Five-Year Distribution Planning Stakeholder Meeting #2

Michigan Public Service Commission
Lake Superior Hearing Room
August 14, 2019
9 AM – 4 PM

MPSC
Michigan Public Service Commission

June 27, 2019 Session Recap

- Covered multiple distribution planning topics:
  - Load and distributed energy resource (DER) forecasting
  - Hosting capacity studies/methodologies
  - Non-wires alternatives
- Q & A with in-person attendees and Skype participants
- Stakeholder suggestions for additional subject matter expert presentations
- Review of draft stakeholder schedule through Fall 2019

….Leading to Today's Agenda

- Continue stakeholder sharing of information
- Utilities share preliminary ideas of how pilot projects can leverage knowledge and explore NWA and hosting capacity options
- Encourage stakeholder comments be submitted to docket U-20147

Others also addressing distribution

Excerpt from "The Electricity Industry – Key Issues Shaping the Transformation"
David Owens (Edison Electric Institute) May 6, 2016

Evolving Distribution Grid Public Policy Issues

The public policy issues relating to the evolving distribution grid fall into five categories:

- What planning processes should be employed for the evolving grid?
- How should the grid be designed and constructed?
- How and by whom should the grid be operated?
- How and by whom should the DER marketplace be designed and managed? What services behind the meter can be provided and by whom?
- How should services be priced and rates determined?

...but let's not forget who is driving the bus

Meeting Agenda

9:00 a.m.	Welcome & Introduction	Patrick Hudson, Manager, Smart Grid Section
9:10 a.m.	Cost Benefit Analysis for Utility-Facing Grid Modernization Investments	Tim Woolf, Synapse Energy Economics *Work supported by the U.S. Department of Energy for Berkeley Lab*
10:10 a.m.	Break	
10:20 a.m.	Cost Benefit Guidelines, Risk Informed Decision Support, and Distribution Performance Metrics	Paul Alvarez and Dennis Stephens, ABATE
10:50 a.m.	Regulatory Innovations in the Treatment of Operating Expenses	Ryan Katofsky, Advanced Energy Economy
11:20 a.m.	Break	
11:30 p.m.	Utility Pilot Programs and Funding	MPSC Staff
11:35 a.m.	Indiana Michigan Power: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Marc Lewis, Paul Loeffelman, David Isaacson and Subin Matthew Indiana Michigan Power
12:05 a.m.	Q&A for I&M Pilot Proposals	
12:15 p.m.	Lunch (local restaurants available)	
1:15 p.m.	Consumers Energy: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Doug Chapel and Don Lynd Consumers Energy
2:15 p.m.	Q&A for Consumers Energy Pilot Proposals	
2:25 p.m.	Break	
2:40 p.m.	DTE: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Yujia Zhou and Richard Mueller DTE
3:40 p.m.	Q&A for DTE Pilot Proposals	
3:50 p.m.	Closing Statements & Docket Responses	MPSC Staff
4:00 p.m.	Adjourn	

Benefit-Cost Analysis for Utility-Facing Grid Modernization Investments

Tim Woolf

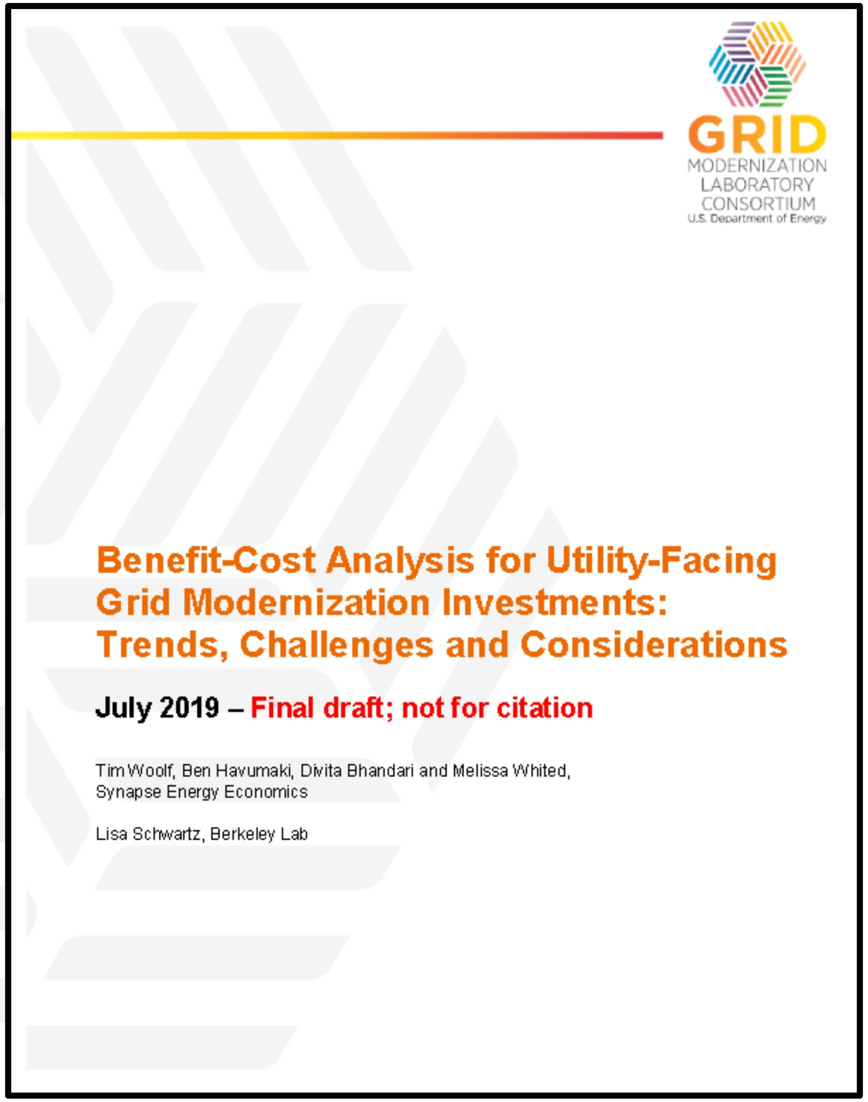
Synapse Energy Economics

Five-Year Distribution Planning Stakeholder Meeting
Michigan Public Service Commission
August 14, 2019

Outline of Presentation

- Presentation is based on draft Berkeley Lab report
- Utility-facing grid modernization concepts
- Grid modernization benefit-cost analysis (BCA) concepts
- Review of recent utility grid modernization plan BCAs
- How to address key challenges of grid modernization BCAs

The work described in this presentation was funded under the U.S. Department of Energy's Grid Modernization Initiative by the Office of Electricity and Office of Energy Efficiency and Renewable Energy's Solar Energy Technologies Office under Lawrence Berkeley National Laboratory Contract No. DE-AC02-05CH11231.


GRID MODERNIZATION LABORATORY CONSORTIUM
U.S. Department of Energy

Benefit-Cost Analysis for Utility-Facing Grid Modernization Investments: Trends, Challenges and Considerations

July 2019 – Final draft; not for citation

Tim Woolf, Ben Havumaki, Divita Bhandari and Melissa Whited, Synapse Energy Economics

Lisa Schwartz, Berkeley Lab

Utility-Facing
Grid Modernization Concepts

Utility Facing Versus Customer Facing

Grid Modernization

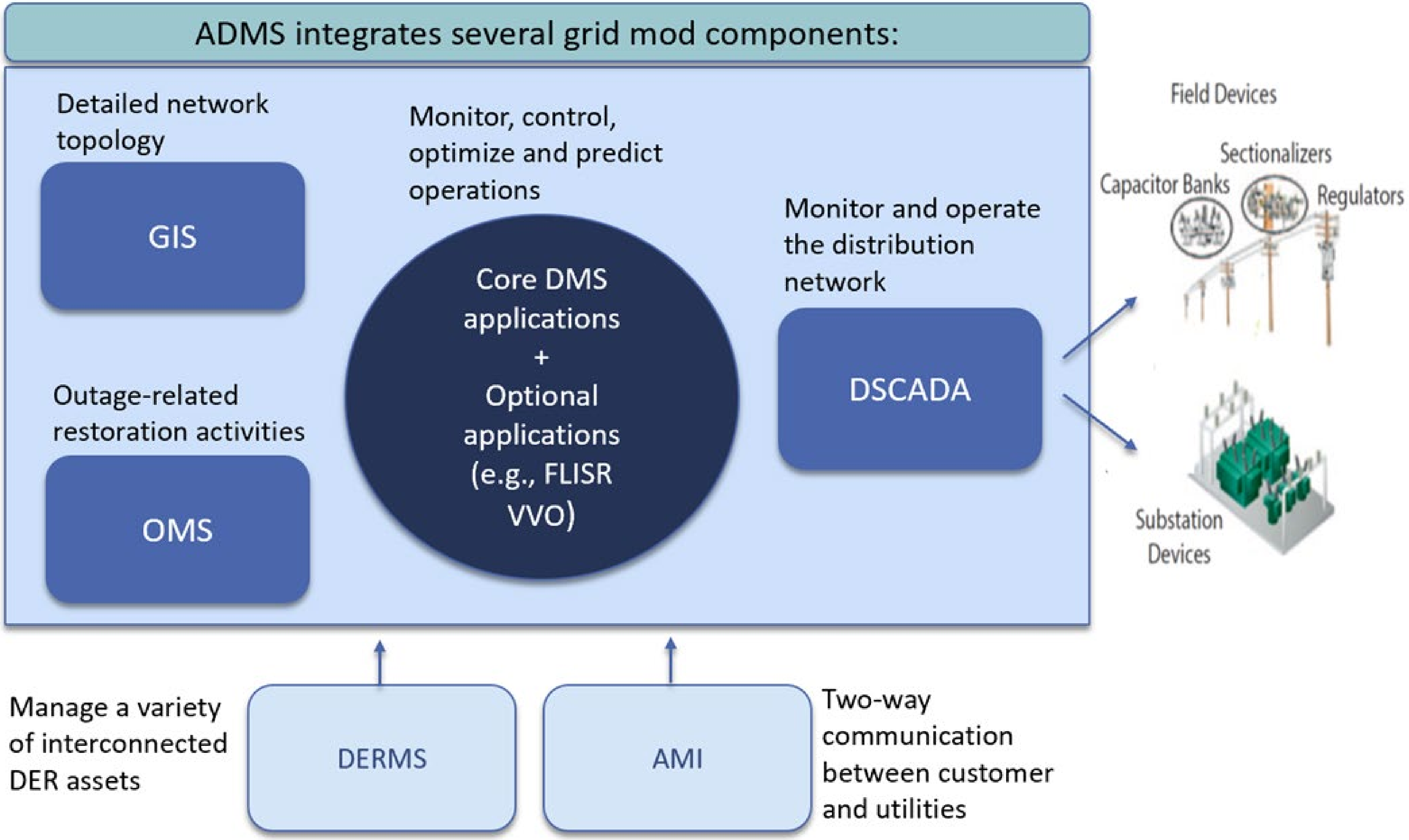
Utility-Facing

- Advanced distribution management system (ADMS)
- Geographic information system (GIS)
- Distribution system supervisory control and data acquisition (DSCADA)
- Outage management system (OMS)
- Distributed energy resource management system (DERMS)
- Fault location, isolation, and service restoration (FLISR) a/k/a dist. automation
- Volt-var optimization (VVO)
- Advanced metering infrastructure (AMI)
- Network monitoring:
  - Substation devices
  - Field- (feeder-) level devices

Customer-Facing

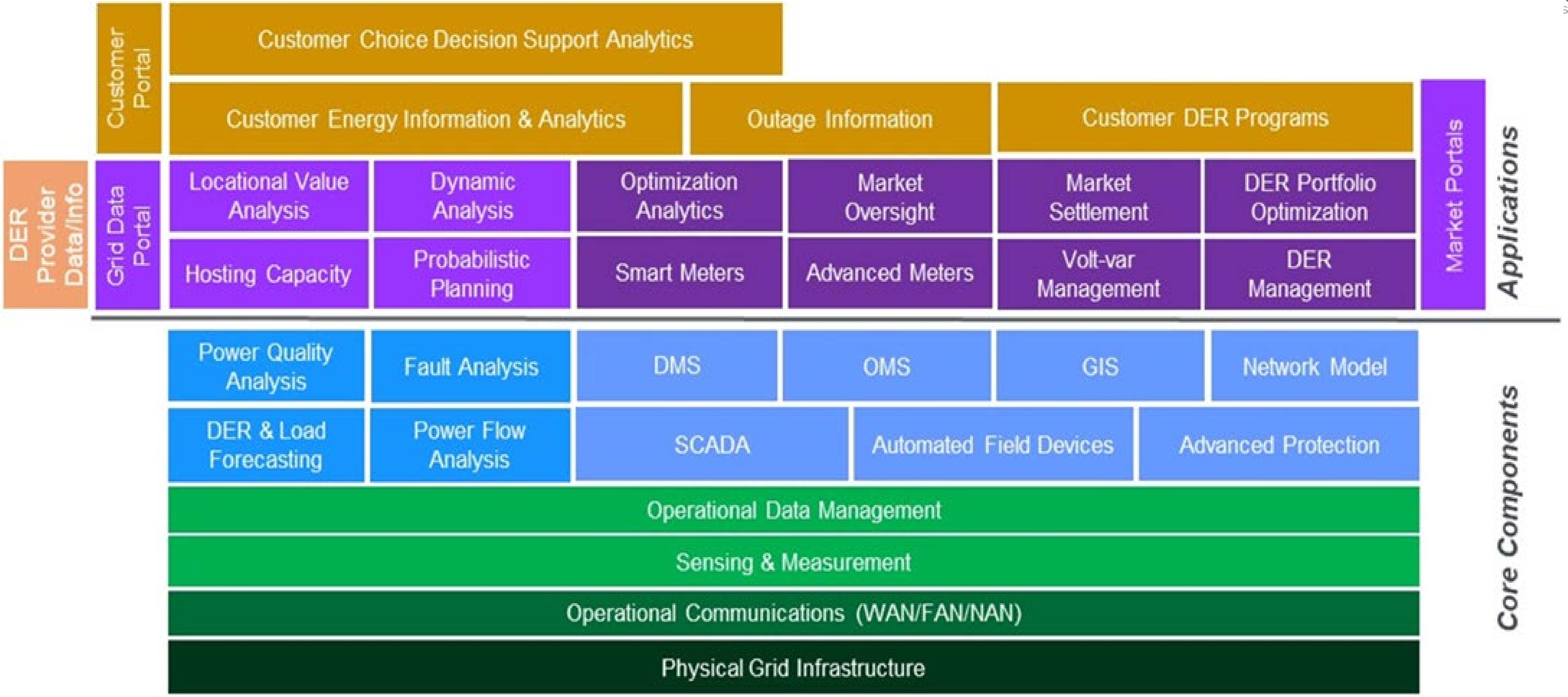
- Energy efficiency
- Demand response
- Distributed generation
- Storage
- Electric vehicles
- Advanced meters
- Third-party access
- Customer data
- Cybersecurity

Interdependence of Components



Source: Adapted from World Bank, *Practical Guidance for Defining a Smart Grid Modernization Strategy: The Case of Distribution*, 2017.

Core (Platform) Components and Applications



Source: US DOE 2017, *Modern Distribution Grid: Decision Guide,* Volume III, page 26, Figure 8.

Grid Modernization Benefit-Cost Analysis Concepts

BCA Regulatory Contexts

1. Utility seeking review of costs *before* spending
   - Typically in a case dedicated to review of proposed investments
   - Allows for focused review of proposal
   - Sometimes initiated by commission; sometimes by the utility
   - Utility often asks for some form of regulatory guidance or approval
   - Implications of regulatory guidance or approval vary by state
2. Utility seeking recovery of costs *after* spending
   - Typically in a rate case
   - Allows for retrospective prudence review
   - Allows for review in context of other utility costs
   - Grid modernization issues might be one of many contentious issues
   - Difficult to modify, reduce, or disallow costs after they are spent

► Most grid modernization plans are submitted *before* spending

Examples of Benefits of Utility-Facing Grid Modernization

Benefit	Utility System	Society
Reduced O&M costs	✓	✓
Reduced generation capacity costs	✓	✓
Reduced energy costs	✓	✓
Reduced T&D costs and losses	✓	✓
Reduced ancillary services costs	✓	✓
Increased system reliability	✓	✓
Increased safety	✓	✓
Increased resilience	✓	✓
Increased DER integration	✓	✓
Improved power quality	✓	✓
Reduced customer outage costs	✓	✓
Increased customer satisfaction	✓	✓
Increased customer flexibility and choice	✓	✓
Reduced environmental compliance costs	✓	✓
Environmental benefits		✓
Economic development benefits		✓

Examples of Costs for Utility-Facing Grid Modernization

Cost	Utility System	Society
Incremental capital costs for grid modernization equipment	✓	-
Incremental O&M costs for grid modernization equipment	✓	-
Incremental costs for T&D upgrades needed to support the grid modernization equipment	✓	-

Utility-facing grid modernization costs are typically recovered from all customers.

Traditional BCA Tests for **Energy Efficiency**

- The California Standard Practice Manual has been widely used for EE
- Describes five standard cost-effectiveness tests
- Three tests commonly used for EE BCA:
  - Utility Cost test: impacts on the utility system
  - Total Resource Cost test: impacts on utility system and participants
  - Societal Cost test: impacts on society
- These tests are increasingly being used to assess grid modernization, DERs, and related initiatives
- But the CA Manual does not address current needs:
  - Does not address regulatory policy goals
  - Has been interpreted inconsistently
  - Does not address some key DER issues

Source: California Public Utility Commission, *Standard Practice Manual*, 2001.

Emerging BCA tests for EE:
The National Standard Practice Manual

- Designed to update, improve, and replace the California SPM
- Includes a set of fundamental BCA principles
- Identifies the importance of accounting for regulatory goals
- Introduces the "regulatory perspective"
- Explains the multiple options for BCA tests
- Provides a framework for determining a primary BCA test
- Introduces the Regulatory test
  - Accounts for a state's regulatory goals
  - Broader than the Utility Cost test
  - Narrower than the Societal Cost test

Source: National Efficiency Screening Project, *National Standard Practice Manual (NSPM) for Assessing the Cost-Effectiveness of Energy Efficiency*, May 2017

BCA Framework for Grid Mod: US DOE (Vol III)

DOE report divides grid modernization expenditures into four types:

No.	Purpose of Expenditure	BCA Approach
1	To replace aging infrastructure, connect new customers, and other traditional services	Apply a "best-fit / least-cost" approach
2	To maintain reliable operations on a grid with much higher levels of distributed energy resources (DERs)	Apply a "best-fit / least-cost" approach, or the traditional Utility Cost test
3	To achieve regulatory policy goals and/or societal benefits	Apply an Integrated Power System approach and Societal Cost test
4	Expenditures paid for by customers	No need for utilities or regulators to conduct a BCA

Source: US DOE 2017, *Modern Distribution Grid: Decision Guide,* Volume III, Section 3.4

BCA Framework for Grid Mod: US DOE (Vol IV)

GRID MODERNIZATION LABORATORY CONSORTIUM
U.S. Department of Energy

Draft DOE report recognizes four justifications for investments:

Justification	BCA Approach
Joint benefits: core platform investments that are needed to enable capabilities and functions	Least-cost, best-fit approach
Policy and standards compliance: utility investments that are needed to comply with policy goals and safety and reliability standards	Least-cost, best-fit approach
Net customer benefits: utility investments from which some or all customers receive net benefits in the form of bill savings	Standard benefit-cost analysis approach
Customer choice: investments triggered by customer interconnection, opt-in utility programs, and customer-driven reliability improvements, paid for by individual customers	No need for utilities or regulators to conduct a BCA

Source: US DOE 2019 forthcoming, *Modern Distribution Grid: Decision Guide,* Volume IV, Section 5.3

BCA Principles from Recent Sources

Principle	NSPM	DOE	NYPSC
Assess projects comparably with traditional resources or technologies	✓	✓	✓
Account for state regulatory and policy goals	✓	✓	
Account for all relevant costs and benefits, including hard-to-monetize	✓	✓	
Ensure symmetry across relevant costs and benefits	✓	✓	
Apply full life-cycle analysis	✓	✓	✓
Apply incremental, forward-looking analysis	✓	✓	
Ensure transparency	✓	✓	✓
Avoid combining or conflating different costs and benefits			✓
Assess bundles and portfolios instead of separate measures	✓	✓	
Address locational and temporal values		✓	✓

Sources: National Efficiency Screening Project, *National Standard Practice Manual,* 2017;
US DOE, *Modern Distribution Grid: Decision Guide,* Volume III, 2017;
New York Public Service Commission, *Order Establishing the Benefit-Cost Framework*, 2016.

Review of Recent Grid Modernization Plans

Review of BCAs from 21 Recent Grid Mod Plans

Utility	State	Year	Utility	State	Year
National Grid	NY	2016	**DTE Energy**	MI	2018
NYSEG & RGE	NY	2016	**APS**	AZ	2016
Unitil	MA	2015	**PSE&G**	NJ	2018
National Grid	MA	2016	**LGE**	KY	2018
Eversource	MA	2015	**Consumers Energy**	MT	2018
Public Service Co.	CO	2016	**Central Hudson G&E**	NY	2018
SDGE	CA	2016	**Hawaiian Electric Cos**	HI	2017
Xcel	MN	2017	**Southern CA Edison**	CA	2016
FirstEnergy	OH	2017	**CT Light & Power**	CT	2010
Vectren	IN	2017	**Entergy**	AR	2016
National Grid	RI	2018			

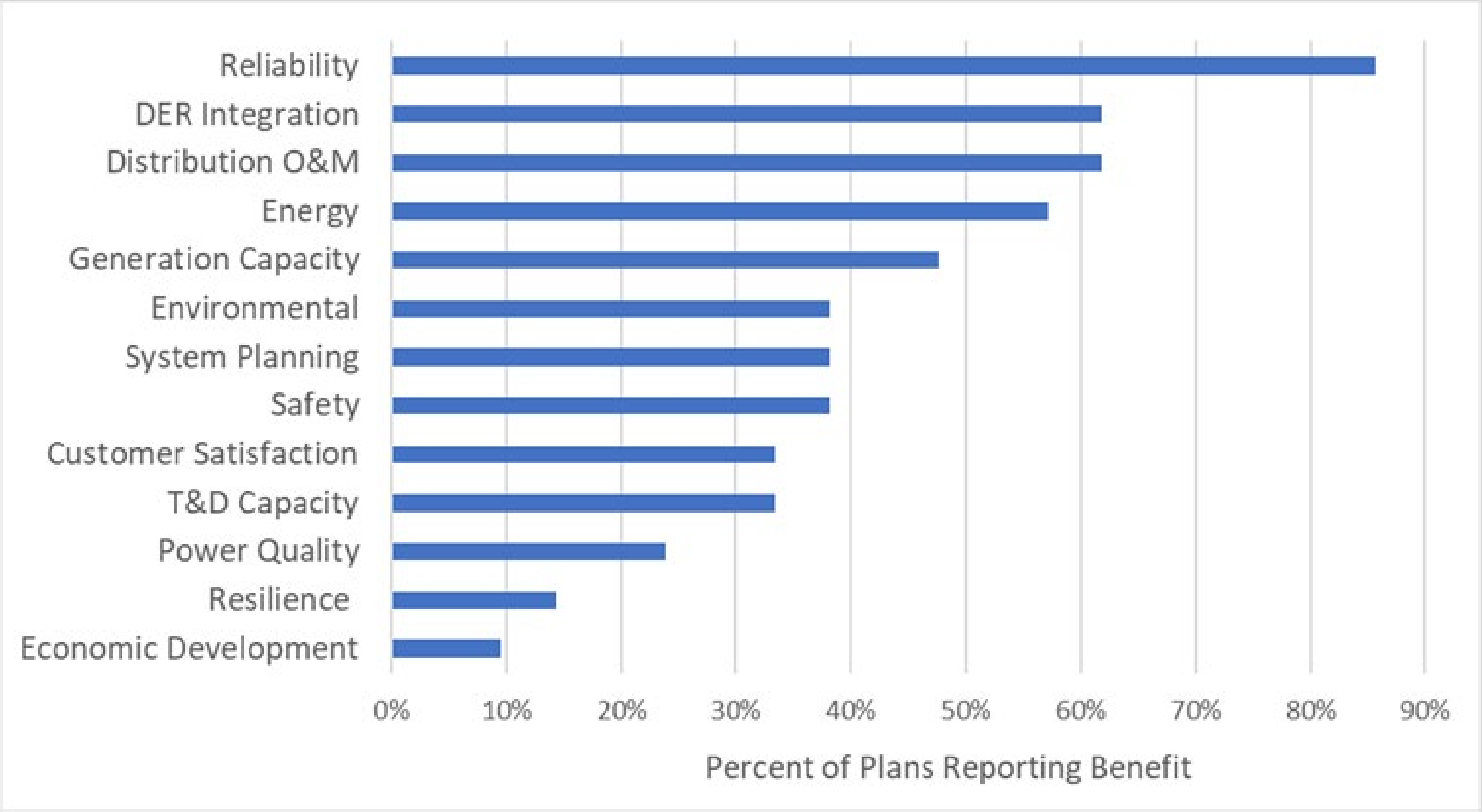
Sources: See Lawrence Berkeley National Laboratory, *Benefit-Cost Analysis for Utility-Facing Grid Modernization Investments*, Draft, February 2019.

