Interfacing Facility Management to the Transactive Grid

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Outline

- Standards framework: Energy Interoperation and 201P for grid connected facilities
- Price communication vs. traditional DR
- SG communications inside the facility
  - energy management for facility cost reduction
  - Value and cost
  - Where is the intelligence and knowledge?
  - Strategies for integrating loads/generation/storage (LGS)
  - When does it make sense to interact via one model vs. the other?
- Standards and LGS common interface.

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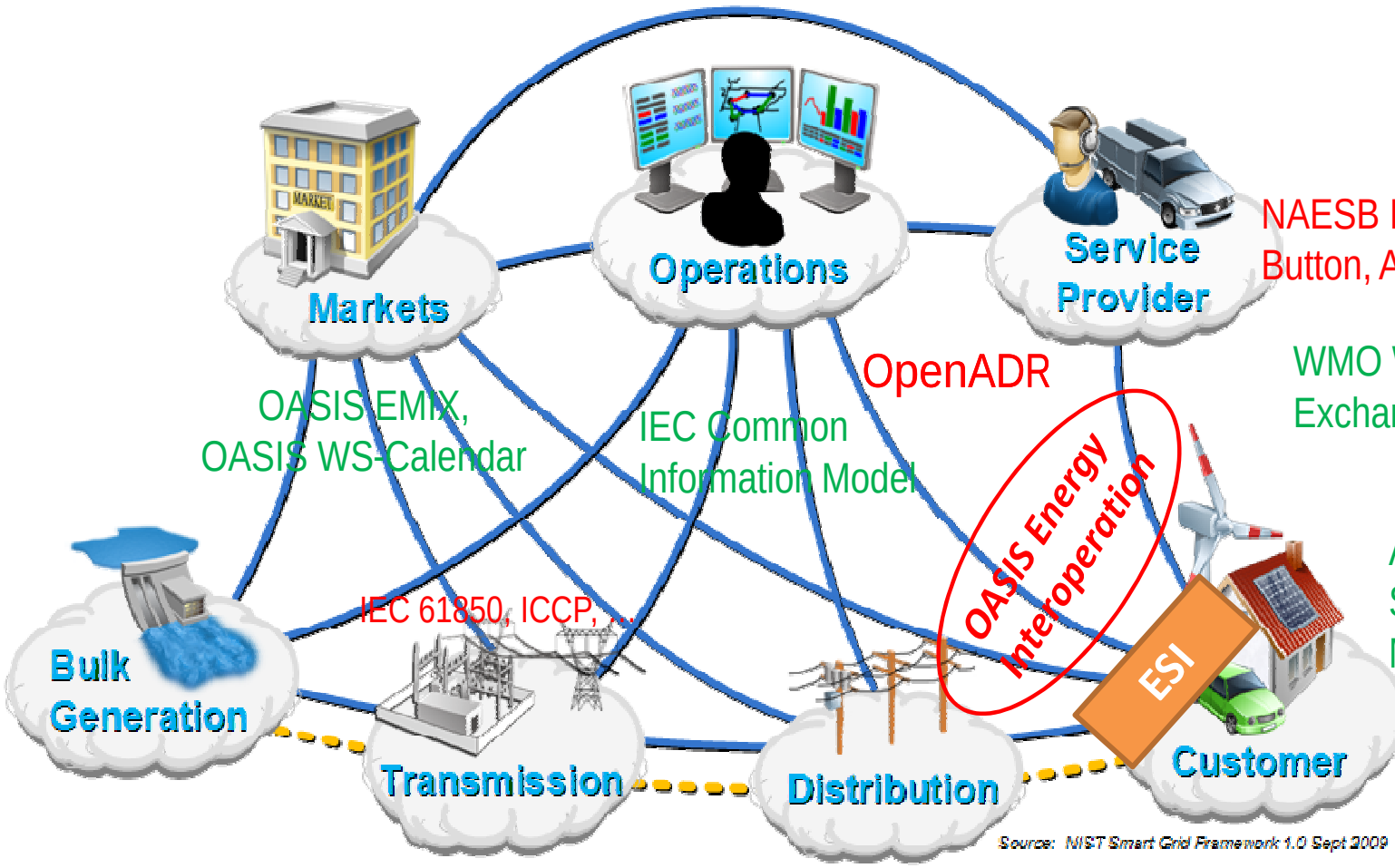
Smart Grid Domains and existing standards



NAESB ESPI/ Green Button, AS/NZS4755

WMO WXXM Weather Exchange Model

ASHRAE Facility Smart Grid Information Model SPC201P

- ASHRAE BACnet, LONtalk
- ECHONET, SEP 2.0
- Modbus, Profibus
- OPC-UA, ISA standards
- CEA 2045
- ...

