Distribution Planning Stakeholder Meeting #3

Michigan Public Service Commission
Lake Michigan Hearing Room
September 18, 2019
9 AM – 4 PM

MPSC
Michigan Public Service Commission

Meeting Agenda

9:00 a.m.	Welcome & Introduction	Patrick Hudson, Manager, Smart Grid Section
9:10 a.m.	Hosting Capacity Analyses	Yochi Zakai, IREC
9:40 a.m.	Break	
9:50 a.m.	Tying it All Together - A Vision for Integrated Distribution Planning	Curt Volkmann, GridLab
10:20 a.m.	Break	
10:30 p.m.	Reliability and Resilience Metrics, and Reliability Value-Based Planning	Joseph Eto, Lawrence Berkeley National Lab
12:00 p.m.	Lunch (local restaurants available)	
1:15 p.m.	Consumers Energy: Response to Pilot Proposal Comments	Consumers Energy
1:30 p.m.	DTE: Response to Pilot Proposal Comments	DTE
1:45 p.m.	I&M: Response to Pilot Proposal Comments	Indiana Michigan Power
2:00 p.m.	Michigan Utility Reliability Reports	Joseph Eto, Lawrence Berkeley National Lab
2:45 p.m.	Break	
3:00 p.m.	Stakeholder Discussion: Resiliency in Michigan – What Matters and How Should it be Valued?	Facilitator: Joseph Eto Lawrence Berkeley National Lab
3:50 p.m.	Closing Statements & Docket Responses	MPSC Staff
4:00 p.m.	Adjourn	

Distribution Planning Recap

- June 27, 2019
  - Modern Distribution Planning
  - Load & DER Forecasting
  - Non-Wires Alternatives
  - Hosting Capacity
  - Cost Benefit Analysis
- August 14, 2019
  - Cost Benefit Analysis
  - Risk Informed Decision Making/Performance Metrics
  - Regulatory Innovations with Operating Expenses
  - Preliminary Look at Utility Pilots
- September 18, 2018
- October 16, 2019
- November 19, 2019

Update from Commission Order

- ***Commission order in U-20147 on Sept. 11, 2019 – tie-in to the State Energy Assessment***
  – The title “Five-Year Distribution Plans” has been replaced with “Distribution Investment and Maintenance Plans”
  – SCHEDULE ADJUSTMENT: staff report filing in the docket: April 1, 2010
  – SCHEDULE ADJUSTMENT: Alignment of IRP’s with Distribution Plans: next Distribution Plan filing for DTE & Consumers Energy - moved from June 30, 2020 to June 30, 2021
  – Additional clarification for I&M (referencing the criteria in the Nov. 21, 2018 order, filing date set for June 30, 2021)
  – Emphasis on resiliency in future utility distribution plans

Hosting Capacity Analyses (HCA)

Yochi Zakai
Shute, Mihaly & Weinberger, LLP
Attorney for IREC

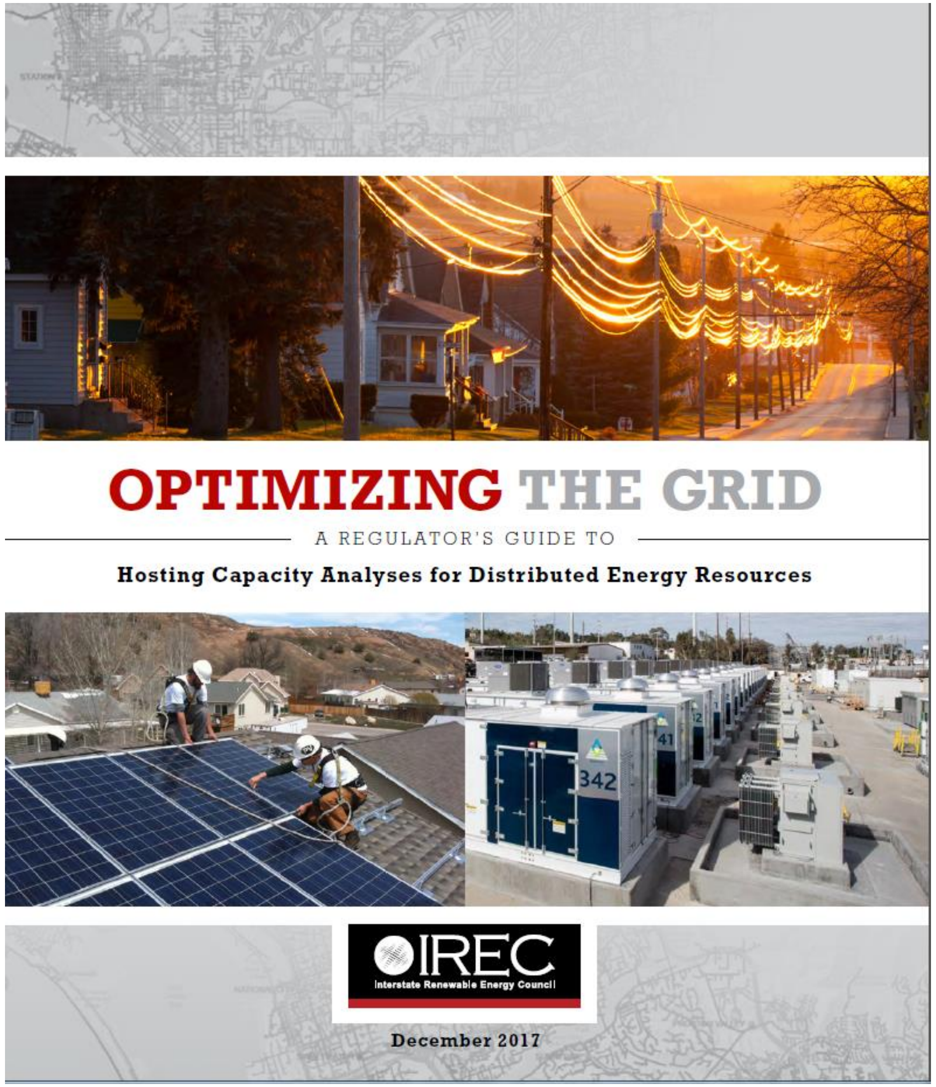
September 18, 2018

Five-Year Distribution Planning Stakeholder Meeting
Michigan Public Service Commission

Today's discussion

- What are the key process steps to develop a hosting capacity analysis?
  - What are the use cases for hosting capacity analysis?
  - What are some criteria to guide implementation?
  - What methodologies are available?
- Case Study: Phased Implementation
- Conclusion:
  - IREC's Response to Proposed Pilots
  - IREC's Recommendations for Michigan: Phased Implementation
- Q&A

IREC



Free Downloads available at: www.irecusa.org/publications/

HCA Process Steps

- Establish a stakeholder process
- Select and define use cases
- Identify criteria to guide HCA implementation
- Select HCA methodology
- Perform analysis
- Validate results
- Share HCA data
- Track, Learn & Evolve

Case Study: Minnesota

The Xcel hosting capacity proceeding illustrates the drawbacks of performing the HCA analysis before establishing goals and a use case.

Concerns raised regarding: 1) accuracy of Xcel's methodology and 2) the usefulness of its results.

It remains to be seen whether the DRIVE tool can be tailored to meet the needs of the use cases ultimately selected.

Significant costs and delays could be avoided by beginning with the broader policy discussion.

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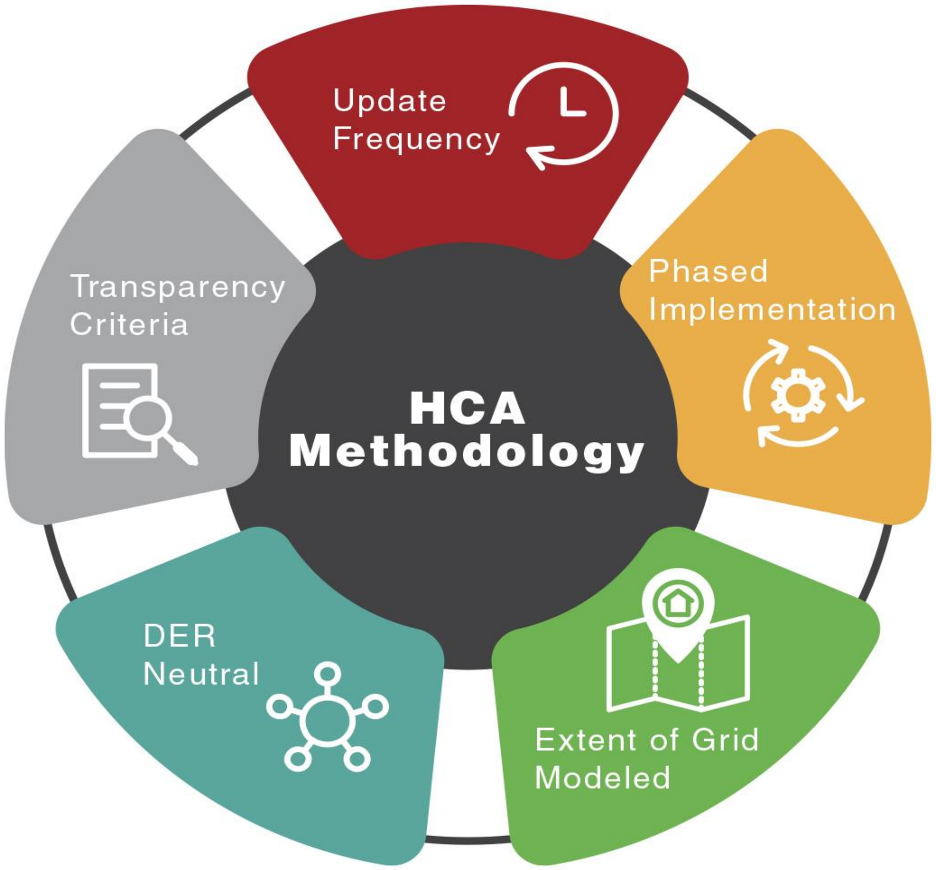
HCA Use Cases

Hosting Capacity Use Cases

Criteria to Guide Methodology



Select & Refine Methodology

- **Streamlined**
  - Fewer Computations
  - Insufficient accuracy for interconnection
- **DRIVE**
  - Replicable
  - Accuracy uncertain
- **Iterative**
  - Mimics a full power flow
  - Computational intensity
- **Stochastic**
  - Fewer Computations
  - Random/ Probabilistic

