



*Complex Adaptive System of Systems
(CASoS) Engineering Initiative
<http://www.sandia.gov/CasosEngineering/>*

A Policy of Strategic Petroleum Market Reserves

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Petroleum Price Spikes

- Petroleum markets are subject to sudden divergences from normal price trends
- Short-term price spikes cause:
 - Markets to become unstable
 - Negative economic effects
 - Cascading impacts across the economy

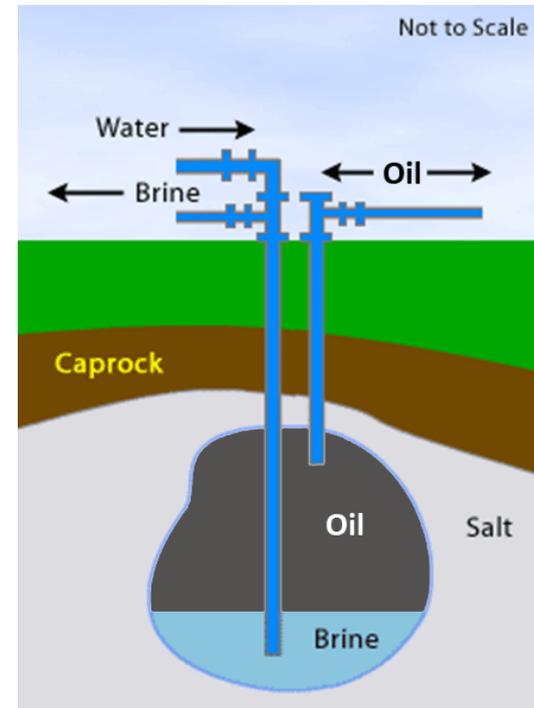


- Mitigating short-term petroleum price spikes with a Strategic Petroleum Market Reserve (SPMR)
- Trading bands to determine when to buy and sell
- Market-driven policy for petroleum reserve maintenance:
 - Predictable
 - Adaptable
 - Effective



Strategic Petroleum Reserve

- Enacted by Congress in 1975
- 750 million barrels of petroleum stored
- Deterrent to organized disruptions in the availability of petroleum to U.S. markets
- Salt domes are used for storage:
 - Large Capacity (150 million barrels)
 - Accessible
 - Self-sealing

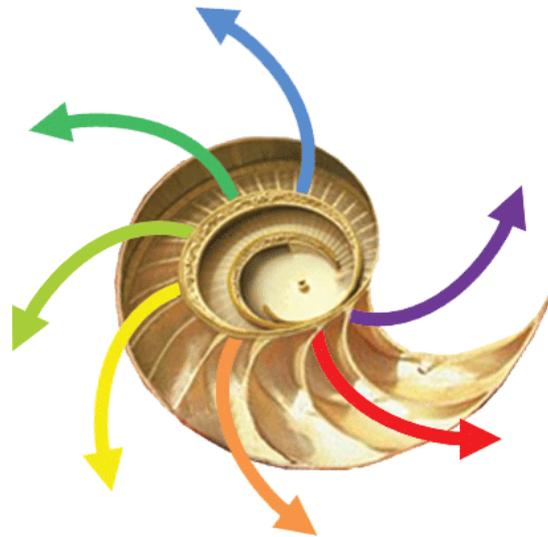


Trading Bands

- Metric used to determine when an observed price diverges significantly from normal price trends
- Trading band algorithm determines when to buy and sell from the reserve
- Bollinger Bands:
 - Simple Moving Average
 - Upper Band (Sell)
 - Lower Band (Buy)