General Themes from Grid Mod Plans

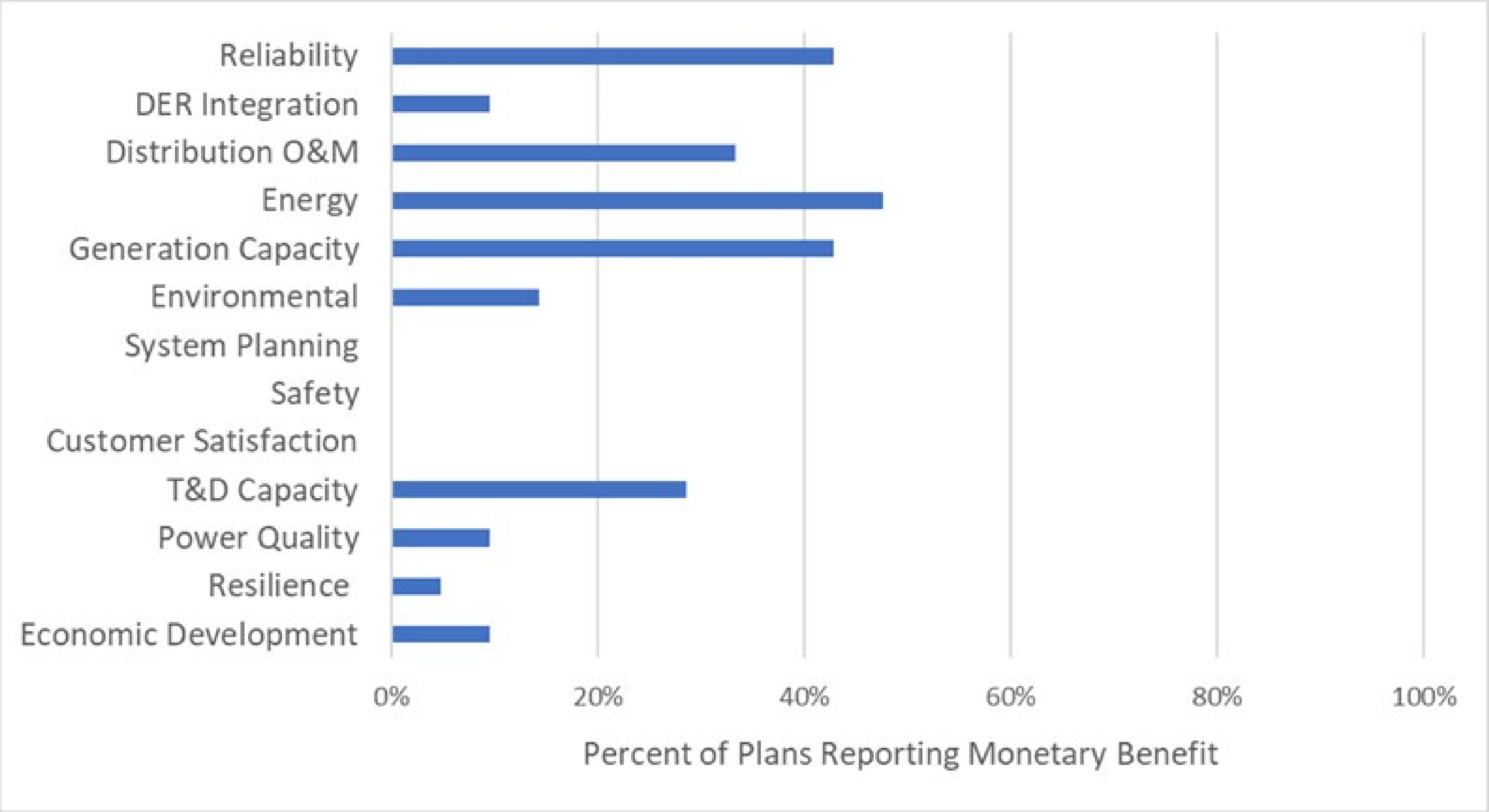
Key items that were lacking in many plans:

- An overarching rationale for grid modernization investments and an explanation of how individual components will help meet overall goals
- Identification of which cost-effectiveness test was used for the BCA
- Identification of which discount rate was used to determine present values
- Methodologies to account for the interdependencies of grid modernization components
- Methodologies to account for unmonetized benefits of grid modernization components
- Robust definitions of grid modernization metrics and how they will be used to monitor grid modernization costs and benefits over time
- Methodologies or discussions of how to address customer equity issues

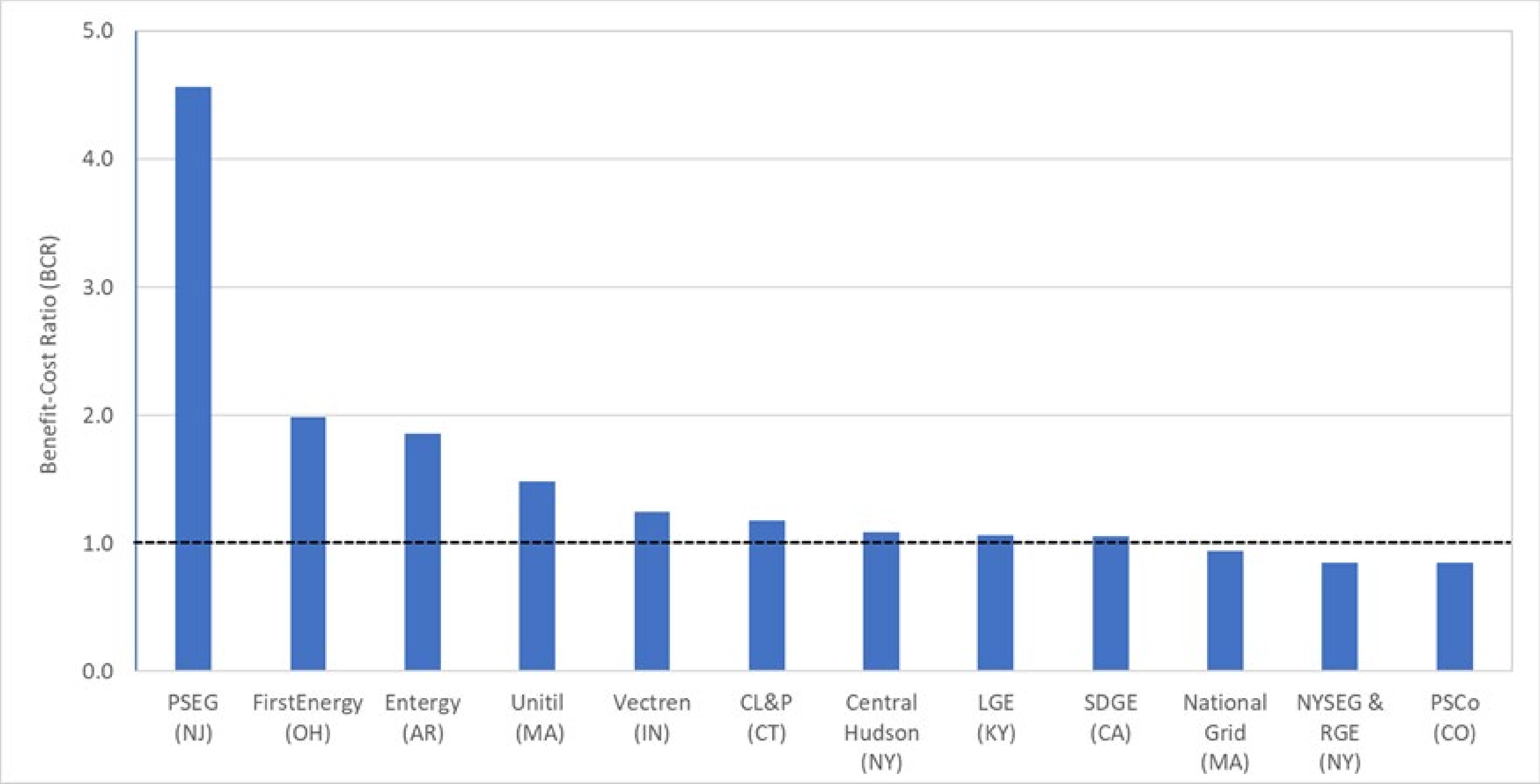
Type and Frequency of Claimed Benefits



Type and Frequency of Monetized Benefits



Grid Modernization Benefit-Cost Ratios



How to Address Key Grid Modernization BCA Challenges

Grid Mod BCA: Key Challenges

- Documenting the purpose of each grid modernization component
- Choosing BCA framework or test
- Choosing the discount rate(s)
- Accounting for interactive effects
- Accounting for benefits that are hard to quantify or monetize
- Addressing uncertainty
- Putting the BCA results in context
- Encouraging follow-through

Documenting the purpose of each grid modernization component

Documenting the purpose of each grid modernization component has several important implications for BCA:

- Document whether component is a traditional expenditure:
  - Replacing aging infrastructure, interconnecting new customers, etc.
- Document whether component plays a core, platform role.
  - Can help justify whether a least-cost, best-fit approach is warranted.
- Document whether component is modular, or optional.
  - Can help justify which BCA approach to use.
- Document whether and how components are consistent with state regulatory directives and goals.

Choosing a BCA Test

- Articulate the BCA test (or framework) upfront
- Apply the least-cost, best-fit framework where warranted
  - Traditional expenditures: replacing aging infrastructure, interconnecting new customers, or maintaining reliability
  - Platform components: necessary to support other, modular components
  - The validity of this test rests upon justification of the type of expenditure
- Apply multiple cost-effectiveness tests
  - Utility Cost test: best indication of impacts on customer bills
  - Regulatory test: best indication of achieving regulatory goals
- Apply both approaches as a check
  - For components where the least-cost, best-fit approach is used, apply the Utility Cost test to check the impact on costs.

Discount Rate Considerations

- The choice of discount rate is a policy decision.
- The discount rate should reflect the time preference chosen by regulators on behalf of all customers, i.e., the regulatory perspective.
- The regulatory perspective should account for many factors:
  - low-cost, safe, reliable service; intergenerational equity; other regulatory policy goals
- The regulatory perspective suggests a greater emphasis on long-term impacts than what is reflected in the WACC.
  - Which implies a lower discount rate
- Grid mod plans can use sensitivities to consider different discount rates.
  - Use the utility WACC as a high case
  - Use a low-risk or societal discount rate as a low case

Accounting for Interdependences

- Apply the least-cost, best-fit framework where warranted
  - For core, platform components
  - The validity of this test rests upon justification of the type of expenditure.
- Apply BCA tests for every component in isolation
  - Utility Cost test
  - Regulatory test
- Apply BCA tests to several scenarios where components are bundled in different ways.
  - Just core, platform components
  - Layers of modular, application components on top of platform components

Accounting for Interdependences: Example

	Scenario 1: Platform Components Only	Scenario 2: Platform Plus FLISR and VVO	Scenario 3: Scenario 2 Plus AMI and DERMS
Costs (Mil PV$)	24	28	32
Benefits (Mil PV$)	22	36	38
Net Benefits (Mil PV$)	-2	8	6
Benefit-Cost Ratio	0.9	1.3	1.2
Findings:	not cost-effective	cost-effective	potentially cost-effective

Scenario 3 has two potential interpretations:

- AMI and VVO are deemed cost-effective, because the portfolio is cost-effective.
- AMI and VVO are deemed not cost-effective, because they reduce the net benefits relative to scenario 2.

Accounting for non-Monetized Benefits

- Put as many benefits as possible in monetary terms
- Define benefits in such a way that they can be monetized
- Provide as much quantitative data as possible
- Apply the least-cost, best-fit framework where warranted
  - This approach does not require monetization of benefits. It requires only a minimization of costs, for the desired function/outcome.
  - The validity of this test rests upon justification of the type of expenditure.
- Establish metrics to assess benefits
  - Metrics do not need to be in monetary terms
- Use quantitative methods to address non-monetized benefits:
  - use a point system to assign value to non-monetized benefits
  - use a weighting system to assign priorities to non-monetized benefits
  - assign proxy values for significant non-monetized benefits
  - use multi-attribute decision-making techniques

Accounting for Non-Monetized Benefits: Example

	Scenario 1: Platform Components Only	Scenario 2: Platform Plus FLISR and VVO	Scenario 3: Scenario 2 Plus AMI and DERMS
Monetary Impacts:	--	--	--
Costs (Mil PV$)	24	28	32
Benefits (Mil PV$)	22	36	38
Net Benefits (Mil PV$)	-2	8	6
Benefit-Cost Ratio	0.9	1.3	1.2
Non-Monetized Benefits:	--	--	--
Resilience	1	1	3
Customer choice& flexibility	1	2	3
Findings:	not cost-effective	cost-effective	cost-effective

Scenario 3 is deemed to be cost-effective because of the high value of non-monetized benefits.

Approaches for Additional Challenges

- Addressing uncertainty
  - Use contingency costs
  - Use scenario and sensitivity analyses
  - Use probabilistic and expected value modeling
- Putting BCA results in context
  - Assess the long-term bill impacts on typical customers
  - Consider prioritizing the results of the Utility Cost test over other tests. The Utility Cost test may provide the best indication of impacts on total customer costs.
- Encouraging follow-through
  - Establish metrics to monitor costs and benefits over time
  - Metrics can also be used as performance incentive mechanisms

Summary: How to Address Key Challenges

Challenge	Potential Approaches
Documenting the purpose of each grid modernization component	• Specify a standard taxonomy for grid modernization • Define purpose and role of grid modernization components
Choosing BCA framework	• Articulate the BCA framework upfront • Focus on two tests: Utility Cost test and Regulatory test • Use the least-cost, best-fit approach where warranted
Choosing discount rate(s)	• Choose a discount rate that reflects state regulatory goals • Conduct sensitivities using different discount rates
Accounting for interactive effects	• Use the least-cost, best-fit approach where warranted • Use scenarios with different combinations of components • Conduct BCA for grid modernization components in isolation
Accounting for benefits that are hard to quantify or monetize	• Use the least-cost, best-fit approach where warranted • Establish metrics to assess the extent of benefits • Apply methodologies to make unmonetized benefits transparent
Addressing uncertainty	• Use approaches that include contingency costs, scenario and sensitivity analyses, and probabilistic and expected value modeling
Putting BCA results in context	• Assess long-term bill impacts
Encouraging follow-through	• Establish metrics to monitor achievement of benefits

Contact Information

Synapse Energy Economics is a research and consulting firm specializing in technical analyses of energy, economic, and environmental topics. Since 1996 Synapse been a leader in providing rigorous analysis of the electric power and natural gas sectors for public interest and governmental clients.

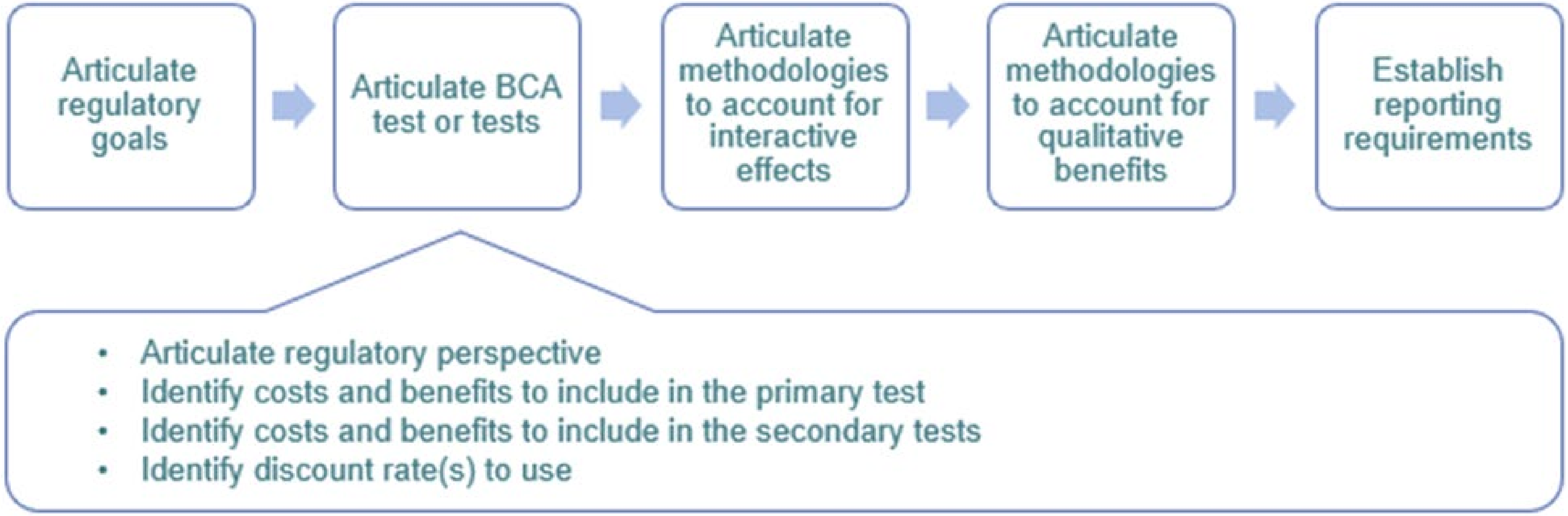
Tim Woolf
Senior Vice-President
Synapse Energy Economics
617-453-7031
twoolf@synapse-energy.com

www.synapse-energy.com

GRID MODERNIZATION LABORATORY CONSORTIUM
U.S. Department of Energy

Appendix

Public Utility Commission Guidance - Summary



Terminology: BCA versus Business Case

- The term "benefit-cost analysis" typically refers to an approach that puts all costs and benefits into monetary values.
  - If benefits exceed costs, the investment is deemed to be cost-effective.
- The term "business case" typically refers to an approach that is broader and more flexible than a BCA.
  - A business case allows utilities to account for impacts that are not monetized.
  - Some business case approaches monetize all costs and benefits, but then leave flexibility for considering non-monetized factors.
  - Other business case approaches include little monetization of the benefits, relying almost entirely on qualitative grounds for justifying the investment.
- Regardless of what the approach is called:
  - Monetary values should be used as much as possible.
  - Non-monetized impacts should be fully documented and accounted for.

Documenting the purpose of each grid modernization component

GRID MODERNIZATION LABORATORY CONSORTIUM
U.S. Department of Energy

Principle	Objective	Capabilities	Functions	Technology
Provide customers information they need to make educated utility choices	Customer Enablement - Example Metric: Provide online customer access to relevant & timely information by 2020 for small business & residential customers	Transparency Confidentiality & Privacy	Customer Information Sharing Distribution Information Sharing Market Information Sharing Customer Information Management	Customer Portal Customer analytic tools Greenbutton Time interval metering Meter Data Management System Customer Info System Data Warehouse Meter communications

Source: U.S. Department of Energy, *DSPx Phase 2 Decision Process & Taxonomy Update*, slide deck, Draft, January 19, 2019.

Choosing a Discount Rate

- The discount rate reflects a particular "time preference."
  - The relative importance of short- versus long-term impacts

- Examples of discount rates

Investor-owned utility WACC:	5%-8%
Publicly-owned utility WACC:	3%-5%
Utility customers:	Varies widely
Low risk:	0%-3%
Societal:	<0%-3%

- Utility weighted average cost of capital (WACC) is widely used in BCA for grid modernization and other purposes.

Limitations of Utility WACC as a Discount Rate

The goal of BCAs for unregulated businesses is different from the goal of BCAs in regulatory settings:

- For unregulated businesses, the goal of BCA is to maximize shareholder value.
  - Investors' time preference is driven entirely by investors' opportunity cost and risk, and the WACC reflects both of those.
- For regulated utilities, the goal of BCA is fundamentally different:
  - The goal is to provide safe, reliable, low-cost power to customers and meet policy goals.
  - The goal is not to maximize shareholder value.
- Since the goal for a regulated utility is different, the time preference is also different. Thus, the choice of a discount rate should take this into consideration.

MORNING BREAK
10:10 – 10:20 AM

Five Year Distribution Planning Stakeholder Meeting

Michigan Public Service Commission

Lake Superior Hearing Room

August 14, 2019

MPSC

Michigan Public Service Commission

Meeting Agenda

9:00 a.m.	Welcome & Introduction	Patrick Hudson, Manager, Smart Grid Section
9:10 a.m.	Cost Benefit Analysis for Utility-Facing Grid Modernization Investments	Tim Woolf, Synapse Energy Economics *Work supported by the U.S. Department of Energy for Berkeley Lab*
10:10 a.m.	Break	
10:20 a.m.	Cost Benefit Guidelines, Risk Informed Decision Support, and Distribution Performance Metrics	Paul Alvarez and Dennis Stephens, ABATE
10:50 a.m.	Regulatory Innovations in the Treatment of Operating Expenses	Ryan Katofsky, Advanced Energy Economy
11:20 a.m.	Break	
11:30 p.m.	Utility Pilot Programs and Funding	MPSC Staff
11:35 a.m.	Indiana Michigan Power: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Marc Lewis, Paul Loeffelman, David Isaacson and Subin Matthew Indiana Michigan Power
12:05 a.m.	Q&A for I&M Pilot Proposals	
12:15 p.m.	Lunch (local restaurants available)	
1:15 p.m.	Consumers Energy: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Doug Chapel and Don Lynd Consumers Energy
2:15 p.m.	Q&A for Consumers Energy Pilot Proposals	
2:25 p.m.	Break	
2:40 p.m.	DTE: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Yujia Zhou and Richard Mueller DTE
3:40 p.m.	Q&A for DTE Pilot Proposals	
3:50 p.m.	Closing Statements & Docket Responses	MPSC Staff
4:00 p.m.	Adjourn	

Grid Planning: How to Maximize "Bang for the Buck" for Customers

Wired Group

Unleashing Latent Value in Distribution Utility Businesses

Michigan PSC Distribution Planning Stakeholder Meeting

August 14, 2019

Preview

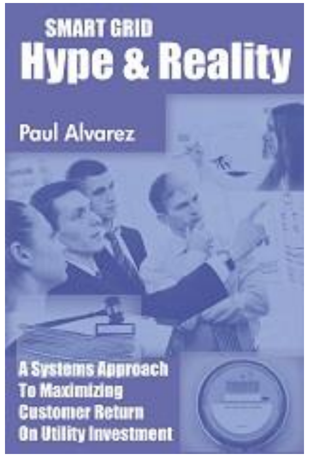
- Background
  - Grid Spending Is Not Delivering Customer Value
  - Traditional Regulation Is Insufficient
- Grid Planning – Where Technical Meets Financial
- Distribution Investments – Types & Eval Methods
- Guidelines for Customer Cost, Benefit estimation
- Risk-informed Decision Support
- Performance Measurement

Intro to the Wired Group

- Leading experts on grid planning, modernization plans, & performance for consumer, business, & environmental advocates (16 states since 2014)

- Experience in states farthest along in modern grids & regulation
  - California (SCE and PG&E Rate Cases; Distribution Resource Planning docket)
  - Hawaii (grid modernization and performance-based ratemaking)

- Attributes:
  - ZERO revenues from for-profit utilities
  - Associates are former for-profit utility and regulatory personnel
  - Favorable orders or settlements in 91% of cases serving as witnesses
  - Full Disclosure: Engaged by ABATE for this proceeding