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Phased Implementation

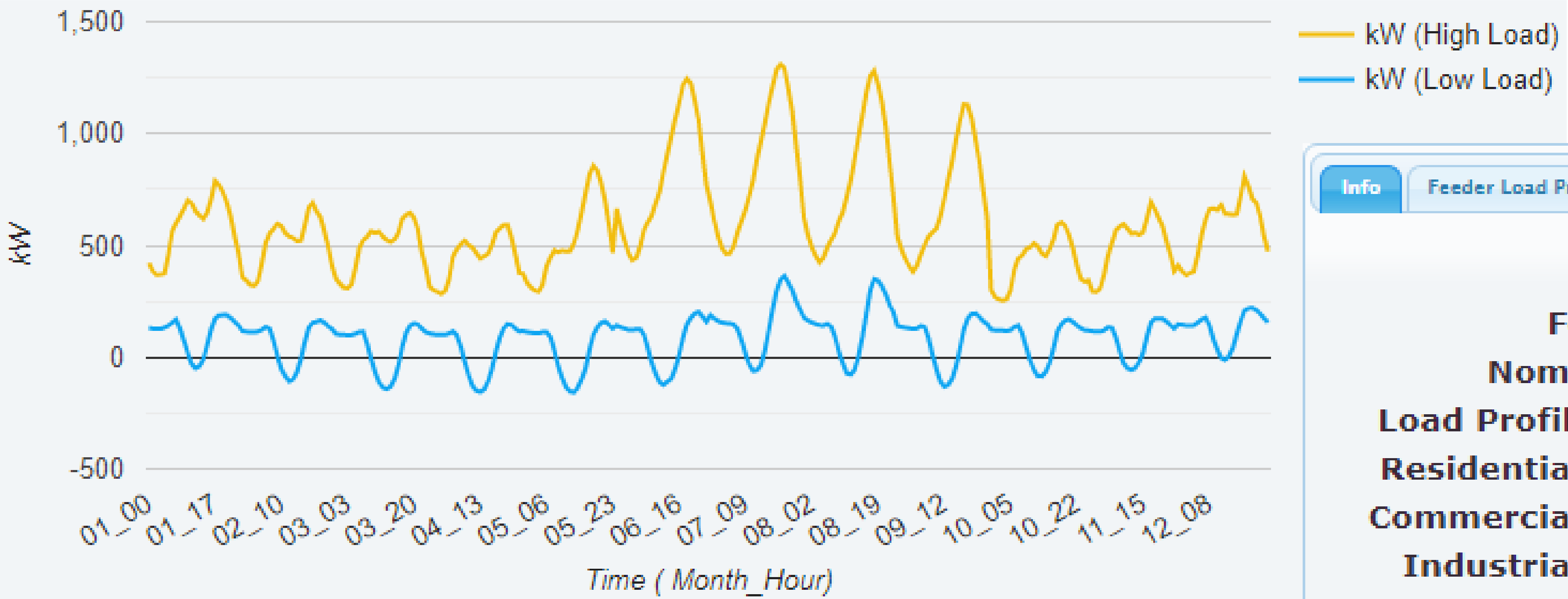
- Start by providing basic system information in a map and spreadsheet format.
- Provide utilities time to develop and clean up their GIS data to be accurate enough for use in an analysis that matches the Commission's selected use case.
- Prevents a utility from expending ratepayer funds on a pilot project using a methodology that the Commission and stakeholders have not vetted as sufficient to meet the needs of the selected use case.

Case Study: Phased Implementation

Phased Implementation: Feeder & Substation Data

WYANDOTTE 1105 (102911105)

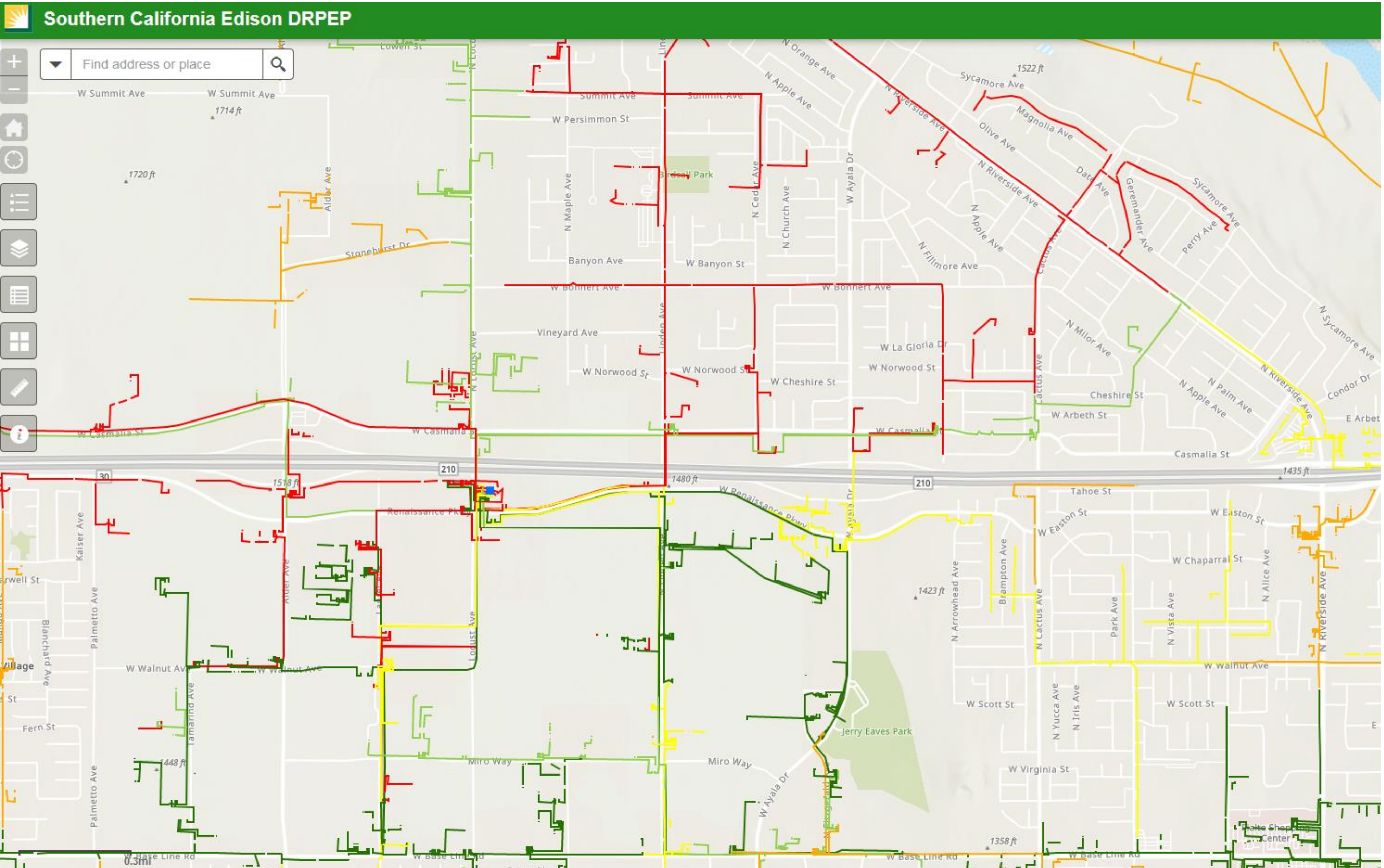
Info | Feeder Load Profile

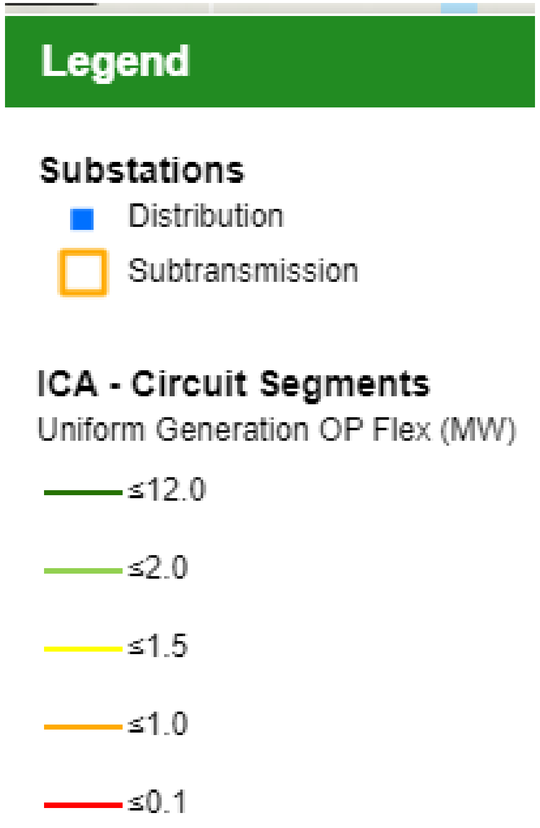


Info | Feeder Load Profile

Substation: OROVILLE
Feeder Name: OROVILLE 1104
Nominal Voltage: 12kV
Load Profile Redaction: No
Residential Customers: 1210
Commercial Customers: 131
Industrial Customers: 22
Agricultural Customers: 0
Other Customers: 3
Existing DG (kW): 1030
Queued DG (kW): 30
Total DG (kW): 1060

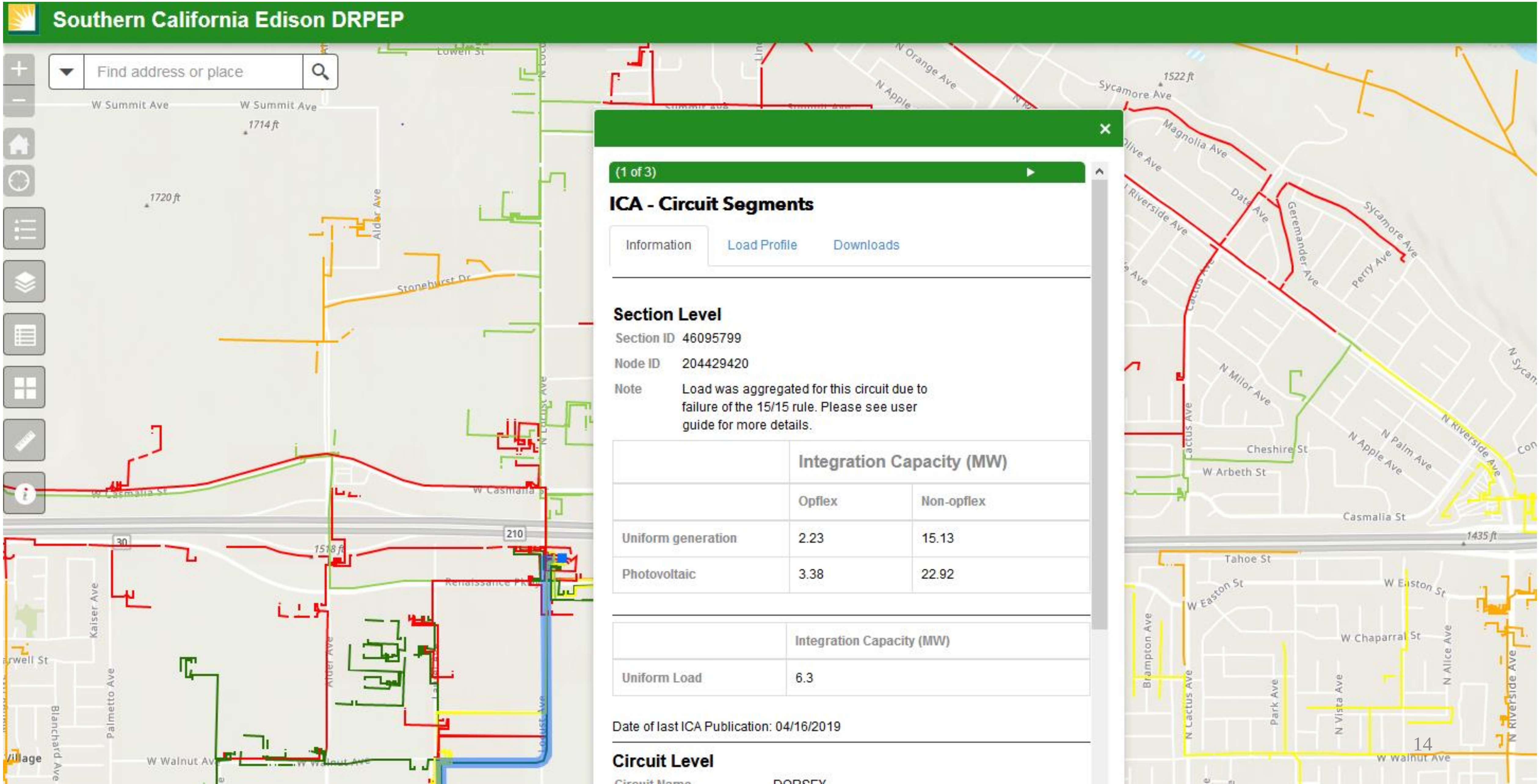
What does full deployment look like?



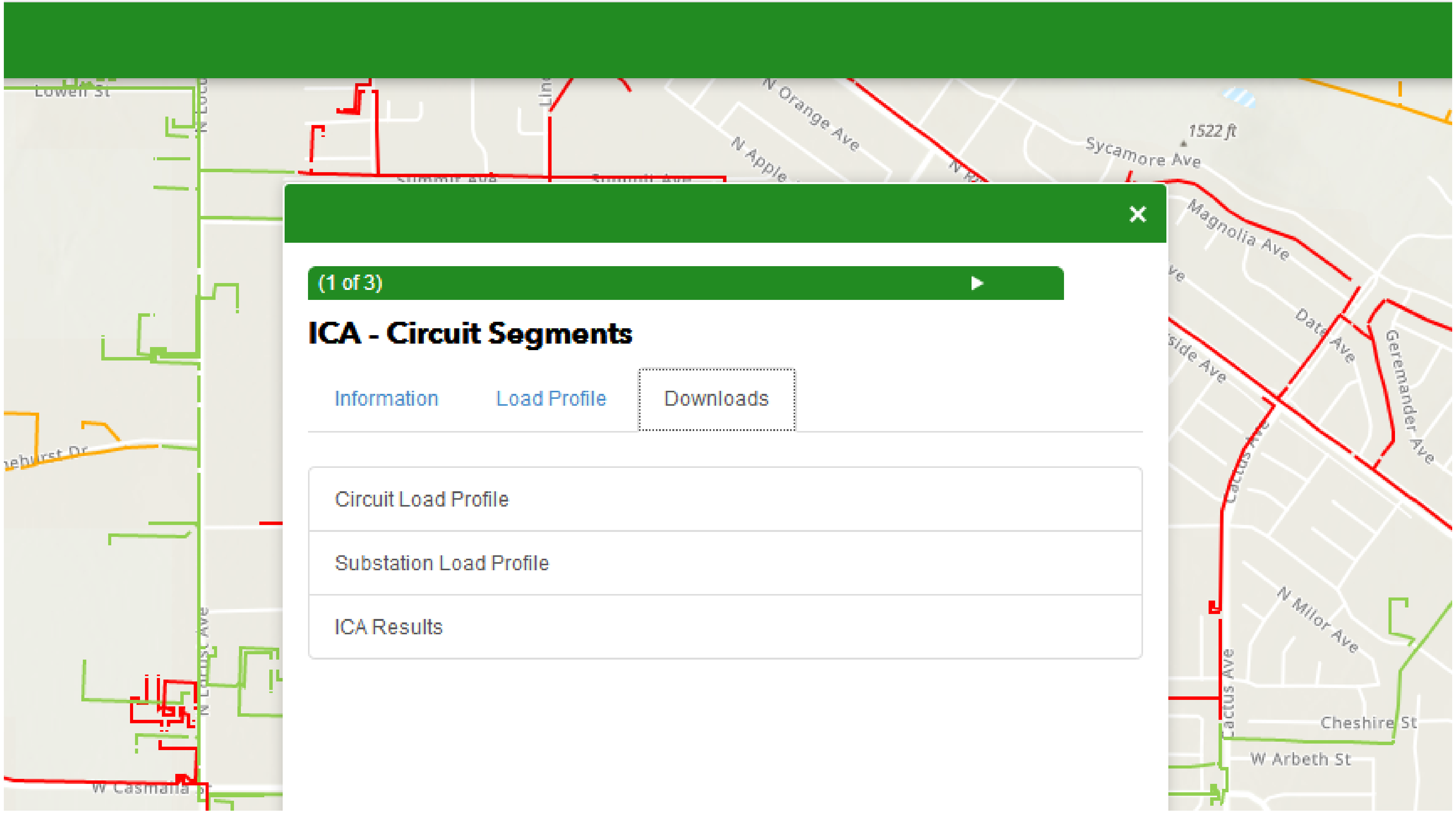


Available at: https://ltmdrpep.sce.com/drpep/

Circuit Segment Data



Data Download



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Hosting Capacity Results (Downloadable)

	Circuit Name	Node ID	Month	Hour	Load Profile Type	Uniform Generation (kW)	Solar PV (kW)	Thermal (kW)	SSV (kW)	Voltage Fluctuation (kW)	Protection (kW)
21	EDWIN	51008697	6	22	MIN	7784.1	31136.4	9626.2	12625	7784.1	20000
22	EDWIN	51008697	6	22	MAX	7547.8	30191.2	9490.4	14334	7547.8	20000
23	EDWIN	51008697	6	23	MIN	7764.3	31057.2	9610.7	12933	7764.3	20000
24	EDWIN	51008697	6	23	MAX	7546.2	30184.8	9465	14808	7546.2	20000
25	EDWIN	51008697	7	0	MAX	5798.3	23193.2	9724	5798.3	8062.9	20000
26	EDWIN	51008697	7	0	MIN	7888	31552	9684	13602	7888	20000
27	EDWIN	51008697	7	1	MIN	7899.7	31598.8	9685.8	13304	7899.7	20000
28	EDWIN	51008697	7	1	MAX	5655.4	22621.6	9720.8	5655.4	8096.3	20000
29	EDWIN	51008697	7	2	MAX	7867.9	31471.6	9683.9	12496	7867.9	20000

Uniform Load (kW)	Thermal Load (kW)	Volt Variation Load (kW)	SSV Load (kW)
6694.1	8645.49	6694.1	13021.4
6507.8	7323	6507.8	11518.6
6677.4	8752.74	6677.4	12813.5
[illegible]	[illegible]	[illegible]	[illegible]

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IREC's Response to Proposed HCA Pilots

- Indiana Michigan Power lacks AMI.
  - SCADA data can be used as an input to the HCA instead of AMI data.
- Consumers Energy proposes to create a "Solar Zone."
  - An HCA is intended to provide information about the system to inform customers and help them choose the best location for their projects.
  - If GIS data is not sufficiently accurate to perform system modeling, Consumers should prioritize cleaning up GIS data.
- DTE proposes to use the DRIVE tool
  - DRIVE's limitations are documented in NY, MN and CA.
  - Better to wait for the Commission to select a use case and methodology

IREC

Conclusion:

Know Where You Are and Where You're Going

- ✓ Establish a stakeholder process
- ➢ **Select and define use cases**
- Identify criteria to guide HCA implementation
- Select HCA methodology
- Perform analysis
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IREC

IREC's Recommendations for Michigan

- The Commission should consider adopting the **interconnection use case**, and proceeding with a **phased implementation.**
- First Phase
  - Utilities publish basic distribution system information in a map and spreadsheet format. See Appendix.
  - Utilities focus on quality control of their GIS and distribution system models, not performing hosting capacity analysis.
  - The Commission solicits stakeholder feedback on criteria by which it will evaluate the different HCA methodologies.
- Second Phase
  - The Commission orders utilities to implement a system-wide HCA using a methodology based on the selected criteria and use case.

IREC

Thank you! Questions?

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IREC

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Appendix:
IREC's Suggested Phase 1 Maps and Spreadsheets

IREC

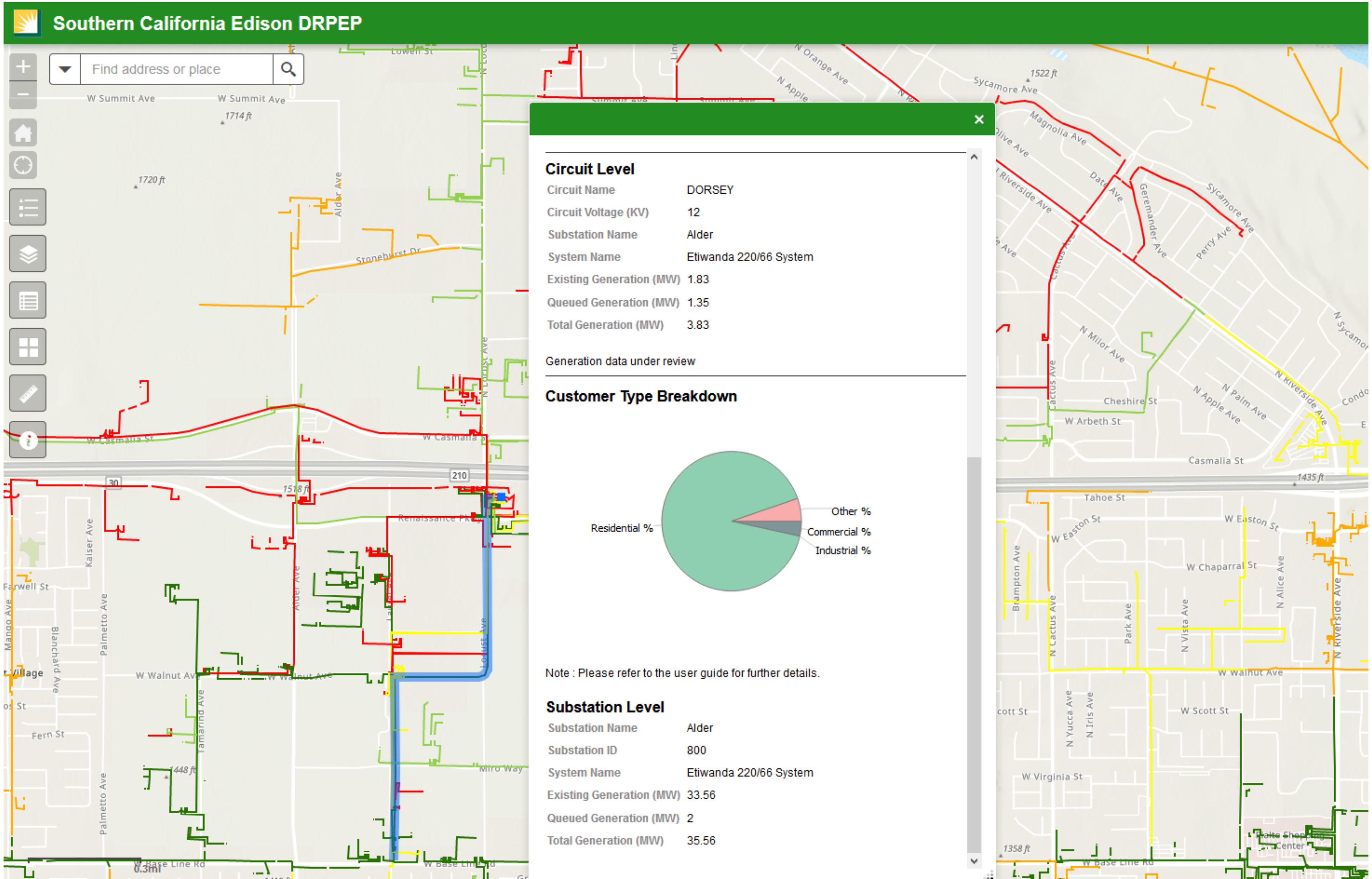
Data Fields for a First Phase Map and Spreadsheet

Substation
Name
Voltages
Existing Generation
Queued Generation
Total Generation
Load profile
Percentage of residential, commercial, industrial customers
Currently scheduled upgrades
Notes (include any other relevant information to help guide interconnection applicants, including electrical restrictions, known constraints, etc.)