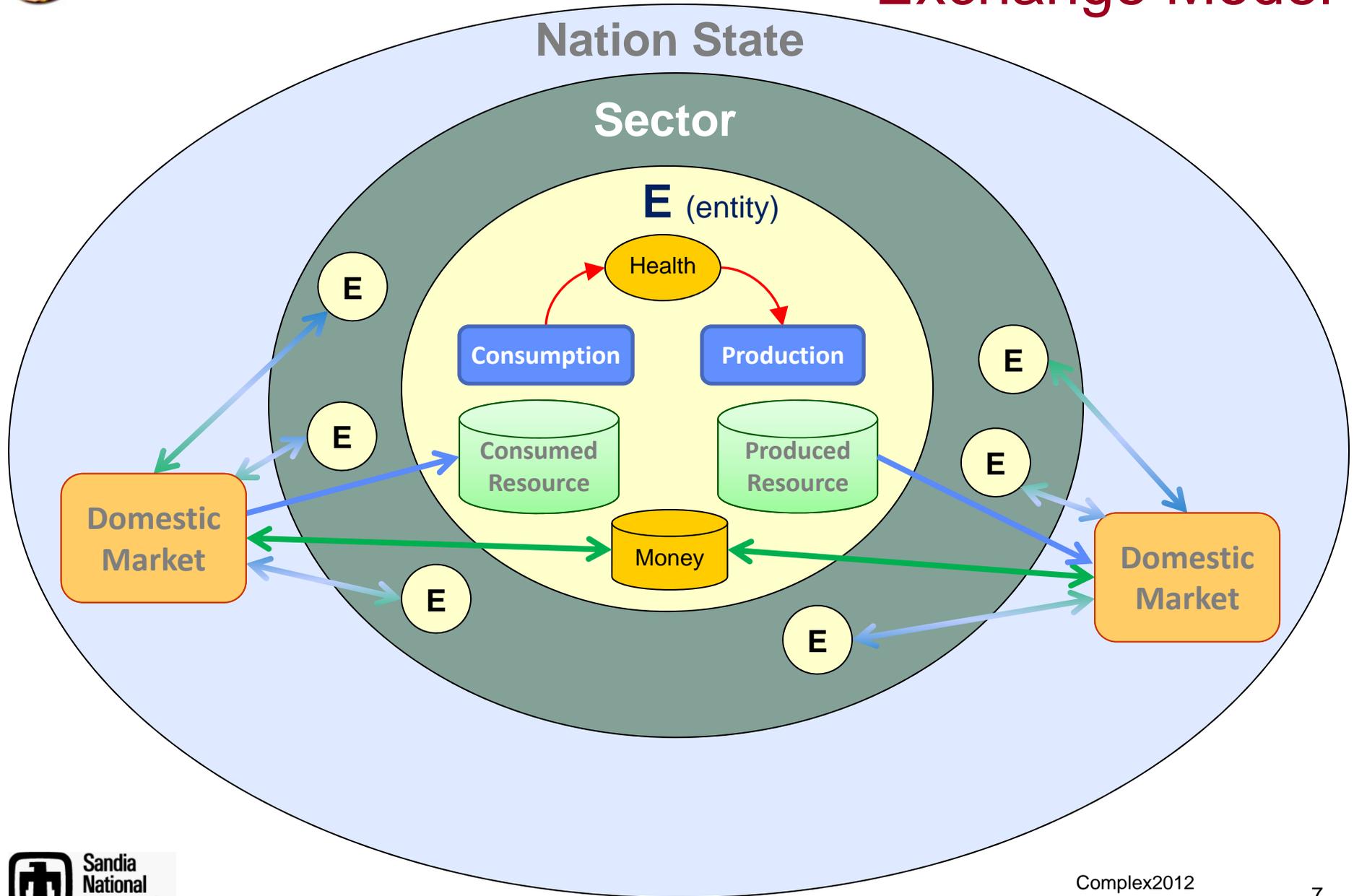


Complex Adaptive Systems (CAS)

