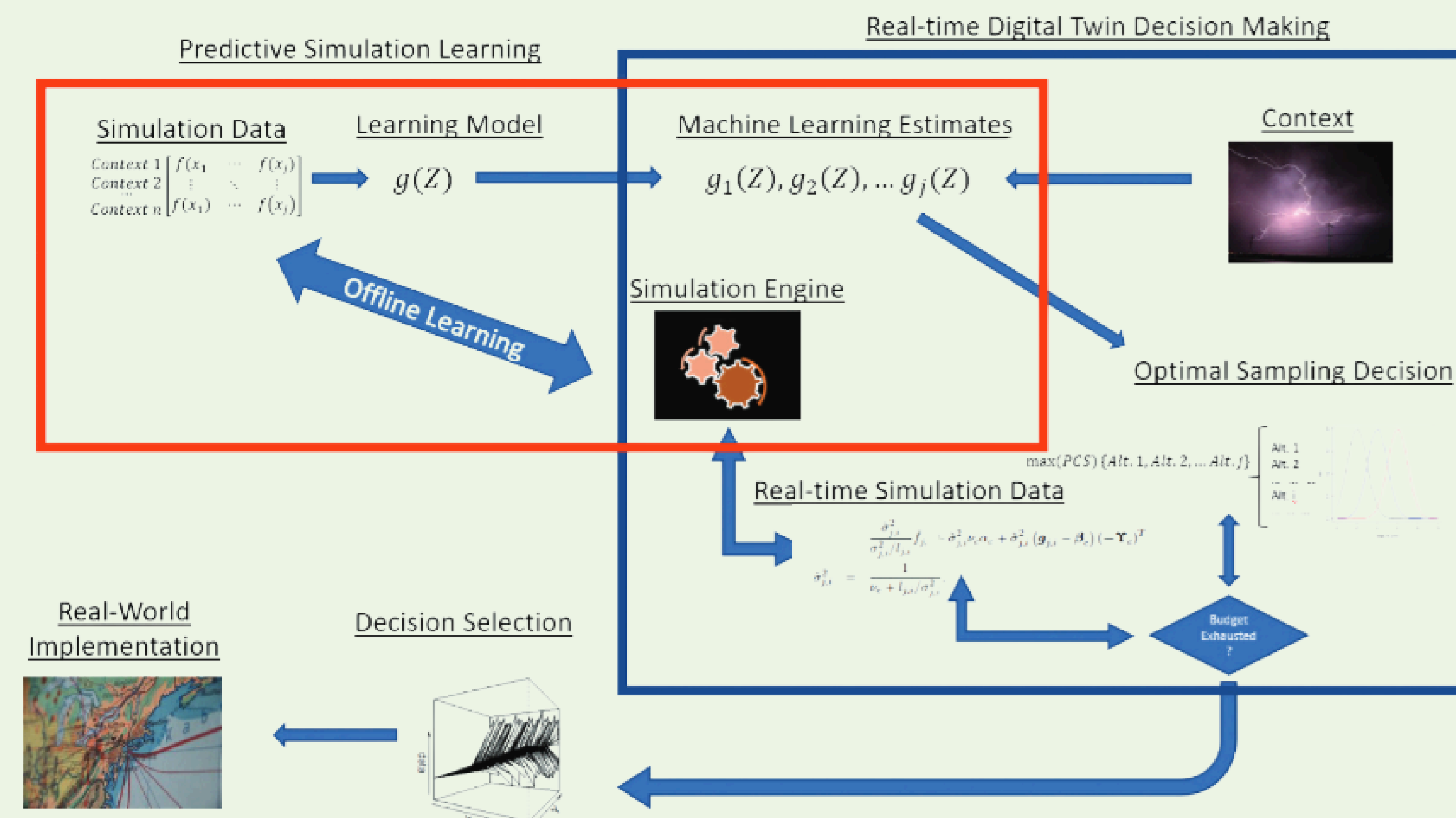# SIMULATION & OPTIMIZATION RESEARCH