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Price vs. Event based DR

- We have lived in a world with
  - dumb meters and thus flat electric rates
  - Flat rates => no signal/reason for customer to adjust consumption patterns
  - So must provide an external signal to motivate customer => Event signal
- We now have smart meters, so we think, "let's use the meter to judge performance of our response to DR events"
  - This is only a transition model. Not the best.
  - It's about making load-response look like generation in a one-sided dispatch-oriented market environment.
- Price communication is a different and better paradigm
  - A forward price is like a 24/7 event signal
  - No DR M&V required (still need a smart meter…)
  - Much better for facility owner *and* grid. Now the facility can justify investment in storage, since all-the-time shifting opportunity.

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Inside the Facility

- Goal: minimize cost and maximize value to the facility
  - Balancing electric/gas/other energy and non-energy costs in the context of requirements to carry out mission of facility.
  - Do it right, and we also enable supporting grid reliability.
- Value vs. cost:
  - Each service in the building or home or industrial site has some value ($/hr), e.g. hot water for showering vs. hot water for industrial process.
  - Each service also has a real cost to provision of which energy is one part (also maintenance, equipment cost, labor, etc.)
  - Value changes dynamically
  - Cost can be reduced

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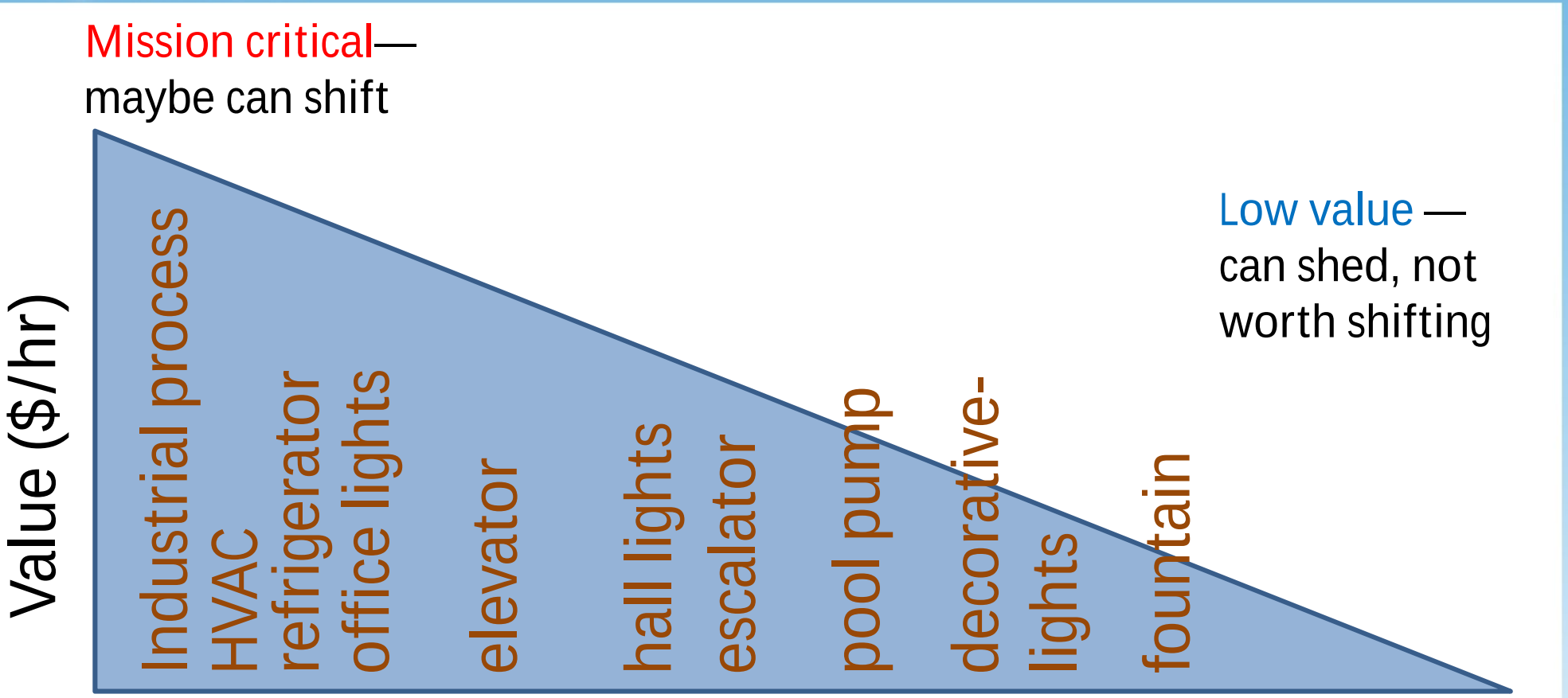
Value of different services



- Not the same as cost of service.
- How to lower cost?