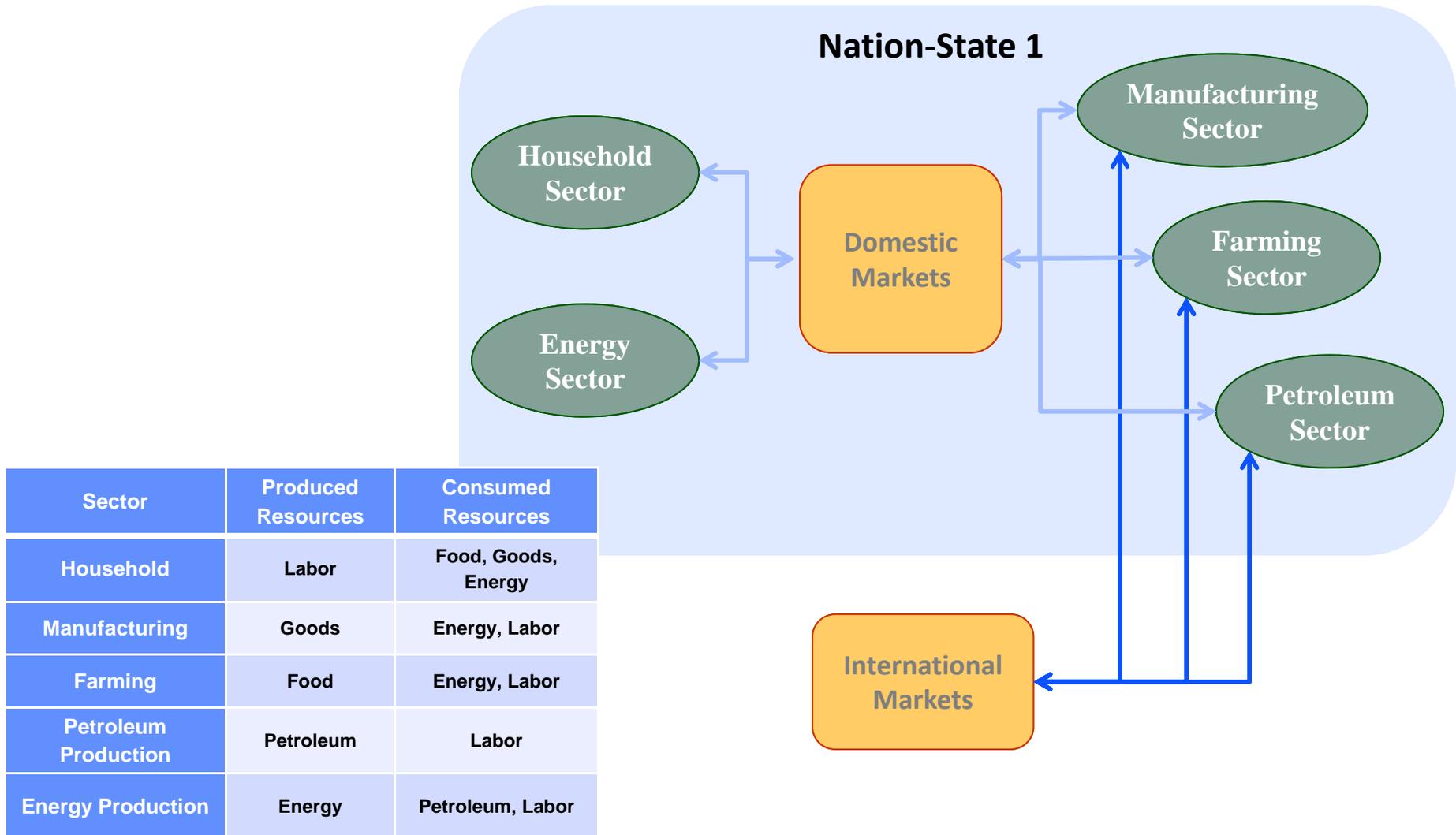


- System: collection of interacting specialists that together serve a common objective
- Adaptive System: one in which complex adaptive system interactions among elements additionally produce emergent non-linear behavior