LAB   (SimLab)
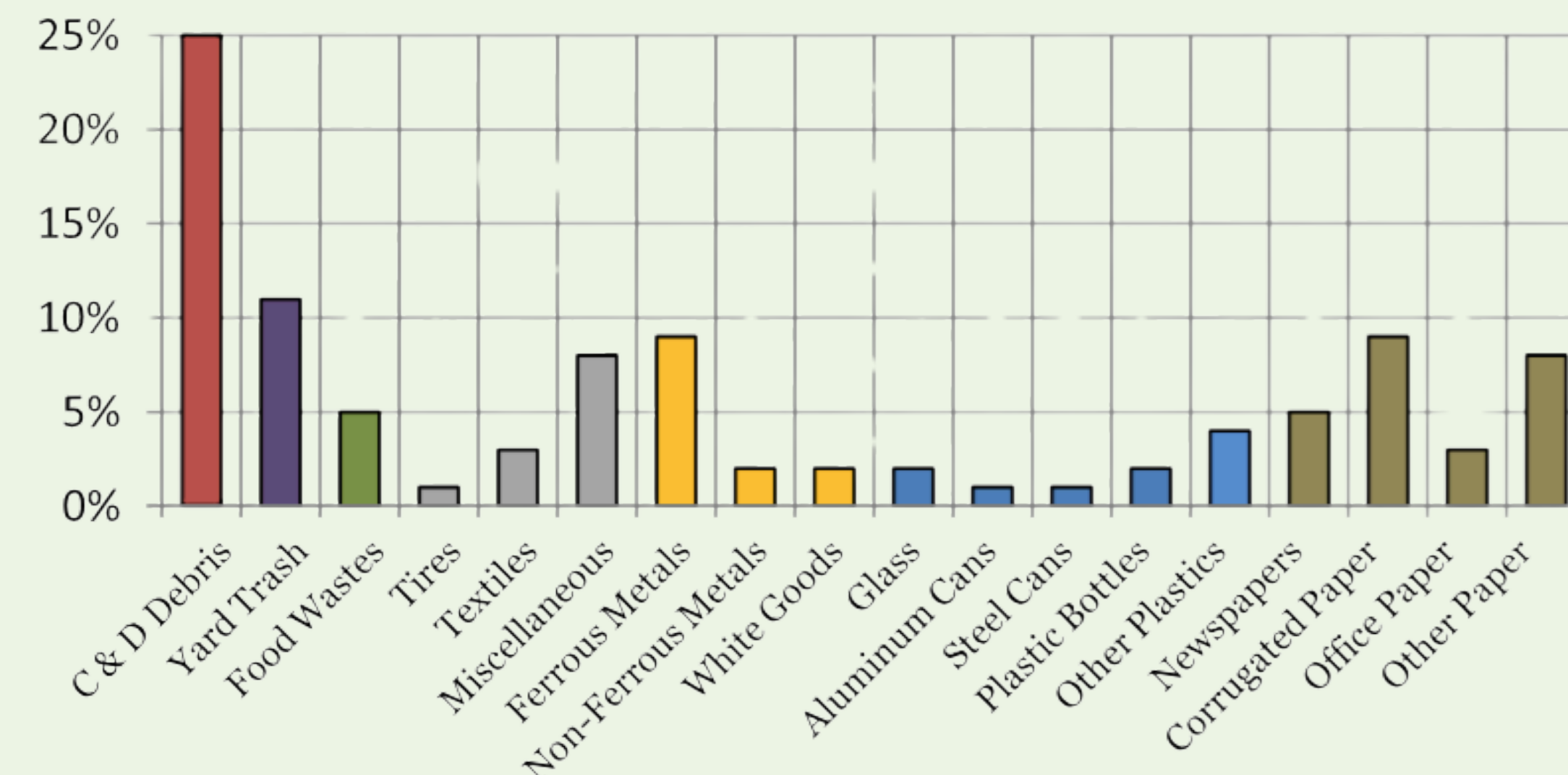
## Core Research Focus

