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Optimal Charging Planning of Electric Vehicles in Power Systems with Integrated Renewable Energy Sources

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Name of Event/ Date

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Introduction

- Rise in popularity of Electric Vehicles (EVs)
- Increased electricity demand
- Need for intelligent charging planning
- Impact on power system stability
- Growing role of Renewable Energy Sources (RES)
- Compatibility of EVs and RES
- Importance of optimal management
- Purpose of the presentation

Characteristics of Electric Vehicles

- Types of EVs (BEV, PHEV, HEV)
- Electricity consumption profiles
- Charging periods (day/night)
- Charging requirements
- Mobility and location uncertainty
- Vehicle-to-Grid (V2G) capability
- Smart chargers
- User role in planning

Challenges in the Power System

- Peak load due to EV charging
- Capacity constraints in distribution network
- Increased power losses
- Risk of voltage instability
- RES production fluctuations
- Synchronization issues
- Load forecasting needs
- Limited real-time resources

Role of Renewable Energy Sources

- Solar and wind energy
- High variability and unpredictability
- Surplus and shortage periods
- Integration with EV charging
- Need for energy storage
- System balancing via EVs
- CO_2 emission reduction
- Potential for decentralized generation

Basics of Optimal Charging Planning

- Goal: minimize cost and load peaks
- Consideration of time dynamics
- Incorporation of RES production
- User behavior modeling
- Charging priorities (e.g., urgency, capacity)
- Charger station localization
- Decision-making algorithms
- Centralized vs decentralized control

Methods and Algorithms

- Linear programming
- Stochastic optimization
- Heuristic algorithms (Genetic, PSO, ACO)
- Machine learning and forecasting
- Time-constrained dynamic planning
- Decentralized agent-based systems
- Simulation platforms
- Integration into smart grids

Real-Time Management

- Grid status monitoring
- Load and production prediction
- Responsive plan adjustments
- EV – charger – grid communication
- Automatic cycle optimization
- Role of IoT devices and sensors
- Data security and protection
- System fault tolerance

Advantages and Benefits

- Reduced electricity costs
- Optimal use of RES
- Lower carbon footprint
- Improved grid stability
- Prolonged infrastructure life
- Enhanced consumption flexibility
- Increased user satisfaction

Conclusion and Future Directions

- Necessity of intelligent EV charging management
- Key role of RES in planning
- Need for infrastructure development
- Regulatory and standardization efforts
- Research and testing of new approaches
- Link to smart city development
- Integration of artificial intelligence
- Guidelines for future growth