Exchange Model

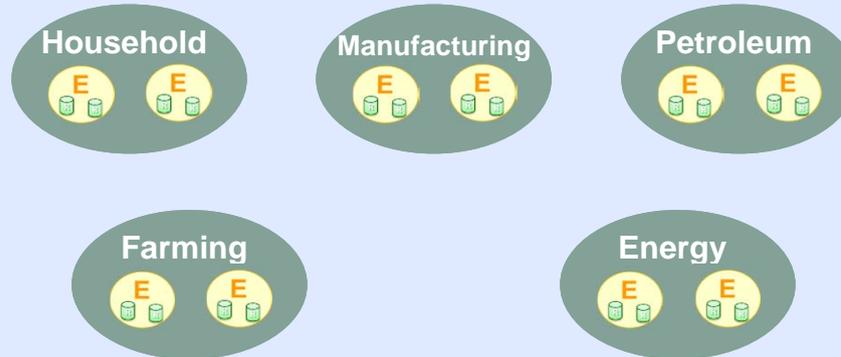


Nation-State Model

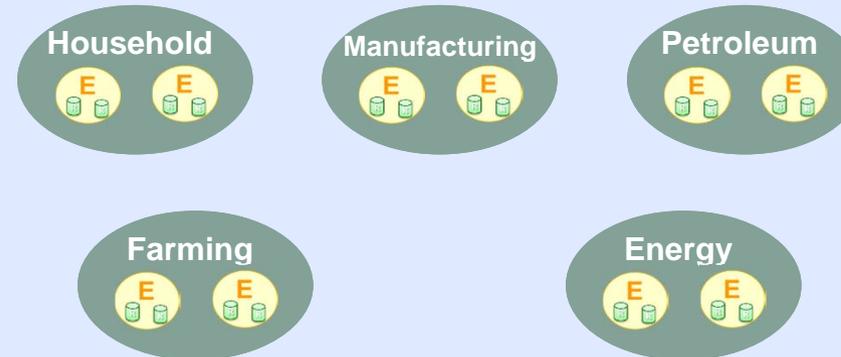


Nation-State Configuration

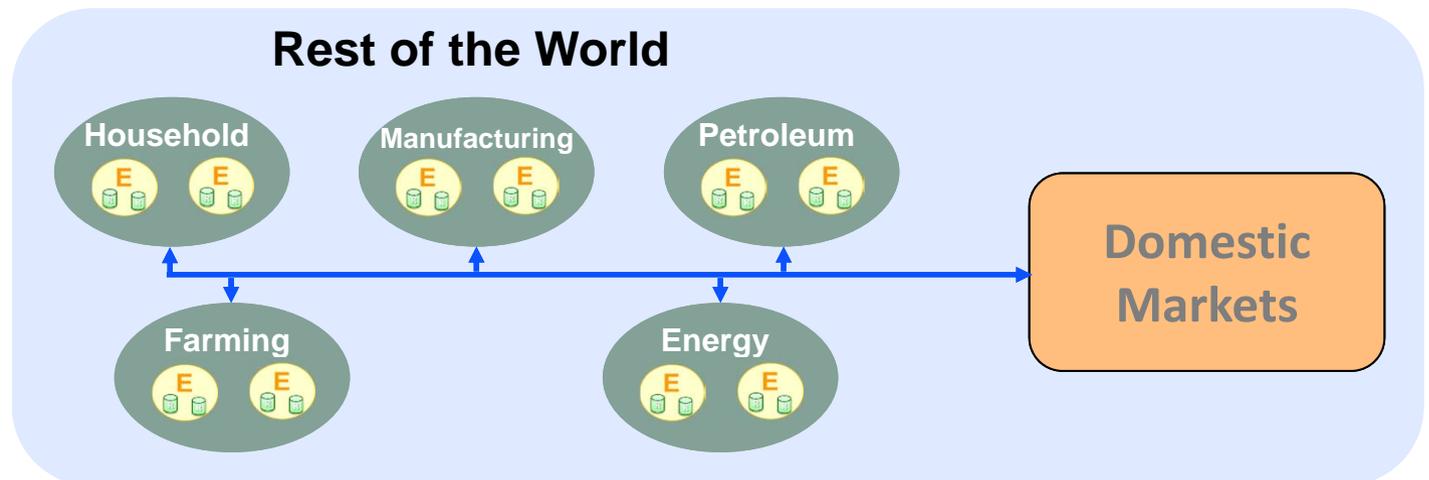
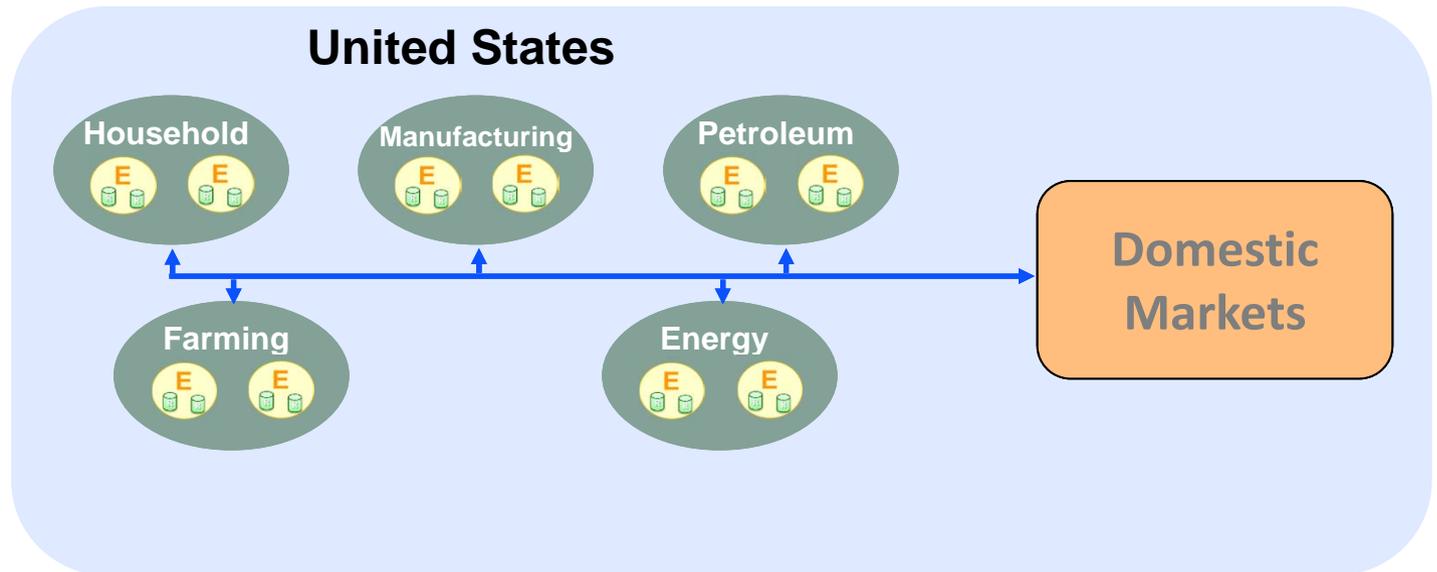
United States



