

# IPRO 311 Integration of PHEVs and Renewable Energy Systems

## Purpose & Objectives

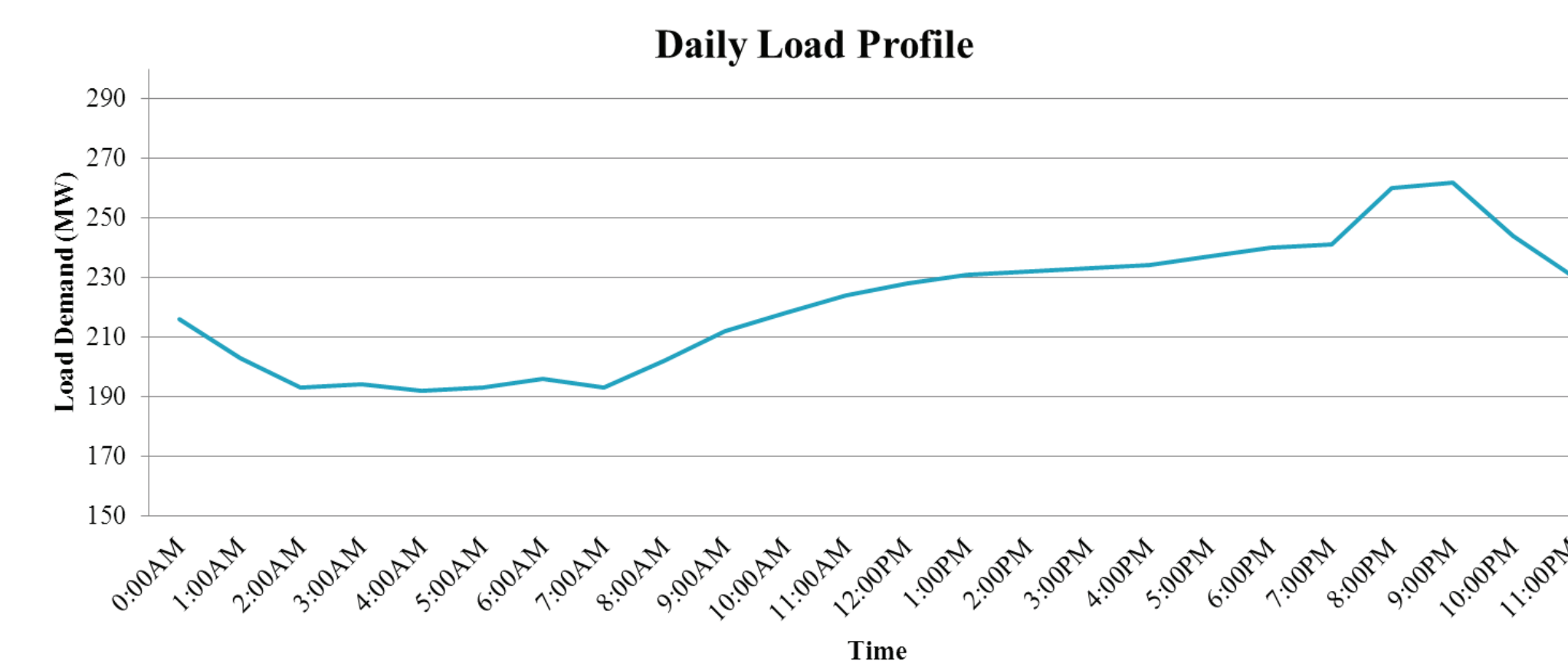
- Investigate economic impact of wind power and PHEV integration
- Determine feasibility of PHEVs as external energy storage
- Find effectiveness of PHEVs at lowering operational cost in various scenarios