Grid Investment Is Not Delivering Value

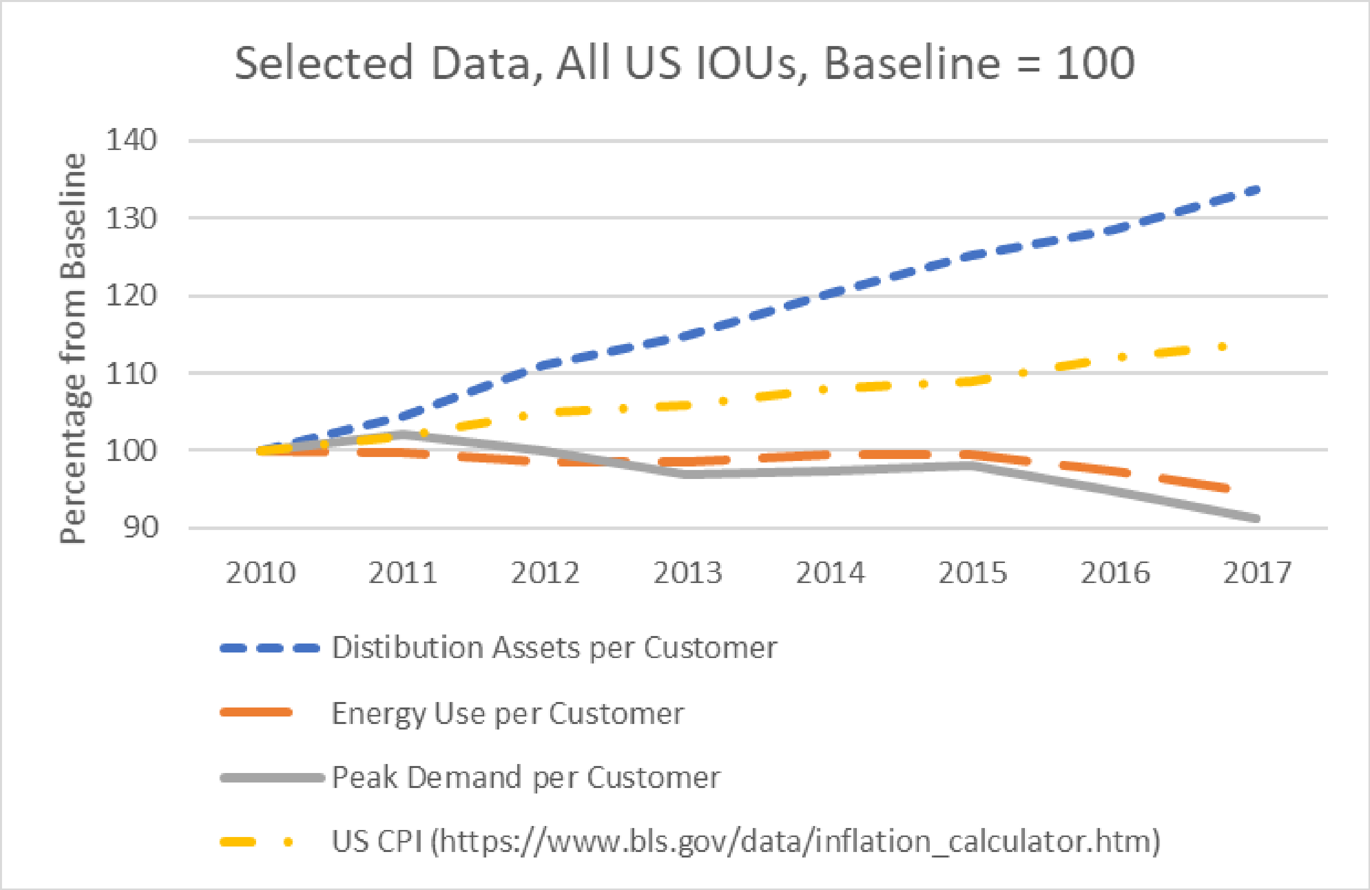


Chart Courtesy of *the Utility Evaluator*™; visit www.utilityevaluator.com for more information

Grid Investment Is Not Delivering Value

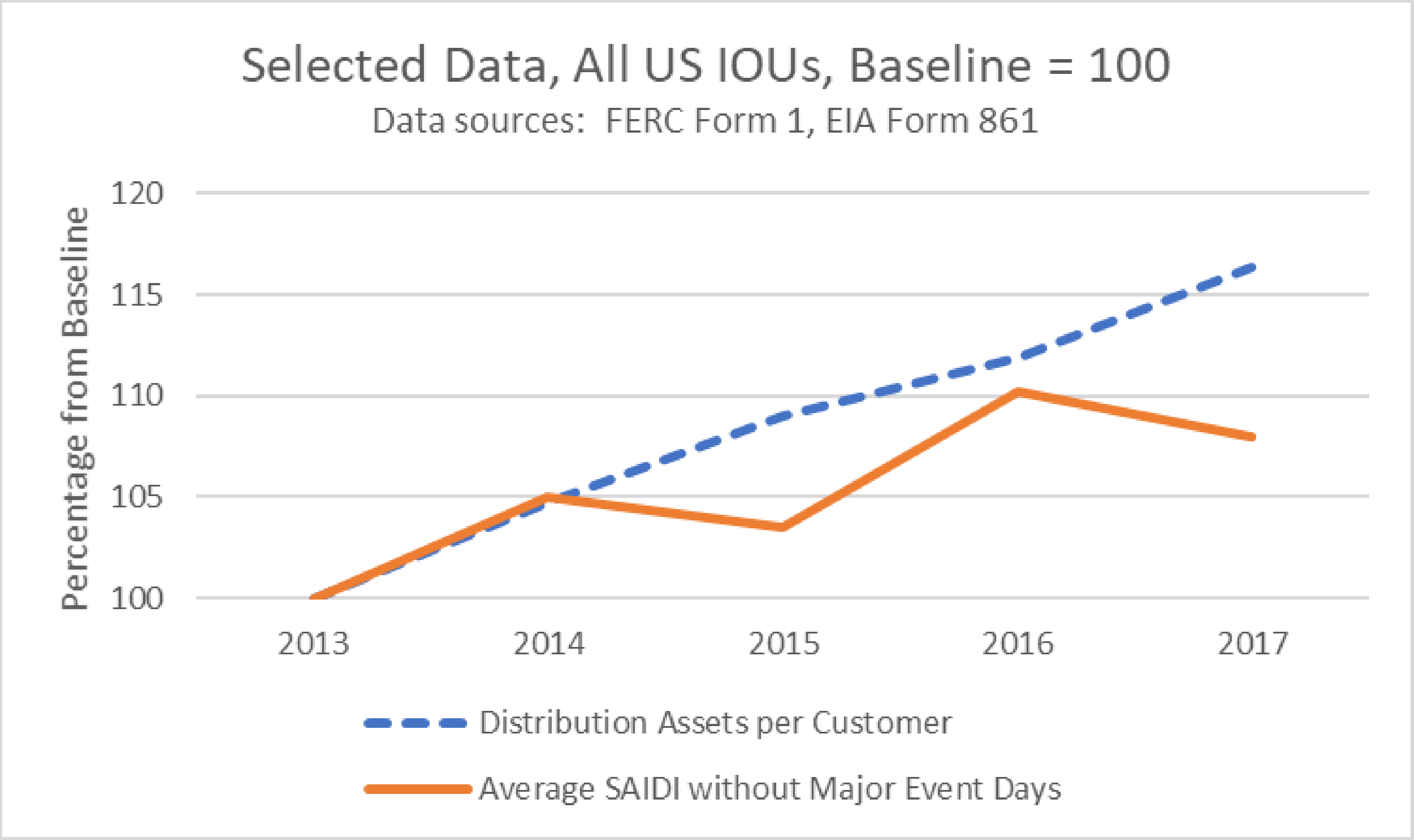


Chart Courtesy of *the Utility Evaluator*™; visit www.utilityevaluator.com for more information

Grid Investment Is Not Delivering Value

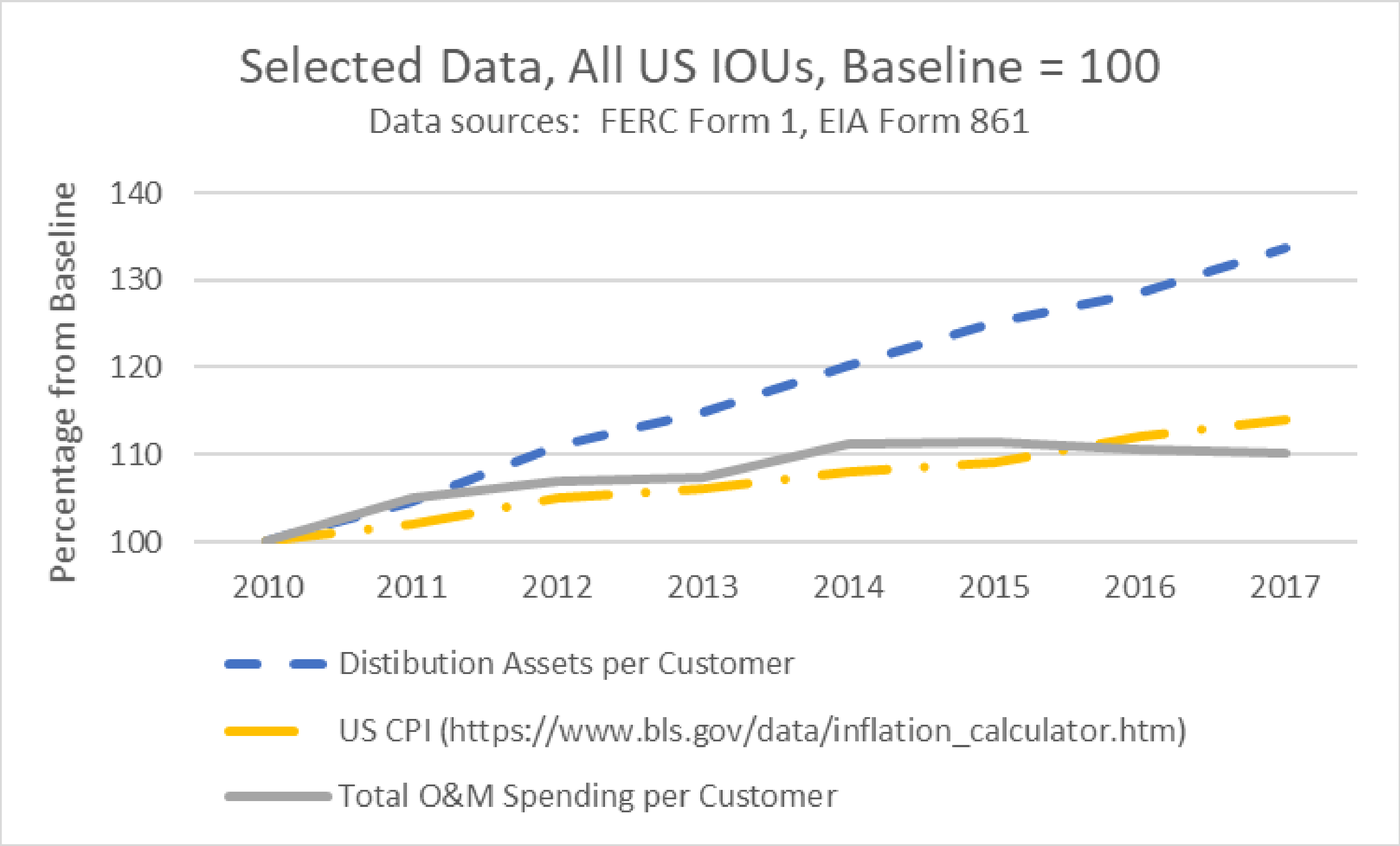


Chart Courtesy of *the Utility Evaluator*™; visit www.utilityevaluator.com for more information

MI Grid Investment: Above Average

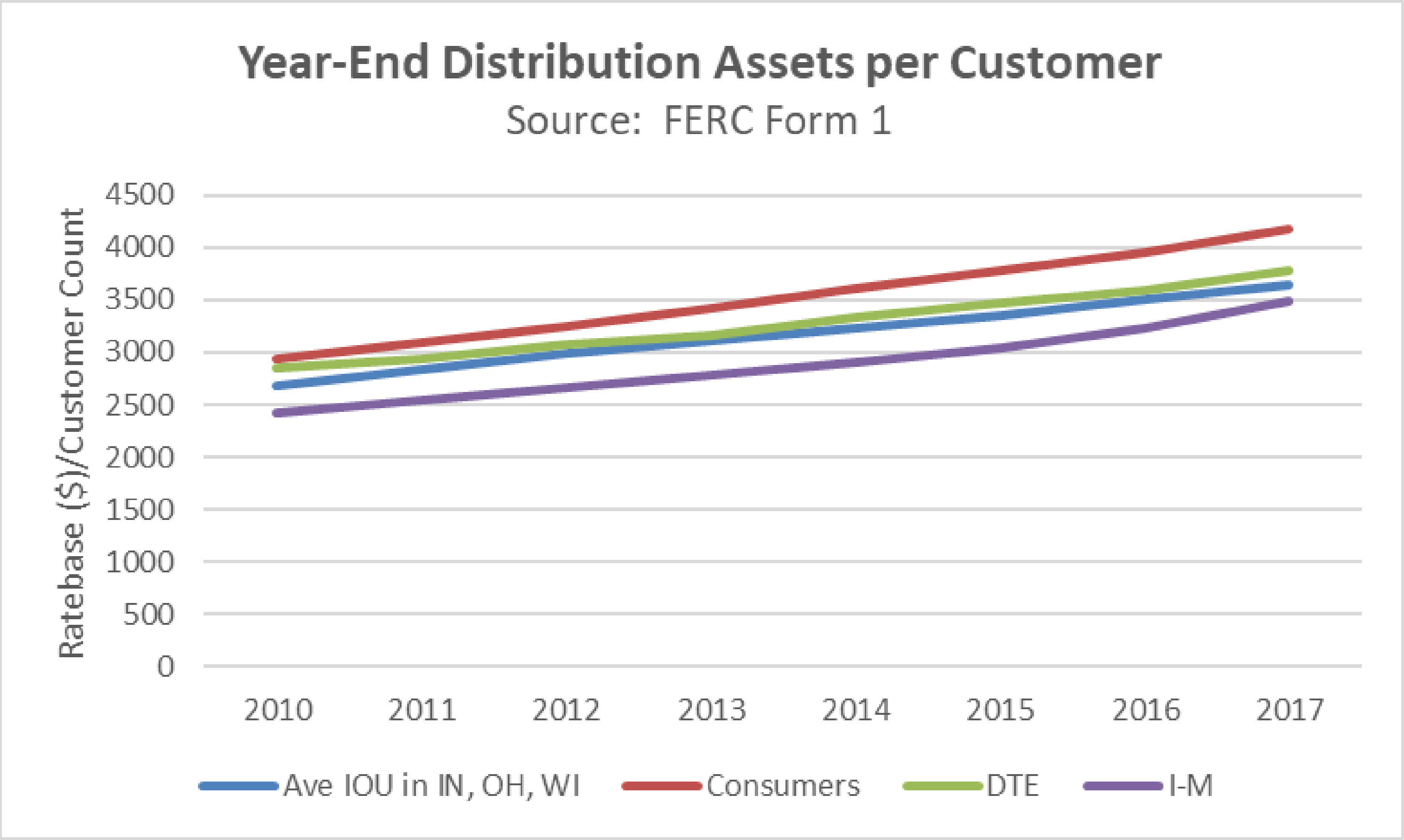


Chart Courtesy of *the Utility Evaluator*™; visit www.utilityevaluator.com for more information

MI Grid Reliability: Below Average

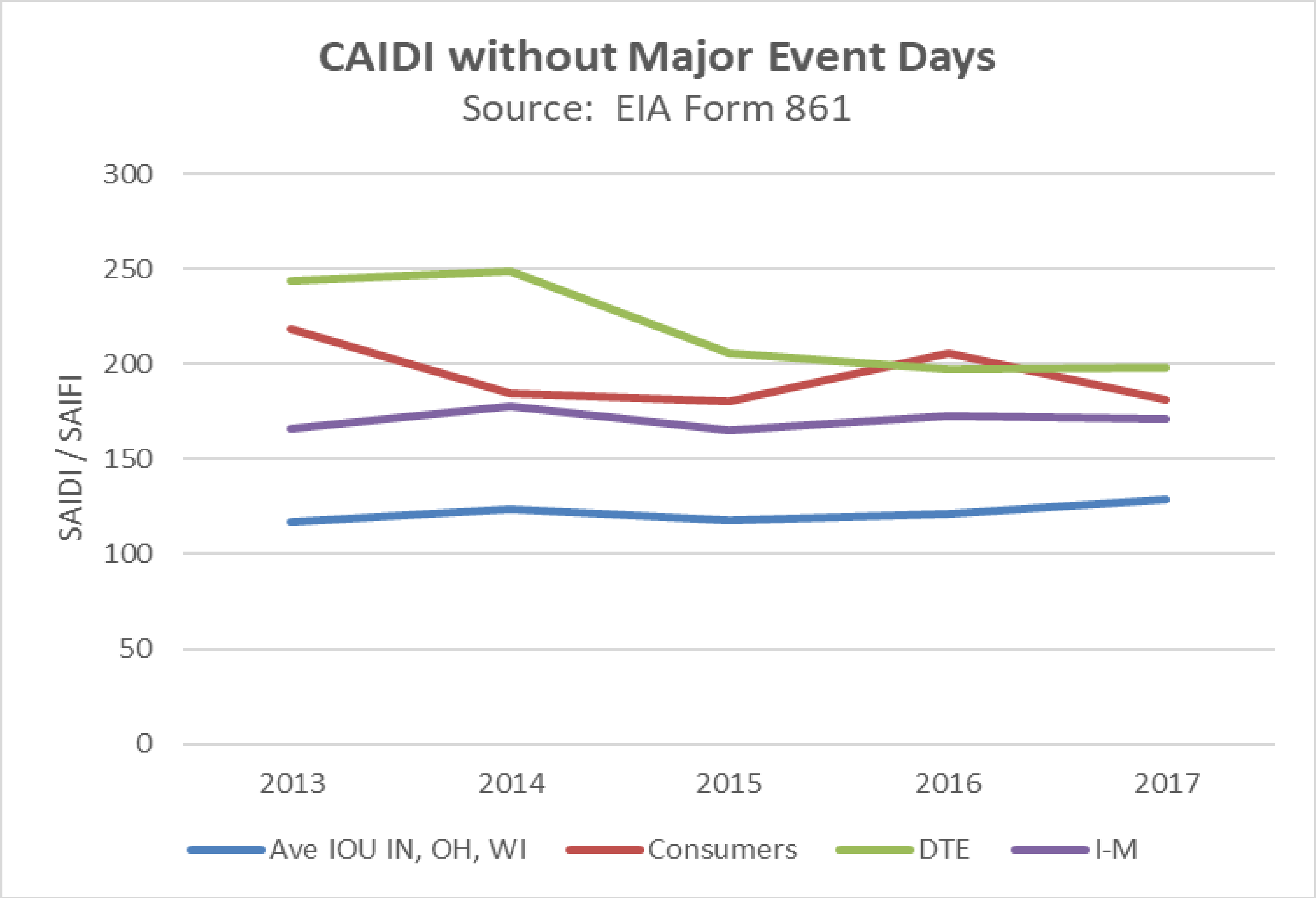
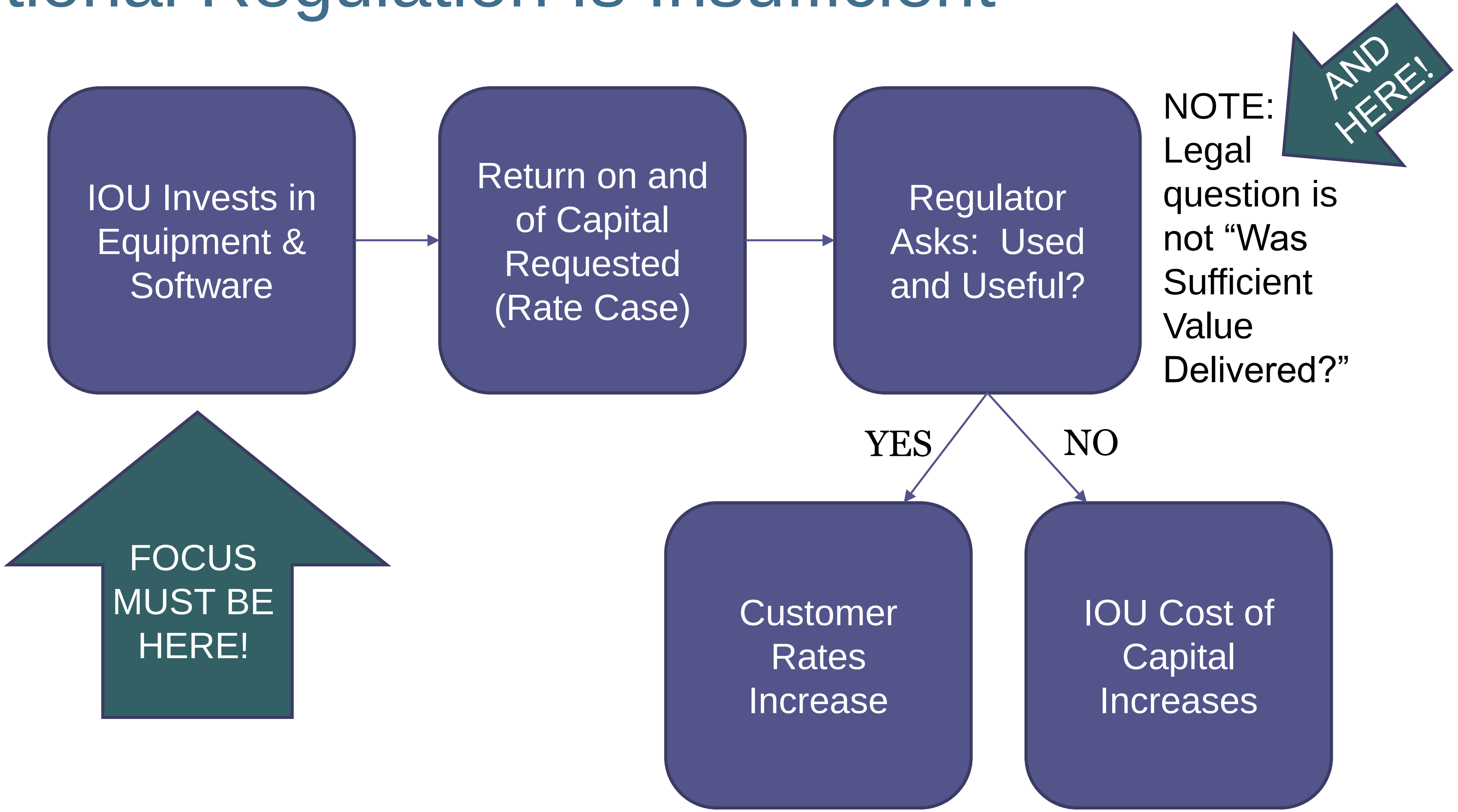


Chart Courtesy of *the Utility Evaluator*™; visit www.utilityevaluator.com for more information

Traditional Regulation Is Insufficient



Traditional Issues vs. The new Paradigm

- Traditional Utility Issues:
  - New load, Overloads, Reliability, and Power Quality
  - Good historical data on: Effectiveness of solutions, Cost of solutions and Value to customers
- The new Paradigm:
  - The utility has little or no experience in assessing potential new problems, including the probability or severity, validity of solutions, or the cost or value to the customers

The new Paradigm-What should be asked

- What are these potential problems?
- What is the impact to the customers if a remedy is not implemented?
- What is the probability that these problems will be significant?
- When will the problems begin to have a significant impact on the system?
- How pervasive are these problems?
- Where should the remedies be applied? Everywhere on the system or selectively?
- What are the most cost-effective remedies to these problems?
- What is the probability that the proposed solution will address the issue?
- What is the probability that the proposed solution will be effective at the estimated cost?
- Can lower cost solutions be implemented on a case by case basis?

Suggested Planning Process Based on Current

Develop Inputs → **Identify Issues** → **Identify Optional Solutions** → **Evaluate Optional Solutions** → **Determine Capital Budget** → **Procure any NWAs Selected**

Develop Inputs

Circuit-specific:
- Load forecasts
- DG forecasts
- Hosting capacity analyses

Identify Issues

Grid locations where load or DG capacity will be reached in next 3-5 years

Identify Optional Solutions

- Grid reconfig-urations
- Capital Projects
- Demand Response
- Non-Wires Alternatives
- New capabilities

Evaluate Optional Solutions

Use Benefit-Cost Analysis or Risk-Informed Decision Support to score and rank optional solutions

Determine Capital Budget

Use ranking to prioritize list of projects and determine capital budget (how far down the list to implement)

↓

Ratemaking & Performance Measurement

Grid Plans Should Be Driven by Grid Needs, not the C-Suite

Grid Investment Types and Evaluation Methods

	Non-Discretionary	Discretionary, Benefits Quantifiable	Discretionary, Benefits Difficult to Quantify
Examples	• Load growth • DER* growth • Public works • Equipment failure	• Advanced Meter Infrastructure • Advanced Distribution Mgmt. System • “Hardening” • Prospective	• Cyber security risks • Safety risks • Non-wires alternative risks • Service interruption risks
Suggested Evaluation Method	Of available options, choose the one with least cost TO CUSTOMERS^	Implement only when customer benefits exceed CUSTOMER costs^	Use Risk-Informed Decision Support to maximize risk reduction per $ across risk portfolio

*Distributed Energy Resources
^Includes carrying charges for IOU investments!