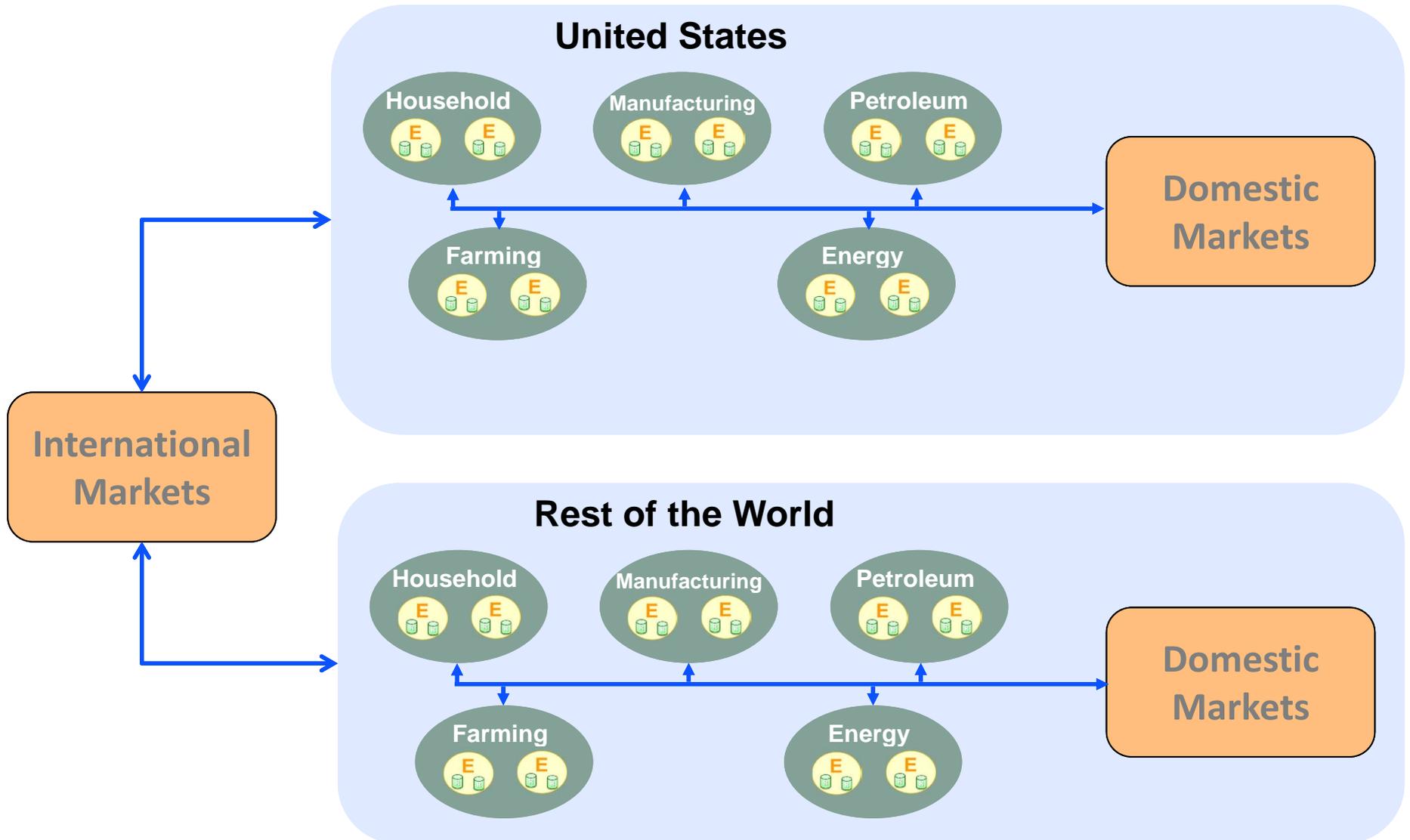
Rest of the World



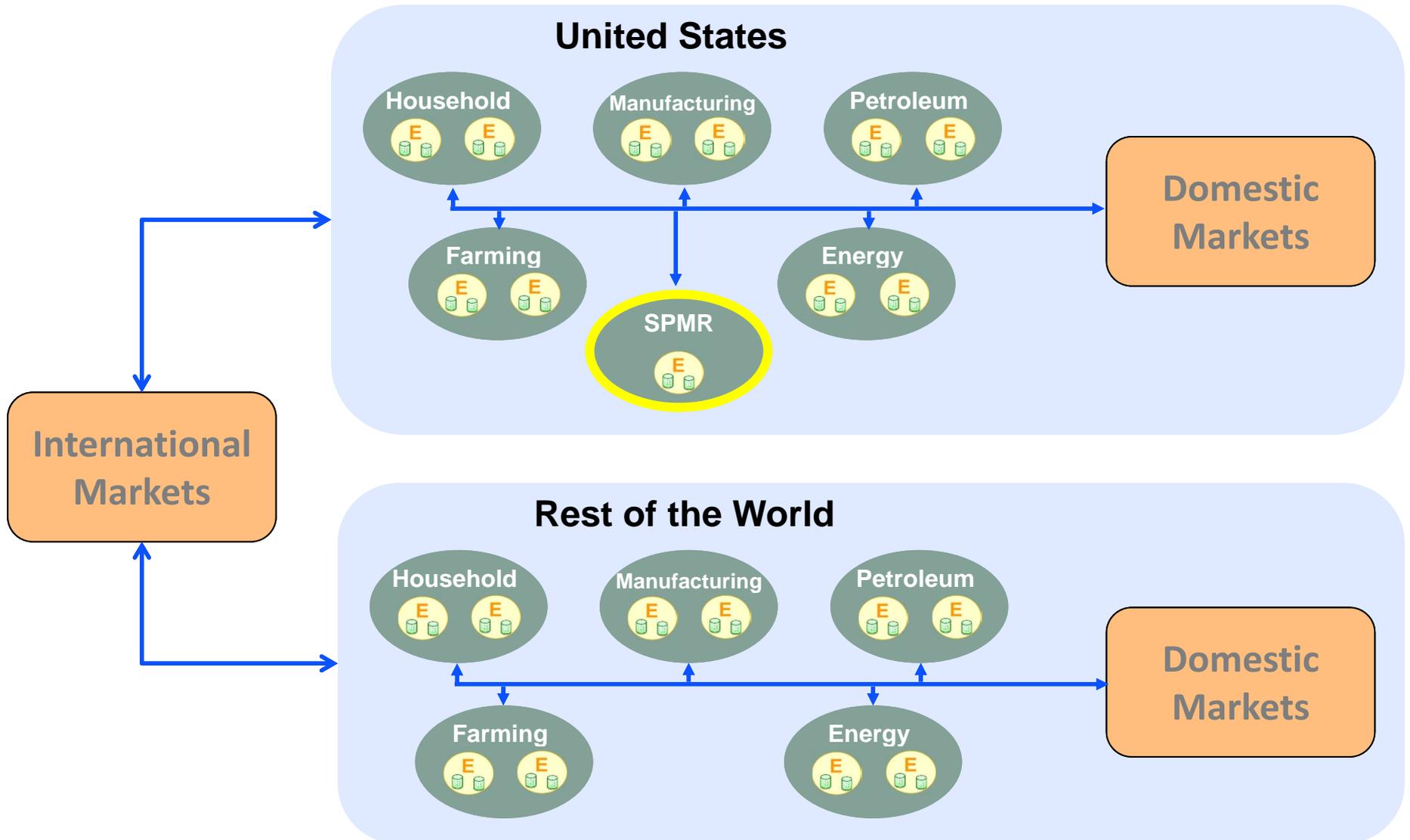
Nation-State Configuration



Nation-State Configuration



Nation-State Configuration



