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Energy Micromarkets and Microgrids

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Who We Are

- **William Cox**
  - Consulting software architect
  - Co-Chair of EMIX (completed PAP03)
  - Co-Chair of Energy Interoperation (PAP09 standard in final ballot)
  - Member SGIP Smart Grid Architecture Committee
- **Toby Considine**
  - Chair of OASIS WS-Calendar (completed PAP04)
  - Member SGIP Smart Grid Architecture Committee
  - Chair of Open Building Information Exchange

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Balancing Supply and Demand

- Emergent order
- Systems and systems of systems
- *The Pretense of Knowledge*
  - Hayek's *Knowledge Problem*
- Centralized control problem difficult
- Localized control problem less difficult

Markets manage the knowledge problem

Markets and Macromarkets

- Markets are defined by market rules:
  - Definitions of products traded
  - Converging algorithms for clearing
- Large markets are *Macromarkets*
  - High reliability
  - Specialized security
  - Generally larger transaction sizes
  - Generally higher financial responsibility
  - Generally more complex control
  - Add-ons like demand response

MicroMarkets

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- Micromarkets
  - Focus on scalability (from small to larger)
    - Geographic dispersion
    - Density of participants
    - Number of participants
    - Transaction size
    - Diversity of participants
  - Focus on simplicity
    - Simpler rules should be easier to understand and apply
  - Local purpose

...and MicroGrids

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- Leverage microgrid implementations
  - *[Microgrids are] modern, small-scale versions of the centralized electricity system. They achieve specific local goals, such as reliability, carbon emission reduction, diversification of energy sources, and cost reduction, established by the community being served.*—Robert Galvin
- Local knowledge of surplus and shortage

Bind Micromarkets to Microgrids

- Micromarkets help balance Microgrids
- Microgrids provide switching and delivery for market actions

Micro Market

Balance
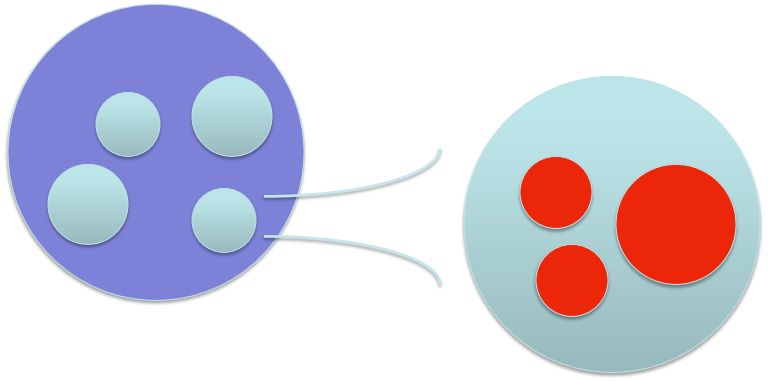
Switching & Delivery

Micro Grid

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Market Cost

- Cost of entry
  - Software
  - Understanding
- Cost of participation
  - Market risks
  - Transaction costs
  - Fixed costs

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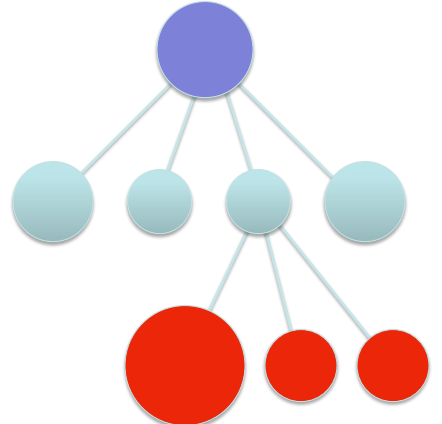## Aggregating Micromarkets

- No inherent limit to scale
- Micromarkets participate in "containing" micromarkets

Aggregating Micromarkets

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Building Micromarkets

- Discovery
- Self-knowledge
- Technology pre-requisites
- Tools to build

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Discovery

- Find what is traded
- Find where to trade
- Find how to trade
- Adaptability without manual programming

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Self-Knowledge

- Assess relevance of market products
- Determine or discover value of services provided
- Know your own pattern of consumption and demand

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Technology Pre-Requisites

- Simple interactions
  - Quote, tender, transaction, delivery verification
- Clearing algorithms and methods
  - From market rules
  - Move toward simpler rules
  - Market clearing as emergent order
- Separation of market interaction and delivery
  - Time scale and commitment
  - Clearing is another issue

Technology Pre-Requisites (2)

- Scalability
  - Support simple rules, high transaction rates
- Reliability
- Security
- Simplification where possible
  - Transactive EMIX is one route—simple block energy

Digression: SGIP Priority Action Plans

- Priority Action Plan 03: Price and product definition for the Smart Grid
  - Two SDO collaboration, used in PAP09
- Priority Action Plan 04: Common schedule information model for the Smart Grid
  - Three SDO collaboration, CalConnect
- Priority Action Plan 09: Common DR and DER Semantics
  - Two SDO collaboration, OpenADR Alliance
  - Energy Interoperation includes transactive energy

Tools for Micromarkets

- Use the standard information models for Schedule, Price, and Product definition
  - OASIS Energy Market Information Exchange addresses markets in general (SGIP PAP03)
  - OASIS WS-Calendar addresses schedule (SGIP PAP04)
- Use standard DR and DER signals and transactive energy framework
  - OASIS Energy Interoperation (SGIP PAP09)

Conclusions

- Micromarkets allow
  - Composition
  - Scalability
  - Low transaction and entry cost
  - Bottom-up and local information to be used
- Standards are now complete for information models and interactions with micromarkets
- Binding micromarkets to microgrids increases the value of switching and of markets

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Questions

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Selected References

- OASIS Energy Market Information Exchange
  - Price and product definition/description
  - Transactional EMIX Notes
  - Committee Specification pending publication
  - http://www.oasis-open.org/committees/emix
- OASIS Energy Interoperation
  - Designed to work to, from, inside, and outside microgrids
  - Committee Specification ballot in process
  - http://www.oasis-open.org/committees/energyinterop
- William Cox Energy Talks & Papers