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How can data analytics and modelling provide information in smart grid energy saving?

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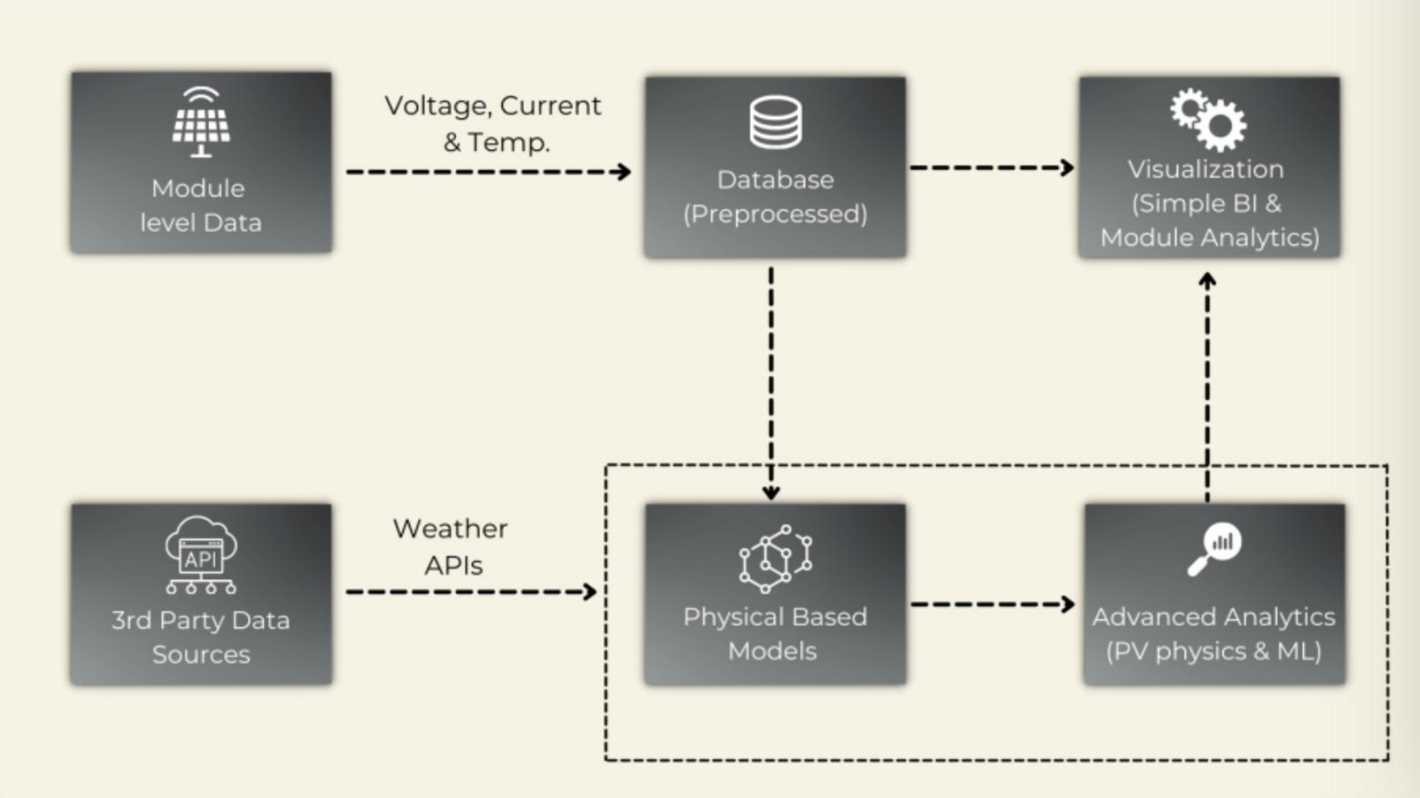
Overview:

- Role of data analytics and modeling in modern energy systems
- Relevance of smart grids in enhancing energy efficiency and stability

Objective:

- Focus on how machine learning predicts energy production and consumption
- Optimization of energy usage in smart grids through these predictions