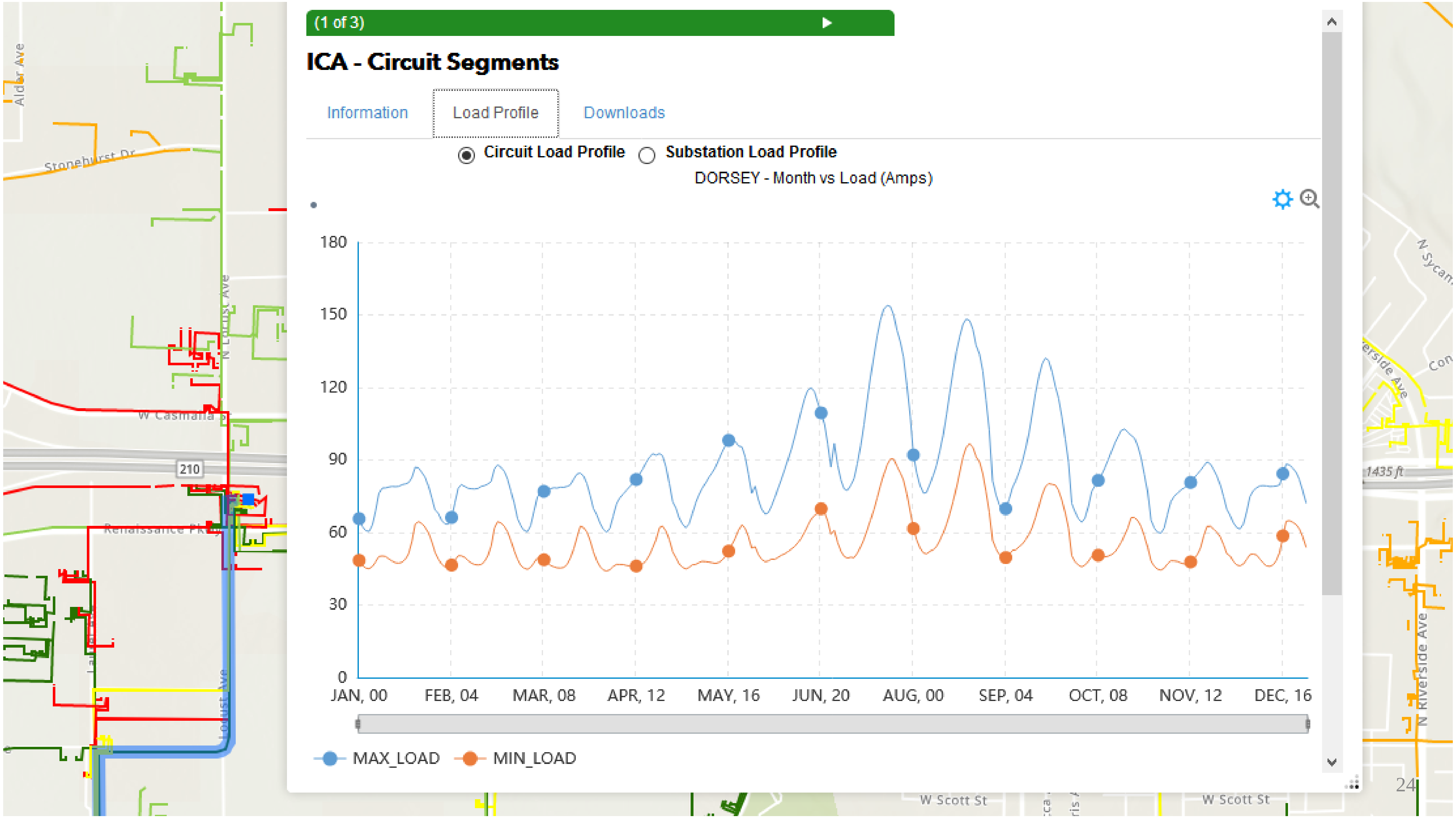
Feeder
Name of substation line connects to
Line voltage
Number of phases
Existing Generation
Queued Generation
Total Generation
Load profile
Percentage of residential, commercial, industrial customers
Currently scheduled upgrades
Notes (include any other relevant information to help guide interconnection applicants, including electrical restrictions, known constraints, etc.)

IREC

Circuit and Substation Data



Load Profile



MORNING BREAK
9:40 – 9:50 AM

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Tying it All Together –
A Vision for Integrated Distribution Planning

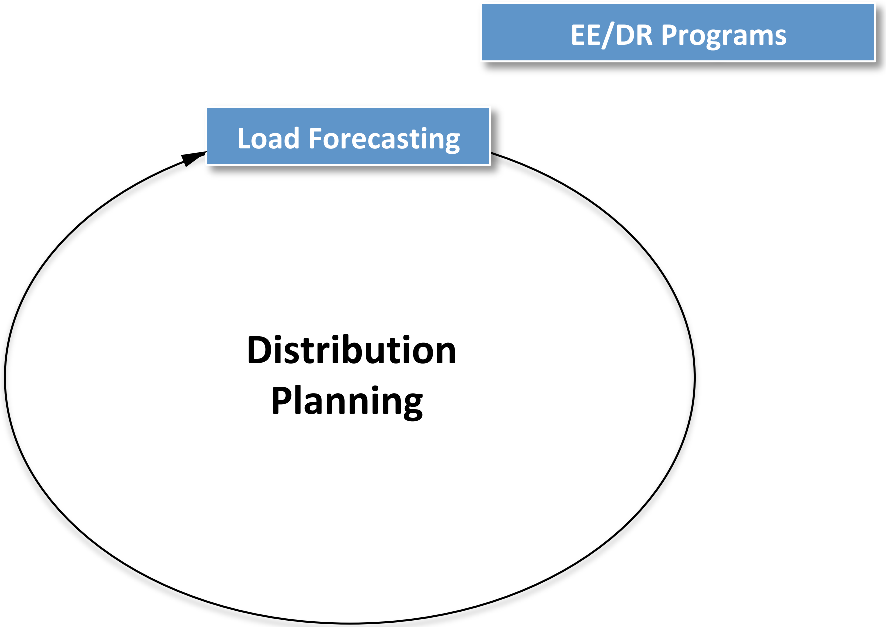
Curt Volkmann
President, New Energy Advisors, LLC
curt@newenergy-advisors.com
www.newenergy-advisors.com

September 18, 2019

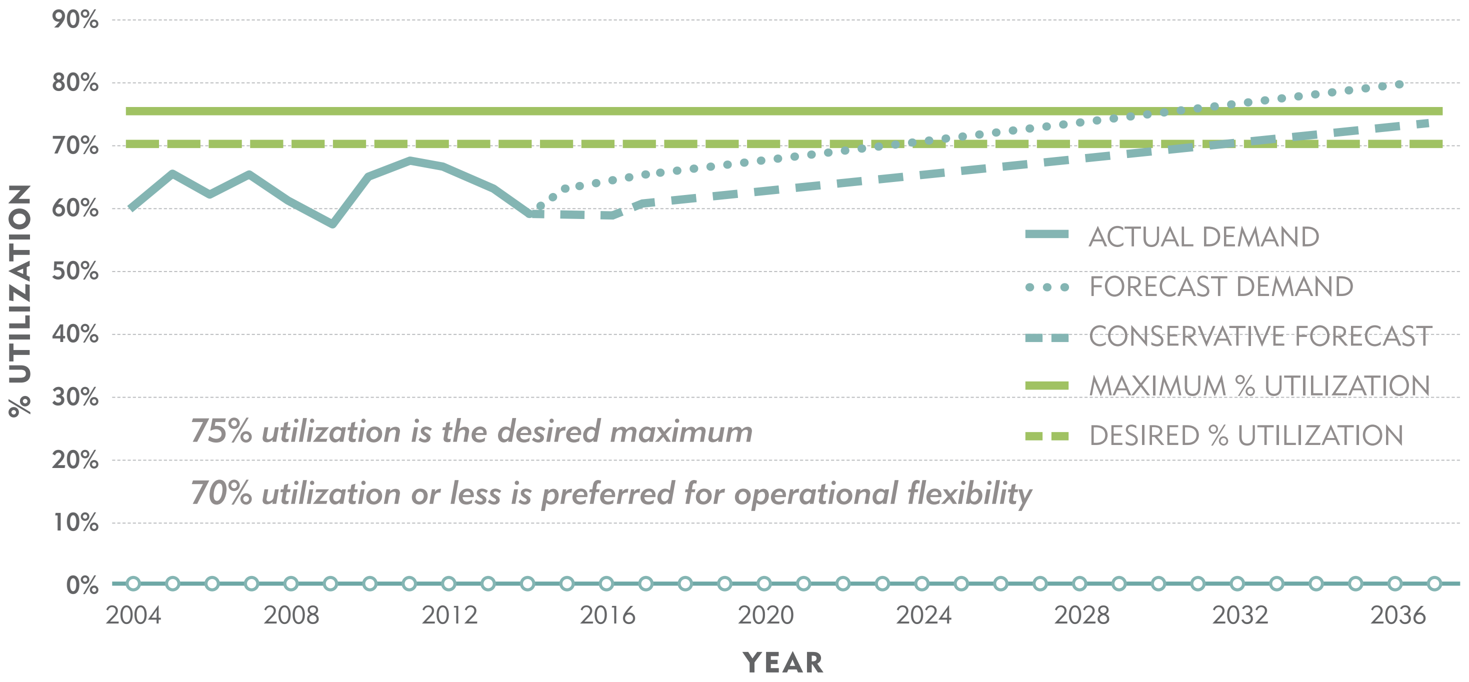
Implications of DER Growth

- Significant growth in distributed generation, EE, DR, CHP, EVs, energy storage, microgrids
- Increased complexity of distribution system planning and operations
- New opportunities for customers and third parties to provide ***Local Distribution Grid Services***, reducing the need for conventional ratepayer-funded capital investments
  - Distribution capacity or peak load reduction
  - Voltage regulation
  - Reliability/resilience
  - Hosting capacity