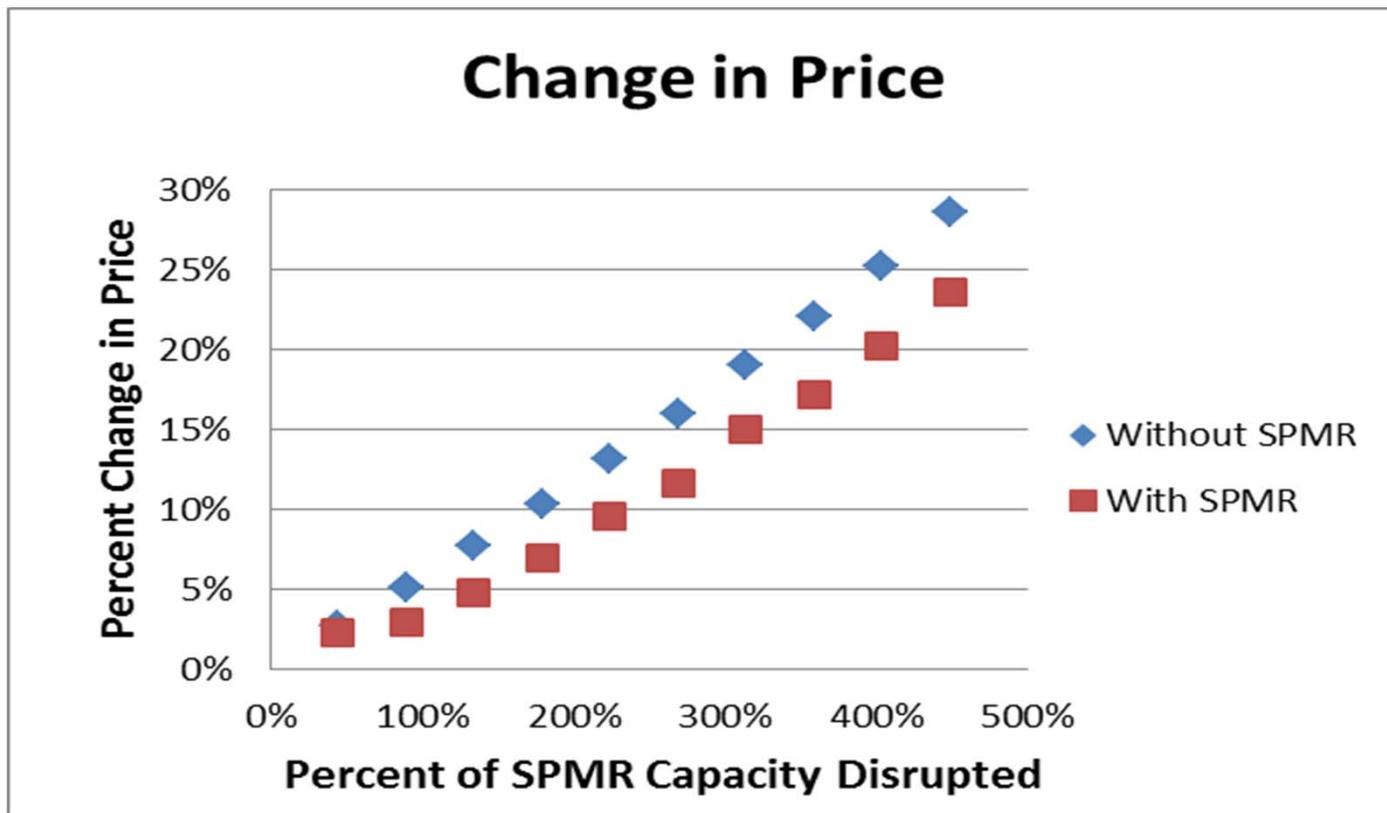
Simulation Parameters

- U.S. Nation State configured to produce less production than it consumes
- We configured 10 environments where international oil was disrupted in varying intensities
- Global supply disruptions induced a price spike
- Each simulation was run with/without a SPMR
- Results compared the effectiveness of SPMR in buffering the price spike