The Role of Smart Grids in Urban Energy Systems

Definition

- Advanced energy networks utilizing digital communication technology
- Capable of detecting and reacting to local changes in energy usage

Importance of Smart Grids

- **Integration with Renewable Energy**
  - Seamlessly integrates renewable energy sources like PV systems into the grid
- **Energy Efficiency**
  - Optimizes energy distribution and consumption to reduce waste
- **Grid Stability**
  - Enhances the stability and reliability of the energy system
- **Reduction of Energy Losses**
  - Minimizes energy losses through better monitoring and management

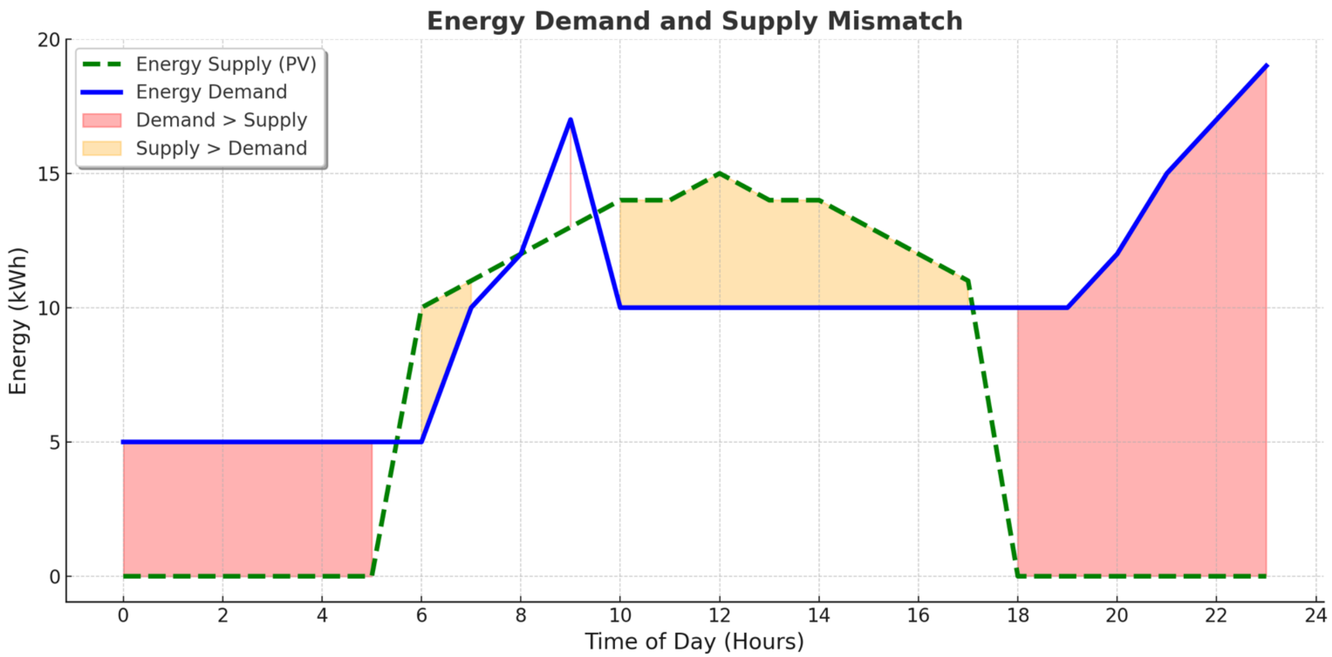
Challenges in Urban Energy Management

Energy Demand and Supply Mismatch

- Fluctuating energy demand and supply, influenced by renewables like PV
- Challenge in balancing intermittent energy generation with consumption needs

Grid Stability and Energy Efficiency

- Importance of accurate forecasting for stable grid operations
- Need to optimize energy use to prevent waste and ensure efficiency



Role of Data Analytics in Energy Systems

Data-Driven Decision Making

- Enhances energy management through informed decisions

Applications in Smart Grids:

