# A Heuristic Approach to Resource Allocation in the Emerging Smart Grid

## Motivation

- **Physical**
  - according to the United States Department of Energy, growth in the peak demand for energy has exceeded transmission growth by 25% each year
  - given current trends, peak energy demands will exceed available transmission capability
  - can deal with this by creating distributed generation or by negative generation in the form of curtailing load
- **Economical**
  - a small reduction in consumption during peak times can lead to a substantial price savings

## Problem Statement

- **Given**
  - information about a set of customer schedulable loads
  - spot market pricing (forecast)
- **Constraints**
  - customer asset availability
  - asset constraints
  - network constraints
  - system constraints
- **Objective**
  - using perceived correlation between aggregator profit and the peak to move the peak loads
  - find a customer incentive vector and schedule loads to maximize aggregator profit
  - aggregator incomes (selling negative load, \( S \) and selling electricity to customer, \( S \)) minus costs (buying from spot market, \( B \))

## System Model

- **Enablers**
  - cyber-physical systems
  - dynamic pricing of electricity
  - control/communication infrastructure
  - end user willingness
- **Aggregator**
  - proposed entity in a deregulated market structure
  - to lower the peak, the aggregator has a set of participating customers and information about their schedulable loads
  - offers the end user the chance to engage in the spot market
- **Customer**
  - has a set of schedulable loads (e.g., smart appliances, PHEVs)
  - by offering their loads, the customer may pay less for electricity (the customer incentive vector instead of dynamic pricing)

## Results and Future Work

- **Results**
  - preliminary results obtained using a genetic algorithm
  - 56,000 loads over 5,555 households
  - final objective value of $36,474.91 (one day)
- **Future Steps**
  - design, implement, and analyze other heuristics
  - explore scalability of the heuristics
  - explore spatial stochasticity of PHEVs and other uncertainties
  - interaction with power systems software
  - parallelize on Cray HPC System

## Smart Grid Resource Allocation

- **Objective**
  - \( N \): income received for selling negative load
  - \( S \): income received for selling electricity to customer
  - \( B \): cost of buying spot market electricity
  - \( P \): aggregator profit (objective)

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P = N + S - B
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Citation: