The Smart Grid's Role in Integrated Resource Planning

Wired Group

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Preview

- Smart Grid Capabilities with Significant Potential IRP Impact
- How Each Works
- Research-Supported EE/DR (IRP) Potential
- Drivers/Limiters of EE/DR (IRP) Value
- Capability-specific options available to maximize
- Systemic options available to maximize

Presenter Introduction

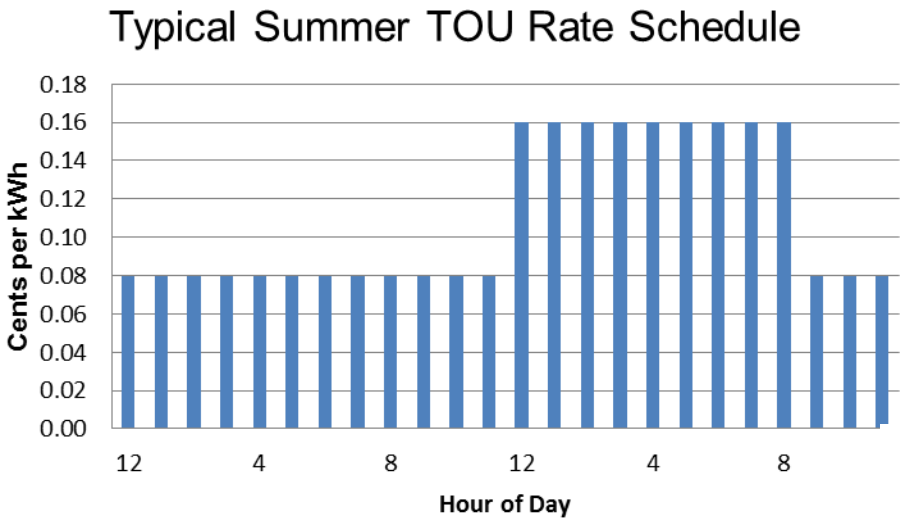
- 25 years' experience in Product Development & Product Mgmt.
- 10 years in DSM and renewables program development
  - Interruptible (C&I) and TOU rates
  - Real-time and Next Day customer usage data access (C&I)
  - Residential AC load control
  - Voluntary renewable energy (Residential, C&I)
  - PV Solar rebate (Residential, C&I)
- 4 years in smart grid (performance evaluations in public domain)
  - SmartGridCity™ for Xcel Energy (Boulder Colorado)
  - Duke Energy Ohio for the Ohio PUC (Cincinnati)
  - Smart Grid Consumer Collaborative Cost/Benefit Research Review
- Adjunct Professor at Michigan State U. and Colorado U.
- BA in Finance (Indiana U); MBA Marketing (Northwestern U.)

Capabilities w/Potentially Significant IRP Impact

Enabling Smart Grid Technology	Capability	Energy Sales Reduction?	Demand Response Reduction?	Customer Benefit / IRP Impact Range?
Smart Meters	Time-varying Rates	YES	YES	Highly Variable
Smart Meters	Prepayment	YES	YES	Highly Variable
Distribution Automation	Conservation Voltage Reduction (IVVC)	YES	YES	Highly Variable
Distribution Automation	Distributed Energy Resource Management	YES	YES	Highly Variable

POTENTIAL CLEAN POWER PLAN VALUE

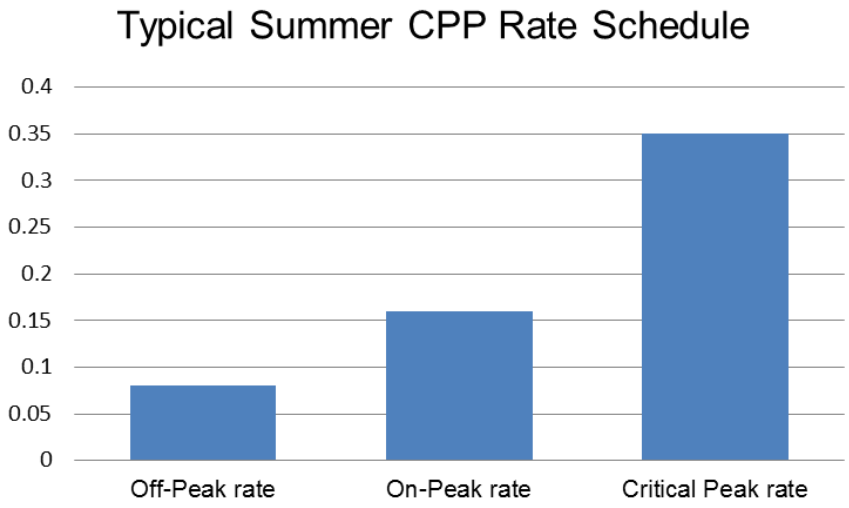
Time-Varying Rates (How They Work)