Customer Cost Estimate Guidelines

- Translate into revenue requirements over time (include carrying charges for IOU investments)
- Include cost of any premature asset retirements (and carrying charges), unless SH willing to absorb
- Include any likely O&M increases over time
- Discount rate impacts over time into today's $ values (present value of the revenue requirement)

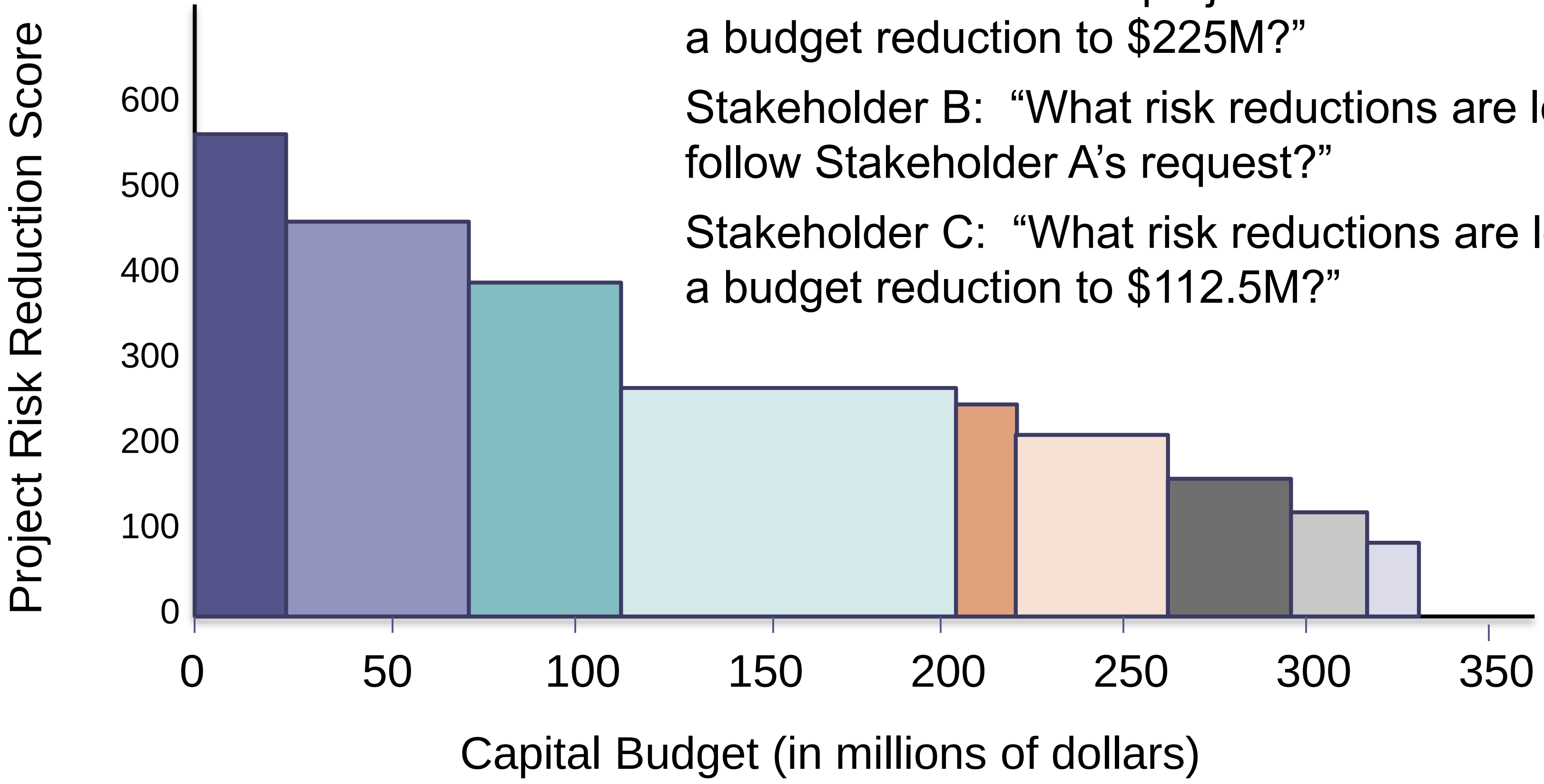
Benefit Estimate Guidelines

- Benefit period should equal depreciation period
- Discount benefits over time into today's $
- Use customer, not IOU, WACC as discount rate
- Consider the impact of rate case timing on customer benefit recognition
- Look for missed opportunities to maximize investment benefits (generally due to the throughput incentive)
- Estimate benefits based on current data, not "rules of thumb"
- Estimate energy benefits based on cost/kWh, not rate/kWh

Risk-Informed Decision Support (RIDS)

- Used by corporations (and IOUs) facing capital constraints to prioritize investments
- RIDS process:
  - Develop a RIDS process, including evaluation software
  - A quantification of various risk impacts in a levelized manner (to facilitate comparison)
  - Projects are evaluated using the RIDS process.
  - Scores are evaluated and the process repeated to achieve agreement
  - Scores are used to eliminate or rank projects within a capital budget.
- The same variable factors should be used for all evaluations.
- Goal: Assure that projects provide value in excess of cost.

Risk Score & Capital Budget: An Example



IOU: "We'd like $300M in capital to reduce risks"

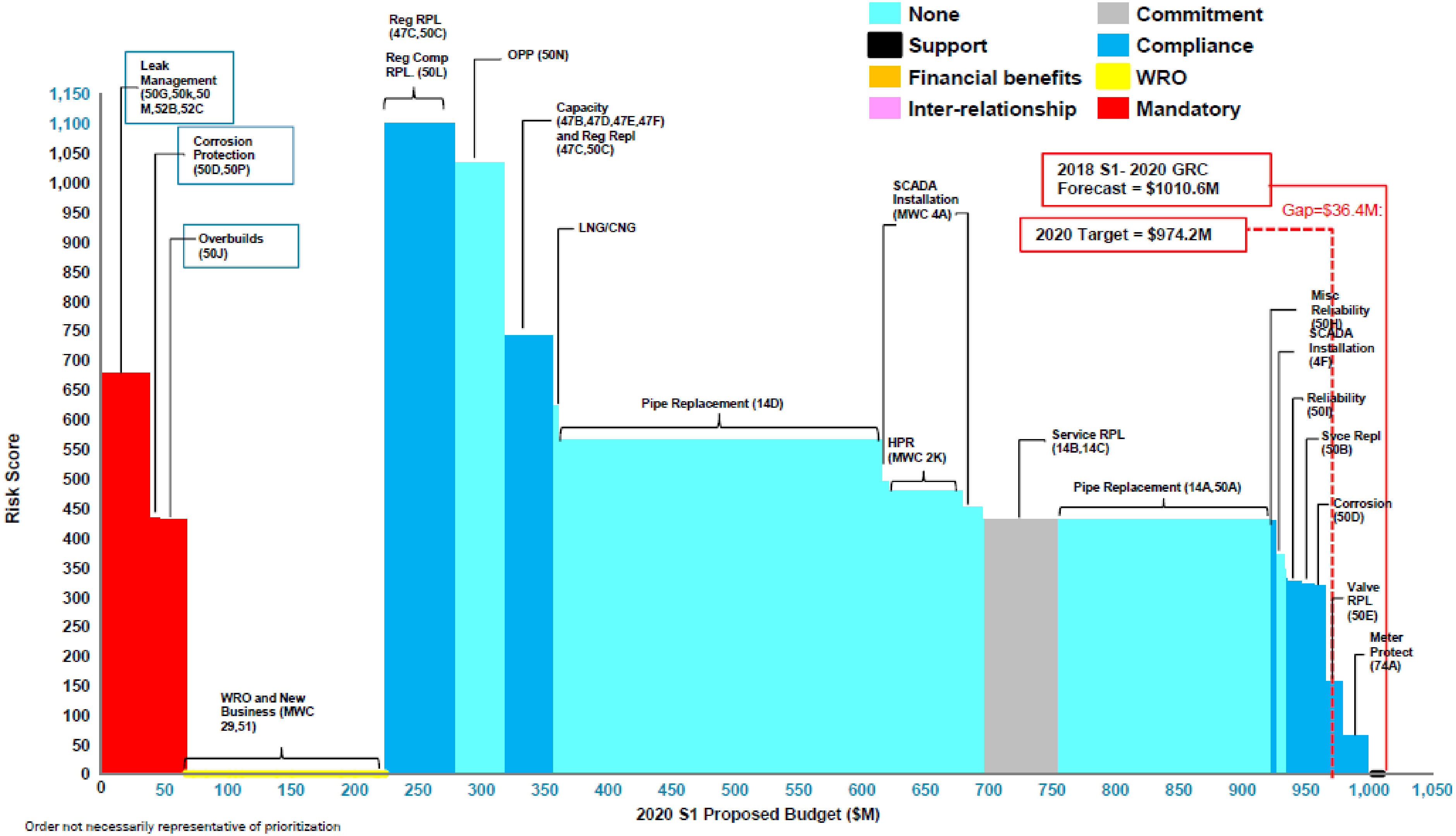
Stakeholder A: "What projects are eliminated with a budget reduction to $225M?"

Stakeholder B: "What risk reductions are lost if you follow Stakeholder A's request?"

Stakeholder C: "What risk reductions are lost with a budget reduction to $112.5M?"

Exar

2018 Gas Distribution Capital S1 ($M) – 2020 Work



Order not necessarily representative of prioritization

The Goals of RIDS

- Assure that projects provide value in excess of cost.
- Value = Sum of (for all adverse events a proposed project helps avoid):

  event likelihood(%) X event consequence($)
- Provide an opportunity for stakeholders to have input into the process and evaluate the utility inputs:
  - Event likelihoods and consequences assessed by IOU
  - Consequences $ and project value estimated by IOU
  - Evaluate project $ and likelihood of problem resolution
  - Help determine where to “draw the line” (what risk level is OK to leave for next capital budget)

Performance Measurement

- Begin with the End in Mind (measure baselines & establish targets *before* planning process begins)
- Targets should be objective, focus only on outcomes (not processes), and include dates
- Benchmark baseline performance against other utilities to help set targets
- Benchmark against other utilities to prioritize among performance measures (weighting?)
- Keep performance targets to a handful of important issues.* Micromanagement is not goal.

*HI PUC 2018-0008: 12 metrics

Thank You!

Paul Alvarez, President
palvarez@wiredgroup.net
303-997-0317, x-700

Dennis Stephens, Sr. Tech Consultant
dstephens@wiredgroup.net
303-997-0317, x-701

www.wiredgroup.net

www.utilityevaluator.com

Regulatory Innovations in the Treatment of Operating Expenses

MPSC Five-Year Distribution Planning Stakeholder Meeting

August 14, 2019

Ryan Katofsky, AEE

The utility business (and business model) is changing

Prevailing Model

- Invest capital & earn a return
- Manage operating expenses to minimize pass-through costs

(Some) Emerging Options

- Performance incentive mechanisms (PIMs)
- Performance-based regulation (PBR)
- New services based on utility as a platform
- Utility procures services in lieu of capex

Earn on outputs (PIMs, PBR, new services based on utility as a platform)

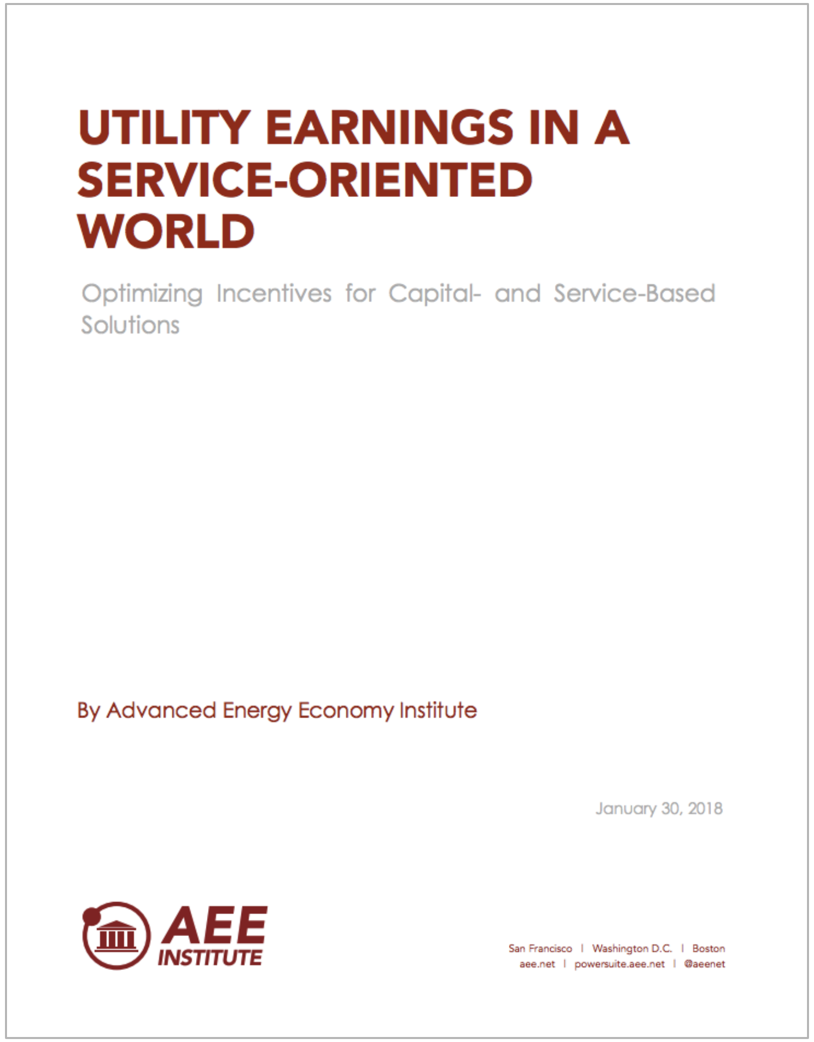
Earn on inputs (utility procures services in lieu of capex)

- **Emerging options build on, not replace, cost-of-service**
- **Modern distribution system planning complements new regulatory models**

Service alternatives can increasingly replace traditional capital investments

	Capital Solution		Service Solution
IT	Servers, software and IT infrastructure	vs.	Cloud Computing
T&D	Transformers, conductors, etc.	vs.	Demand management, dispatch rights for DER, NWAs
Supply	Utility-owned generation	vs.	PPAs, demand management

AEE Institute published a paper examining options for regulatory treatment of services


UTILITY EARNINGS IN A SERVICE-ORIENTED WORLD

Optimizing Incentives for Capital- and Service-Based Solutions

By Advanced Energy Economy Institute

January 30, 2018

AEE INSTITUTE

San Francisco | Washington D.C. | Boston
aee.net | powersuite.aee.net | @aeenet

- Explores adjustments to cost of service regulation to prepare utilities for the future
  - What regulatory options can level the earnings opportunities for service-based alternatives?
  - Which regulatory options best align cost savings for customers and utility earnings? ("win-win")
- Models utility earnings and customer costs for two types of service solutions:
  - Cloud Computing
  - Non-Wires Alternatives

What the paper *does not* do

The analysis did not …

- Evaluate the relative benefits (operational, technical, or otherwise) of traditional capital investments and service-based alternatives
- Assume that all service-based solutions are lower cost than the utility capital solution
- Look at the application of new regulatory options to all potential types of service-based solutions
- Contemplate a departure from cost of service regulation
- Require changes in accounting rules

Status Quo (traditional) Options

Capital Solution

- Utility purchases and operates its own solution.
- Each year, a portion of the upfront expenditure is amortized, and the utility collects its interest (WACC, including return for equity investors) on the unamortized balance (the rate base).

Service Solution as O&M Expense

- Utility pays for a service periodically as an O&M expense.
- These payments do not not provide meaningful earnings.*
- If the payments were not budgeted during the rate case, the new expenses can threaten the utility's efficient use of its operating budget.

* A utility would pay for any expense out of working capital, a small portion of which goes into the rate base for a short time. This would provide *de minimis* earnings, assuming the expense was budgeted. If unbudgeted, the payment could easily cost the utility more earnings than it provides if it lowers the potential of the utility to retain operational savings.

New Regulatory Options

DER Adder	Utility receives a 4% markup on NWA projects paid through O&M. Earnings are mostly from incentive.
Prepaid Contract	Contract is prepaid and placed into rate base as regulatory asset. Earns like a traditional investment from rate base.
NWA Shared Savings	Same as Prepaid Contract, but the utility receives 30% of cost savings compared to cost of capital alternative. Earnings are rate base + incentive.
Modified Clawback	Differences between projected opex and capex spend vs. actual go unreconciled until next rate case. Utility retains all savings as incentive until next rate case.
Pay as You Go	Service is paid yearly. Regulatory asset grows over time and amortized based on expected length of service. Variable shared savings applied. Earnings are rate base + incentive.

We tested the options with a detailed financial model

- The model calculated detailed revenue, expenses, taxes, costs to customers, and earnings to the utility for up to 42 years, and estimated the costs for further years as needed.
- Each of the 7 options was modeled under different conditions:
  - 3 Deployment Scenarios: allows the model to evaluate technology-specific considerations.
  - 2 Cost Cases
    - **Equivalent Cost**: capital and service solution have same $1M net present cost.
    - **Lower Cost**: Service solution is 75% of Equivalent Cost Case (helps model the impact of shared savings).

Deployment Scenarios

Short-Term Replacement (cloud focused)

Reference — Capital - 5 yr

Alternative — Service - 5 yr

Short-Term Deferral (NWA focused)

Reference — Capital - 40 yr

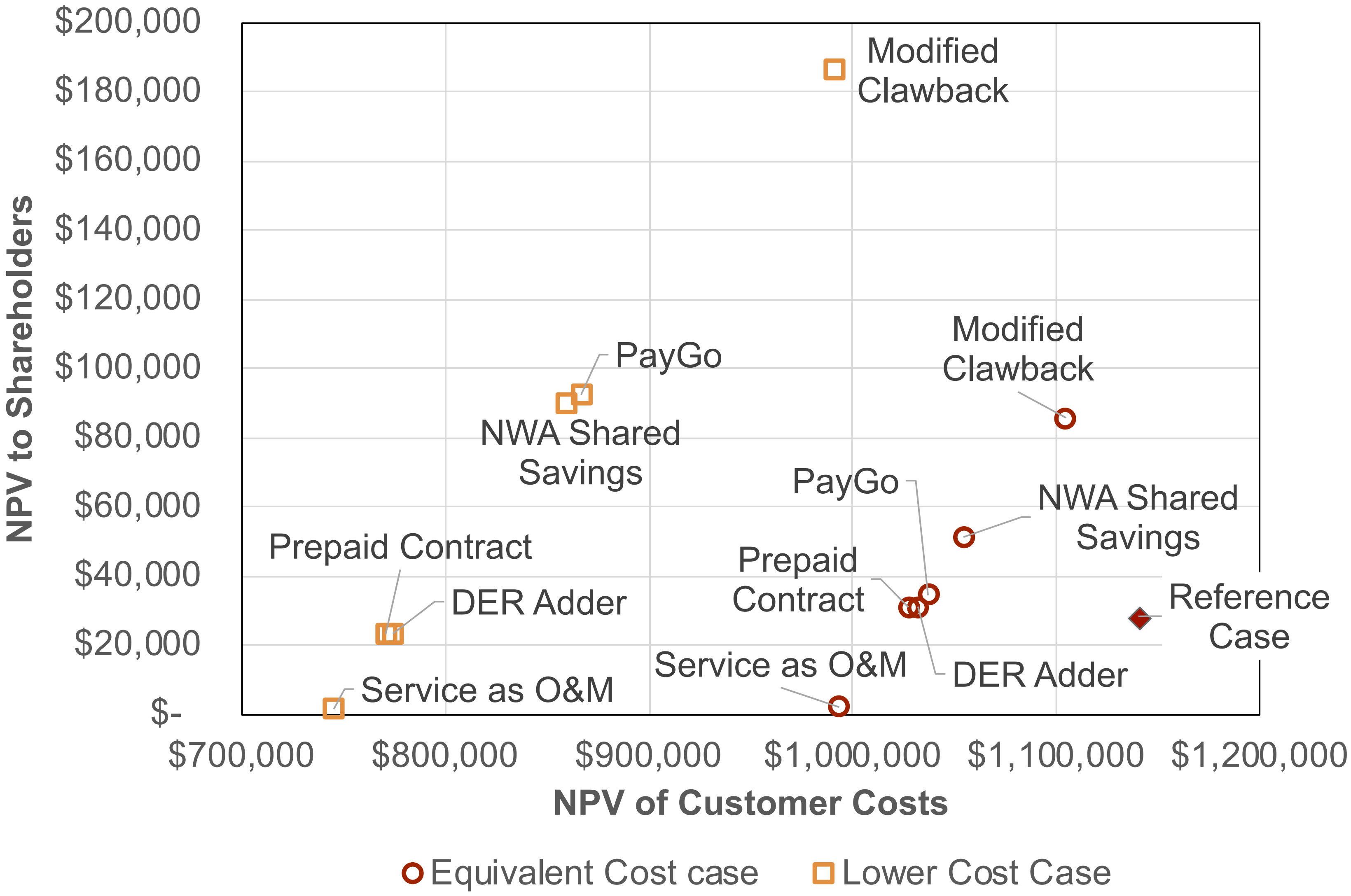
Alternative — Service - 5 yr | Capital - 40 yr

Long-Term Replacement (NWA focused)

