (arxiv_2024_Multiscale Spatio-Temporal Enhanced Model for Load Forecasting at Electric Vehicle Charging Stations)
- **Authors**: Wenmeng Zhao (Corresponding Author), Yaohui Huang
- **Journal**: arXiv
- **Publisher**: Not specified
- **Published Year**: 2024
- **Workflow/Process**:
    - The paper introduces the MSTEM model, which integrates a multi-scale graph neural network and recurrent learning components to forecast electric vehicle charging loads. It captures both linear trends and nonlinear temporal representations through a structured approach involving data processing, model training, and evaluation against baseline models.

- **Methodology**:
    - MSTEM employs a combination of LSTM networks and graph convolutional networks (GCNs) to address the challenges of load forecasting, focusing on nonlinear temporal dependencies and local correlations among charging stations.
- **Approaches**:
    - The model utilizes a multiscale graph construction to analyze spatio-temporal dependencies and a residual fusion mechanism to enhance predictive accuracy. It also incorporates a hierarchical approach to discern patterns across various time scales.
- **Source**: arXiv:2405.19053v1[eess.SY]
- **Dataset**:
    - Real-world datasets for both fast and slow charging loads at EVCS in Perth, UK.
- **Dataset Availability/Public/Open-Accessible**:
    - The dataset is not explicitly stated as open-access in the provided context.
- **Dataset Source Link**:
    - Not provided.
- **Research Gaps**:
    - Previous models primarily focused on temporal patterns without adequately addressing the complex local correlations between charging stations, which MSTEM aims to improve.
- **Research Key Findings**:
    - MSTEM outperforms traditional forecasting models by effectively capturing nonlinear dynamics and interrelationships among charging stations.
- **Paper's Results/Output**:
    - The experimental results demonstrate that MSTEM significantly enhances short-term load forecasting accuracy across multiple evaluation metrics compared to six baseline models, validating its effectiveness in real-world applications .

5. **Summary of the Paper**

- **Title**: Non-Intrusive Load Monitoring for Feeder-Level EV Charging Detection: Sliding Window-based Approaches to Offline and Online Detection
- **Paper Name**: (arXiv_2023_Non-Intrusive Load Monitoring for Feeder-Level EV Charging Detection: Sliding Window-based Approaches to Offline and Online Detection)
- **Authors**: Cameron Martin, Fucai Ke, Hao Wang
- **Journal**: arXiv
- **Publisher**: None
- **Published Year**: 2023
- **Workflow/Process**: The paper develops a framework for EV charging detection at the feeder level using sliding window techniques for feature extraction and classical machine learning models (Random Forest and XGBoost) for classification. The framework supports both offline and online detection of EV charging events.
- **Methodology**: The methodology involves aggregating household smart meter data to synthesize feeder load data, applying sliding windows to extract features, and utilizing machine learning algorithms for classification.
- **Approaches**: The study employs three types of sliding windows (forward-looking, centered, and backward-looking) to extract effective features, including time-series statistics and peak counts. The extracted features are then used in Random Forest and XGBoost models for classification.
- **Source**: arXiv:2312.01887v1[cs.LG]
- **Dataset**: The dataset consists of real-world household smart meter data aggregated to represent feeder load.
- **Dataset Availability/Public/Open-Accessible**: The dataset is not explicitly stated as publicly available in the provided context.
- **Dataset Source Link**: Sorry, can't generate citation of the paper due to insufficient data.
- **Research Gaps**: The paper identifies a gap in existing studies that primarily focus on NILM for individual households, highlighting the need for effective detection methods at the feeder level due to unique challenges.
- **Research Key Findings**: The developed method achieves high accuracy in EV charging detection, with an F-Score of 98.88% for offline detection and 93.01% for online detection.
- **Paper's Results/Output**: The results indicate that the proposed framework is lightweight, efficient, and capable of quick training, addressing the challenges of feeder-level EV charging detection effectively .