In general, exposes customers to same economics faced by utilities (*economic transparency)*

Also

1. Peak Time Rebate (PTR): Like CPP, but with replaces stick with carrot
2. Real Time Pricing (RTP): Prices change hourly based on market



Time-Varying Rates (Potential IRP Benefits)

- Demand Reduction (Faruqui*)
  - 5%-35% (74 studies)
  - Greater response as price differential increases
  - Greater response with enabling technologies
- Conservation Effect (Delurey & King)
  - +5% to -13% change in usage (24 studies)
  - Average -4% change in usage

Opt-out (default) offer with 25% active participation delivers:

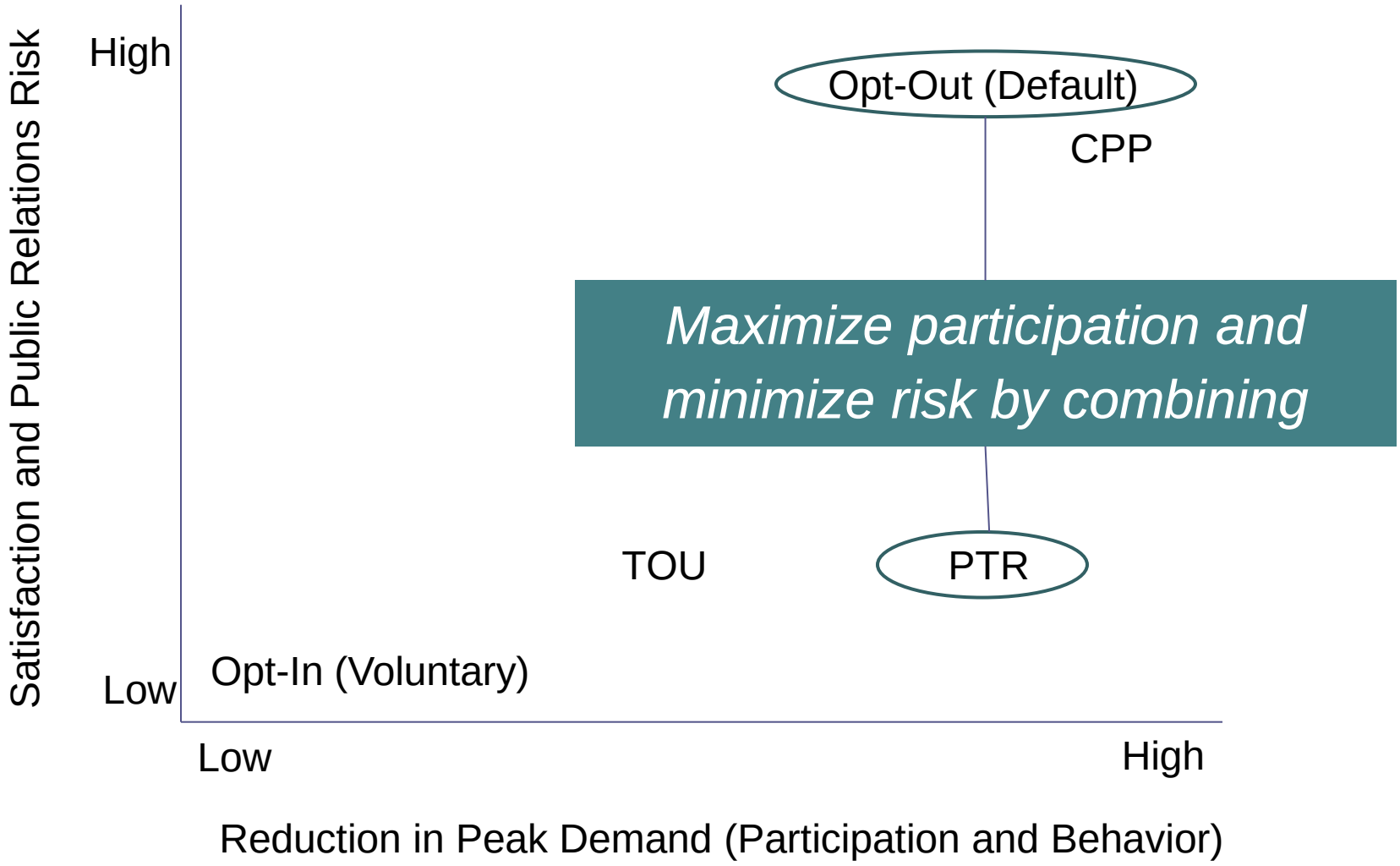
- *5% reduction in system peak demand (20% impact level)*
- *1% reduction in system energy sales (4% impact level)*