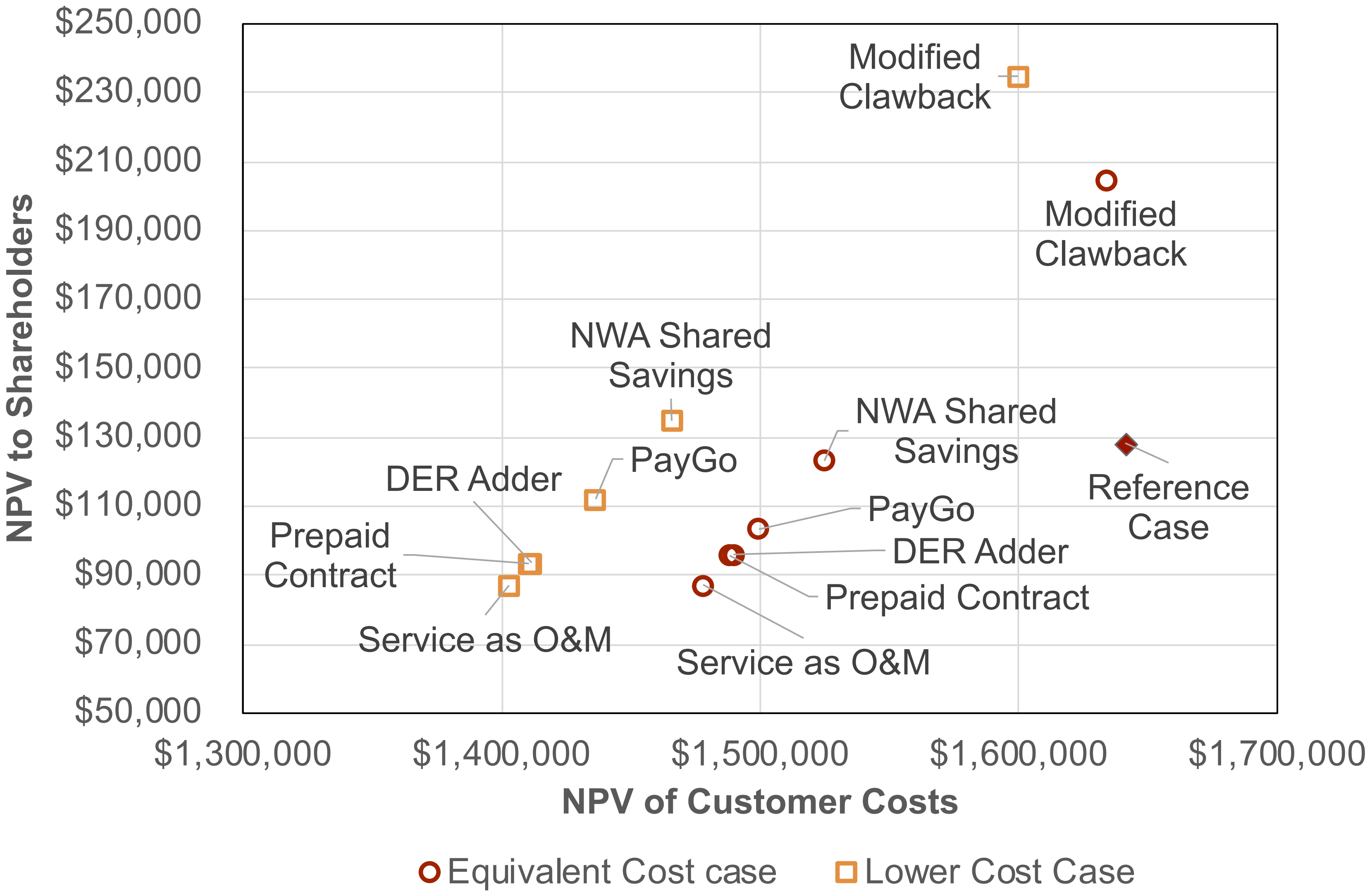
Reference — Capital - 40 yr

Alternative — Service - 40 yr

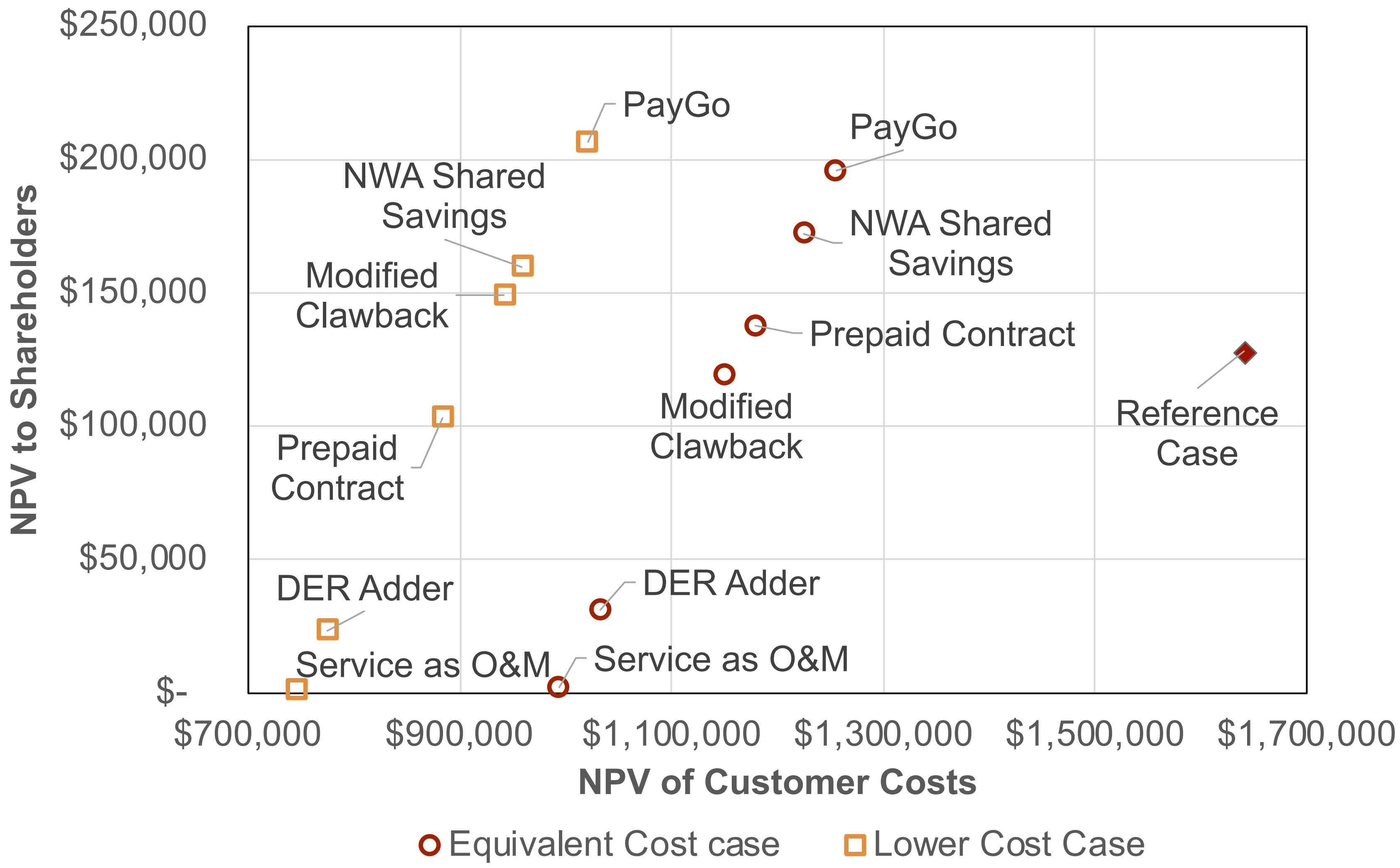
Results – Short Term Replacement Scenario



Results – Short Term Deferral Scenario



Results – Long Term Replacement



Conclusions

- If a service solution is more cost effective, there are options for both utilities and customers to benefit
- Utility earnings and financial health can be protected, regardless of the growth of services and new technologies
- Some of the options we explored are already in use and can be readily implemented
  - Prepaid contract and NWA
- Other options allow utilities to leverage the flexibility provided by services and are good, long-term solutions
  - Pay as you Go, DER Adder, and Modified Clawback
- Regulators have multiple options to choose from and can tailor the options to meet state policy goals

Thank You!

rkatofsky@aee.net

Download the report at:
https://info.aee.net/reports

MORNING BREAK
11:20 – 11:30 AM

Five Year Distribution Planning Stakeholder Meeting

Michigan Public Service Commission
Lake Superior Hearing Room
August 14, 2019

MPSC
Michigan Public Service Commission

Meeting Agenda

9:00 a.m.	Welcome & Introduction	Patrick Hudson, Manager, Smart Grid Section
9:10 a.m.	Cost Benefit Analysis for Utility-Facing Grid Modernization Investments	Tim Woolf, Synapse Energy Economics *Work supported by the U.S. Department of Energy for Berkeley Lab*
10:10 a.m.	Break	
10:20 a.m.	Cost Benefit Guidelines, Risk Informed Decision Support, and Distribution Performance Metrics	Paul Alvarez and Dennis Stephens, ABATE
10:50 a.m.	Regulatory Innovations in the Treatment of Operating Expenses	Ryan Katofsky, Advanced Energy Economy
11:20 a.m.	Break	
11:30 p.m.	Utility Pilot Programs and Funding	MPSC Staff
11:35 a.m.	Indiana Michigan Power: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Marc Lewis, Paul Loeffelman, David Isaacson and Subin Matthew Indiana Michigan Power
12:05 a.m.	Q&A for I&M Pilot Proposals	
12:15 p.m.	Lunch (local restaurants available)	
1:15 p.m.	Consumers Energy: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Doug Chapel and Don Lynd Consumers Energy
2:15 p.m.	Q&A for Consumers Energy Pilot Proposals	
2:25 p.m.	Break	
2:40 p.m.	DTE: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Yujia Zhou and Richard Mueller DTE
3:40 p.m.	Q&A for DTE Pilot Proposals	
3:50 p.m.	Closing Statements & Docket Responses	MPSC Staff
4:00 p.m.	Adjourn	

Utility Pilot Programs & Funding

Michigan Public Service Commission
Lake Superior Hearing Room
August 14, 2019
9 AM – 4 PM

MPSC
Michigan Public Service Commission

Background: Unfamiliar Process to Most

- General population unfamiliar with utility regulation
  - Interested, but unaware of processes
  - Would like to participate, but how?
    - Encourage stakeholder comments to docket U-20147

Background: Stakeholder Participation

- Stakeholders can provide input on a specific MPSC docket by:
  - Attending stakeholder meetings and provide comments
    - Usually staff report summarizing stakeholder meetings and outcomes
  - Submitting comments to the docket
    - Reference docket number (i.e. U-20147) and submit comments to:

      mpscedockets@michigan.gov or Michigan Public Service Commission
      P.O. Box 30221
      Lansing, MI 48909

    - Note: Comments posted publicly and part of official record
      - Do not include sensitive personal information!
  - Becoming a formal intervenor, represented by a lawyer, in contested case

Background: Utility Pilots and Funding

- Similarly, not all stakeholders understand utility pilot process
  - What are the criteria?
  - How are they funded?

General Characteristics of Utility Pilots

- Clearly stated goals/objectives
- Serves as test-bed for new technologies, program designs, etc.
  - Post-pilot information: lessons learned & milestones achieved
- Less investment than full utility-wide implementation
  - Time limited
  - Participation limited
- Pilot expenditures eligible for recovery
  - Pilot costs allowed to be recovered through customer rates

Meeting Agenda

9:00 a.m.	Welcome & Introduction	Patrick Hudson, Manager, Smart Grid Section
9:10 a.m.	Cost Benefit Analysis for Utility-Facing Grid Modernization Investments	Tim Woolf, Synapse Energy Economics *Work supported by the U.S. Department of Energy for Berkeley Lab*
10:10 a.m.	Break	
10:20 a.m.	Cost Benefit Guidelines, Risk Informed Decision Support, and Distribution Performance Metrics	Paul Alvarez and Dennis Stephens, ABATE
10:50 a.m.	Regulatory Innovations in the Treatment of Operating Expenses	Ryan Katofsky, Advanced Energy Economy
11:20 a.m.	Break	
11:30 p.m.	Utility Pilot Programs and Funding	MPSC Staff
11:35 a.m.	Indiana Michigan Power: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Marc Lewis, Paul Loeffelman, David Isaacson and Subin Matthew Indiana Michigan Power
12:05 a.m.	Q&A for I&M Pilot Proposals	
12:15 p.m.	Lunch (local restaurants available)	
1:15 p.m.	Consumers Energy: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Doug Chapel and Don Lynd Consumers Energy
2:15 p.m.	Q&A for Consumers Energy Pilot Proposals	
2:25 p.m.	Break	
2:40 p.m.	DTE: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Yujia Zhou and Richard Mueller DTE
3:40 p.m.	Q&A for DTE Pilot Proposals	
3:50 p.m.	Closing Statements & Docket Responses	MPSC Staff
4:00 p.m.	Adjourn	

Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots

Michigan Public Service Commission
Five Year Distribution Planning
August 14, 2019

INDIANA MICHIGAN POWER
An AEP Company
BOUNDLESS ENERGY

Pilot Experience

Michigan Public Service Commission
Five Year Distribution Planning

AMERICAN ELECTRIC POWER

BOUNDLESS ENERGY℠

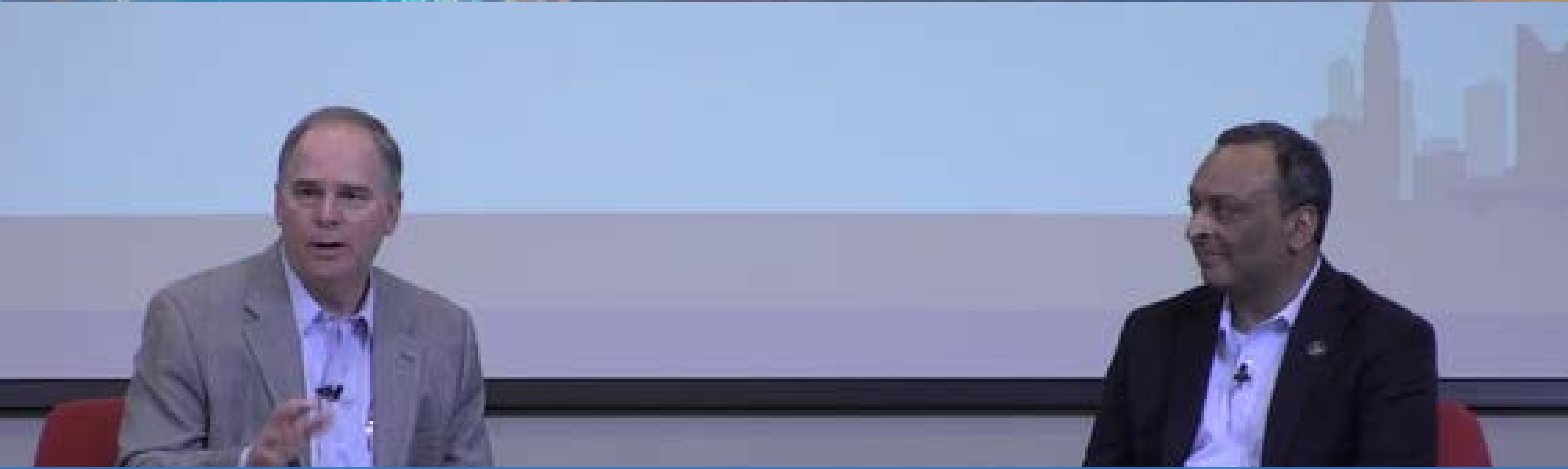
Innovation Overview and Advanced Technology Focus Areas

Ram Sastry, AEP Innovation and Technology Group

August 14, 2019

Finding Cutting Edge Innovative Technologies and Deploying Them at Scale

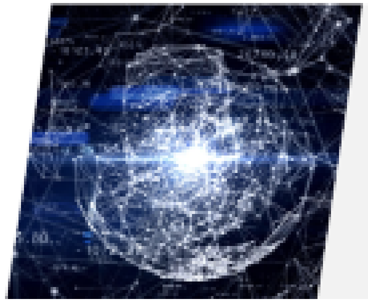
- Utilities have a long history of achieving operational and economic efficiency through innovation.
- Today, our customers are asking for new services and products beyond reliable and affordable energy.
- Consumers are savvy and expect AEP and other electric companies to find new ways to deliver enhanced services and benefits. And to do it faster than ever before.
- To be successful in this environment, electric companies need to: (1) scout out new innovation technologies; (2) prove them out at high speed; (3) demonstrate their benefits to customers and policymakers; (4) secure timely regulatory support or contractual approvals for innovation and deployment; and (5) deploy them at scale.
- It is critical for state regulators and lawmakers to better understand what technology innovations are available to benefit customers and the role electric companies need to have in broadly deploying advanced energy technologies.



"I am confident in our ability to transform our industry for the benefit of the communities we serve. AEP is globally searching for, and validating innovative, advanced technologies, especially to integrate into the distribution grid of the future, for all of our customers and for our operations. Our electrification activities need to improve the lives of all members of society."

Nick Akins, Chairman, President and CEO

THE GRID OF THE FUTURE



Decentralized

Intelligent devices from substations to customers' homes and premises – Industrial Internet of Things

Digitalized

Network services across multiple platforms providing customers with greater control over energy products and services

Decarbonized

Cleaner, greener more sustainable energy options

AEP program to find and validate advanced technologies

- A team, led by Ram Sastry, vice president, Innovation and Technology, has developed a program to search the globe for innovative technologies AEP can quickly pilot. We are seeking deployable opportunities that are looking 2-5 years into the future.

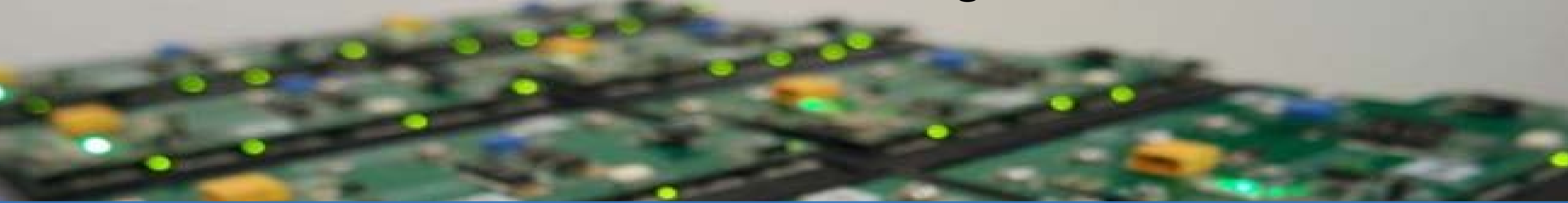
- This strategy includes participating in global accelerators, and strategic partnerships with international electric utilities that focus on three key areas:
    1. Platforms or advanced software that integrates and optimizes our assets
    2. e-mobility that will be integral to our transportation electrification efforts
    3. Resiliency which includes energy storage, and nano-and microgrids.

Free Electrons Global Energy Acceleration Program

- The Free Electrons Accelerator (www.freetheelectron.com) is an example of how we are able to efficiently find and prove out advanced technologies.
- AEP is the only North American utility member.
- Over two editions, the program received more than 1,000 applications, from 65 different countries to pitch their technologies to the 10 member utilities.
- We are validating 10 technologies from the best 2018 and 2019 applicants that have the potential to improve AEP operations and to provide benefits to our customers.
- By asking technology providers a few questions, the corporate team, our operating companies and business units are able to collaboratively develop cost-effective scopes of work to show us functionality results, usually in a matter of months.

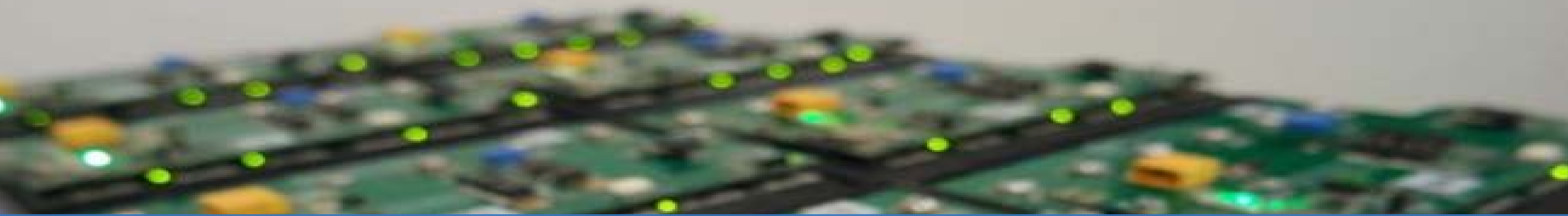
Toby Thomas, President and COO, Indiana Michigan Power, and AEP corporate executives Nick Akins, Steve Haynes and Ram Sastry discussing a design for a pilot with a Free Electrons start-up company

We are piloting 10 technologies from the Free Electrons Program



- A California startup automates plug load management and enables behind-the-meter visibility and controls for increased C&I facility energy efficiency. I&M is piloting this at two service centers in Indiana.
- A company in Massachusetts developed a microgrid platform that integrates distributed energy resources with reduced deployment time and automatically controls and optimizes their performance. SWEPCO is piloting the technology in Louisiana.
- An Australian startup developed an advanced battery management system (power electronics and software) that could repurpose retired electric vehicle batteries for very cost-effective residential and grid support. Dolan Technology Center is validating the technology with support from Nissan.

We are piloting 10 technologies (cont'd)



These potentially can

- Automatically balance building loads, EV charging, storage and distributed generation
- Use smart meter data to dynamically describe distribution grid load flows, congestion, etc.
- Peak shave, shift load required by the grid during EV charging at homes
- Increase commercial building energy efficiency, DSM, by analyzing smart meter data
- Aggregate C&I demand side resources for customer benefits in ancillary services markets
- Increase care of a family member with alerts when they change appliance use patterns
- Maintain operating appliances with plug-in large capacity batteries.

INDIANA MICHIGAN POWER

An AEP Company

BOUNDLESS ENERGY

Proposed Pilots

Michigan Public Service Commission
Five Year Distribution Planning

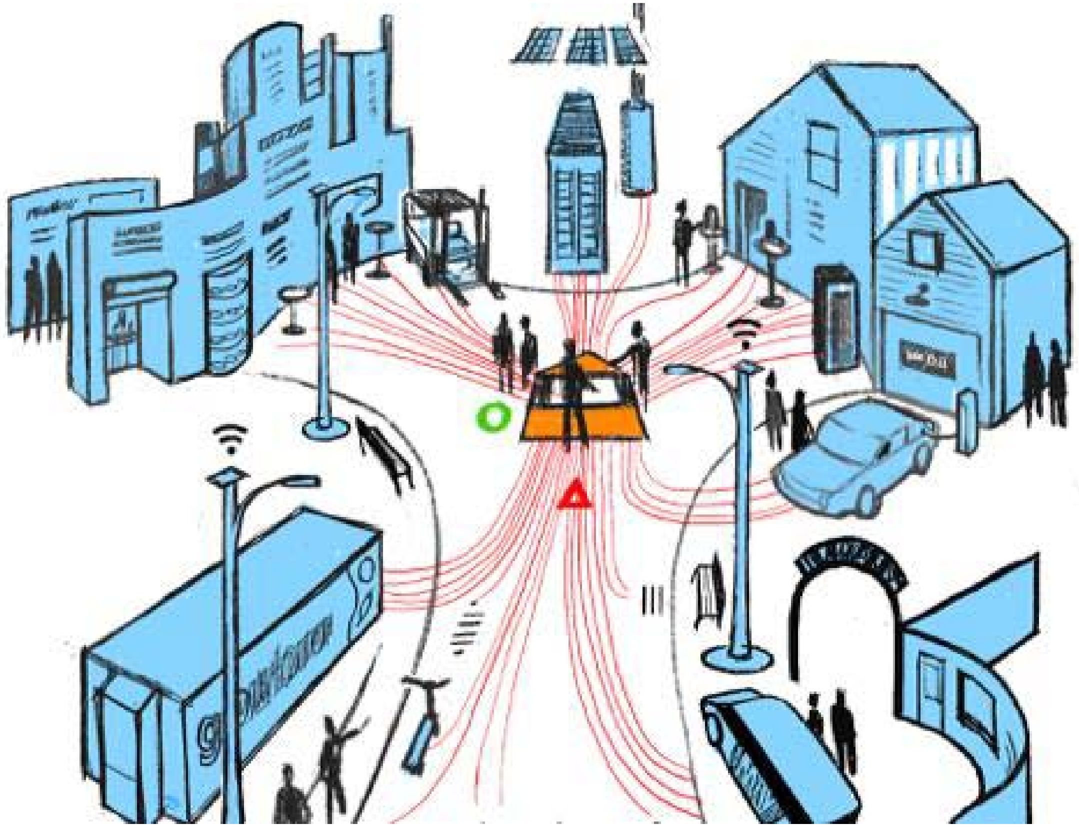
1
2

Our Focus


INDIANA MICHIGAN POWER
An AEP Company
BOUNDLESS ENERGY
I&M's
MICHIGAN PLAN
AEP is investing in Southwest Michigan to better serve customers, reduce outage durations and prepare for the future.
Cook Infrastructure
Strengthening the Grid
Empowering Customers
Investing in Technology

New planning approaches are needed for the grid of the future

- Hosting Capacity
- Load & DER Forecasting
- Non Wires Alternatives
- Cost Benefit Analysis



INDIANA MICHIGAN POWER
An AEP Company
BOUNDLESS ENERGY

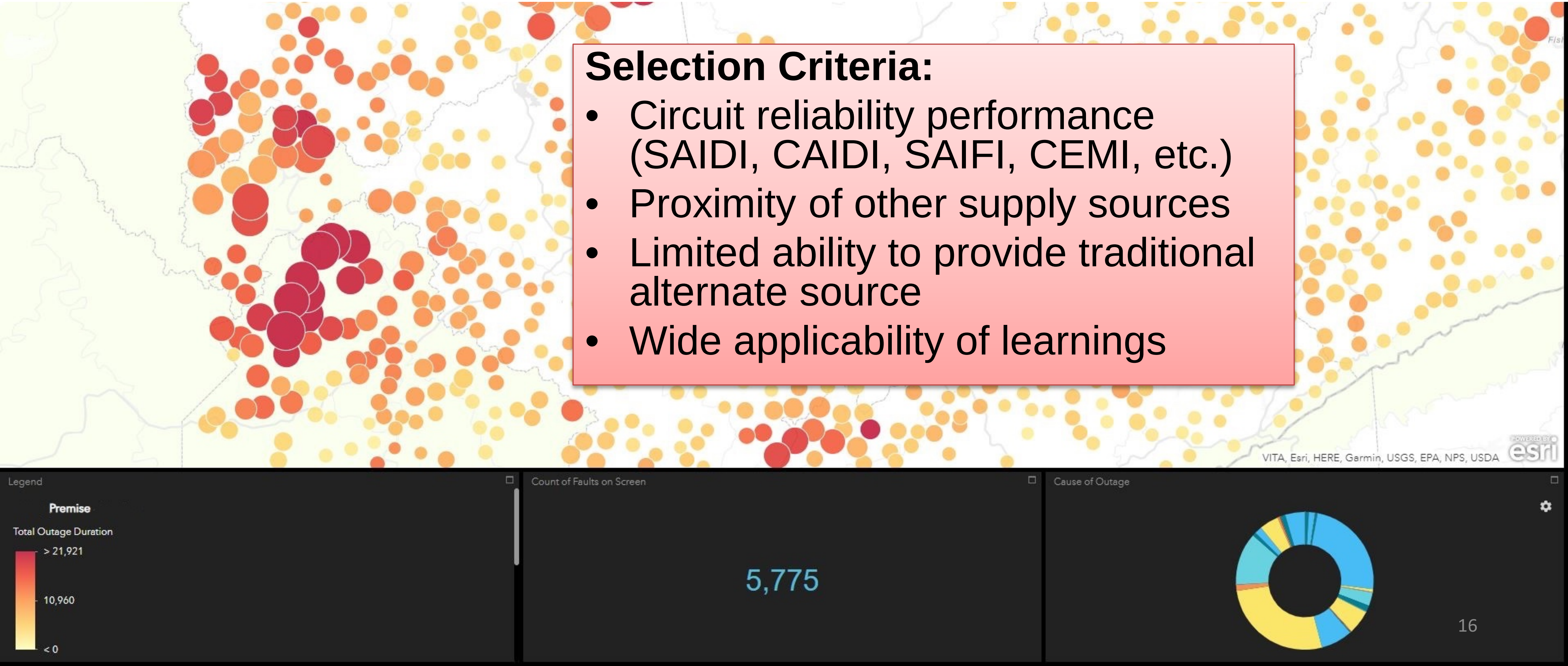
Objectives of NWA Pilots

- Improve reliability for customers in considered location(s)
- Leverage DSM in optimizing the sizing of the components in the NWA solution
- Leverage learnings and insights to develop framework that can be used to value DER