From today's Distribution Planning …



Typical Load Forecasting Today



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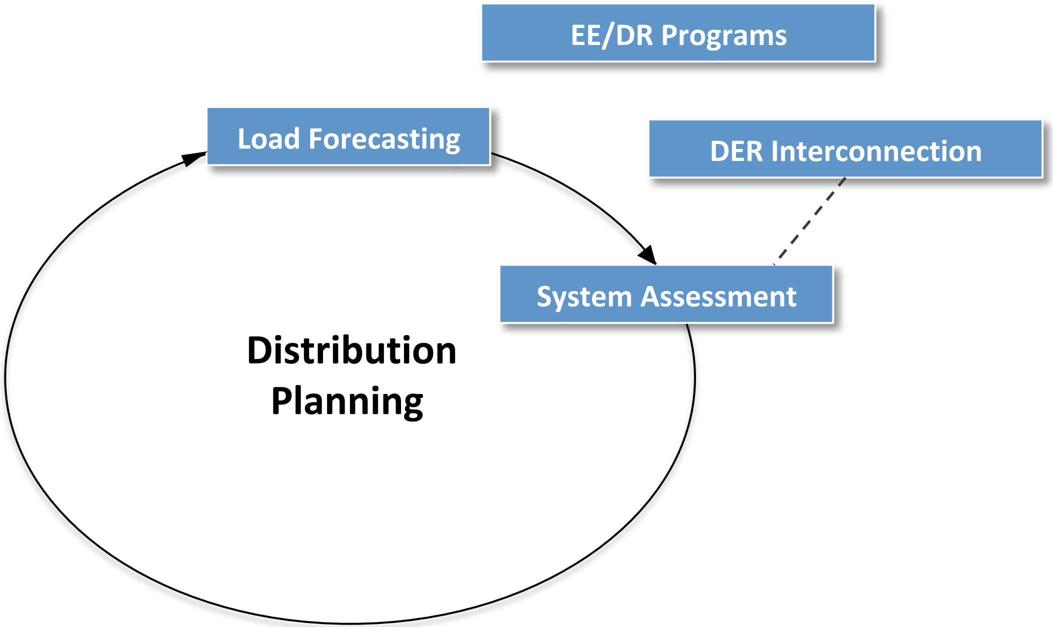

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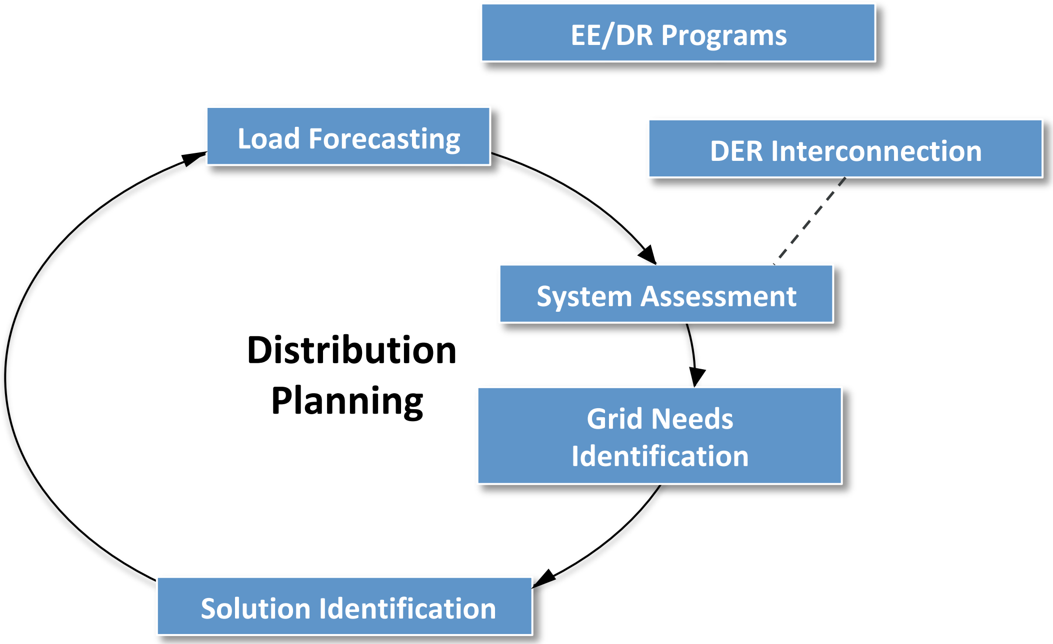

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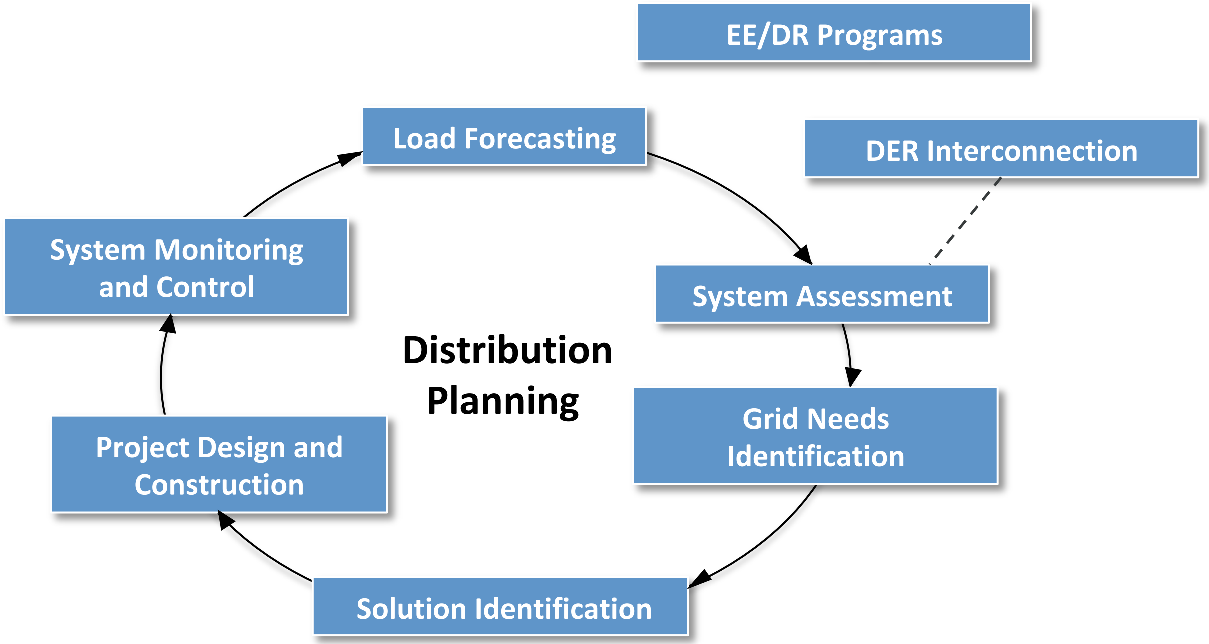
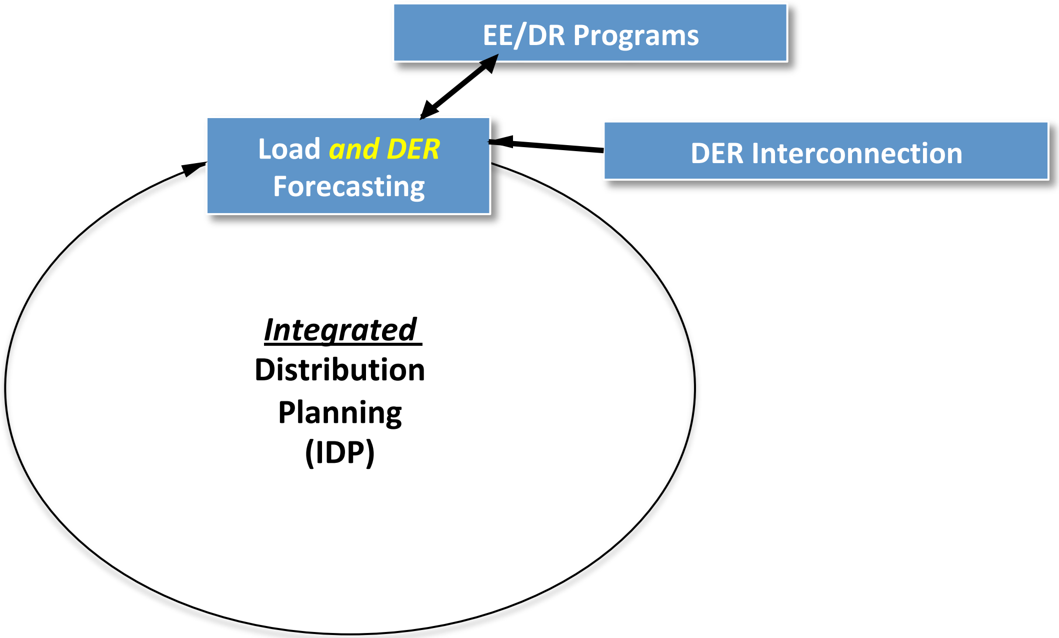


… to Integrated Distribution Planning



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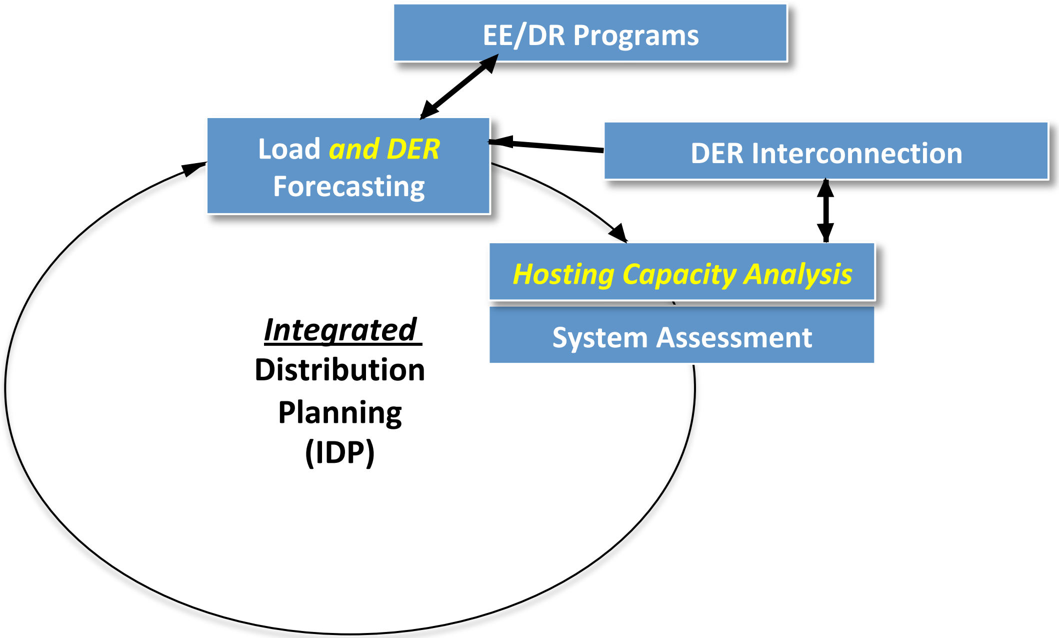