* See also the work of Steve George and Craig Williamson

Time-Varying Rates (Benefit Drivers/Limiters)

- Rate Design
- Enabling Technologies
- PARTICIPATION RATES!
  - Opt-in (voluntary): 1-2% of customers choose
  - Opt-out (default): 90+% remain; 20-40% “active”

Time-Varying Rates (Options to Maximize)



Prepayment (How It Works)

- Customers pay in advance (no monthly bill)
- Most pay weekly in cash at convenience & grocery stores, check cashing centers, payment kiosks
- In-home display talks to meter(PLC), CRM(wireless); details remaining balance; projects depletion date
- Can be used with Nat Gas, LIHEAP funds, existing balance payment plans, time-varying rates
- Low-income advocate concerns can be addressed with proper program designs
- Extremely popular with “unbanked” customers (up to 10% of the U.S. population)

Prepayment (Potential IRP Benefits)

- Average participation rates of around 10%
- Average usage reductions of 10%+ (Salt River Project; Oklahoma Electric Cooperative)
- Reductions apply to peak periods as well?

10% participation with 10% usage reductions:

- *1% reduction in system peak demand*
- *1% reduction in system energy sales*

PLUS: O&M cost reductions and customer satisfaction improvements are huge!

Prepayment (Benefit Drivers/Limiters)