We applied data analytics to identify candidate locations

Selection Criteria:

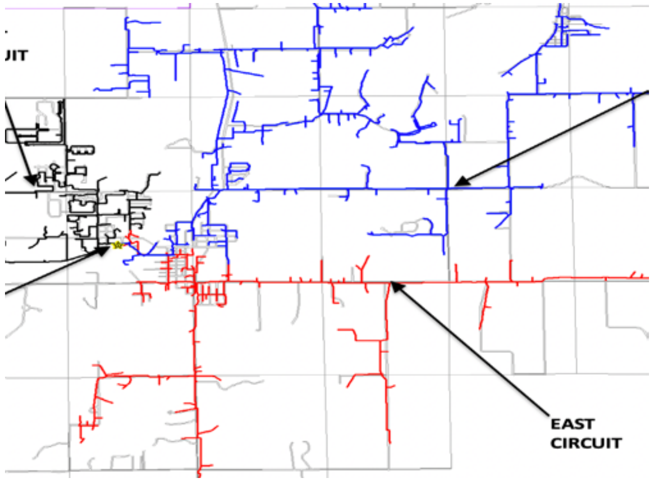
- Circuit reliability performance (SAIDI, CAIDI, SAIFI, CEMI, etc.)
- Proximity of other supply sources
- Limited ability to provide traditional alternate source
- Wide applicability of learnings



Candidate pilots share common attributes

West Street – Paw Paw Lake

Stubey West

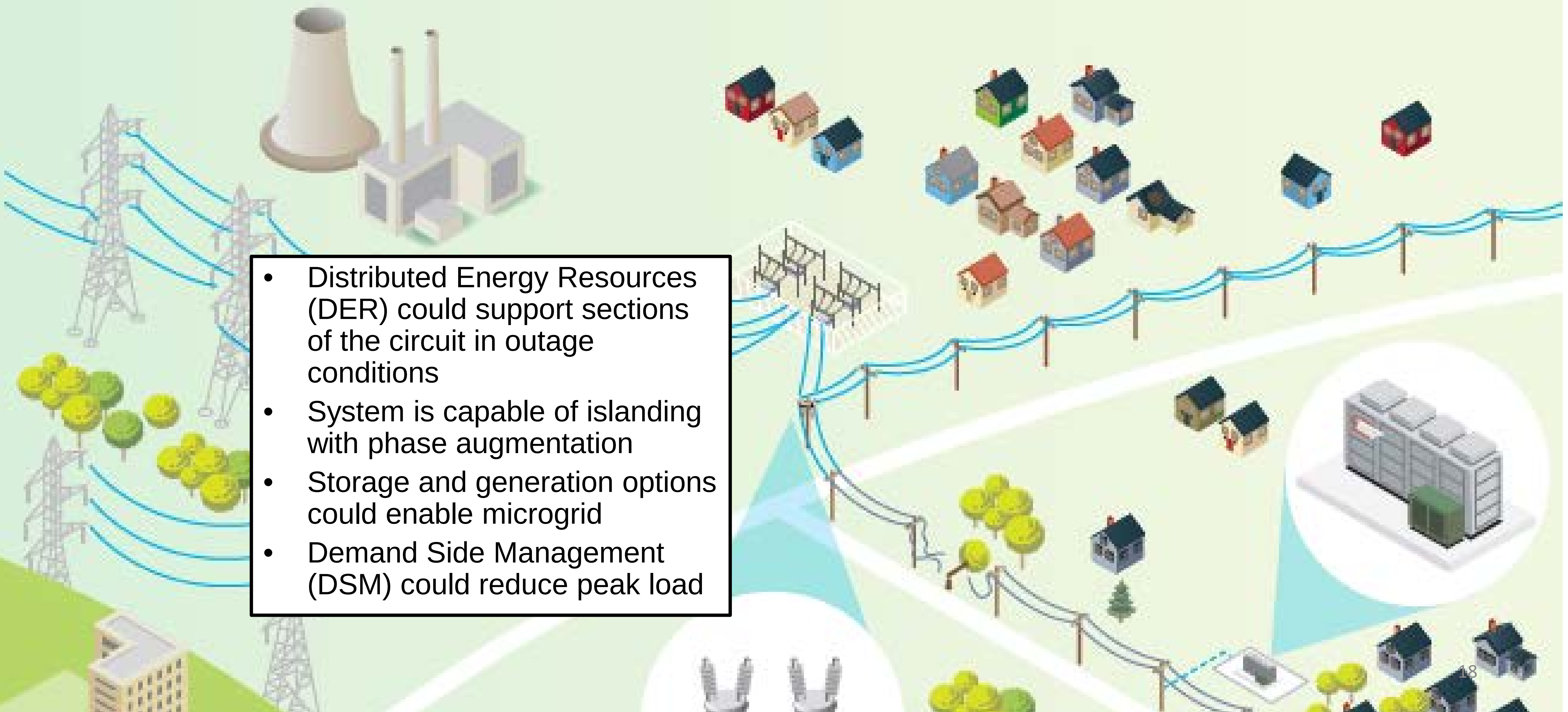


Vicksburg Richardson

- On radial circuits with high customer density
- Far from source/ substation at fringe of territory
- Experiencing reliability issues
- Limited access to alternate source

BOUNDLESS ENERGY℠

Example of Pilot Opportunity



- Distributed Energy Resources (DER) could support sections of the circuit in outage conditions
- System is capable of islanding with phase augmentation
- Storage and generation options could enable microgrid
- Demand Side Management (DSM) could reduce peak load

Next Steps

- Solicit and incorporate feedback on approach
- Refine/fully characterize pilot options
- Submit pilot request/recommendation(s)

Questions?

SUPPLEMENTAL INFORMATION REGARDING AEP'S PILOT EXPERIENCE

AEP AREAS OF INTEREST EXAMPLES:
Platforms (P), E-Mobility (E) and Resiliency (R)

- P/R-Distributed Energy Resource Management Systems (DERMS)
- P/E-Mobility – EV Fleet Management and Optimization
- P/E-Mobility – Vehicle to Grid, etc. (V2x) applications (Grid and Home)
- P/E/R-Machine Learning (ML)/Artificial Intelligence (AI) Use Cases for Energy Management for Commercial Customers
- P/R-ML/AI Use Case for Asset Management (aka Predictive Analytics)
- P/R-ML/AI Use Case for sensor data (on grid and at customer premise)
- Resiliency as a service
- Reliability as a service
- P-UAS/Image Processing/Work Management Integration
- P-Blockchain Use Case – Customer Data Management and Digital ID
- P-Blockchain Use Case – Transactive Systems
- P/R-Micro and nano grids
- R-Residential distributed solar plus storage
- P/R-second life storage

Seeking deployable opportunities that are looking 2 – 5 years into the future

QUESTIONS AEP ASKS STARTUPS ABOUT THEIR TECHNOLOGIES

1. What is the challenge your technology can solve for AEP?
2. What is the solution that your technology provides?
3. Describe a pilot with the minimum, fastest to complete activities that would demonstrate its benefits to AEP and its customers
4. What would you need from AEP to have a successful pilot?
5. What would be the approximate cost of your pilot?
6. What would be the milestones and duration of your pilot?

More Examples of Pilots with startups from the Free Electrons Global Energy Accelerator Program (cont'd)

- A startup that developed a software energy management storage platform that optimizes and automatically balances building loads, EV charging, storage and distributed energy generation. They were purchased by a company from California. AEP Ohio has validated the technology.
- Advanced artificial intelligence and machine learning technology that uses smart meters for distribution situational awareness such as load flows and congestion from a startup in France. AEP Texas is conducting the pilot.
- Based in London, England, this company uses advanced software optimizing residential EV charging to shift load. Pilot to include installations at homes of a small number of Ohio employees.
- A startup based in Spain that uses advanced software analyzing commercial building smart meter data and comparing it to 600,000 monitored buildings in its global portfolio for cost-effective energy efficiency, demand side and demand response management recommendations. Pilot to include 300 buildings across the AEP system.

More Examples of Pilots with startups from the Free Electrons Global Energy Accelerator Program (cont'd)

- A startup based in Dublin, Ireland transforms demand side resources into revenue opportunities for commercial and industry (C&I) customers and their energy provider. Commercial Operations is piloting the technology.

- A British startup that developed software that detects daily behavior pattern changes by a family member, an elderly one for example, using home appliances. The software sends an alert to caregivers. PSO is validating the technology in Oklahoma.

- A Colorado-based company that is customer-friendly (UL Certified) battery backup, targeted at outlets for cable and network power backup. AEP's Dolan Technology Center is testing the performance of the storage devices.

PRELIMINARY PILOT CANDIDATES

West Street – Paw Paw Lake

PRELIMINARY

Problem Statement:

- West Street: Paw Paw Lake is a radial circuit stemming from the West Street station. It contributes significantly to I&M's SAIDI metric**.**

Risks & Considerations:

- Having controllable loads would boost the potential value of the pilot and help with optimizing the solution

Potential Solutions:

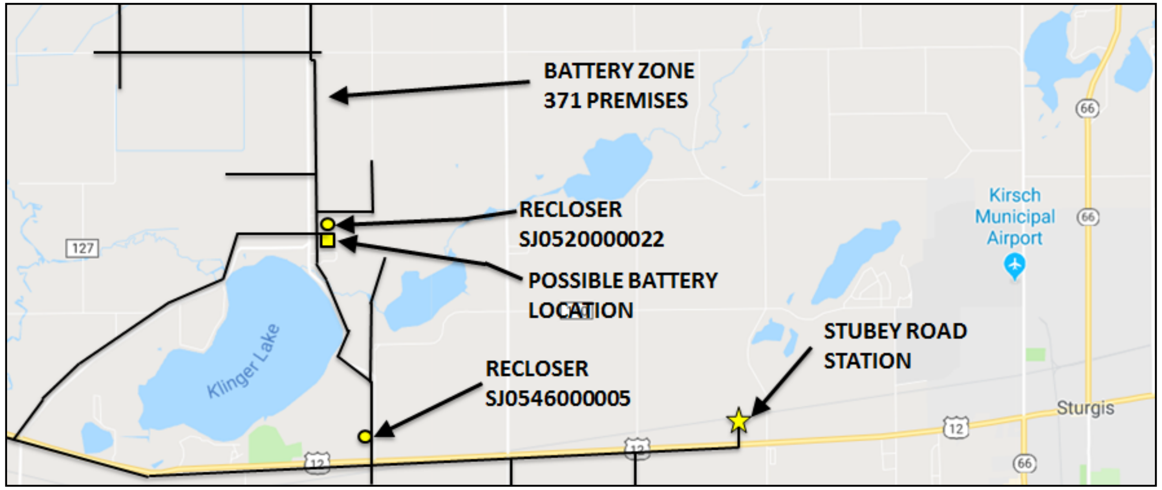
a. Deploy large battery

Anticipated Benefits

- Maintain service for the given area even during outage conditions

PRELIMINARY

Stubey West



Problem Statement:

- Stubey West is located near the edge of I&M territory and lacks circuit ties. Data shows that customers on the eastern edge of Klinger Lake experience the higher outage minutes.

Risks & Considerations:

- Heavy tree density, limited customer tolerance to cut trees
- Area at fringe of territory with limited ability for alternate source
- Having controllable loads would boost the potential value of the pilot and help with optimizing the solution

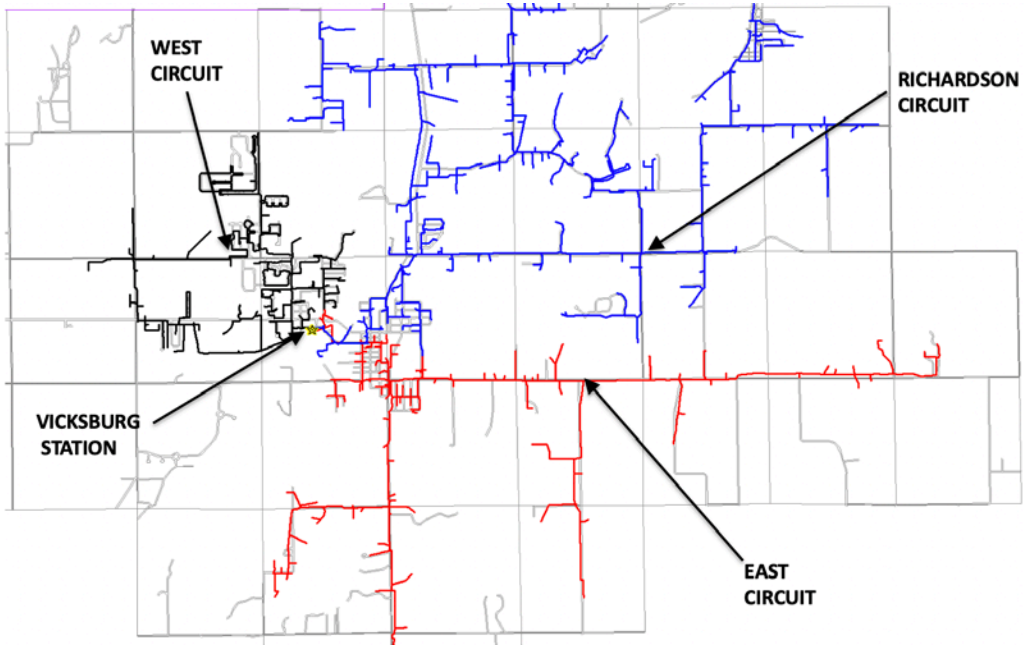
Potential Solutions:

a. DACR with Pigeon River
b. DER remote from source near lake

Anticipated Benefits

- Maintain service for the given area even during outage conditions

Vicksburg Richardson



Problem Statement:

- Reliability concerns at northeast end of circuit.
- 6 outages average from 2016-18

Risks & Considerations:

- Customer density
- Area at fringe of territory with limited ability for alternate source
- Having controllable loads would boost the potential value of the pilot and help with optimizing the solution

Potential Solutions:

a. DACR with Vicksburg East
b. DER near end of circuit

Anticipated Benefits

- Maintain service for the given area even during outage conditions

Hagar – Covert Fire Lanes

PRELIMINARY

Problem Statement:
- Reliability on western end of Hagar Michigan Beach circuit near Lake Michigan.

Risks & Considerations:
- Significant environmental sensitivities (trees, sand dunes)
- Primarily weekend homes

Potential Solutions:
a. Install new distribution line on Blue Star and tap customers off this main line
b. Install DER

Anticipated Benefits
DER would not alleviate dispersed tree/reliability issues

PRELIMINARY

Buchanan Hydro – River Road

Problem Statement:

- Southeastern portion of River Road circuit experiencing high duration and frequency of outages. Area has no ties to surrounding circuits due to river barrier.

Potential Solutions:

a. New station in 2020 will not improve reliability for this remote area
b. DACR currently in planning stage
c. DER

Risks & Considerations:

- 140 customers / .49 MW
- 4.3 outages / year 2014-18

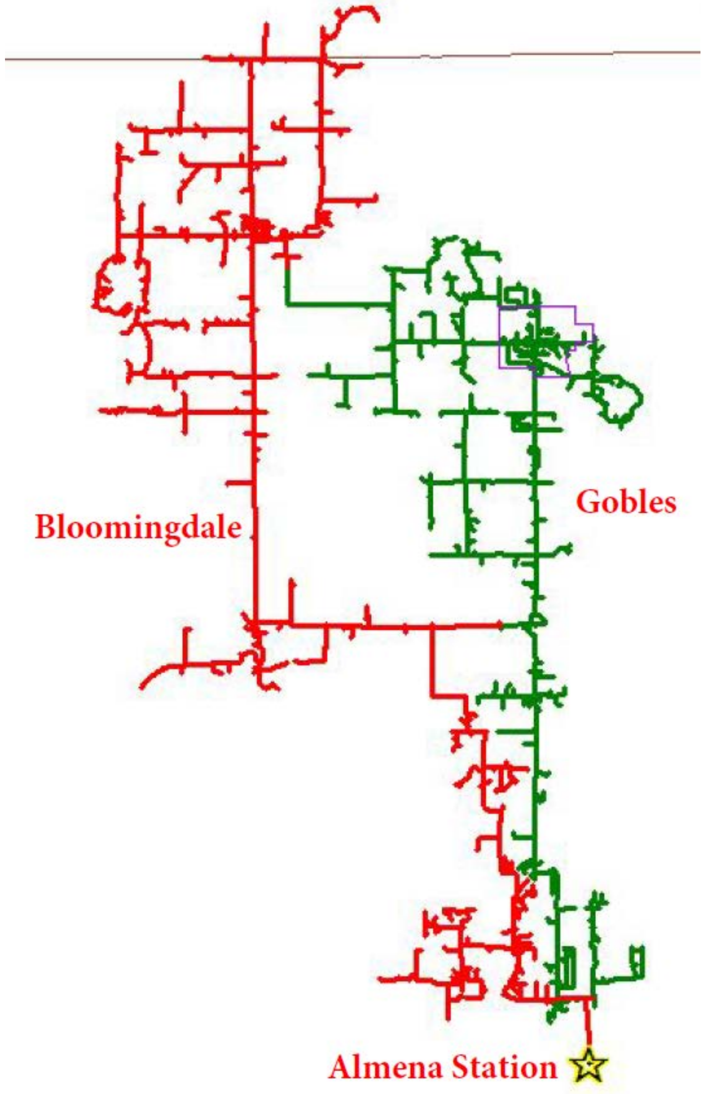
Anticipated Benefits

- Reduction in overall frequency of outages stemming from upstream faults

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY

Almena Station-Gobles & Bloomingdale

PRELIMINARY



Problem Statement:

- Two circuits looped with approximately 30 miles of main line exposure. Consistent reliability issues over years. Northern portion (10MVA) of this area averaged 3.86 outages per year between 2014-18.

Risks & Considerations:

- There have been community meetings discussing reliability concerns. Natural gas supply is currently limited.

Potential Solutions:

a. New station at north end of area
b. Currently a DA scheme is in place
c. DER at north end of circuitry

Anticipated Benefits

- Maintain service when primary source is outaged

LUNCH BREAK: 12:15 AM – 1:15 PM

MPSC Michigan Public Service Commission

- Some food/restaurant suggestions
  - American
    - Buffalo Wild Wings
    - Chick-fil-A
    - Culver’s
    - Jersey Mike’s Subs
  - Asian
    - Panda Express
    - Ukai Hibatchi Grill & Sushi
  - Italian
    - Cottage Inn Pizza
  - Mexican
    - Chipotle
  - Mediterranean
    - ChouPli Wood-Fired Kabob
  - Other
    - Horrocks (soup, salad, & pizza bar)

Meeting Agenda

9:00 a.m.	Welcome & Introduction	Patrick Hudson, Manager, Smart Grid Section
9:10 a.m.	Cost Benefit Analysis for Utility-Facing Grid Modernization Investments	Tim Woolf, Synapse Energy Economics *Work supported by the* *U.S. Department of Energy for Berkeley Lab*
10:10 a.m.	Break	
10:20 a.m.	Cost Benefit Guidelines, Risk Informed Decision Support, and Distribution Performance Metrics	Paul Alvarez and Dennis Stephens, ABATE
10:50 a.m.	Regulatory Innovations in the Treatment of Operating Expenses	Ryan Katofsky, Advanced Energy Economy
11:20 a.m.	Break	
11:30 p.m.	Utility Pilot Programs and Funding	MPSC Staff
11:35 a.m.	Indiana Michigan Power: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Marc Lewis, Paul Loeffelman, David Isaacson and Subin Matthew Indiana Michigan Power
12:05 a.m.	Q&A for I&M Pilot Proposals	
12:15 p.m.	Lunch (local restaurants available)	
1:15 p.m.	Consumers Energy: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Doug Chapel and Don Lynd Consumers Energy
2:15 p.m.	Q&A for Consumers Energy Pilot Proposals	
2:25 p.m.	Break	
2:40 p.m.	DTE: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Yujia Zhou and Richard Mueller DTE
3:40 p.m.	Q&A for DTE Pilot Proposals	
3:50 p.m.	Closing Statements & Docket Responses	MPSC Staff
4:00 p.m.	Adjourn	

Hosting Capacity Analysis “Solar Zone” Pilot Proposal

Don Lynd

August 14, 2019

Consumers Energy
Count on Us®

Hosting Capacity Analysis ("HCA") Issue Definition

HCA definition[1]: Illustration of how much Distributed Energy Resources ("DER") can be accommodated on distribution system without impacting power quality, under current existing conditions, without upgrades to system

- Location dependent and circuit-specific
- Time-varying (on different timescales)
- Evaluates voltage violations, thermal overloads, protection mis-operation, using distribution system modeling
- Results published in map and/or spreadsheet, usually updated quarterly or annually

Full HCA would reflect all circuits on utility distribution system to differentiate areas where DERs are suitable and not suitable

[1] EPRI presentation to workgroup, 6/27/2019

November 2018 MPSC Order

"The Commission believes that an appropriate next step would be to hold a technical conference with utilities, stakeholders, and experts… to examine what types of information is needed to conduct such studies and the availability of such information in Michigan, as well as the cost, uses, and feasibility of such studies."

- This workgroup process reflects the technical conference ordered by the Commission

"Depending on the outcome of that discussion, the Commission would be interested in a pilot application in the next iteration of distribution plans."

- We will discuss a proposed pilot application today

Complexities of Hosting Capacity Analyses[1]

- Four differing technical approaches to conducting HCAs
  - Stochastic
  - Iterative
  - Streamlined
  - Hybrid – employed by EPRI DRIVE technology

- HCAs require data relying on:
  - SCADA on each circuit
  - GIS mapping of distribution infrastructure

  More common for utilities to have GIS than full SCADA coverage

- Data needed to model circuits at both peak and off-peak, with circuit models integrated into a system model

- On system with 1,000s of circuits, full system modeling is difficult to develop and maintain; difficult to get certainty rather than estimates at granular customer level

[1] EPRI presentation to workgroup, 6/27/2019

Value of Hosting Capacity Analyses

- Full-system HCAs require significant investment in human and computing resources
- Michigan is at an early stage of DER penetration, particularly inverter-based supply
- Primary value: HCAs highlight where DERs can interconnect, incentivizing their development
    - Significant amounts of inverter-based DERs have already made interconnection applications
- A pilot represents a prudent intermediate step to learn for future scenarios of high DER penetration
    - Full HCAs are not necessary in 2020, given costs and complexity

Pilot Proposal: Solar Zone

- Issue to be explored:
  - How can the utility provide greater customer access to the distribution system without harm to the system?
  - How can the utility increase solar penetration?
- Inspired by Wind Zone concept defined in PA 295 Section 147[1]
  - Smaller in size than a Wind Zone (20-40 MW)
- Potential Solar Zone identification criteria:
  - Distribution system capacity
  - Community acceptance
  - Appropriate land characteristics
  - Coincidence with planned system upgrades
  - Potential to socialize interconnection costs
- Potential utility process:
  - Identify area(s) that are appropriate for solar generation
  - Perform a mini interconnection study
  - Propose collector network to gather all generation to single HVD interconnection

[1] MCL 460.1147

Non-Wires Alternative Pilots

Doug Chapel

August 14, 2019

Consumers Energy
Count on Us®

Non-Wires Alternative ("NWA") Issue Definition

NWA definition[1]: A portfolio of distributed energy resources ("DER") such as energy efficiency ("EE"), demand response ("DR"), solar PV, battery energy storage ("BES"), combined heat and power ("CHP"), etc. that can be used to help address grid needs

In particular, NWAs use one or more DER solutions to address an issue that would have otherwise required a capital investment in wires infrastructure, thereby deferring or avoiding the need for that capital investment

[1] ICF presentation to workgroup, 6/27/2019

November 2018 MPSC Order

"Unconventional solutions, including targeted EE, DR, energy storage, and/or customer-owned generation, that could displace or defer investments in a cost-effective, reliable, and timely manner should be considered and evaluated," but "the Commission is also sensitive to the need to ensure prudent distribution investments can be made in a timely manner and that NWAs are not always an appropriate technical solutions. Therefore, the Commission believes that further discussions related to the criteria for alternative analyses are warranted and would help shape the development of the next set of distribution plans."

- This workgroup process reflects the "further discussion" ordered by the Commission

"The Commission sees a tremendous opportunity to inform policy and technical issues through pilot applications and encourages the development of additional NWAs by utilities."

- We will discuss our current plans for NWA pilots today

General Considerations for NWAs

- Maintaining distribution system reliability is paramount; to use an NWA as a distribution solution, we must know:
  - Will the NWA reliably work to solve the distribution issue?
  - Will the NWA be the least-cost solution?