6. **Summary of the Paper**

- **Title**: Optimizing demand response and load balancing in smart EV charging networks using AI integrated blockchain framework
- **Paper Name**: (Scientific Reports_2024_Optimizing demand response and load balancing in smart EV charging networks using AI integrated blockchain framework)
- **Authors**: Arvind R Singh, R Seshu Kumar, K Reddy Madhavi, Faisal Alsaif, Mohit Bajaj, Ievgen Zaitsev (Corresponding Author)
- **Journal**: Scientific Reports
- **Publisher**: Nature Publishing Group
- **Published Year**: 2024
- **Workflow/Process**: The paper presents the Demand Response and Load Balancing using Artificial intelligence (DR-LB-AI) framework, which integrates AI for predictive demand forecasting and dynamic load distribution, enhancing real-time optimization of EV charging infrastructure.
- **Methodology**: The framework employs AI for demand forecasting and utilizes Blockchain technology for secure, decentralized communication, ensuring tamper-proof energy transactions.
- **Approaches**: The DR-LB-AI framework focuses on predictive analytics for demand management and employs decentralized systems to enhance security and efficiency in energy distribution.
- **Source**: The findings are based on the integration of AI and Blockchain technologies in managing EV charging networks.
- **Dataset**: The paper does not specify a particular dataset used for the research.
- **Dataset Availability/Public/Open-accessible**: Not specified.
- **Dataset Source Link**: Not applicable.
- **Research Gaps**: The paper identifies challenges in scalability, real-time demand management, and data security in current Demand Response systems.
- **Research Key Findings**: The DR-LB-AI framework improves energy distribution efficiency by 20%, enhances data protection by 97.71%, and achieves a 98.43% improvement in scalability.

- **Paper's Results/Output**: The framework contributes to a more resilient, scalable, and sustainable EV charging infrastructure, critical for the viability of smart grids and the expansion of electric mobility .

7. **Summary of the Paper**

- **Title**: Probabilistic forecast of electric vehicle charging demand: analysis of different aggregation levels and energy procurement
- **Paper Name**: (Energy Informatics_2024_Probabilistic Forecasting of Electric Vehicle Charging Demand)
- **Authors**: Adrian Ostermann (Corresponding Author), Theodor Haug
- **Journal**: Energy Informatics
- **Publisher**: Springer
- **Published Year**: 2024
- **Workflow/Process**: The paper analyzes EV charging demand using a dataset of over 350,000 charging sessions, employing wavelet analysis to identify patterns and assess the impact of different site compositions on forecasting accuracy. It also explores the effects of forecast inaccuracies on energy procurement and model performance across various aggregation levels.
- **Methodology**: The study utilizes wavelet analysis for signal decomposition and evaluates machine learning methods against a naïve benchmark model to predict charging demand.
- **Approaches**: The research investigates random site aggregation, forming groups of different sizes to analyze the influence of fleet size on prediction quality. It also considers data augmentation techniques to enhance model training.
- **Source**: Not specified
- **Dataset**: Over 350,000 charging sessions from more than 500 locations in Germany.
- **Dataset-availability**: Open-accessible
- **Dataset-source-link**: Not provided
- **Research-gaps**: Future research could focus on clustering hard-to-predict sites and optimizing procurement strategies based on balancing energy prices.

- **Research Key Findings**: Machine learning methods like Ada Boosting and Random Forest achieved robust forecasting results, with normalized root mean square errors of 0.42 and 0.41, respectively, at the highest aggregation level.
- **Paper's Results/Output**: The results indicate that robust forecasts can be achieved with sufficient site compositions, and energy managers can reliably predict energy needs for fleets, thus optimizing procurement strategies .

8. **Summary of the Research Paper**

- **Title**: Short-term EV Charging Load Forecasting using Transfer Learning and Model-Agnostic Meta-Learning
- **Paper Name**: (Energy Systems_2024_Short-term EV Charging Load Forecasting using Transfer Learning and Model-Agnostic Meta-Learning)
- **Authors**: Shashank Narayana Gowda, Keshav Nath, Chen Zhang, Rohan Gowda, Rajit Gadh
- **Journal**: Energy Systems
- **Publisher**: Springer
- **Published Year**: 2024
- **Workflow/Process**: The study employs Transfer Learning (TL) and Model-Agnostic Meta-Learning (MAML) for forecasting EV charging loads. It involves pre-training a model on a comprehensive dataset followed by fine-tuning with localized data.
- **Methodology**: The methodology includes using multiple datasets to ensure robustness across different scales and demographics, incorporating additional temporal features, and utilizing adjacent time windows for MAML.
- **Approaches**: The research compares MAML and TL models against traditional Deep Learning (DL) models, focusing on their performance in short-term load forecasting with limited data.
- **Source**: The research is based on datasets from shared chargers in Norway and Colorado.
- **Dataset**: Norway shared charger dataset and Colorado dataset.
- **Dataset Availability**: Not specified if public or open-accessible.
- **Dataset Source Link**: Not provided.
- **Research Gaps**: The need for an optimal balance between private and shared charging data during pre-training to enhance forecasting metrics.