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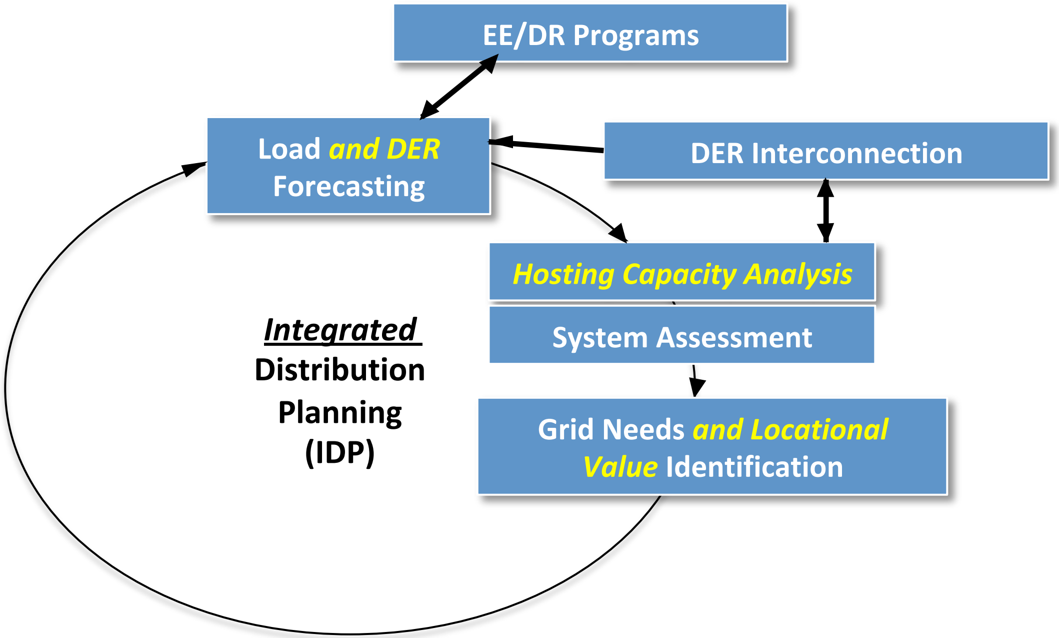
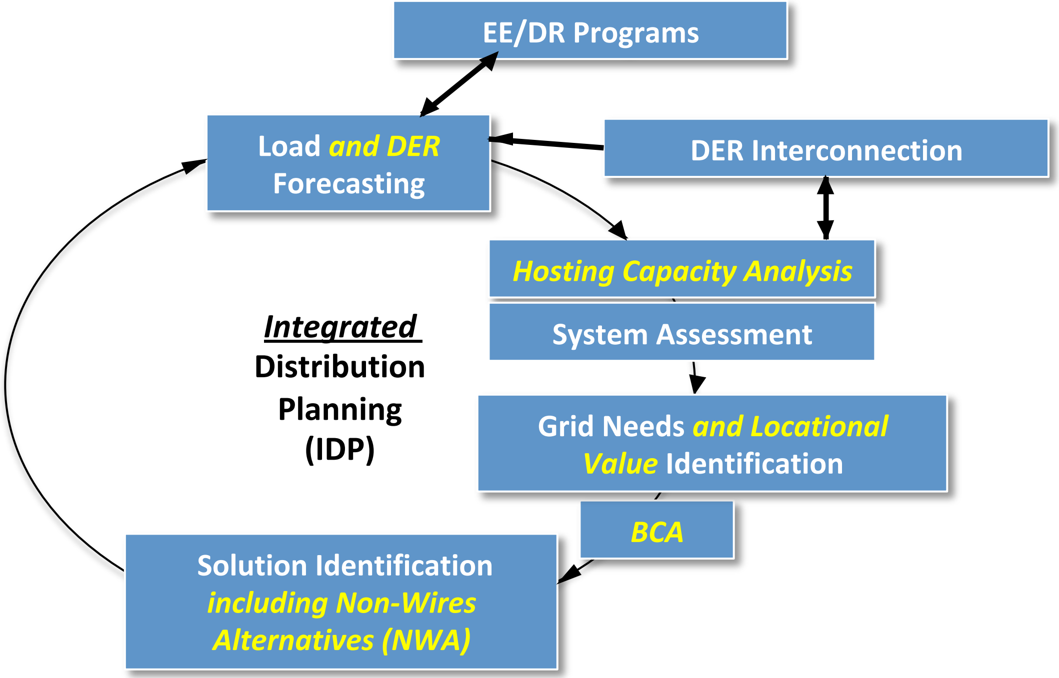


… to Integrated Distribution Planning

GridLAB



BCA = Benefit/Cost Analysis

… to Integrated Distribution Planning

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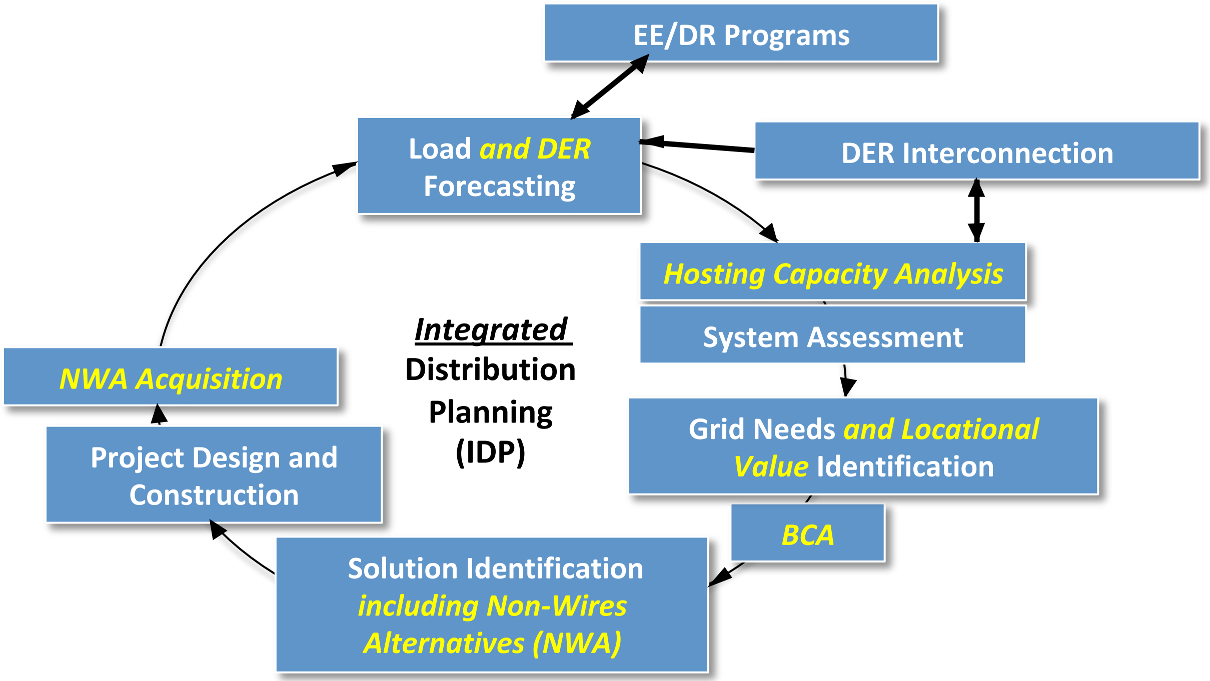

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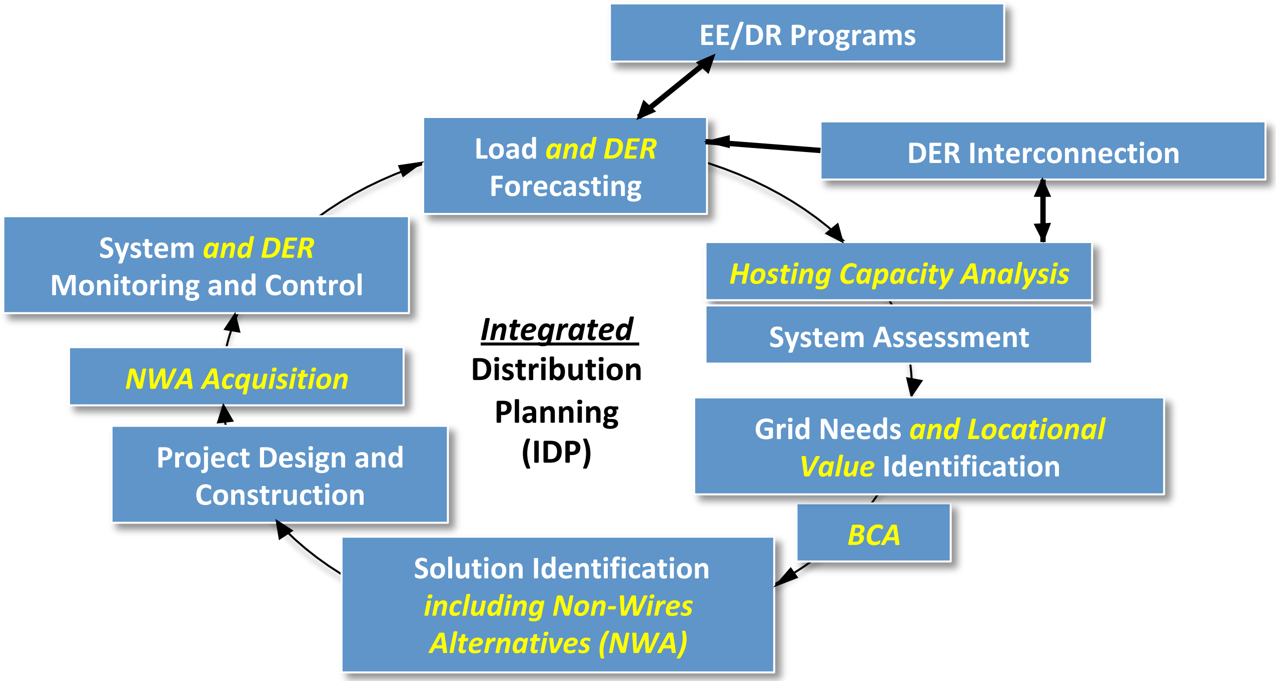

