

Purpose

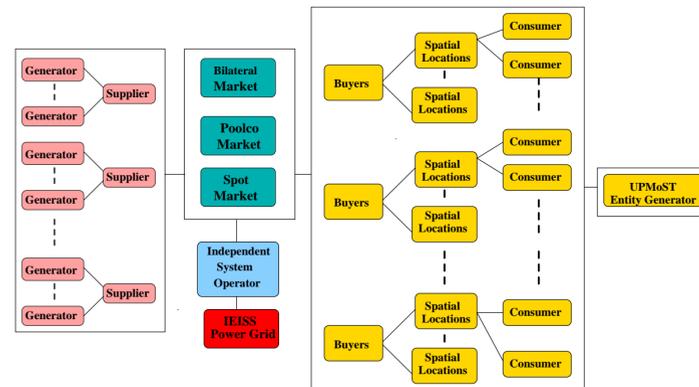
- Build an interdependency aware analytical tool for vulnerability assessment of the deregulated energy markets
- Analyze effects of deregulation - shift of focus from reliability and continuity of operations to profit maximization
- Provide artificial socio-economic laboratory for policy makers

Why Useful to DHS

- Provides a tool for consequence management and planning in the financial and energy sector
- Effect of various gaming strategies on the reliability and robustness of physical grid operations
- Assess interdependent infrastructural vulnerabilities

Approach

Overall View of Marketecture



- Agent based, parallelizable, multi-scale, end-to-end simulation of energy markets
 - Integrated with built urban infrastructure to create individualistic disaggregated power demand
 - Integrated with a physical electrical grid and realistic coverage areas
 - Scales to millions of users
- Generic and detailed representation of commodity markets
 - Disaggregated generic players: can be combined to simulate oligopolistic, competitive, monopsony, monopoly players.
 - Markets: Forward and real-time
 - Clearing Rules: Vickrey, double auction, pay-as-bid, weighted average
 - Can be extended to other commodities

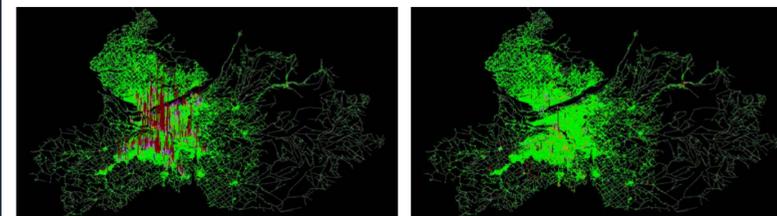
Novelty

- Theory based market design and simulation.
- Designed to analyze interdependent infrastructures
- Unprecedented in scope (millions of agents) and scale (multi-scale)
- End-to-End simulation – urban infrastructure to physical power grid
- Urban population mobility based individualistic demand profiles

Configurable Markets

Time	Aggregation	Matching Algorithm	Clearing Algorithm
Forward	Monopoly	Random	Vickrey Auction
Real Time	Monopsony	User Defined	Weighted Average
Futures	Monopolistic	Double Auction	Pay\$as\$bid
	Competitive		Normal

Mobility Based Individual Demand Profiles for Portland



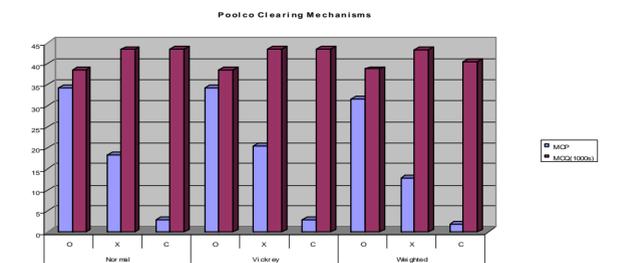
Scale of Simulation

Consumers – 1.6 million, Spatial Locations – 243000
Substations - 624, Transmission Lines – 718
Generators - 39

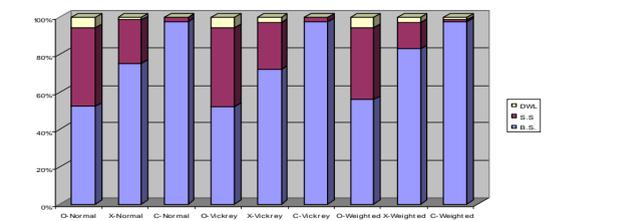
Results

Case Study – Analyze the market performance and efficiency under different market clearing algorithms and suppliers' strategies

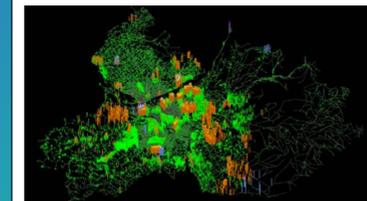
Poolco Clearing Price and Quantity



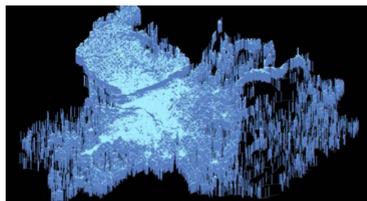
Market Efficiency and Performance



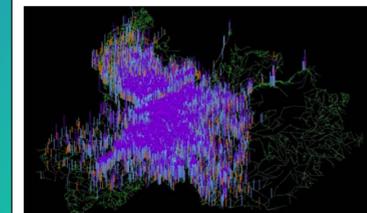
Bilateral Clearing Prices



Poolco Clearing Price



Spot Clearing Prices



Grid Congestion