- Fully-developed NWAs that can be regularly used off the shelf by distribution planners must therefore have an established
  - Cost
  - Deployment schedule
  - Reliability parameters

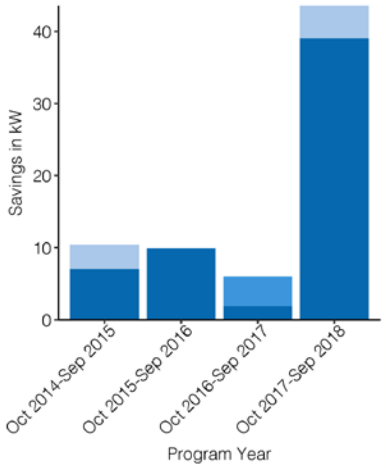
- Objective of pilots is to study how NWA programs and technologies operate in the field to establish confidence in reliability of NWAs

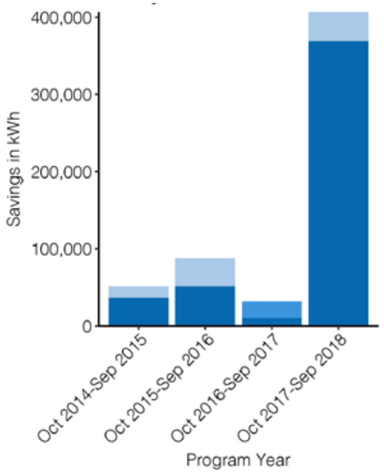
Pilot Review: Swartz Creek "Energy Savers Club"

Timeframe	• October 2017 – December 2018
Goal	• Demonstrate feasibility of using targeted Residential and C&I EE and Residential DR to reduce peak load on Swartz Creek substation to defer future capacity upgrade • Reduce peak load by 1.4 MW in 2018 • Defer $1.1M in future capital spending
Selection Criteria	• Distribution system upgrade expected based on projected load growth • Expected upgrade need at least 2 to 3 years out • Deferrable upgrade cost of at least $1 million
Approach	• All customers of all classes in Swartz Creek zip code invited to participate • Outreach educated and encouraged customers to save energy and money through EE and DR programs - Public outreach events - Energy Ambassador-led outreach - Advertising: radio, billboards, postcards, mailings • Bonus incentives offered to targeted customers for enrolling at certain stages in program

Pilot Review: Swartz Creek "Energy Savers Club"

- Results
  - Total demand reductions <u>due to EE programs</u> was ~795 kW in City of Swartz Creek, ~363 kW on Swartz Creek substation
  - Residential demand reductions <u>due to EE and DR programs</u> at key times of the year:
    - Peak demand day of 2018 for Swartz Creek substation: 10.4 kW
    - Peak demand hour of 2018 for MISO system: 37.2 kW
    - Peak MISO LMP hour of 2018: 63.7 kWh *in reduced energy usage*
  - Over the pilot period, C&I customers saw reductions in both demand and total usage, but C&I DR was not used





Pilot Review: Swartz Creek "Energy Savers Club"

- Lessons Learned
  - Residential customers – and substations serving predominantly residential customers – do not always peak on weekdays when DR events are most easily called; Swartz Creek substation had annual peak on a Sunday
    - Greater presence of C&I in load profile could address this
  - Offering bonus incentives clearly increases participation
  - Marketing must be targeted; direct customer contact is more effective than general broadcast advertising
  - Direct outreach by Company is helpful, particularly with C&I customers; Company representatives can guide them through the options and process

Pilot: Four Mile substation

Timeframe	• Quick launch August 2019 • Pilot to run through mid-2021, evaluating 2020 and 2021 summer seasons
Goal	• Continue studying leveraging targeted EE an DR can be leveraged to address distribution capacity needs, building on lessons learned from Swartz Creek • Reduce peak load by 0.5 MW • Defer $2.5M-$3M in future capital spending
Selection Criteria	**Primary** • Estimated Load Relief Needed 5-20% • Upgrade Cost $1M-$3M • Project need date 3-5 years out **Secondary** • DSCADA available • % Res Load - Maximum 40% • Review of historical EE and DR participation and high propensity for DER adoption

Pilot: Four Mile substation

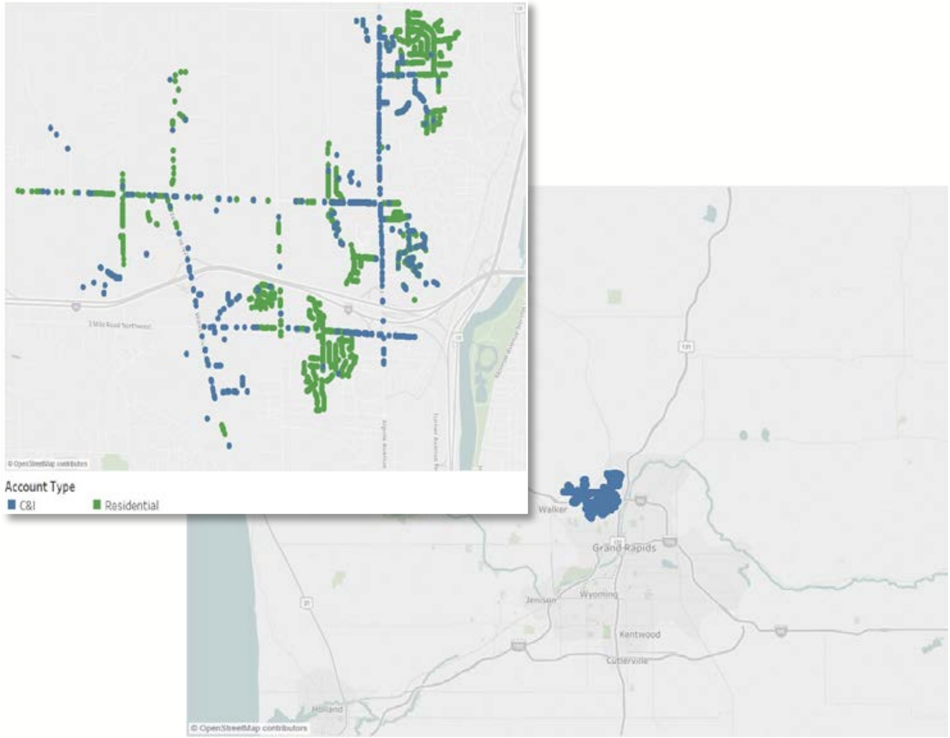
Assessment of Four Mile against selection criteria:

Criterion	Target Range	Four Mile
Load relief needed	5%-20%	10%
Deferrable project cost	$1M-$3M	$2.5M-$3M
Expected upgrade need	3-5 years out	2023-2024
DSCADA available	Yes	Yes
Residential load share	≤40%	18%

Pilot: Four Mile substation

- Location: Four Mile substation in northwest Grand Rapids; mix of Residential and C&I customers

Load Profile		
	Swartz Creek	Four Mile
Residential Customers	3,800	3,500
C&I Customers	300	750
Residential Load Share	63%	18%
C&I Load Share	37%	82%



Pilot: Four Mile substation

- Incorporating lessons learned from Swartz Creek:
  - Increased (doubled or tripled) financial incentives up front for the Quick Launch
    - C&I customers to receive up to $1,000 each for air conditioning, refrigeration, and lighting programs
    - Residential customers to received increased amounts for various programs

Residential Bonus Incentives		
Measure	**Typical Incentive**	**NWS Total Incentive**
HVAC- 14.5-14.99 SEER	$50	$100
HVAC- 15.0-15.99 SEER	$150	$300
HVAC- 16.0-16.99 SEER	$200	$400
HVAC- 17.0- 18.99 SEER	$400	$800
HVAC- 19.0-20.99 SEER	$450	$900
HVAC- 21.0 SEER or Higher	$500	$1,000
HVAC- AC Tune-up	$50	$150
AC Peak Cycling	$25	$50
Appliance Recycling	$50	$75

  - Adding C&I DR as an option during full roll-out
  - More targeted advertising plan
  - More direct engagement with customers instead of community events

Pilot: Four Mile substation

- More focus on direct advertising to targeted customers
  - Emails, postcards, and mailings to residential customers on key programs (special emphases on bonus incentives)
  - Mailings to C&I customers

- Increased engagement with C&I customers
  - Company's Local Affairs Manager to identify and meet with customers on substation
  - LAM and C&I account managers to educate key trade allies

Additional NWA Efforts

Improved **capability and tools** to use NWAs for distribution planning

- Consumers Energy is partnering with EPRI in an effort to develop new software to analyze NWA suitability of circuits
- EPRI to test software on set of Consumers Energy circuits
- Software would help planners determine best locations to deploy NWAs

New programs and technologies – potential future NWA applications

- Battery Storage
- Behind-the-Meter Residential Storage
- Bring Your Own Device
- Backup Generators
- Customized Load Control Switch

AFTERNOON BREAK
2:25 – 2:40 PM

Five Year Distribution Planning Stakeholder Meeting

Michigan Public Service Commission
Lake Superior Hearing Room
August 14, 2019

MPSC
Michigan Public Service Commission

Meeting Agenda

9:00 a.m.	Welcome & Introduction	Patrick Hudson, Manager, Smart Grid Section
9:10 a.m.	Cost Benefit Analysis for Utility-Facing Grid Modernization Investments	Tim Woolf, Synapse Energy Economics *Work supported by the U.S. Department of Energy for Berkeley Lab*
10:10 a.m.	Break	
10:20 a.m.	Cost Benefit Guidelines, Risk Informed Decision Support, and Distribution Performance Metrics	Paul Alvarez and Dennis Stephens, ABATE
10:50 a.m.	Regulatory Innovations in the Treatment of Operating Expenses	Ryan Katofsky, Advanced Energy Economy
11:20 a.m.	Break	
11:30 p.m.	Utility Pilot Programs and Funding	MPSC Staff
11:35 a.m.	Indiana Michigan Power: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Marc Lewis, Paul Loeffelman, David Isaacson and Subin Matthew Indiana Michigan Power
12:05 a.m.	Q&A for I&M Pilot Proposals	
12:15 p.m.	Lunch (local restaurants available)	
1:15 p.m.	Consumers Energy: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Doug Chapel and Don Lynd Consumers Energy
2:15 p.m.	Q&A for Consumers Energy Pilot Proposals	
2:25 p.m.	Break	
2:40 p.m.	DTE: Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots	Yujia Zhou and Richard Mueller DTE
3:40 p.m.	Q&A for DTE Pilot Proposals	
3:50 p.m.	Closing Statements & Docket Responses	MPSC Staff
4:00 p.m.	Adjourn	

Five-Year Distribution Plan

Pilot Experience & Proposed Non-Wire Alternative and Hosting Capacity Pilots

August 14, 2019

Agenda

- Context
- Non-Wire Alternatives (NWA) Pilot Proposals
  - Range of Options
  - Methodology
  - Key Considerations
- Hosting Capacity Pilot Proposals
  - Overview of the Hosting Capacity Analysis
  - Range of Options
  - Key Considerations

DTE submitted its first Distribution Operations Five-Year Investment and Maintenance Plan in January 2018

DTE Electric Company

Distribution Operations Five-Year (2018-2022)

Investment and Maintenance Plan

Final Report

January 31, 2018

MPSC Case No. U-18014

Strategic Pillars

Tree Trimming

Infrastructure Redesign

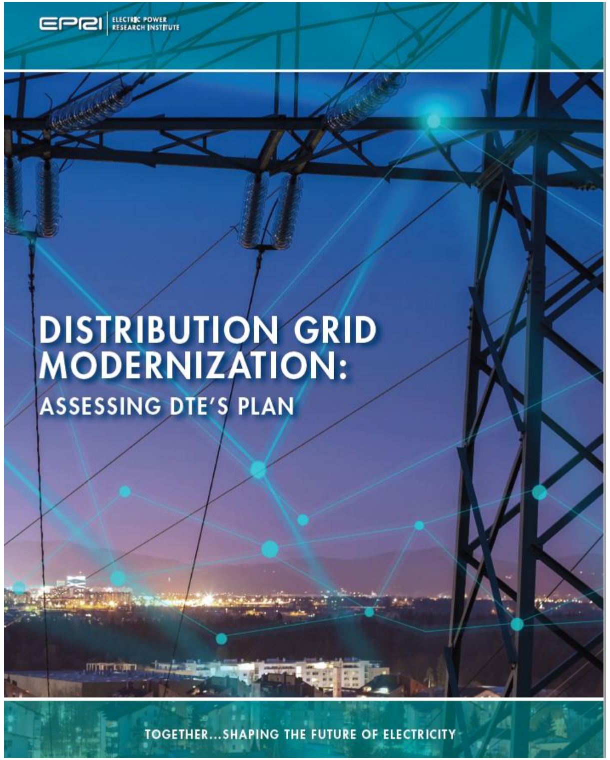
Infrastructure Resilience and Hardening

Technology and Automation

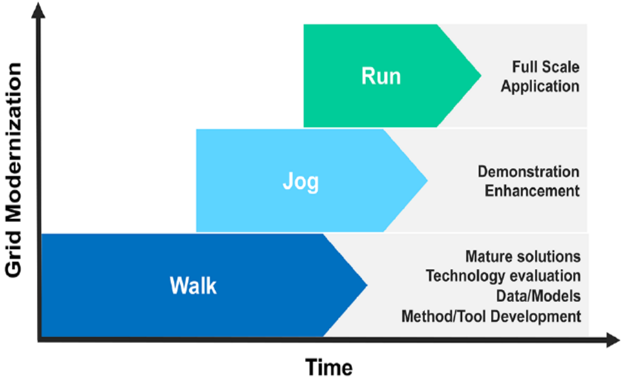
Desired Outcomes

- Mitigate Risk
- Improve Reliability
- Reduce Cost

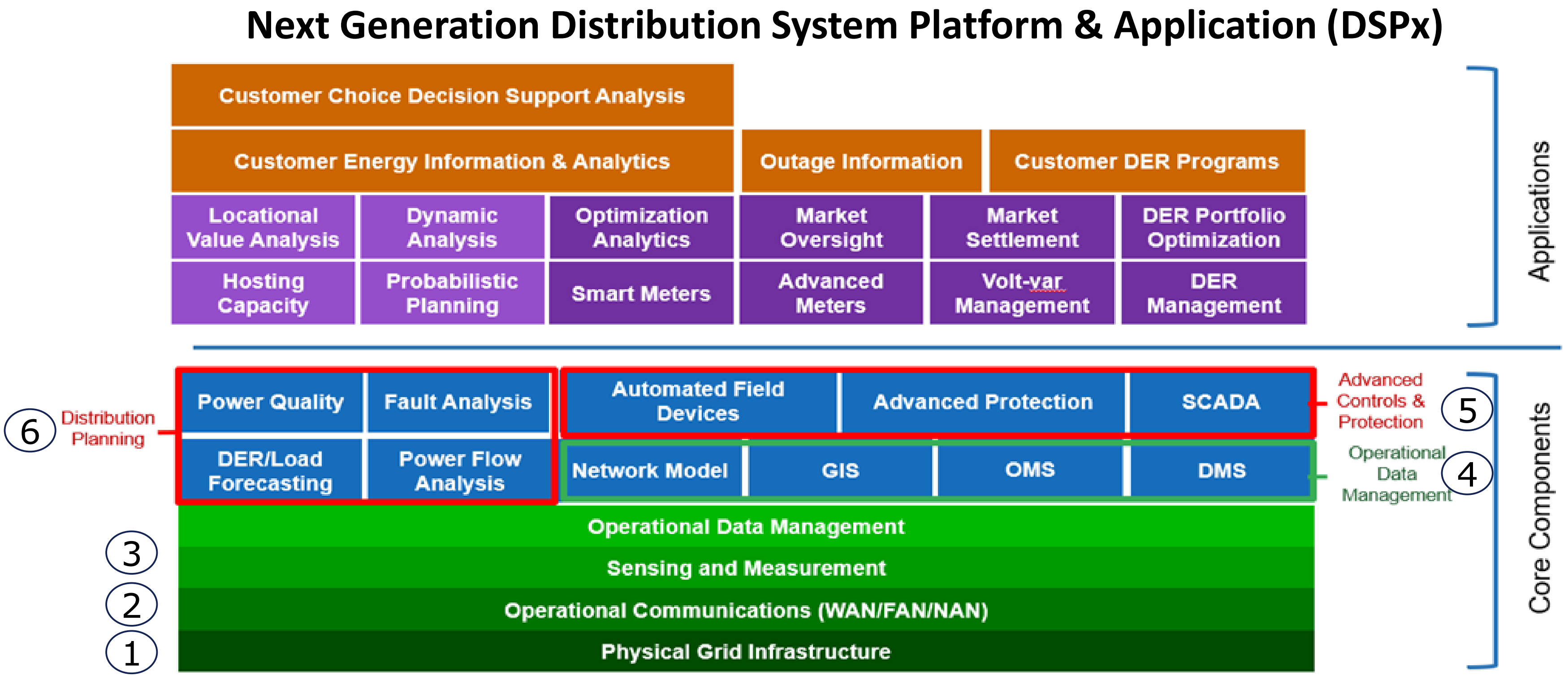
To prepare for the next submission, DTE engaged EPRI to assess how the Company's current investment plan aligns with the requirements of a modern grid



- Each distribution system has a unique starting point, set of drivers and objectives, and policy considerations
- A deliberate, incremental approach to implementation, referred to as "Walk-Jog-Run" is useful to guide modernization decisions

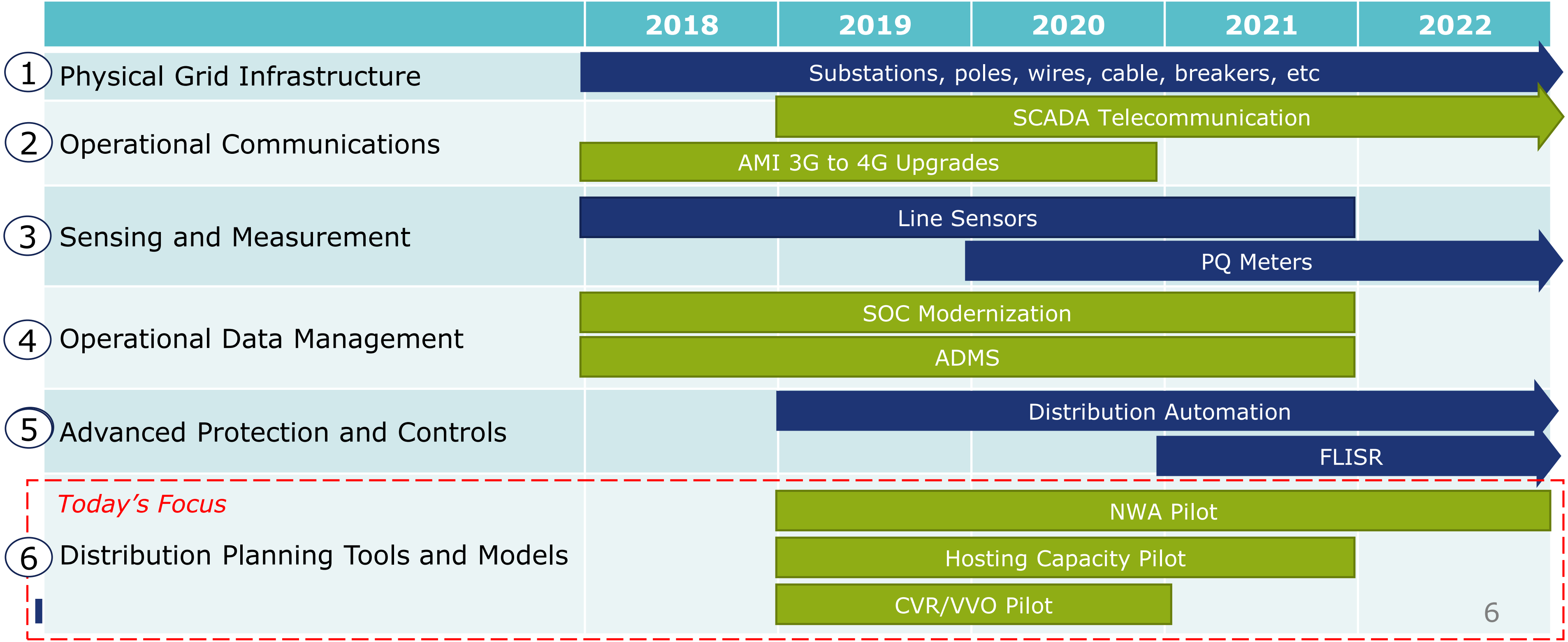


DOE's DSPx framework provides a recognized industry reference for aligning and assessing utility grid modernization plans



DTE has been investing in the core components under the DSPx frameworks and exploring pilots for advanced applications

Progression and Timing of DTE Grid Modernization Investments



Agenda

- Context
- Non-Wire Alternatives (NWAs) Pilot Proposals
  - Range of Options
  - Methodology and Framework
  - Key Considerations
- Hosting Capacity Pilot Proposals
  - Overview of the Hosting Capacity Analysis
  - Range of Options
  - Key Considerations

Energy waste reduction (Energy Efficiency), demand response and energy storage are the three primary technologies being explored by DTE

Energy Waste Reduction (Energy Efficiency)

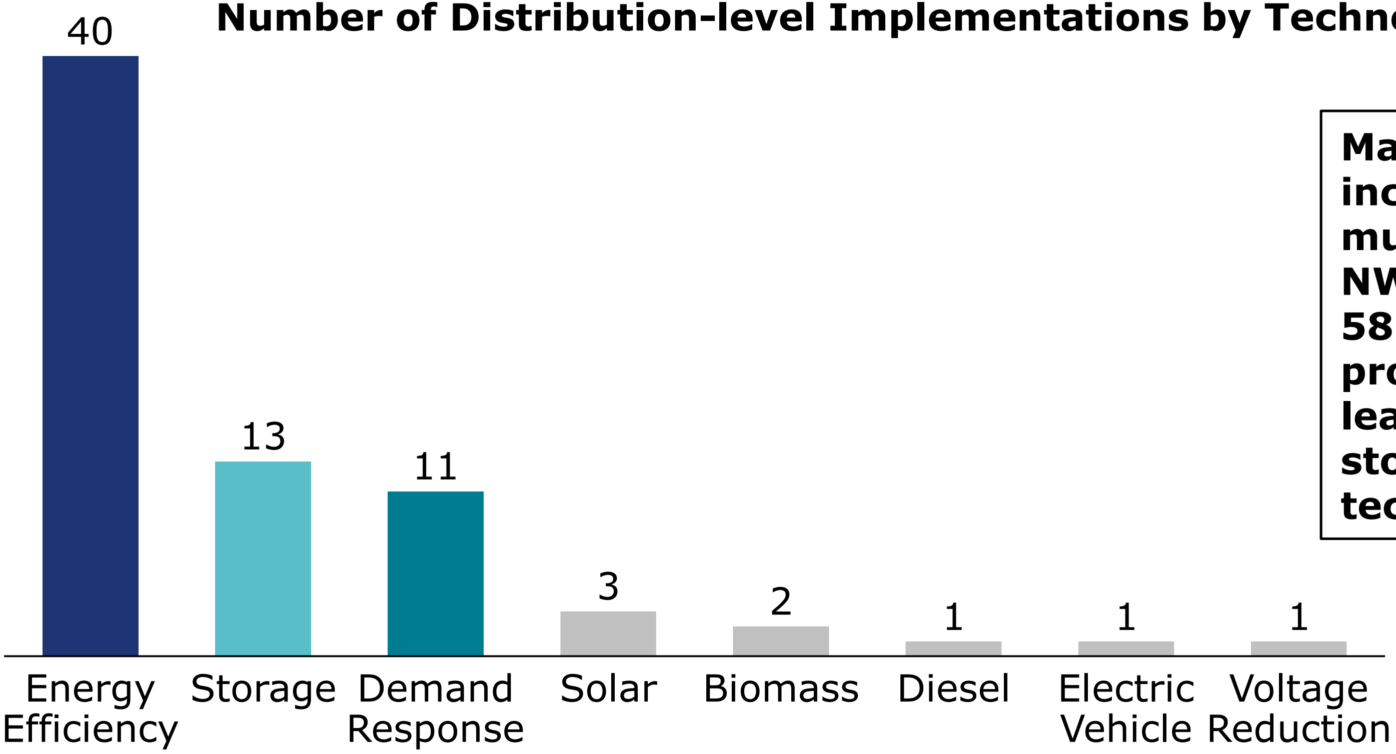
Demand Response

Energy Storage

- DTE has been utilizing many low cost options to address system needs and defer major grid investments in the past. Examples include circuit load transfer, phase balancing, installation of capacitors and regulators
- NWAs can be one additional toolkit used by DTE to address system needs

The primary technology choices are consistent with the rest of the industry

Number of Distribution-level Implementations by Technology[1]