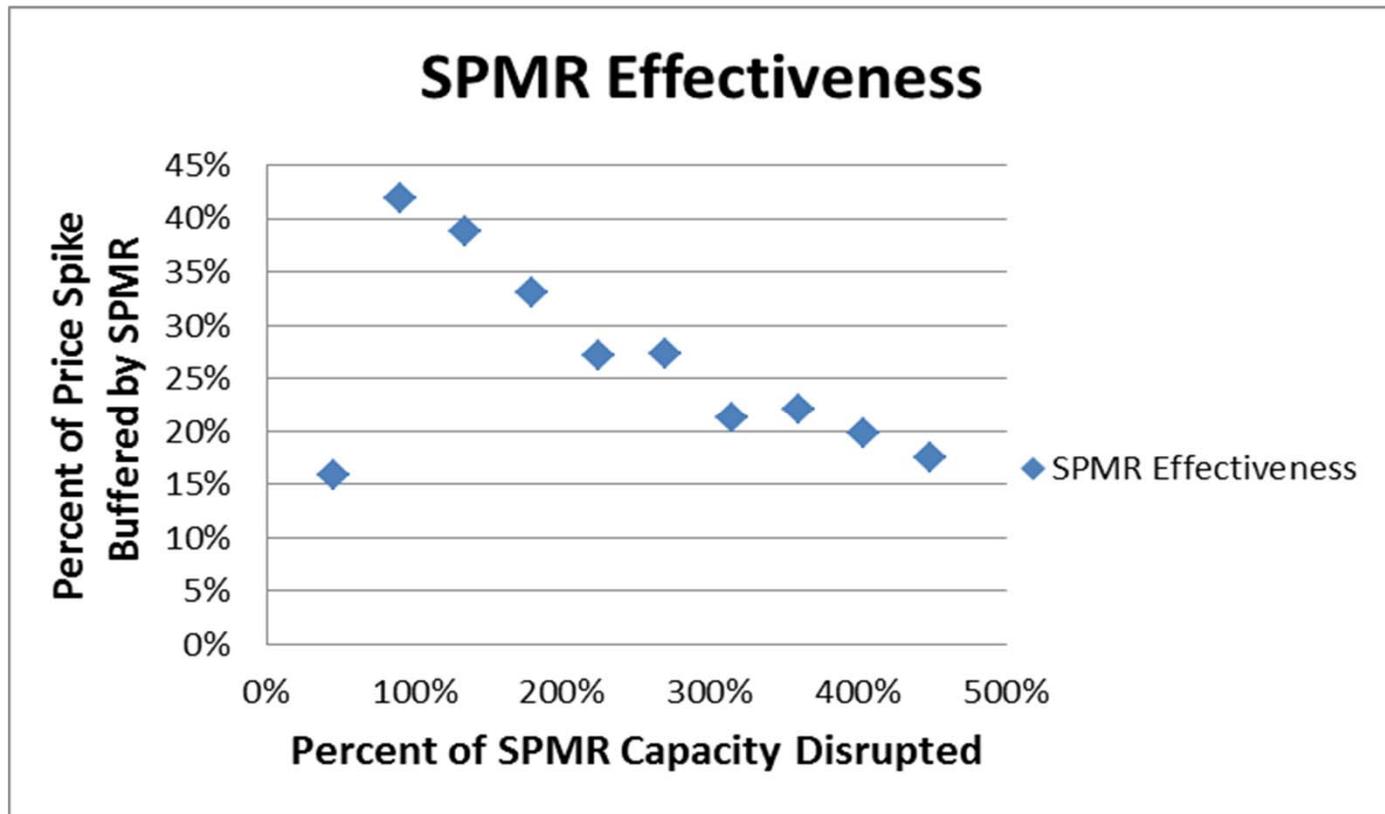
Policy's Impact on Price Spikes

The policy of an SPMR effectively buffers price spikes



Policy's Effectiveness at Mitigating Price Spikes

The policy effectiveness is relational to the total size of the disruption



- A policy of a Strategic Petroleum Resource Reserve will help buffer short-term price spikes
- Utilizing trading bands to determine when to buy and sell from the reserve allows the petroleum market to function without intervention unless there is a price deviation
- The resources needed to buffer a disruption is not relative to the domestic impact but the global disruption

Questions

