



# SNS COLLEGE OF TECHNOLOGY



(An Autonomous Institution)

COIMBATORE-35

Accredited by NBA-AICTE and Accredited by NAAC – UGC with A++ Grade  
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

## UNIT III: REQUIREMENTS IN HYBRID AND ELECTRIC VEHICLES

TOPIC: **Energy Management Strategies**



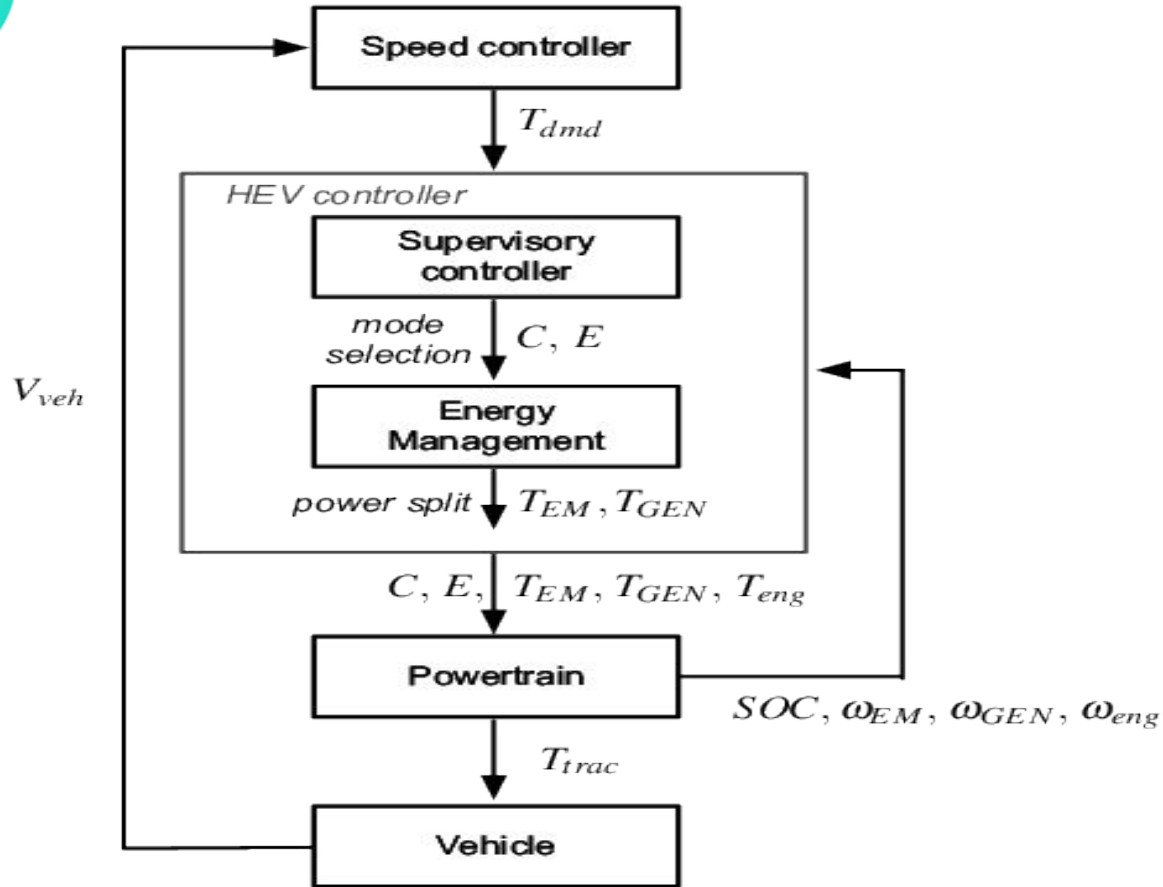


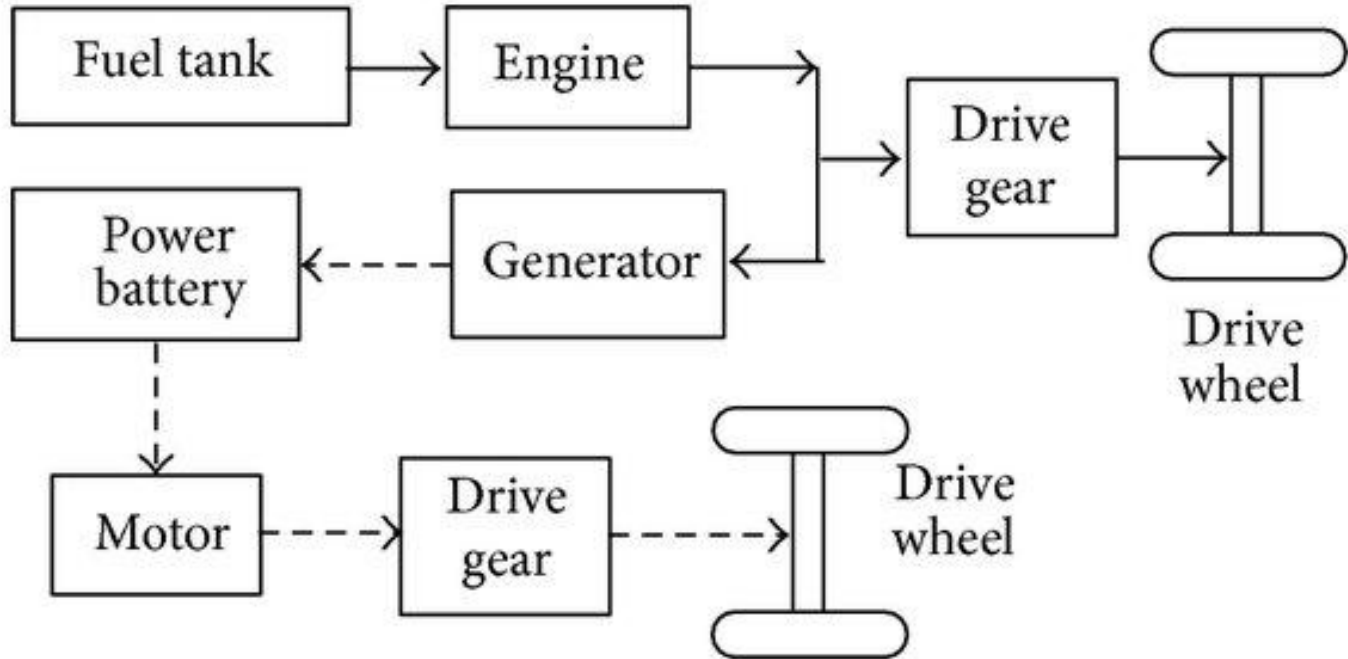
# Introduction

**Title:** Why Energy Management Matters in EVs

- **The Challenge:**
  - Balancing energy consumption, performance, and range in EVs.
- **Importance of Energy Management:**
  - Enhances battery life.
  - Improves vehicle efficiency.
  - Reduces environmental impact.









# Objectives of Energy Management

- Maximize Driving Range
- Optimize Battery Life and Health
- Ensure Safety and Thermal Stability
- Enhance Driving Performance
- Integrate with Renewable Energy Sources

## Key Energy Management Strategies

### 1. Battery Energy Management (BEMS)

- State of Charge (SOC) monitoring.
- State of Health (SOH) estimation.
- Thermal management for optimal battery performance.

### 2. Regenerative Braking

- Captures kinetic energy during braking.
- Converts it back to electrical energy stored in the battery.



### 3. Thermal Management

- Maintaining optimal temperature for battery and power electronics.
- Strategies: Liquid cooling, air cooling, and phase change materials.