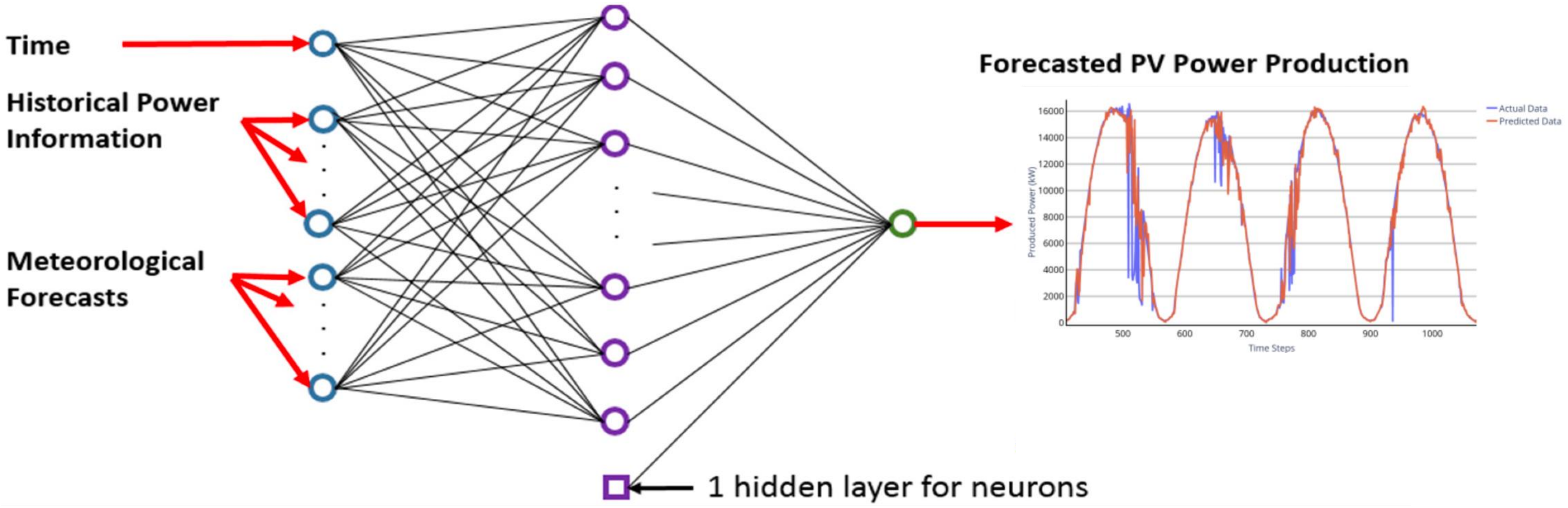
- Predicts energy production from renewable sources
- Forecasts energy consumption trends
- Identifies opportunities for energy savings

What is Machine Learning?

- Technology that learns from data to make accurate predictions

Why Machine Learning for Energy Forecasting?

- Handles complex, non-linear energy data relationships
- Offers higher accuracy and adaptability than traditional methods



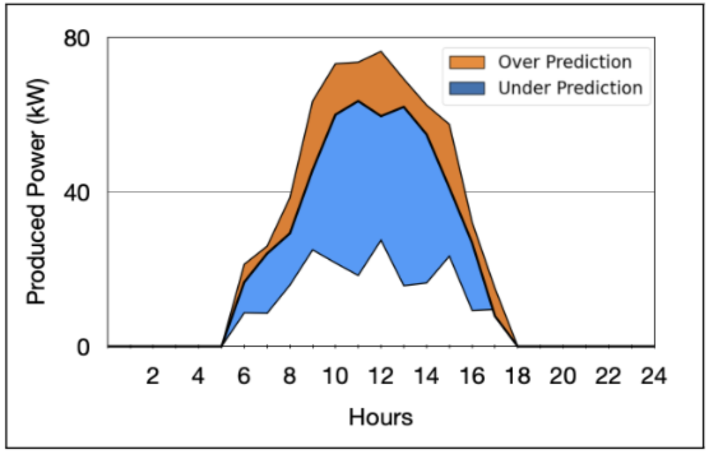
Predicting Energy Production and Consumption with Machine Learning