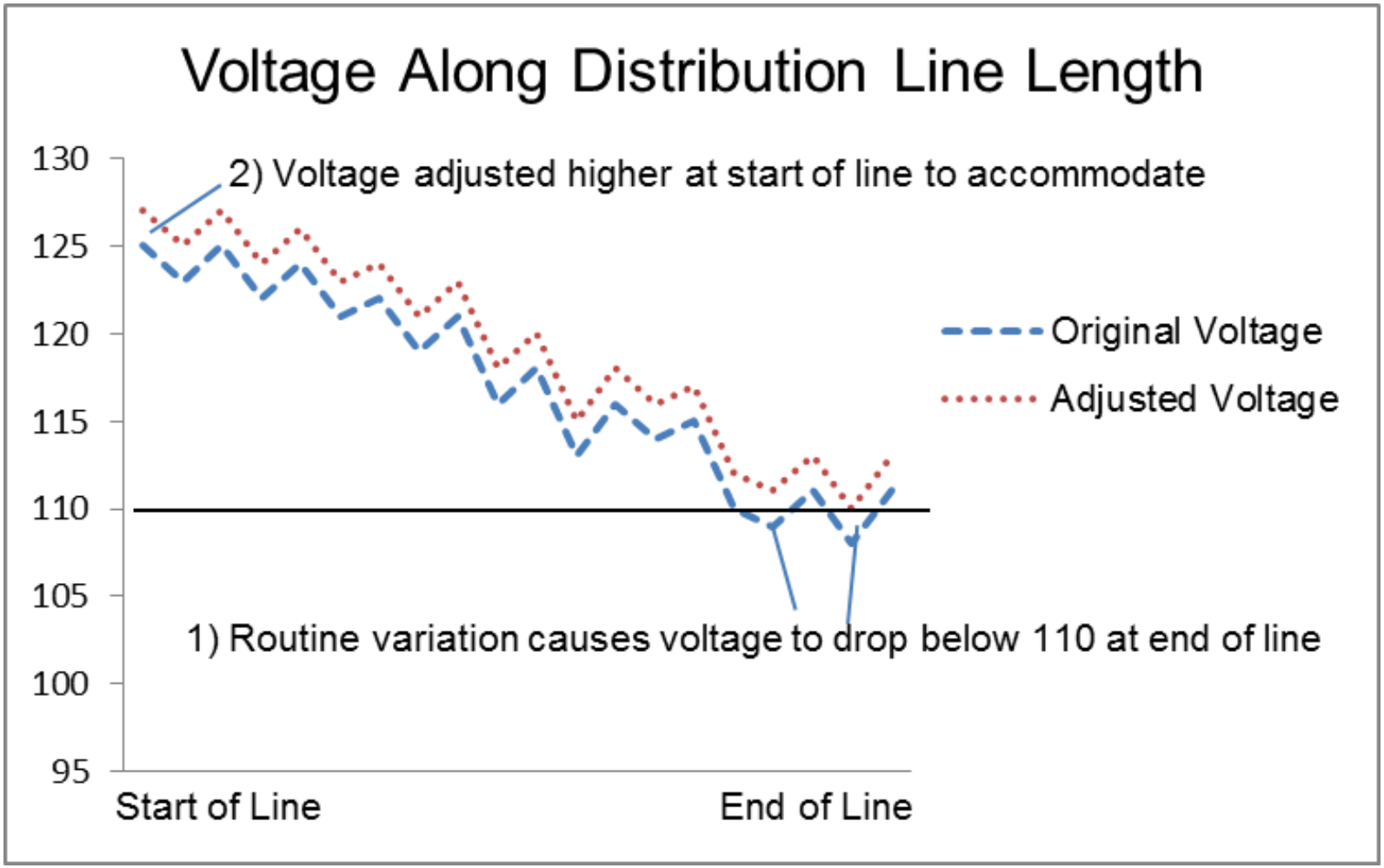
- PARTICIPATION RATES!
- Challenge: Common low-income customer protection proposals
  - Prohibit customers with a DNP in last 12 months from participating
  - Prohibit customers with an outstanding balance from participating
  - Prohibit customers on LIHEAP from participating

Prepayment (Options to Maximize)

- Use an alternative low-income customer protection: “3 strikes and you’re out” policy
- Allow any customer to participate; participants must earn the right to remain on prepayment
- Any participant whose prepaid balance goes negative 3 times in any 12 month period is disqualified and placed on standard service (traditional billing with post payment)
- Participants want to remain on prepay so badly they will work very hard to avoid the 3 strikes