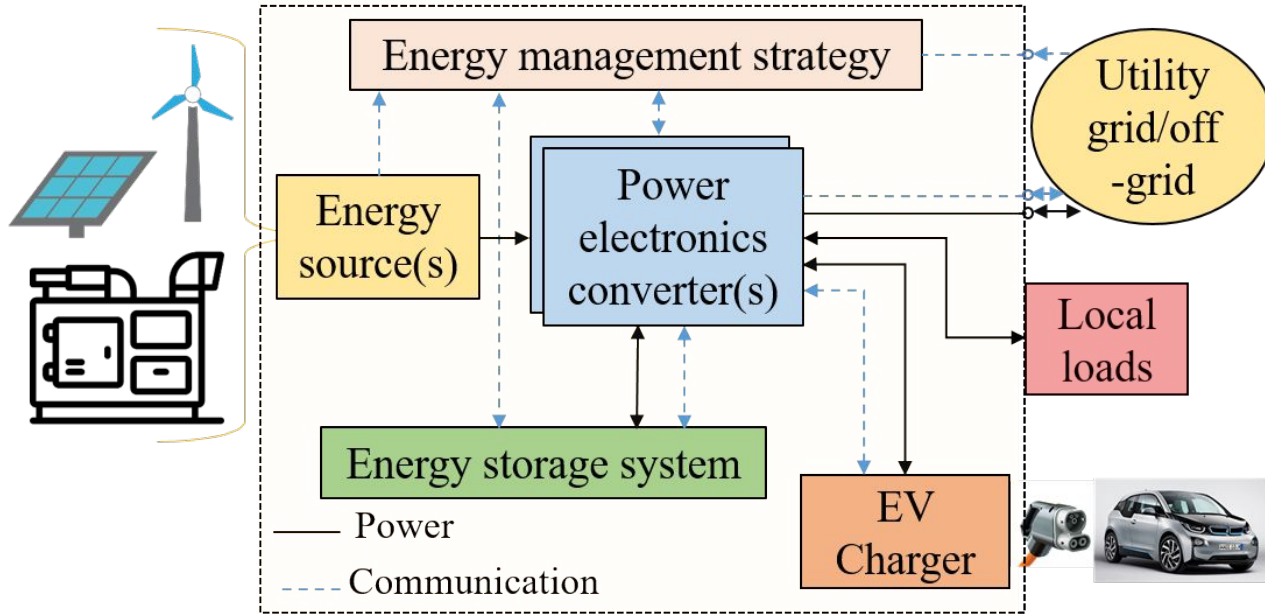
### 4. Eco-Driving Modes

- Adaptive driving modes for efficiency:
  - **Eco Mode:** Prioritizes efficiency over performance.
  - **Sport Mode:** Prioritizes performance over efficiency.