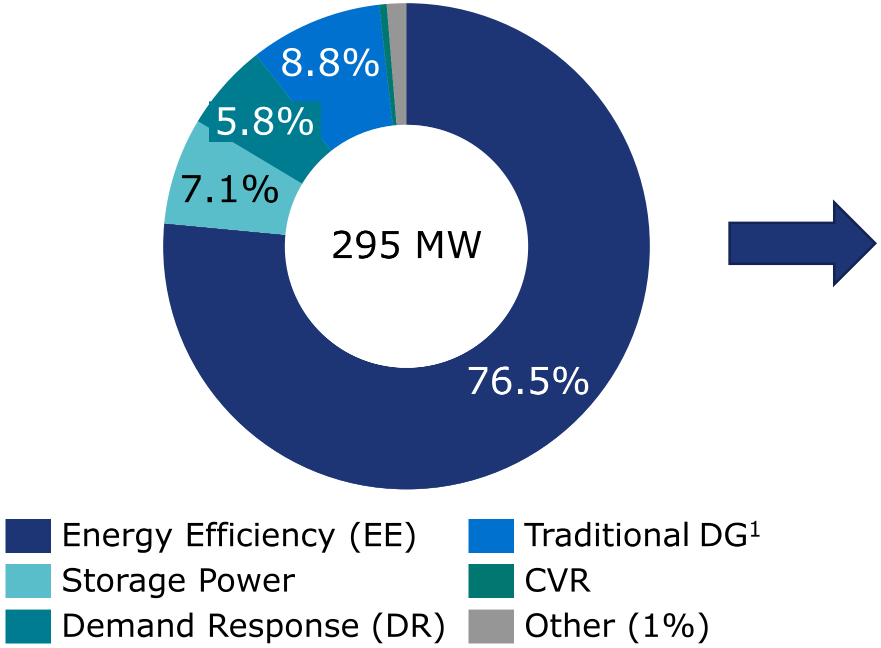


Many projects incorporated multiple types of NWAs, but 56 of the 58 distribution projects included at least 1 of EE, DR, or storage technologies.[1]

Munoz-Alvarez, Daniel. "Non-Wires Alternatives Project: Emerging Utility Revenue Sources for the Distributed Energy Market." GTM Research June 2017

Although energy efficiency provides the majority of NWA capacity, it can be sometimes difficult to enroll the full capacity needed to defer or displace traditional investments

Distribution-level NWA Capacity by Technology[2]



EE projects not enrolled at full capacity[3]

Kenmore: 1.2MW load relief by 2018. Latest published data shows 975kW capacity achieved. National Grid is now proposing 2MW of battery storage

CenHub Peak Perks – Fishkill/Shenandoah: 5MW load reduction required by 2018. Data released July 31, 2018 shows 3.87MW of capacity achieved

Pomona: 2 MW load relief required by 2020. As of 2017, load growth outgrew projections and required traditional wired investment

DTE

1. Traditional DG is made up of 1 project with a natural gas and diesel generator
2. "Non-Wires Alternatives Project: Emerging Utility Revenue Sources for the Distributed Energy Market." GTM Research June 2017
3. Per latest available filings by utilities on NWA status

DTE is in the process of exploring multiple NWA pilots

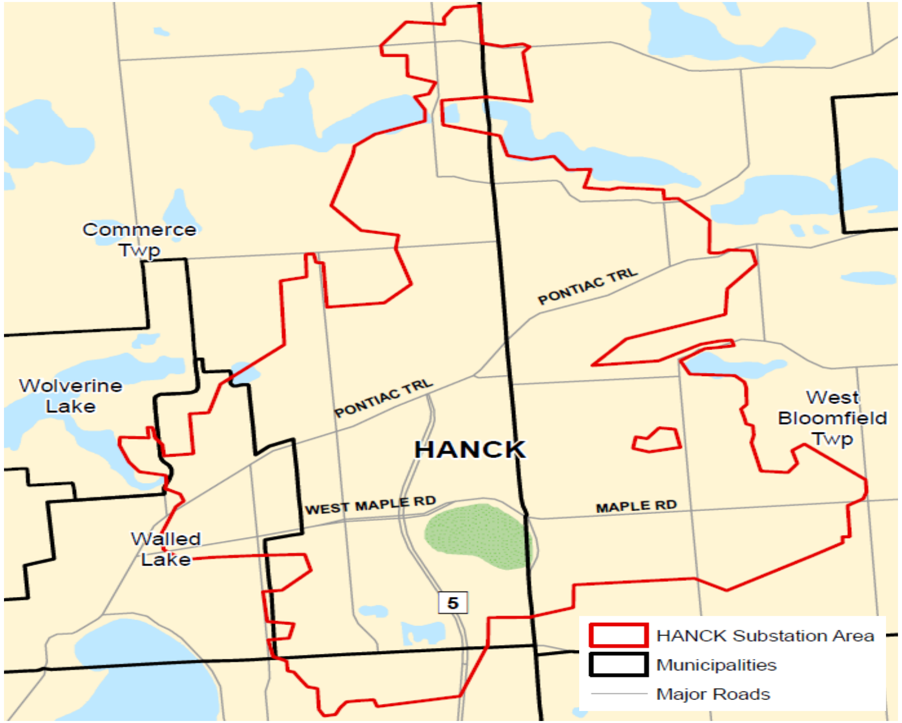
NWA Use Cases and DTE pilots

Use Case	Description
Geo-Targeted Load Relief	• Provide geo-targeted load relief as alternatives to traditional investments • DTE Pilots: EWR NWA Phases 1 (Hancock) and 2
Power Quality Support	• Help integrate intermittent resources into distribution system • DTE Pilot: Energy storage for O'Shea Solar Park
Behind-the-meter Load Management	• Pair energy storage with EV charging station to reduce infrastructure investments • DTE Pilot: EV+ Storage Project
Operational Support	• Provide operational supports to various applications at different locations of the system (e.g., peak shaving, system maintenance, outage restoration) • DTE Pilot: Battery Trailer

The Hancock NWA pilot is in execution stage with additional measures being launched in August

Geo-Targeted Load Relief

Hancock Substation Area



Project:

- Utilize EWR and DR measures to achieve load reduction in Hancock substation area, with 28% of load reduction from Residential and 72% from Commercial sectors

Status:

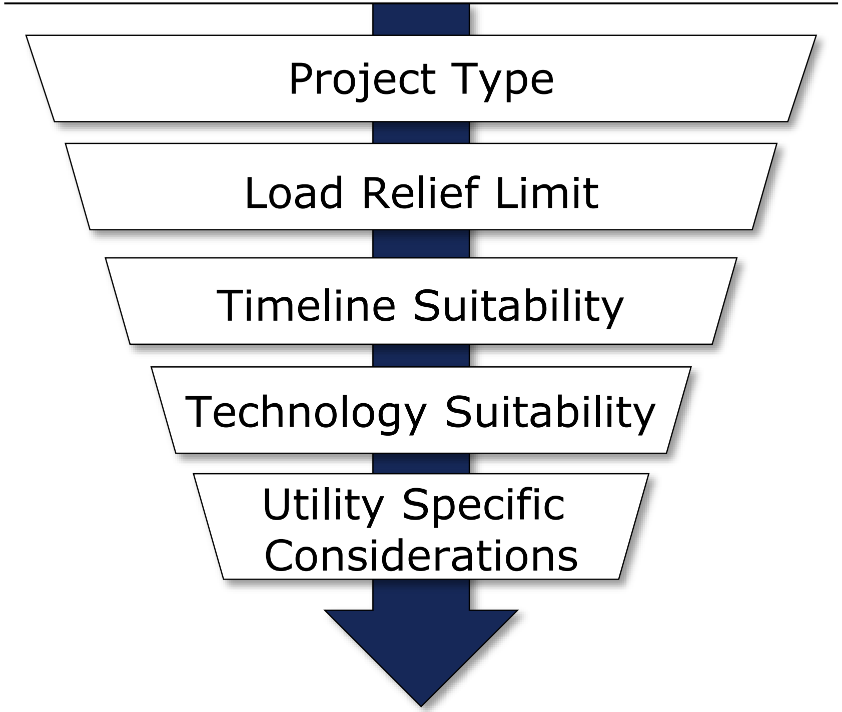
- A total of 56 priority measures were analyzed to form a supply curve and prioritized for field execution
- Residential HVAC program has reached 31% of load reduction target to date
- Commercial Direct Install Lighting is gearing up for launch as a new market offering
- Project has achieved 4% of overall load reduction target today

DTE

Meanwhile, DTE has been developing the framework with key stakeholders and industry experts to select the site for next phase of geo-targeted NWA pilot

Geo-Targeted Load Relief

Screening Criteria



Technology Suitability:

- Number of Residential and C&I Customers
- Configuration and space availability of the substation

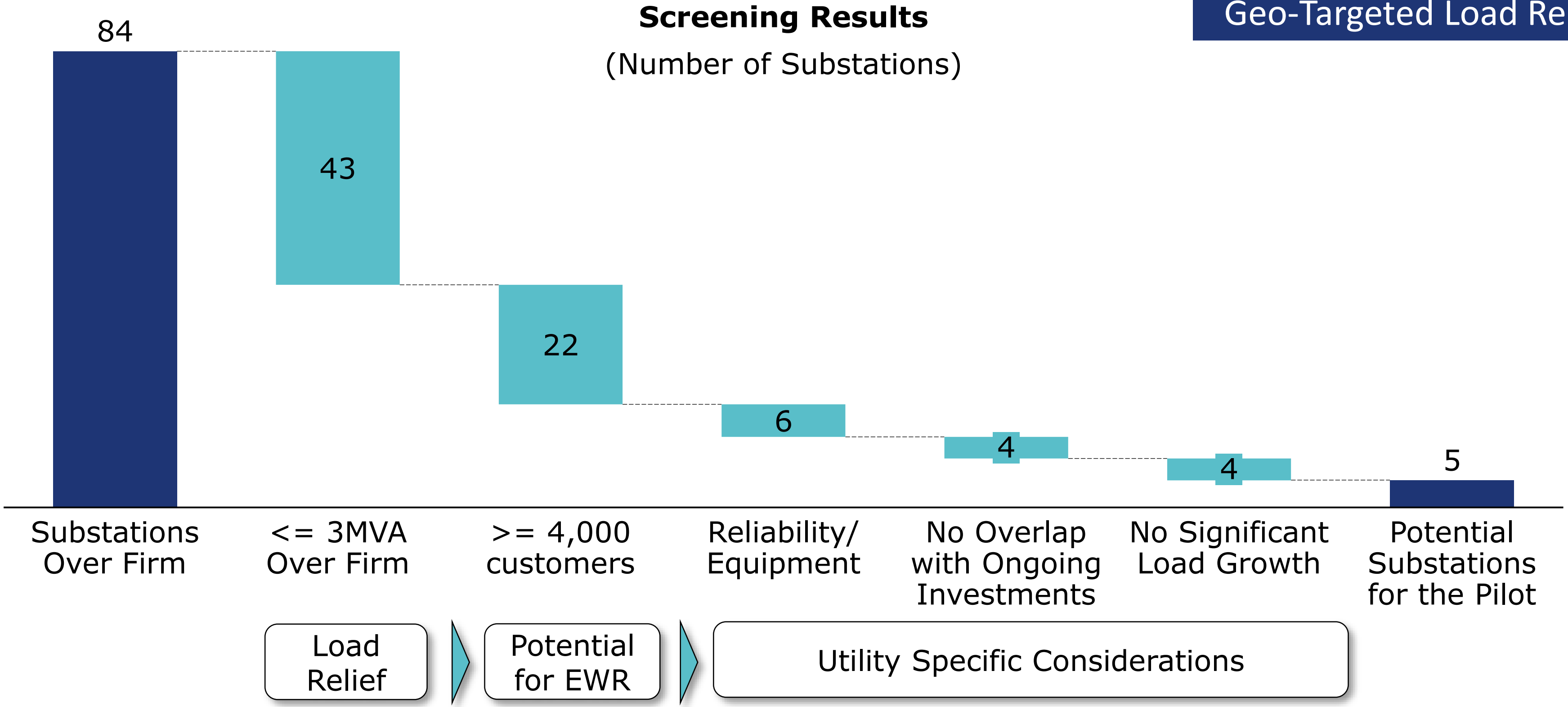
Utility Specific Considerations:

- Reliability and equipment conditions
- Overlap with ongoing projects
- Prospect of major new business customers

DTE

The selection criteria was applied to all substation areas in DTE system that has capacity constraints based on 2018 Area Load Analysis results

Geo-Targeted Load Relief



DTE

Five potential sites across DTE’s service territory are being considered for the next phase of geo-targeted NWA pilot

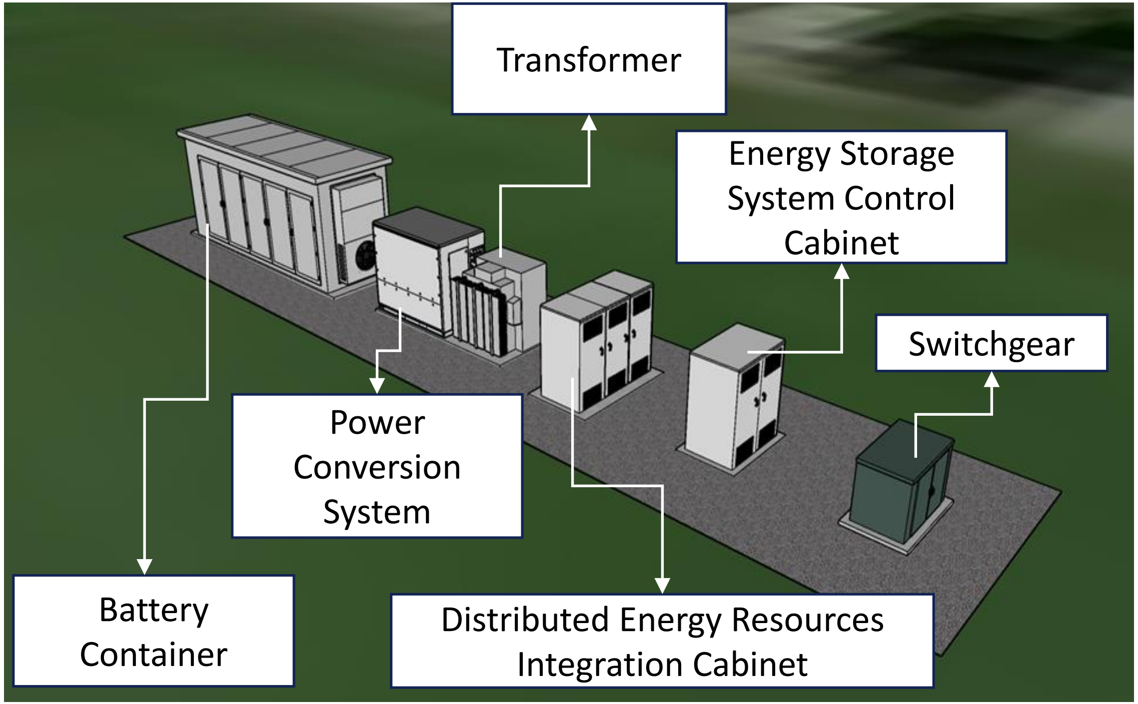
Geo-Targeted Load Relief

Phase 2 of the Geo-Targeted NWA Pilot

- Projects are expected to utilize EWR, DR, and energy storage to achieve load relief in a substation area
- The team is performing detailed analysis to select one substation for phase 2 of the geo-targeted NWA pilot
- Pilot is expected to start early 2020

The battery storage at the O'Shea solar site will help DTE test use case of batteries as voltage support to integrate intermittent generation resources

Power Quality Support



O'Shea Battery Project

Project:

- Install approximately 1 MW x 1 MWh stationary energy storage facility co-located at the 2 MW O'Shea solar site in Detroit

Status:

- Majority of the construction is expected to be complete in 2019 with commissioning in early 2020

Behind-the-meter battery storage is paired with EV fast charging to help reduce infrastructure investments

Behind-the-meter Load Management

Project:
- Install a ~250 kW battery which will supply power to 2-60 kW EV fast chargers

Status:
- Majority of the construction and procurement to be complete in 2019 with commissioning in early 2020

DTE is in the process of procuring a battery storage trailer to provide various operational support at different system locations

Operational Support

Mobile Battery Trailer

Project:
- Procure and construct a 1 MW x 4 MWh mobile battery system

Status:
- Procuring equipment in Summer 2019
- Manufacturing and testing by December 2019
- Final delivery in January 2020

The NWA pilots will be helpful in addressing a number of key questions related to the technology deployments

- Does the non-wire alternative make economic sense when compared to traditional investments?

- What is our ability to enroll customers in various EWR and DR program offerings?

- What is the protocol or process in dispatching the same distributed resources for generation, transmission and distribution purposes, given conflicts may arise in real-time operations between MISO and distribution utilities?

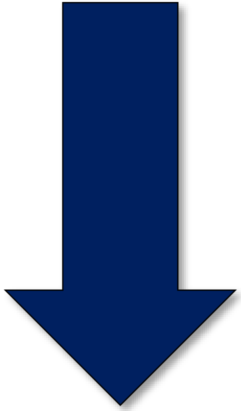
- What are the desired construction, operation and maintenance standards for electric storage to reduce risk of fires?

Agenda

- Context
- Non-Wire Alternatives (NWA) Pilot Proposals
  - Range of Options
  - Methodology
  - Key Considerations
- Hosting Capacity Pilot Proposals
  - Overview of the Hosting Capacity Analysis
  - Range of Options
  - Key Considerations

Hosting capacity analysis can be performed in phases with increasing levels of detail

- Lower spatial accuracy
- Lower data accuracy requirements
- Lower cost
- Lower level of effort



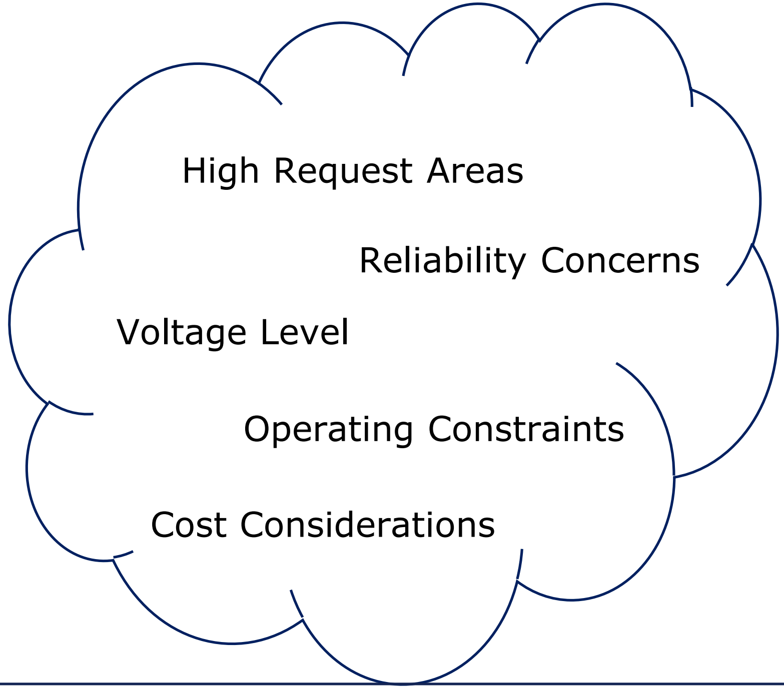
- Higher spatial accuracy
- Higher data accuracy requirements
- Higher cost
- Higher level of effort

Levels of Hosting Capacity

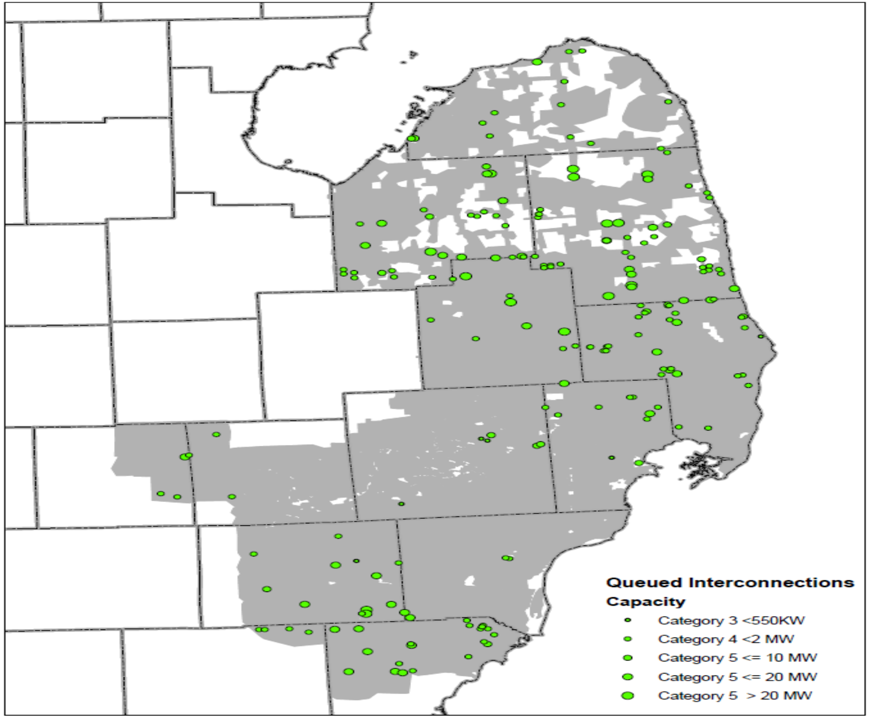
- **Area maps and rules of thumb** – high level assessments generalized to a geographic area
- **Red circuit maps** – locations identified that would be unlikely to support projects of certain size or where development is not practical
- **Circuit level hosting capacity** – based on constraints at start of circuit, indicates maximum circuit can sustain without major upgrades
- **Zone level hosting capacity** – isolated to specific zones on a circuit, such as protection or operating point
- **Full hosting capacity** – line by line assessment of circuit utilizing power flow analysis with a high degree of locational accuracy

DTE is in the process of developing criteria to identify a targeted area for performing a hosting capacity analysis pilot

DTE is using industry benchmarking in working towards development of criteria



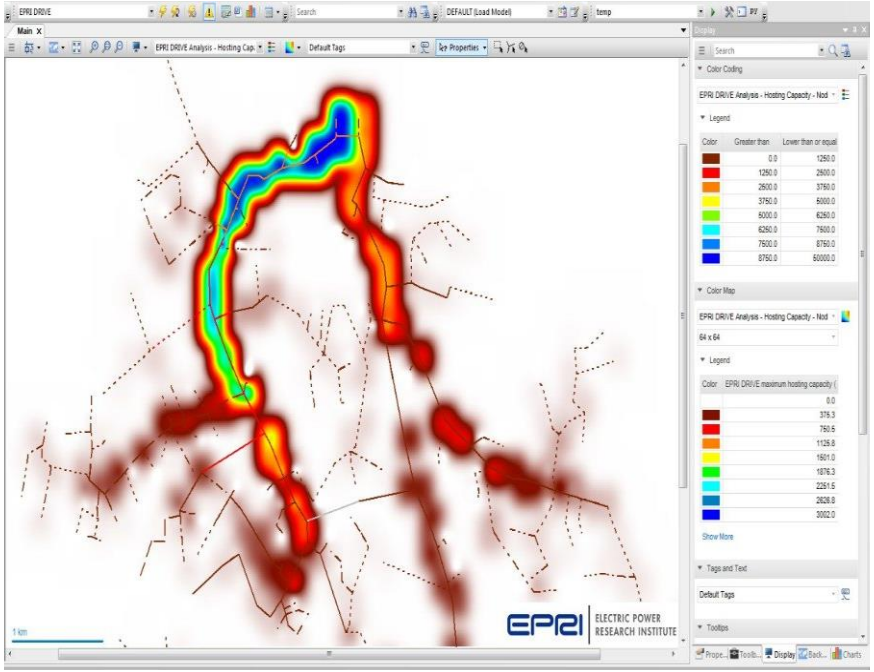
Interconnection Requests



DTE

The pilot will identify the hosting capacity of the target geographic area by utilizing industry analytical tools

Illustrative Output from EPRI DRIVE



<u>Approach:</u>

- Analyze a targeted geographic area with industry analytical tools to determine minimum and maximum DER capacity that can be accommodated

<u>Goals:</u>

- Evaluate the capability of the target area in interconnecting DER resources
- Evaluate time, costs and resources taken to perform hosting capacity on DTE's electrical system
- Assess the accuracy and ability of the tools to make a more accurate assessment than less intensive methods such as rules of thumb

The hosting capacity pilot will help in addressing key questions related to the study and associated outputs

- What are the costs associated with the hosting capacity study?
- How is the value of the study assessed, and what value will hosting capacity bring to DTE’s customers?
- How do the results differ by type of DER resource?
- How do the industry analytical tools address system complexity such as DTE’s networked systems?