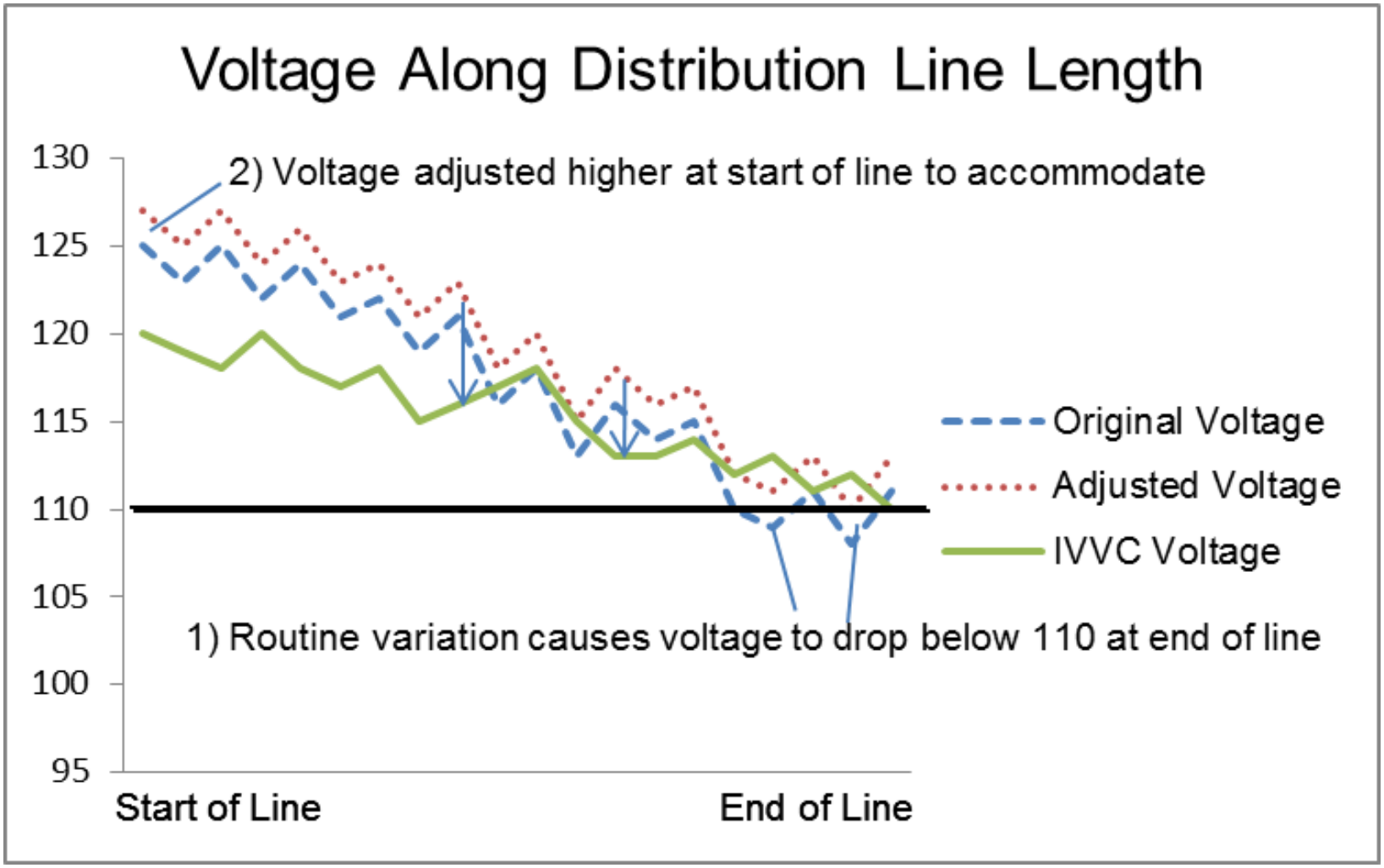
CVR/IVVC (How it Works)

BEFORE CVR/IVVC



CVR/IVVC (How It Works)

AFTER CVR/IVVC



(back)

CVR/IVVC (Potential Benefits)

- Rule of Thumb: 2/3% energy reduction for each 1% volt reduction (1/2 to 9/10 in multiple studies)
- Voltage reduction potential: 3%
  - Average voltage pre CVR/IVVC: 118v
  - Average voltage post CVR/IVVC: 114.5v
- Energy reduction potential 2% on treated circuits
- Also applies during peak periods

3% voltage reduction w/2/3 "CVR factor", installed on circuits representing 50% of a utility's annual load:

- *1% reduction in system peak demand*
- *1% reduction in system energy sales*

CVR/IVVC (Benefit Drivers/Limiters)

1. Number of circuits to which the capability is added
2. Days of the year in which capability is switched on

CVR (Options to Maximize)

- Prioritize circuits to which the capability is added
  - Greatest loads (highest energy sales)
  - Highest average voltages (greater reduction opportunity)
  - Poorest power factors (greatest improvement opportunity)
- Strive to use the capability 24 hours/day, 365 days/year