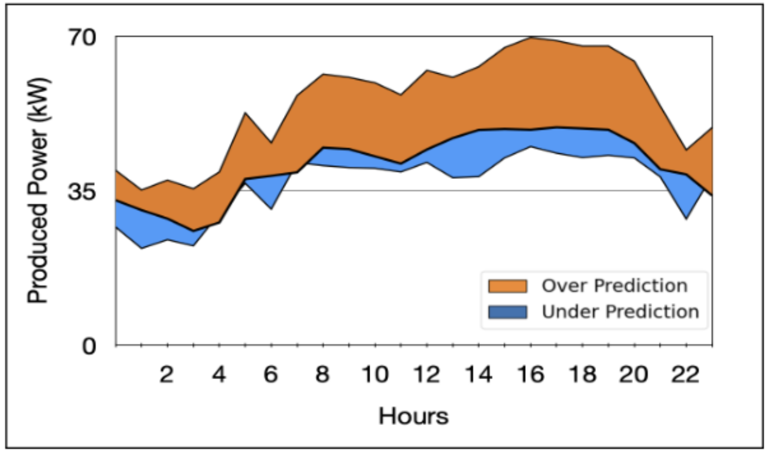
Predicting PV Energy Production

- Uses historical data, weather forecasts, and variables to predict PV energy output
- **Benefits**
  - Better PV grid integration
  - Reduced reliance on backup power sources

Predicting Energy Consumption

- Forecasts consumption patterns using machine learning
- **Benefits**
  - Enhanced energy efficiency
  - Minimized waste and improved grid stability
  - Load balancing
  - Demand response strategies





Optimization of Energy Usage

Using Predictions for Optimization:

- Accurate predictions enable optimized scheduling of energy use
- Facilitates efficient energy storage and load management

Example:

- Smart grids adjust energy distribution based on predicted PV production and consumption