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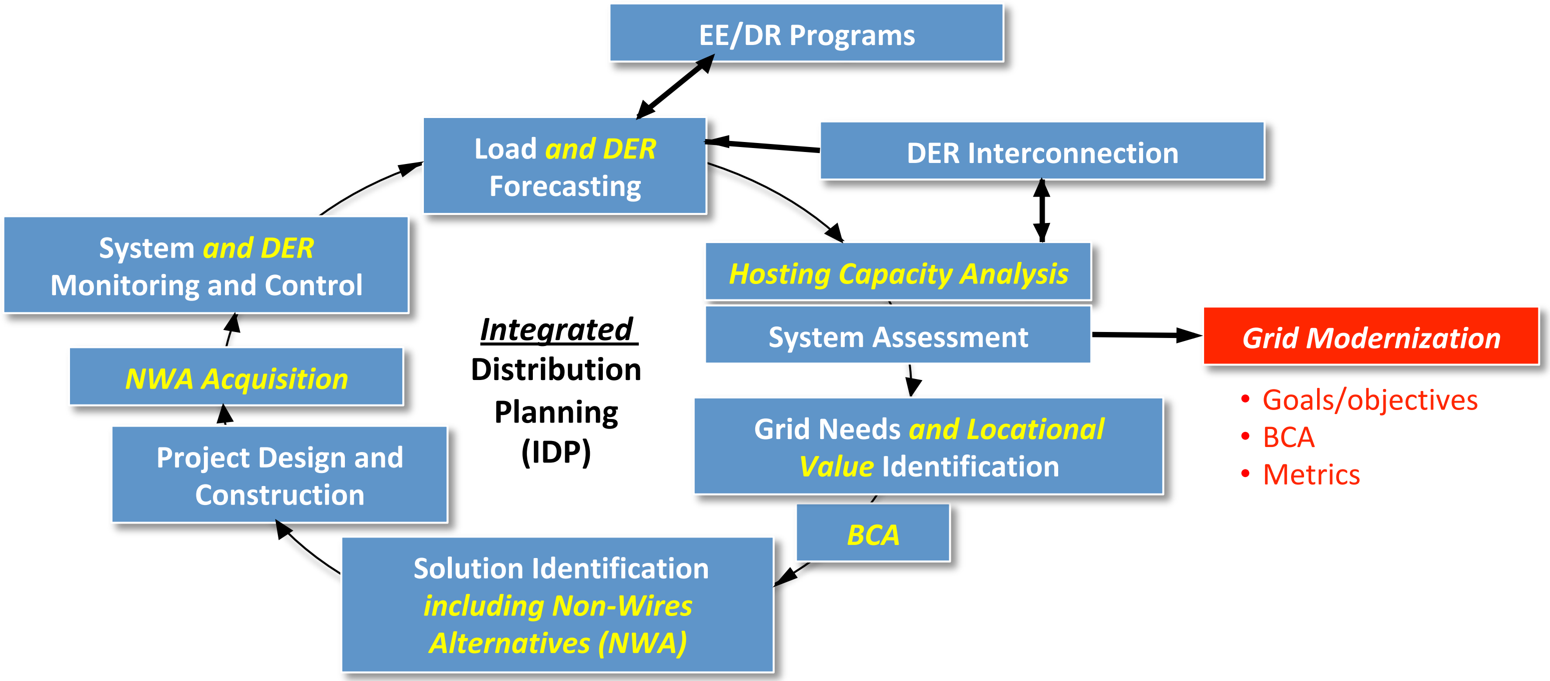

BCA = Benefit/Cost Analysis

New IDP Capabilities

Capability	Description
1) **Advanced Forecasting and System Modeling**	Probabilistic planning and DER adoption scenario analyses; more granular load and power flow modeling; enhanced modeling of new smart inverter capabilities; and the ability to monitor, manage and optimize DER connected to the system.

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5) **Meaningful Stakeholder Engagement**	Establishing processes for open dialogue, transparent information sharing, collaboration, and consensus building among stakeholders.

Additional IDP Topics to Consider

- DER adoption and growth scenarios
- NWA suitability criteria
- HCA use cases, identification of appropriate HCA methodology
- Data sharing policy, process and tools
- Smart inverter required functions and settings

Thoughts on proposed pilots

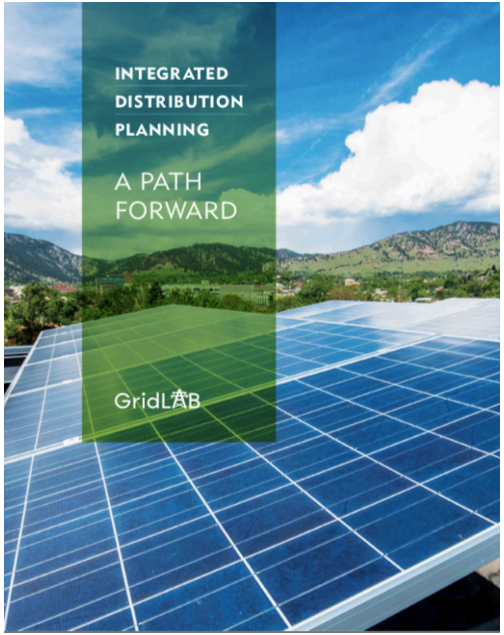
Hosting Capacity Analysis

- Define use cases, then methodology (ideally common across MI)
- Develop plans & timeline for publication of basic system information
- Don’t wait to get started
  - Data clean up, distribution system model enhancements

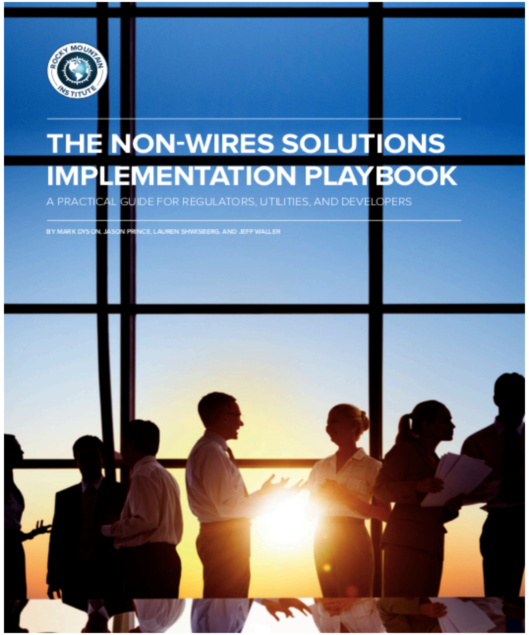
Non-Wires Alternatives

- Define and publish grid needs and locational value
- Define and publish suitability criteria
- Include procurement of service solutions utilizing non-utility owned resources

Additional resources …



https://gridlab.org/publications/



https://rmi.org/insight/non-wires-solutions-playbook/

Thank you!

Curt Volkmann

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Reliability and Resilience Metrics and Reliability Value-Based Planning

Joseph H. Eto

Lawrence Berkeley National Laboratory

Five-Year Distribution Planning Stakeholder Meeting

Lansing, MI, September 18, 2019

Overview of this presentation

- Reliability Metrics
- IEEE Standard 1366 Identification of Major Events
- Reliability vs. Resilience
- Resilience Metrics
- Value-Based Reliability Planning
- The Interruption Cost Estimate (ICE) Calculator
- LBNL Bibliography

Electricity reliability is measured by the duration and frequency of the times when the lights are out

System Average Interruption Duration Index

$$\text{SAIDI} = \frac{\text{total duration of sustained customer interruptions } (\geq 5\text{min each})}{\text{number of customers served}}$$

System Average Interruption Frequency Index

$$\text{SAIFI} = \frac{\text{frequency of sustained customer interruptions } (\geq 5\text{min each})}{\text{number of customers served}}$$

Customer Average Interruption Duration Index

$$\text{CAIDI} = \frac{\text{SAIDI}}{\text{SAIFI}}$$

Momentary Average Interruption Frequency Index

$$\text{MAIFI} = \frac{\text{frequency of momentary customer interruptions } (< 5\text{min each})}{\text{number of customers served}}$$

SAIDI, SAIFI, and CAIDI represent aggregations of customers' experiences with power interruptions

Example: Circuit 3 Outage History

Circuit	Customers Served	Outage Number	Customers Interrupted	Outage Duration in Minutes	Customer-Minutes Interrupted
Circuit 3	3,000	1	1,500	90	135,000
Circuit 3	3,000	2	750	150	112,500
Circuit 3	3,000	3	3,000	120	360,000
Circuit 3	3,000	4	750	150	112,500
Total	**3,000**		**6,000**		**720,000**

Example: SAIFI Calculations (Assume system serves 2,000,000 customers)

Circuit	Customers Interrupted	Circuit Customers Served	Circuit SAIFI	System Customers Served	System SAIFI
Circuit 1	1,000	500	= 1,000/500 = 2.0	2,000,000	= 1,000/2M = 0.0005
Circuit 2	4,000	2,000	= 4,000/2,000 = 2.0	2,000,000	= 4,000/2M = 0.0020
Circuit 3	6,000	3,000	= 6,000/3,000 = 2.0	2,000,000	= 6,000/2M = 0.0030

Example: SAIDI Calculations (Assume system serves 2,000,000 customers)

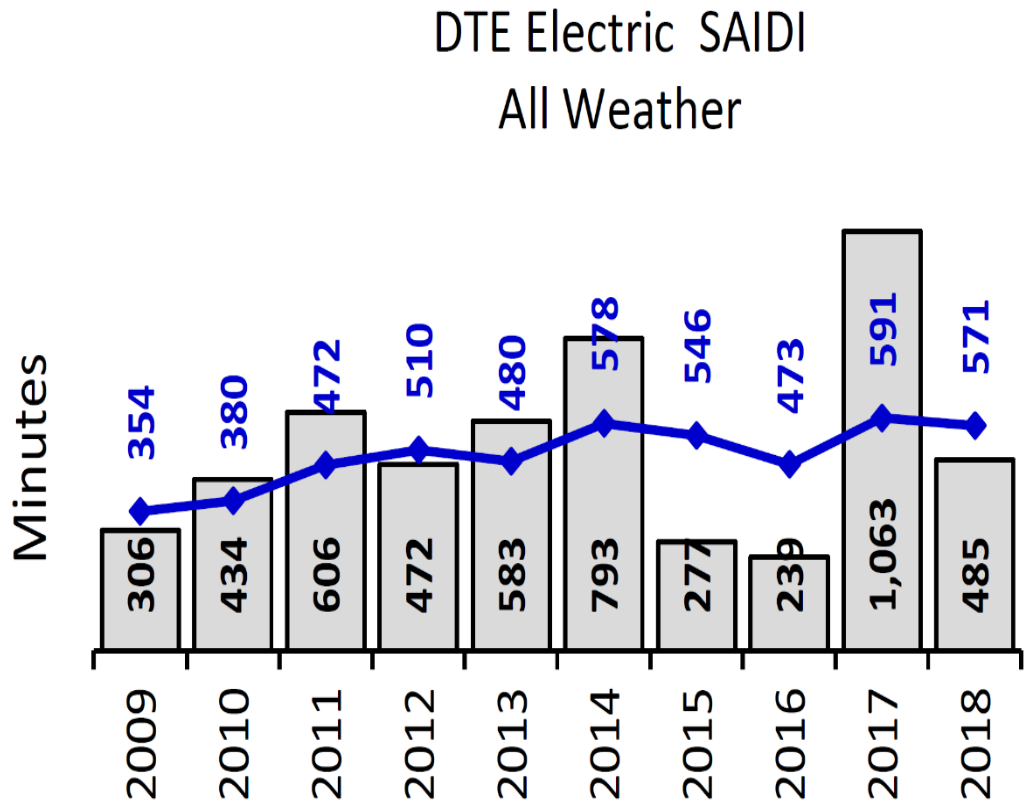
Circuit	Customer-Minutes Interrupted	Circuit Customers Served	Circuit SAIDI	System Customers Served	System SAIDI
Circuit 1	120,000	500	= 120,000/500 = 240.0	2,000,000	= 120,000/2M = 0.060
Circuit 2	480,000	2,000	= 480,000/2,000 = 240.0	2,000,000	= 480,000/2M = 0.240
Circuit 3	720,000	3,000	= 720,000/3,000 = 240.0	2,000,000	= 720,000/2M = 0.360