## Background

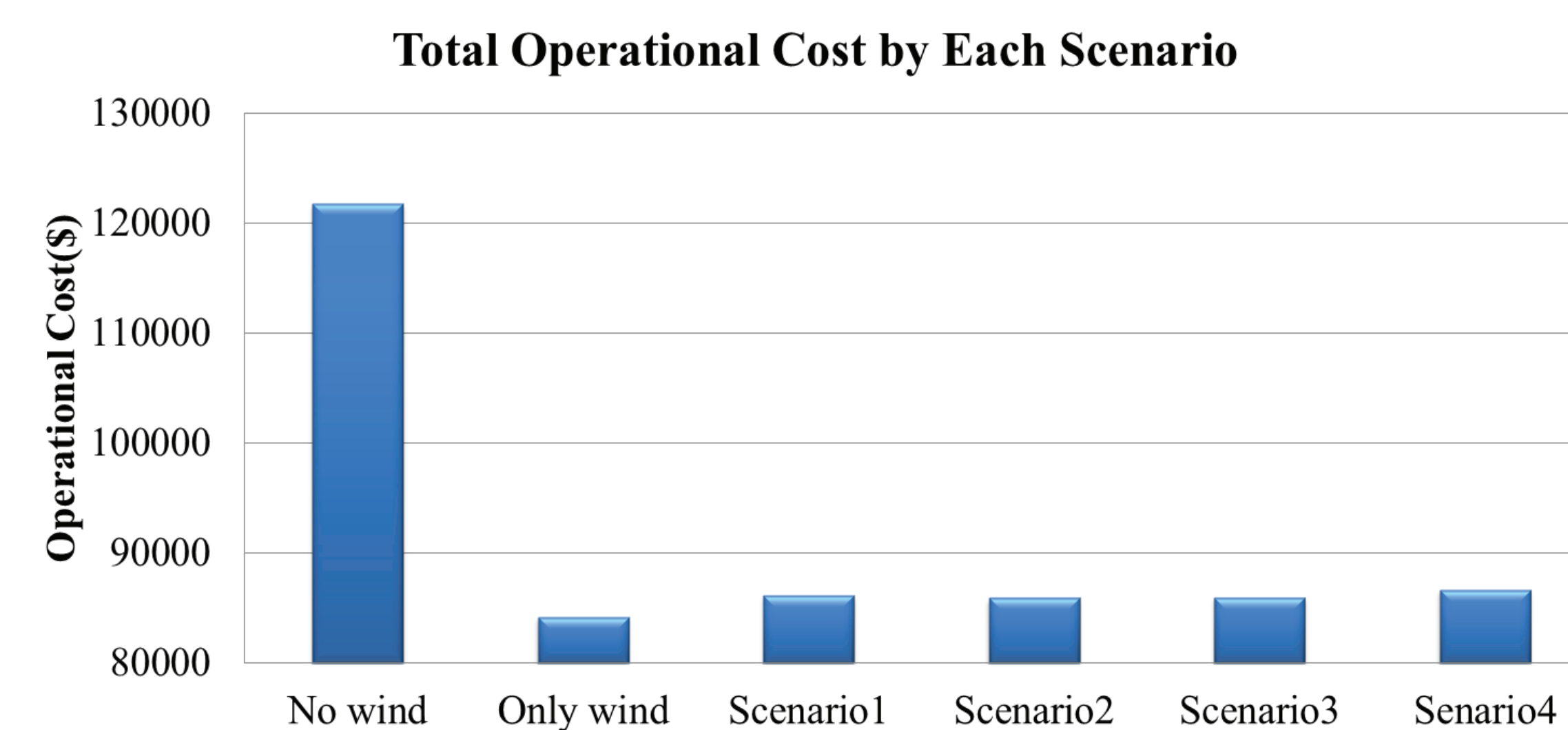
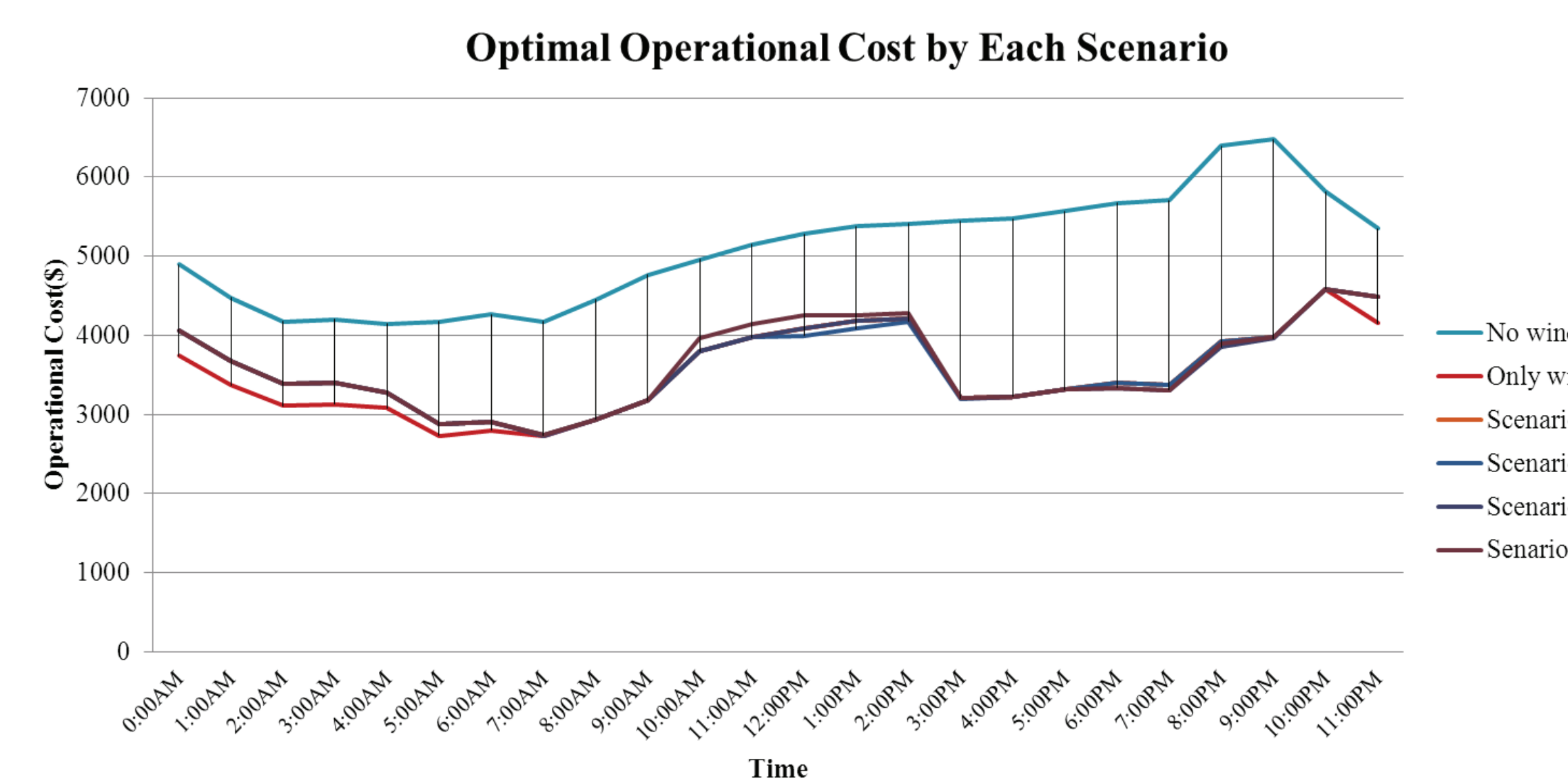
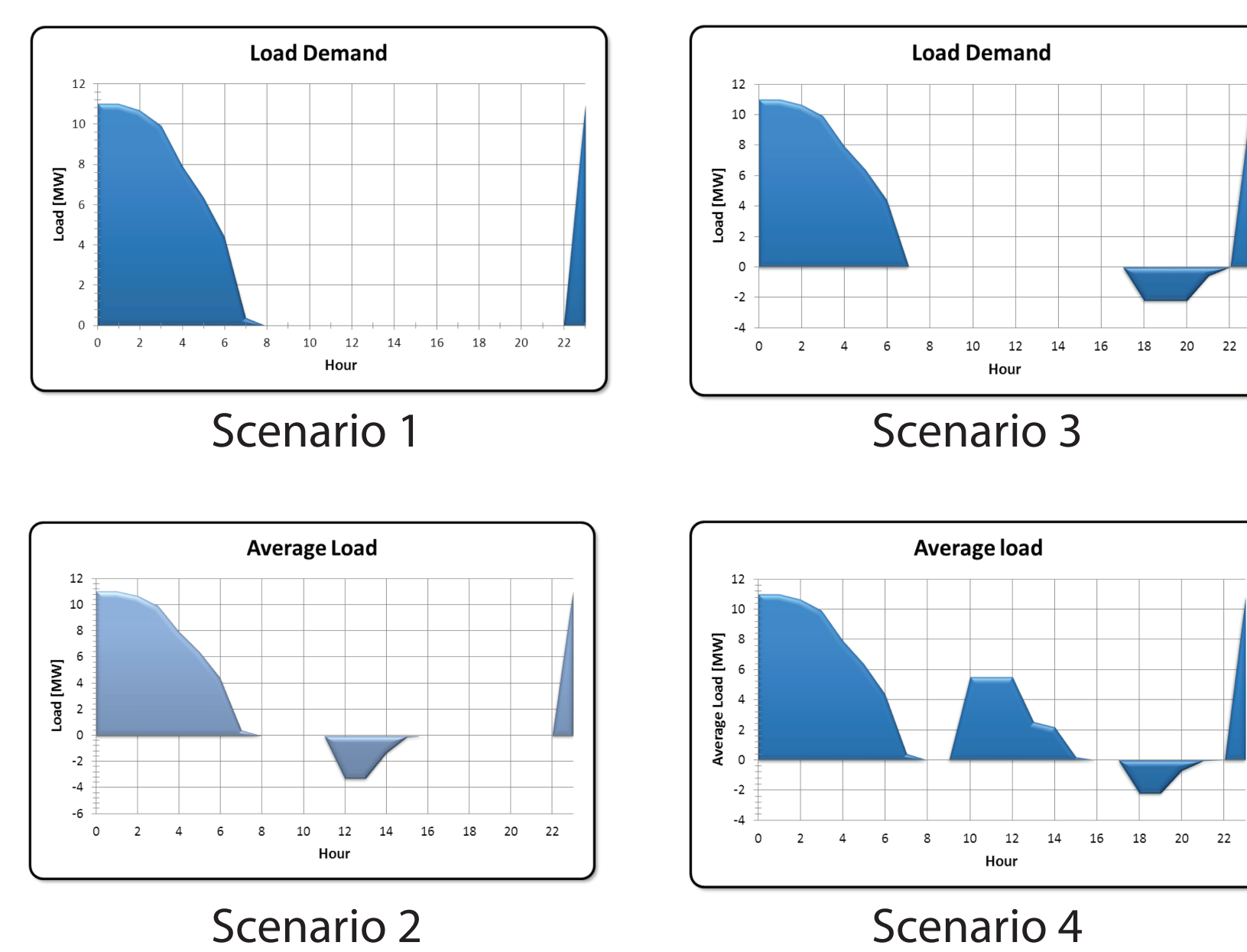
- PHEV: Plug-in Hybrid Electric Vehicle
  - Both electric and gas powered
  - Can be charged with standard 120v outlet
- V2G: Vehicle to Grid
  - PHEV can provide power back to the grid
  - Used to offset demand during peak hours
- Chevy Volt was used for our simulations
  - 16kwh battery capacity
  - 4.8kwh to 13.6kwh energy range
  - 3 hour charge time @240v; 8hrs @120v
- Objective Function
  - Determines optimized result given inputs

## Methodology

- Break up simulation into several scenarios
  - PHEVs travel to and from work, charging time and location are variable, as is V2G
  - Must consider
    - Fleet size
    - Time to charge/V2G
    - Available state of charge
1. Calculate amount of power needed to charge PHEVs
  2. Calculate power reintroduced via V2G
  3. Create power/hour curve



## Results



## Analysis

- Addition of wind power decreased operational cost by 30.8 percent
- 11:00pm to 7:00am - best charge time
- 12:00pm to 3:00pm - best discharge time
- Peak time unaffected by inclusion of PHEV in power grid
  - 10:00pm to 1:00am - first peak time
  - 10:00am to 3:00pm - second peak time

## Conclusion

- Wind energy provides volatile, but plentiful energy
- PHEV batteries are most effectively charged at night, with V2G during early evening
- Integration of wind energy and PHEVs into a standard power system can decrease operational cost by a significant percentage

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