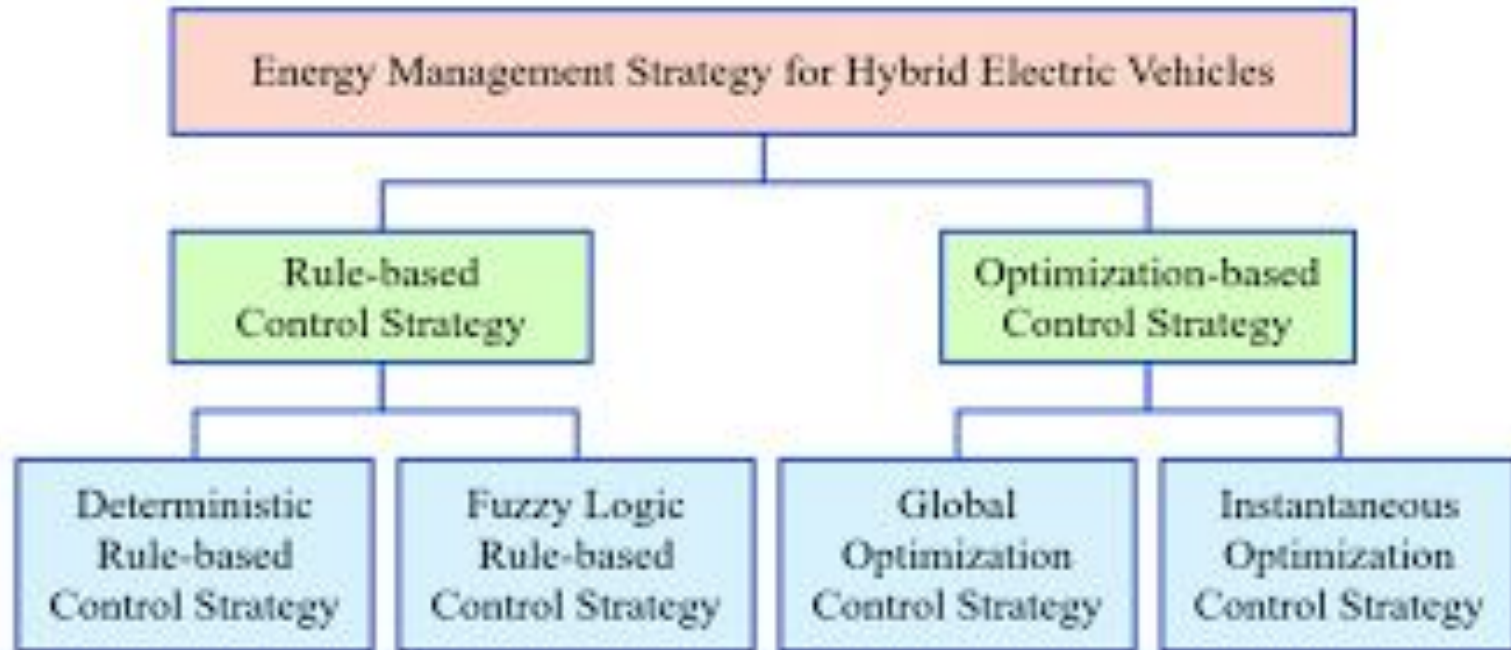


# Advanced Energy Management Technologies

1. **Artificial Intelligence (AI) & Machine Learning (ML):**
  - Predictive energy management based on driving patterns.
  - Real-time energy optimization.
2. **Vehicle-to-Grid (V2G) Technology:**
  - EVs act as energy storage for the grid.
  - Bidirectional energy flow between vehicle and grid.
3. **Smart Energy Management Systems (SEMS):**
  - Integrates with home energy systems and renewable sources.









# Regenerative Braking in Detail

**Title:** Regenerative Braking: Turning Motion into Energy

- **How It Works:**
  - Converts kinetic energy into electrical energy.
  - Stores the energy back into the battery.
- **Benefits:**
  - Increases range.
  - Reduces brake wear and maintenance.



# Role of Thermal Management

**Title:** Keeping Cool: The Role of Thermal Management

- **Challenges:**

- Batteries generate heat during charging and discharging.
- Excessive heat can degrade battery life and reduce efficiency.

- **Solutions:**

- Liquid cooling systems.
- Heat pumps for temperature control.
- Smart ventilation systems.



# AI and Machine Learning for Energy Management

**Title:** Smarter Energy Management with AI

- **Data Sources:**
  - GPS data, driving patterns, battery state, and external conditions.
- **Applications:**
  - Predictive maintenance.
  - Adaptive energy optimization based on driving behavior.
  - Real-time route optimization for maximum efficiency.



## Case Studies

- 1. Tesla's Energy Management System:**
  - Uses AI to optimize battery performance and range.
  - Integration with Tesla's Supercharger network for fast charging.
- 2. Nissan Leaf:**
  - Regenerative braking system for enhanced range.
  - Eco-driving modes for energy efficiency.
- 3. BMW i3:**
  - Advanced thermal management for improved battery life.
  - Seamless integration with renewable energy sources



## Future Trends in Energy Management

- **Wireless Charging:** Dynamic charging while the vehicle is in motion.
- **Solid-State Batteries:** Higher energy density and faster charging.
- **Integration with Smart Grids:** Intelligent load balancing and energy distribution.
- **Energy Harvesting:** Utilizing solar panels and other sources for auxiliary power

## Conclusion

— Driving the Future of Energy Management

- **Key Takeaways:**
  - Energy management is crucial for EV performance, efficiency, and sustainability.
  - Advanced technologies like AI, regenerative braking, and thermal management are reshaping the industry.
  - Continued innovation will drive the future of electric mobility.



# ...THANK YOU