- Dynamic Data-Driven Decision Making
- Simulation-based Optimization
- Digital Twins for Smart Grids
- Microgrid Operations & Resilience
- Sustainable Waste & Energy Systems
- High-Dimensional Data Analytics
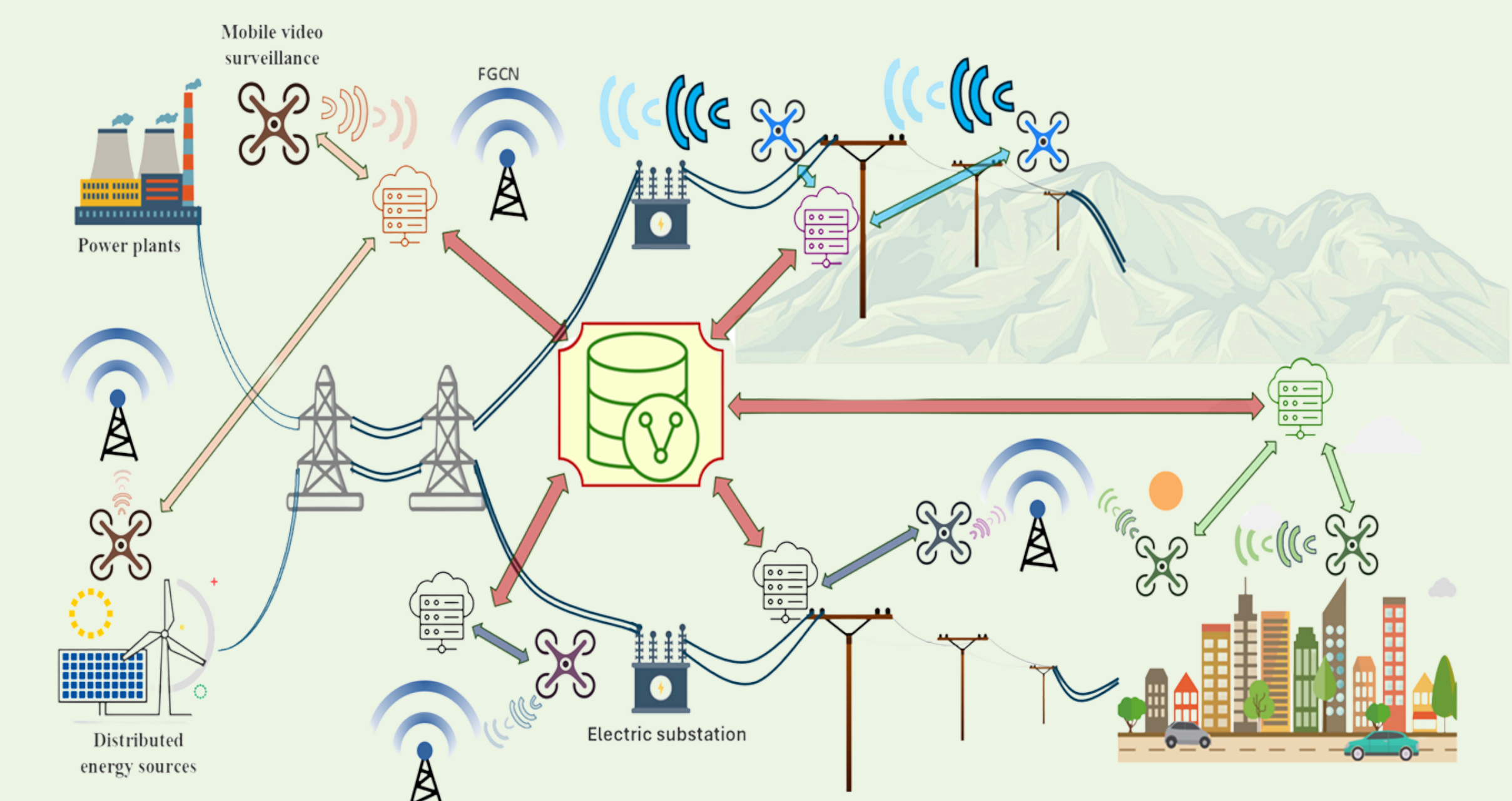- Healthcare Analytics

