



The Importance of IoT for the Smart Grid

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IoT – NoT!

Cheerios floating in a bowl of milk!



CA Electrification Goals

- [SB100](#) : Renewable energy and zero-carbon resources shall supply 100% of all retail sales of electricity by 12/31/2045
- [SB350](#) : Increased energy efficiency and electrification of buildings and transport to reduce carbon emissions



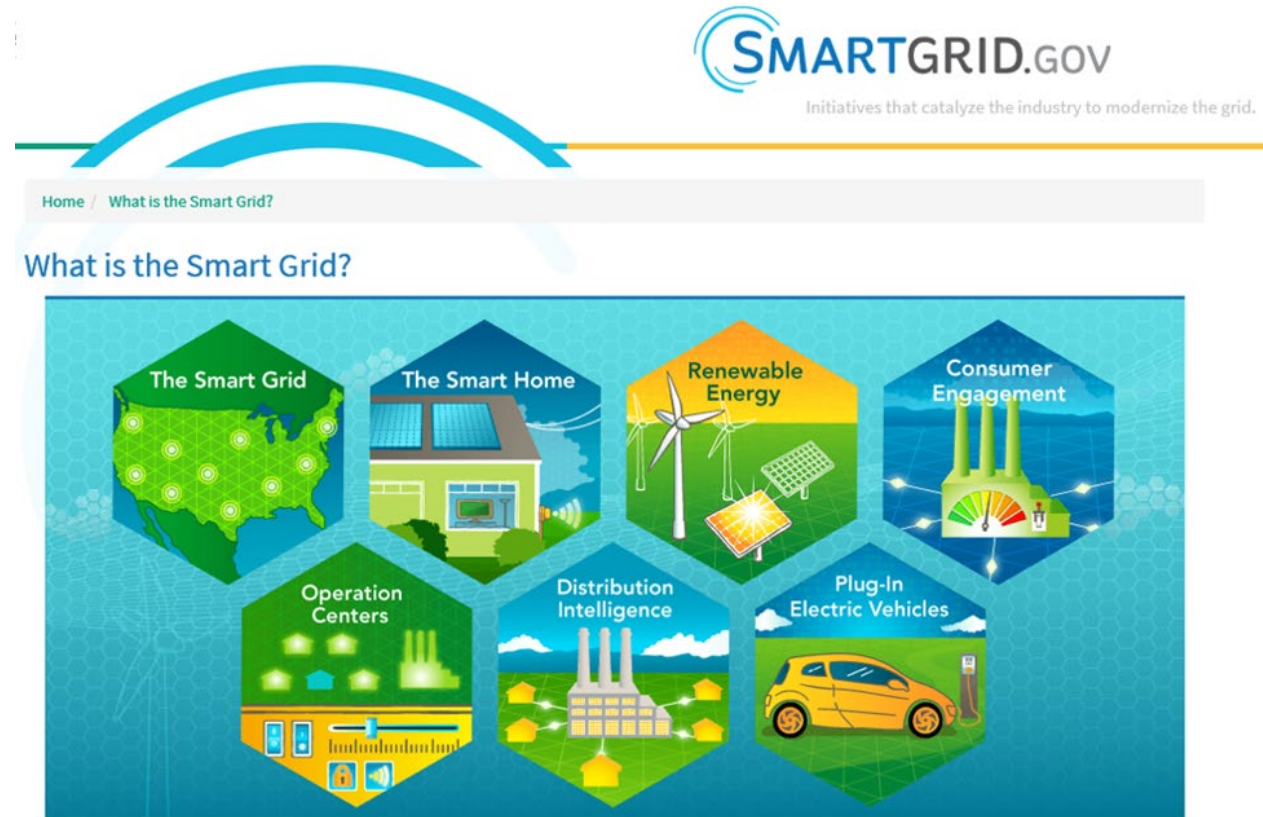
Or Electrocution?

- Rapidly increasing *variable* generation with *decentralized* ownership and location and increased electrical demand
 - Millions of *things* that can be both suppliers and consumers
 - Demand is as important as supply
- Grid reliability and stability concerns
 - Traditional DR (shed peak demand) is of limited value ¹
 - Balancing the grid between supply and demand will be really complex
 - How to address reactive power



The Smart Grid

- The digital technology that allows for two-way communication between the utility and its customers
- Consists of controls, computers, automation, and new technologies and equipment working together
- Responds quickly to changing electric demand (& supply)



But Wait ...

- What exactly are we talking about?
 - Direct control of things?
 - If so, what controls what, when, and how?
 - If not – and since traditional DR is of limited value – what's the most optimal information exchange model?



The Shimmy!

- **Shape:** advance notice to things to reshape their load
 - OpenADR event with *price* signals (day ahead or more)
- **Shift:** let things know the best times to use more or less energy (save money)
 - OpenADR event with *price* or *mode* signals
- **Shed:** reduce peak demand for emergency – traditional DR
 - OpenADR event with *mode* signals
- **Shimmy:** requests fast response from the things
 - OpenADR event with *mode* signals



But Wait ...

- What about the supply side?
 - What information should be communicated to the suppliers?
 - How do they do settlement?
 - How do they do forecasting?
 - Maybe it's *Transactive Energy!*



RATES

Retail Automated Transactive Energy System

GFO 15-311 - Advancing Solutions That Allow Customers To Manage Their Energy Demand

Group 2

- Load Management Systems that Facilitate Participation as Demand-side Resources
- Evaluate customer response to **Transactive Signals**



What is Transactive Energy?

- It's Block Chain!
 - No, it's really not
- Most widely used definition comes from PNNL/GWAC
 - “A system of economic and control mechanisms that allows the dynamic balance of supply and demand across the entire electrical infrastructure using **value** as a key operational parameter”



Transactive Signals = Price Signals?

- How do we
 - Recoup transportation charges?
 - Represent Reactive Power?
- Since there's no binding delivery and payment commitment/records
 - Settlement is complicated: for future signals, what's the actual cost?
 - Forecasting is not optimal: relationship between quantity and price is implicit



If there are no "Transactions" anywhere so why even call it Transactive?

The Authentic Transactive Energy

- Transactions at specific *locations* on time *intervals*
 - Energy related products such as Real and Reactive Power
 - Transport related products such as two-way energy transport
- Full lifecycle
 - Tender (or offer), transaction, and delivery
 - Bidirectional to buy/sell (DER)
 - Settlement does not require baselines and measurement/verification
- Tariff independent (Dr. Cazalet)



What's It Got to Do with OpenADR?

- OpenADR is a known and mature brand
 - The standard for communications between the utilities and customers
- They share many concepts
 - TeMIX and OpenADR are both based on OASIS | eMIX and share many constructs
- Complements OpenADR
 - OpenADR 2.0a/2.0b address Informational and Directive signals
 - Transactive Energy addresses Transactional signals
 - Very important for microgrids/DER
- Regulatory, utility, manufacturer, and ultimately more customer friendly
 - Dealing with multiple standards is costly and confusing for everyone

It's Complex But It's Already Solved!