- **Research Key Findings**: MAML and TL models outperform traditional DL models, with MAML showing superior performance in the Norway dataset and TL excelling in the ACN dataset.
- **Paper's Results/Output**: The error metrics from TL and MAML are up to 24% and 61% lower than those of DL and classic machine learning models, respectively, indicating their effectiveness in short-term load forecasting .

9. **Summary of the Paper**

- **Title**: Study of Electric Vehicle Charging Prediction using Different Machine Learning Algorithms
- **Paper Name**: (IEEE_2024_Study of Electric Vehicle Charging Prediction using Different Machine Learning Algorithms)
- **Author**: Satyam Sharma, Deepa K, S. V. Tresa Sangeetha
- **Journal**: 2024 10th International Conference on Advanced Computing and Communication Systems (ICACCS)
- **Publisher**: IEEE
- **Published Year**: 2024
- **Workflow/Process**: The paper focuses on predicting average charging times for electric vehicles (EVs) using various machine learning algorithms. It involves data processing, cleaning, and filtering to ensure accurate predictions. The output of different algorithms is compared to identify the most efficient one for the task .
- **Methodology**: The study employs a comparative analysis of several machine learning algorithms to determine their effectiveness in predicting charging times and frequencies for EVs .
- **Approaches**: The proposed model emphasizes dimensionality reduction and support vector machines as the most effective algorithms for classification and regression tasks, respectively. It also highlights the importance of real-time data updates to adapt to changing charging patterns .
- **Source**: Not specified
- **Dataset:** The dataset used is open-source, which minimizes privacy concerns. It can be encrypted for real-time applications .

- **Dataset Availability/Public/Open-Accessible**: Yes, it is open-accessible .
- **Dataset Source Link**: Not provided
- **Research Gaps**: The paper notes that certain outliers may still affect algorithm performance despite data filtering and preprocessing .
- **Research Key Findings**: The study indicates that the demand for EVs will rise significantly, necessitating more charging stations. The model can help predict average charging times, aiding in the planning of new charging infrastructure .
- **Paper's Results/Output**: The results suggest that employing dimensionality reduction can effectively mitigate potential grid failures due to increased demand for charging stations. The model is designed to be software-based, allowing for updates based on evolving charging patterns .

10. **Summary of the Paper**

- **Title**: Temporal Spatial Neural Network for Electric Vehicle Charging Load Prediction
- **Paper Name**: (The Journal of Engineering_2023_Temporal Spatial Neural Network for Electric Vehicle Charging Load Prediction)
- **Authors**: Zeyang Tang, Yibo Cui, Qibiao Hu (Corresponding Author), Minliu Liu, Wei Rao, Xinshen Liu
- **Journal**: The Journal of Engineering
- **Publisher**: None specified
- **Published Year**: 2023
- **Workflow/Process**: The paper outlines a process that includes rasterizing the urban map of Wuhan, aggregating user-level driving and charging data, and constructing a spatio-temporal graph data structure to model user travel trajectories.
- **Methodology**: A temporal spatial neural network based on graph attention and Autoformer is proposed for predicting electric vehicle charging loads.
- **Approaches**: The model utilizes sequence decomposition to separate trend and seasonal components, enhancing prediction accuracy by addressing complex temporal patterns.
- **Source**: doi|10.1049/tje2.70009
- **Dataset**: User-level charging load data from electric vehicle users in Wuhan.

- **Dataset Availability**: Open-accessible
- **Dataset Source Link**: Sorry, can't generate citation of the paper due to insufficient data.
- **Research Gaps**: Existing methods primarily model from the charging station perspective, neglecting user travel habits and charging demands.
- **Research Key Findings**: The proposed method significantly improves prediction accuracy by leveraging the distribution of EV user clusters in time and geographic space.
- **Paper's Results/Output**: The GAT-Autoformer model outperforms baseline methods, achieving a relative decrease of 0.288% in MAPE, 3.3% in MAE, and 14.6% in RMSE compared to the best baseline model, Autoformer, confirming superior prediction accuracy .