Lowering cost (methodology)

- DR perspective has the unfortunate tunnel vision of seeing loads in terms of electric cost, not value. Overall cost is tied to a wide range of component costs.
- How to lower overall costs?

1. Evaluate mission requirements and the value of services
2. Do cost assessment (not just energy)
3. Consider how to reduce costs and tradeoffs. For energy:
    1. Look at energy efficiency of equipment
    2. Consider storage options/availability and fuel switching (assuming we have dynamic rates)

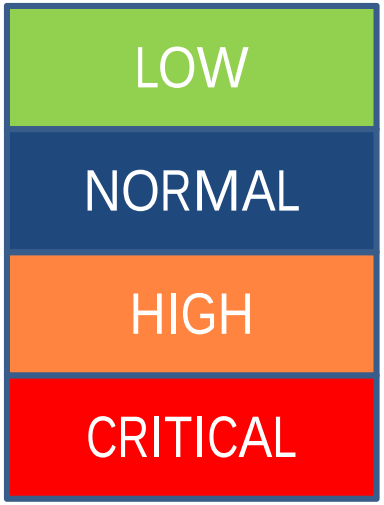
Energy Management
and a common L/G/S interface

- After value and cost assessment, we now have a facility running as efficiently as possible, able to move high-value loads (via storage or other means) to lower-price periods.
- For EM, have to ask, “Where is the *knowledge* (information) and *intelligence* (to act on the knowledge) in the facility that will allow managing loads/generation/storage (LGS)?”
  - Intelligence must be at the system level
  - Given a price signal, an intelligent controller can decide when to use electricity to minimize cost, shifting or shedding loads
  - Forward price signal required for load shifting
  - Other (external) information streams may be required
    - Weather, schedules, fuel costs, etc.

Four models for control

1. Market interaction
2. Forward Price Communication
3. Simple Levels
4. Command

"ON/OFF"
"Raise set point temp"



1. Market interaction (e.g. TEMIX)

- Passing actionable forward price signal
- ESI as market-maker, or ESI-EM interacting with sub-EMs in bilateral interaction.
- Sub-EM makes a forward demand commitment via a transaction.
- Requires intelligence, knowledge, meter.
- Can be leveraged to take facility off-grid, or to manage LGS to use local renewable generation instead of taking grid price.
- Forward positions for risk arbitrage

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2. Forward Price Communication

- Forward price signal passed from ESI-EM down to Sub-EMs
- Sub-EM is price-taker, no forecast demand passed back to higher-level EM
- Load or generation
- Sub-EM does not need a meter, does not need algorithms to estimate future demand.
- Only needs to know capabilities to shift demand to lower price periods, or simple programming interface for facility manager to tell it what to do (shed/shift) at certain price levels.

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3. Simple Levels

- Instead of forward price signals, communicate only current price or simple level (e.g., low, normal, high, critical)
- Not good for loads that can shift demand, or generation resources.
- Ideal for equipment that has manufacturer pre-programmed energy modes, and no shift-ability.
- Office copier, fountain, escalator.

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4. Command

- 201P Load or Generator
- EM to Load/Generator direct control
- Inside a system, or facility EMS to dumb equipment communications.
- Equipment doesn't have the intelligent controller or knowledge to make decision to shed or shift.
- Simple equipment (or else have to exercise the complexity of 201P Load model)
- Fan, damper, pool pump, etc.

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Common LGS interface?

- Different EM/control protocols in the facility space (SEP, BACnet, LON, many more)
  - 201P a common Information Model
  - TEMIX (based on EI) and other market protocols
  - Price communication in EI, BACnet, other.
  - Simple Levels in EI, BACnet, other
  - Commands in BACnet, SEP, other
- Price communication to the end-node is the closest we get to “common LGS interface”
- What fits my facility needs?
- What can I go buy?

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Thank You!

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