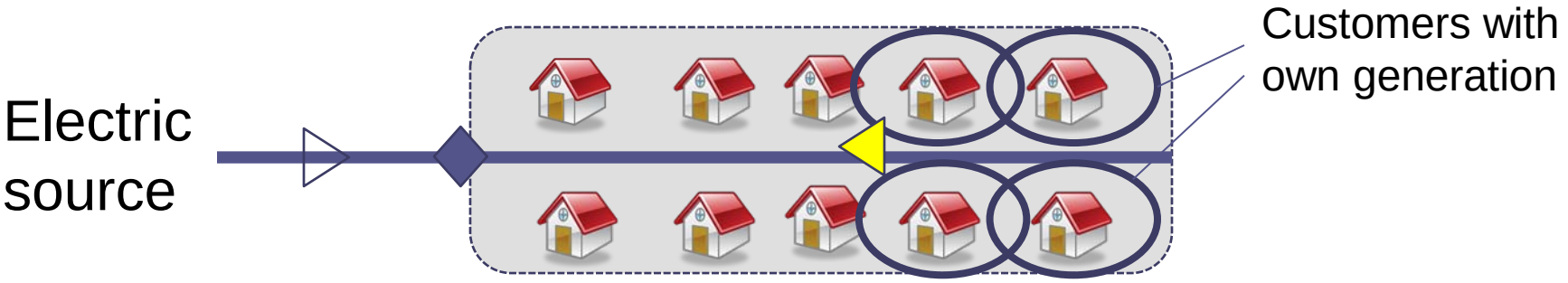
DERMS* (How It Works)

- A combination of multiple smart grid capabilities to help manage distributed generation challenges
  - CVR/IVVC (manages voltage, power factor)
  - Fault location (finds faults faster)
  - Fault isolation/automated service restoration (limits the impact of a fault to fewer customers)
- On the horizon: "Settingless Protection"

* Distributed Energy Resource Management System

DERMS (How it works)

The distribution reliability challenge associated with high levels of distributed generation:



- Distribution lines
- Routine power flow direction
- Fuse or Circuit Breaker
- Power flow on low load day
- Customers who lose power when breaker trips

Microgrids: same challenge but also an additional one: rejoining system after outage (how to match frequency?)

DERMS (Potential Benefits)

- Enables grid to reliably accommodate higher levels of distributed generation (DG)
- How much higher? It's difficult to say
  - Level of DG which grid without DERMS can reliably handle is unknown, situation-specific
  - Level of DG which grid with DERMS can reliably handle is unknown, situation-specific

- *Reduction in system peak demand? YES*
- *Reduction in system energy sales? YES*

DERMS (Benefit Drivers/Limiters)

- The number of circuits to which DERMS capabilities are added
- Circuit-specific characteristics
  - Loads
  - Prevalence of distributed generation
  - Types of distributed generation
    - PV solar (energy value, but perhaps not demand value)
    - CHP/microturbines (generally energy and demand value)

DERMS (Options to Maximize)

- Delay installation of capabilities until needed?
- Follow R&D developments associated with “Settingless Protection”

Smart Grid IRP Impact Summary

Capability	Best Case System Energy Benefit	Best Case System Demand Benefit	Best Case Requirements
Time-varying Rates	1%	5%	Maximize participation through default use of Peak-Time Rebate Rate
Prepayment	1%	1%	Don't discourage appropriate participation by motivated customers
CVR/IVVC	1%	1%	Prioritize circuits and strive for 24 x 365 operation
DERMS	YES	YES	Need may not materialize for several years yet
TOTALS	3%	7%	

POTENTIAL CLEAN POWER PLAN VALUE

Systemic Options to Maximize Value

1. Require utilities to maximize smart grid capabilities through rulings and performance measures?
2. Consider ways to eliminate utilities' "throughput incentive" (EE/DR disincentive)?
   - Institute decoupled ratemaking (reflect risk reduction by reducing the authorized rate of return?)
   - Provide DSM program credit (incorporating raised performance targets, of course)
   - Move to demand rates (cover fixed costs w/fixed revenues, variable costs w/variable revenues)
   - Adjust energy sales volume forecast to reflect anticipated sales reductions in rate case proceedings

Questions?

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Please call with comments, questions, and input!

Domains: smart grid, DSM, renewables
Services: visioning, planning, execution, evaluation
Clients: utilities, regulators, advocates, suppliers

"Smart Grid Hype and Reality: A Systems Approach for Maximizing Customer Return on Utility Investment" available at Amazon.com and at www.wiredgroup.net