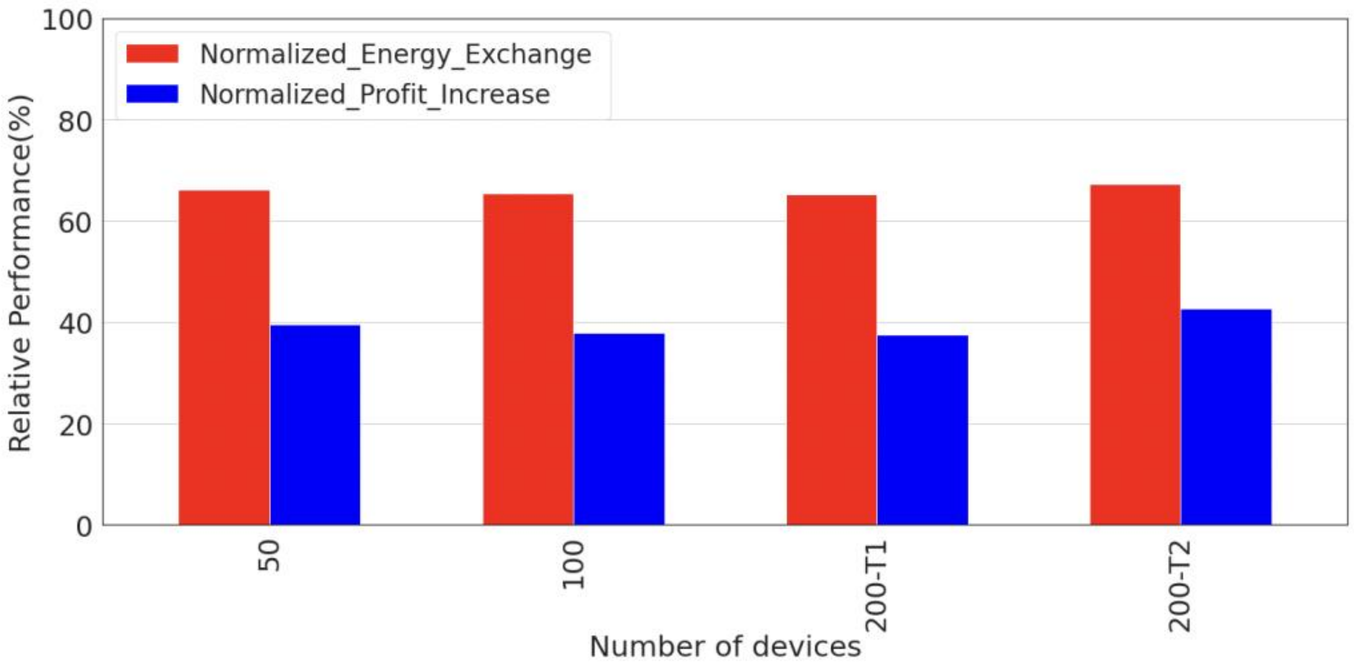
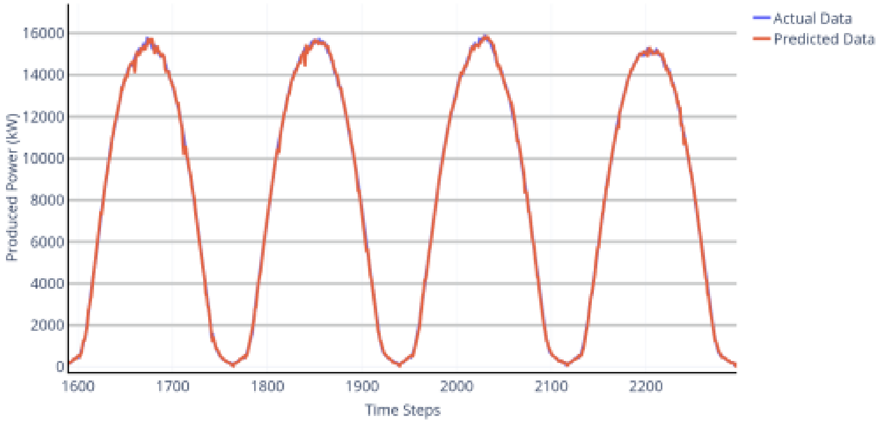
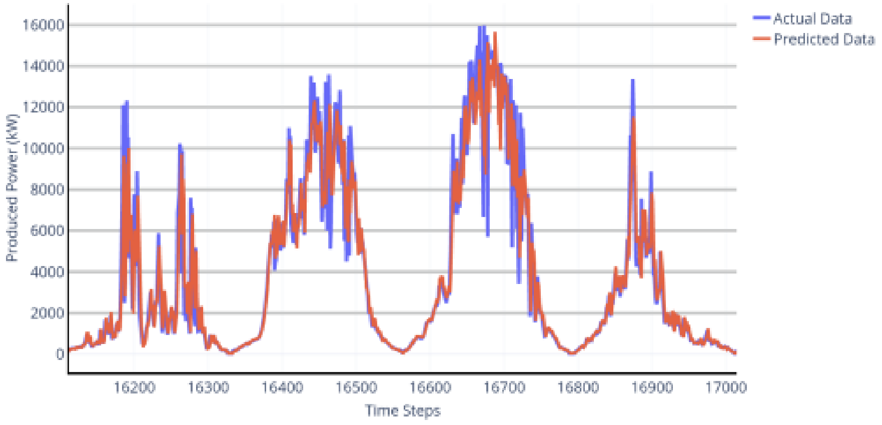


Fig. 8. Relative performance of the cost minimization/profit maximization strategy normalized with BAU strategy results.

Examples from prior studies



(a) Consecutive sunny days



(c) Consecutive overcast days

Challenges and Conclusion

Challenges:

- **Data Quality:** Ensuring accurate, high-quality data for reliable predictions
- **Model Accuracy:** Improving the precision of machine learning models
- **System Integration:** Seamlessly integrating new technologies with existing energy systems

Conclusion:

- **Summary:** Data analytics and machine learning are crucial for optimizing smart grids
- **Key Takeaways:** Actionable insights from ML lead to energy savings and grid stability
- **Final Thoughts:** Continued innovation is essential for creating sustainable and resilient energy systems

Thank you

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