## Research Methods

- Machine Learning & AI
- Agent-based Simulation
- Multi-fidelity Modeling
- Social Networks
- Particle Filtering
- Evolutionary Algorithms
- Hybrid Simulation Frameworks

### Predictive Simulation Learning

### Real-time Digital Twin Decision Making



Simulation Data — $g(Z)$ — Learning Model — Machine Learning Estimates $g_1(Z), g_2(Z), \ldots g_j(Z)$ — Context — Offline Learning — Simulation Engine — Optimal Sampling Decision — Real-time Simulation Data — Budget Exhausted — Real-World Implementation — Decision Selection

### Data-Driven Modeling



C&D waste
Food waste
Paper waste

### Simulation-Based Optimization



## Research Highlights

Advanced Decision Frameworks
- Digital Twin-based Control & Fault Diagnosis
- Multi-objective Simulation Optimization

Machine Learning for Smart Systems
- Scenario-driven Resilience Planning
- Predictive Control with Deep Learning
- Hybrid Neural Networks for Microgrids

### Smart Infrastructure Applications
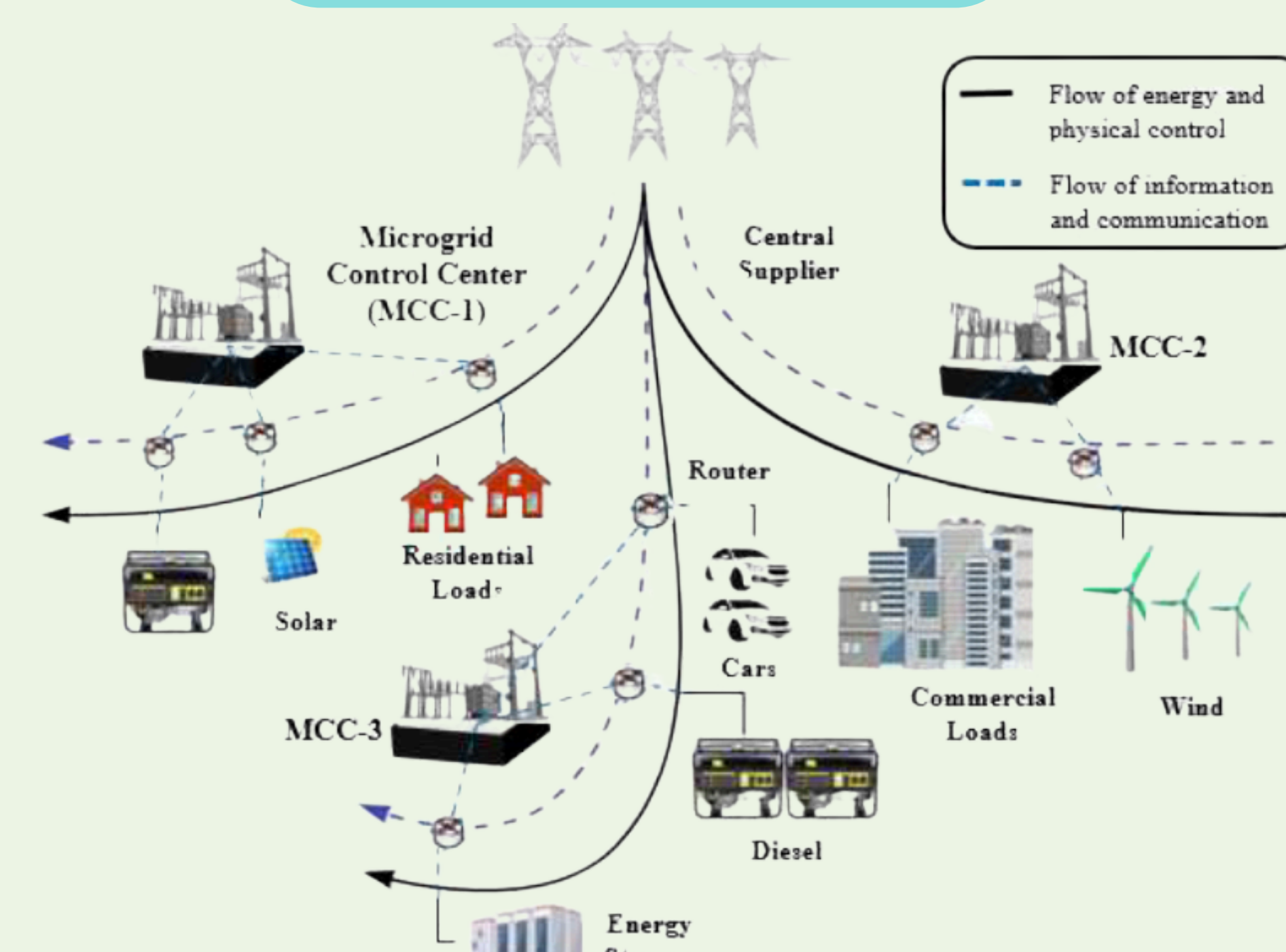


## Application Domains

- Smart Grids & Microgrids
- Energy Systems & Disaster Response
- Solid Waste Management
- Cyber-Physical Systems
- Cellular Networks & IoT