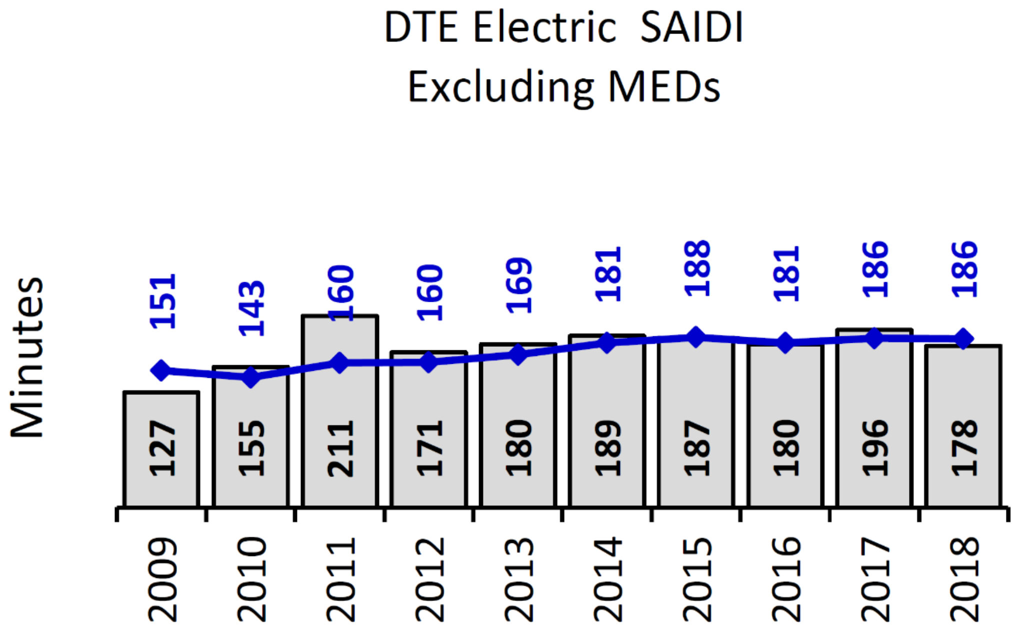
Source: DTE Electric Company's Distribution Operations Five-Year (2018-2022) Investment and Maintenance Plan Final Report, January 31, 2018

Exclusions or major events will vary from year to year—yet account for a measurable portion of overall utility reliability

EIA Form 861 for calendar 2015	Investor Owned	Cooperative	Municipal
Number of utilities reporting (following IEEE Standard 1366)	137	296	117
% of U.S. sales by type of utility	51%	47%	43%
SAIDI with Major Events	237	302	115
SAIDI without Major Events	136	159	50
SAIFI with Major Events	1.4	2.8	0.9
SAIFI without Major Events	1.2	2.1	0.7

IEEE Std. 1366 facilitates year-on-year comparisons of by removing major events, which vary on a yearly basis





Source: DTE Electric Co. 2018 Report to MPSC Regarding Electric Distribution System Power Quality, May 6, 2019

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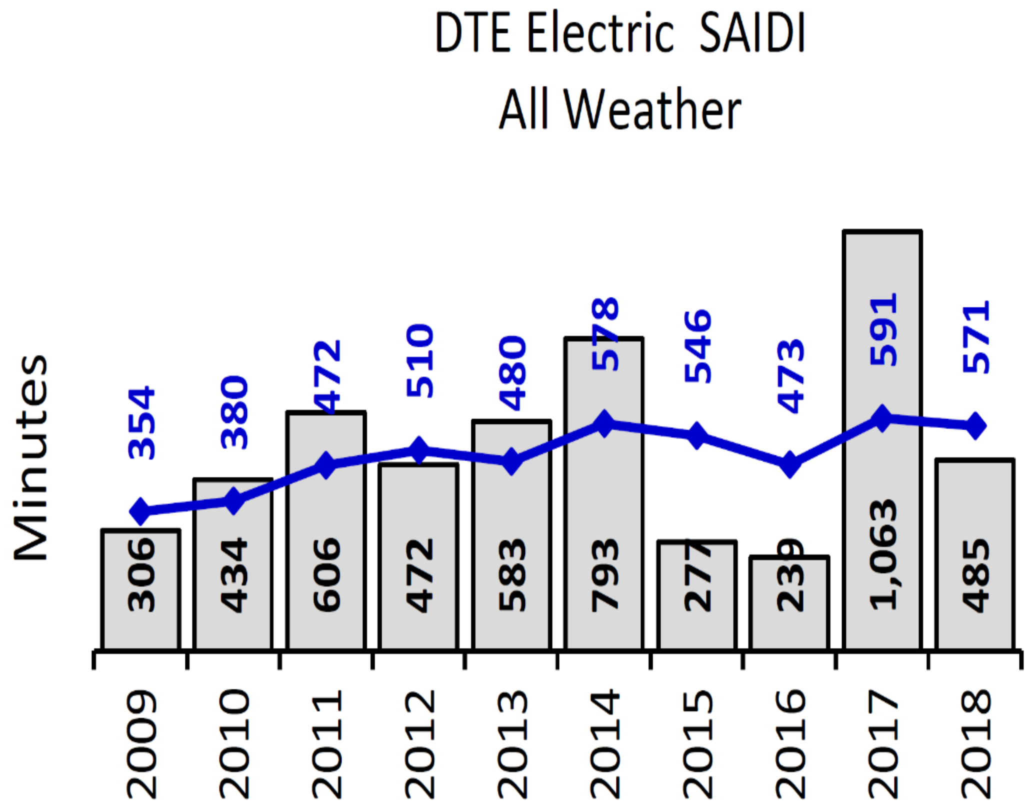
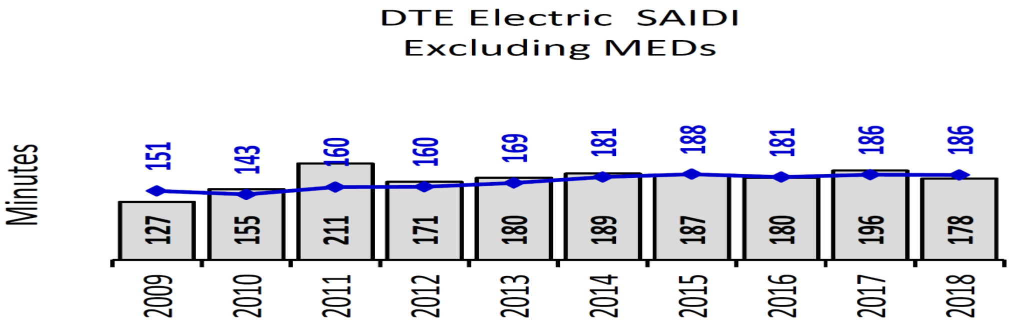


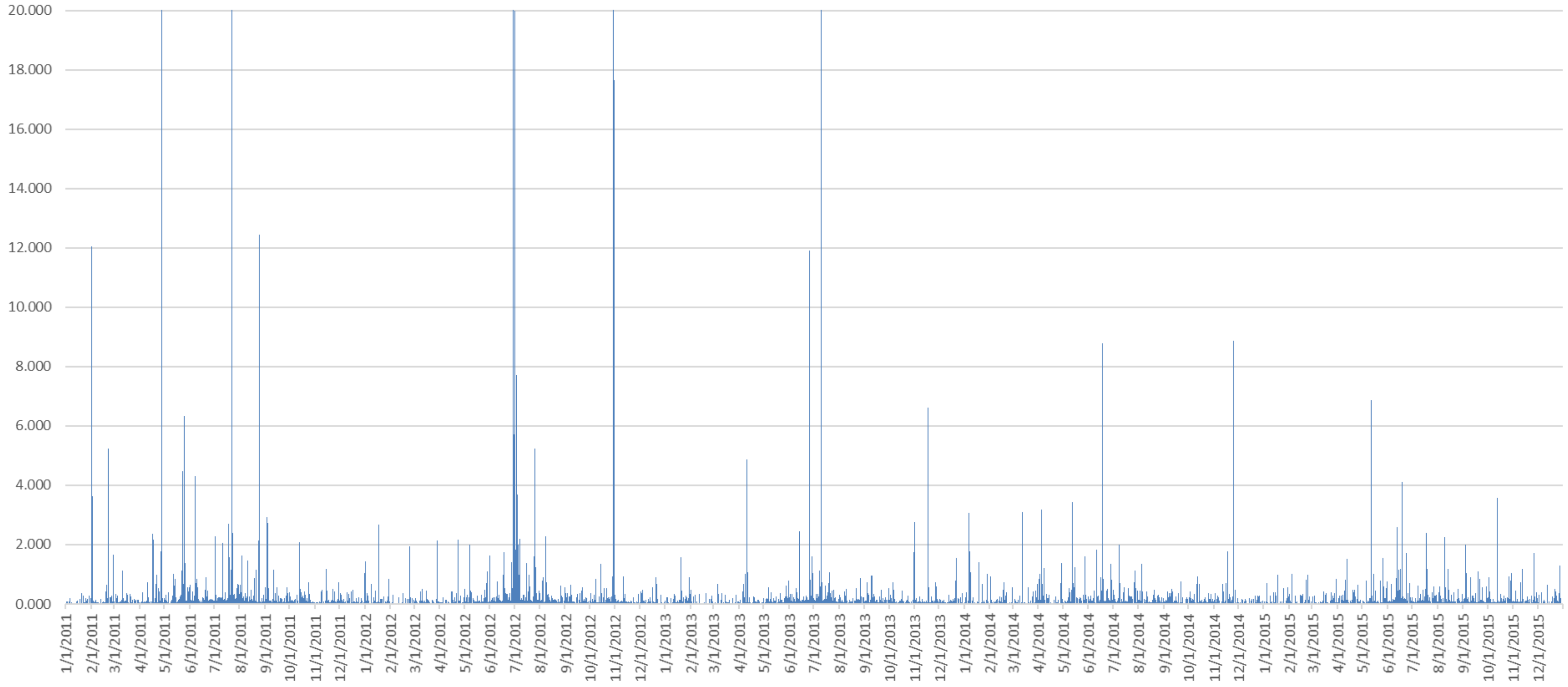


Source: DTE Electric Co. 2018 Report to MPSC Regarding Electric Distribution System Power Quality, May 6, 2019

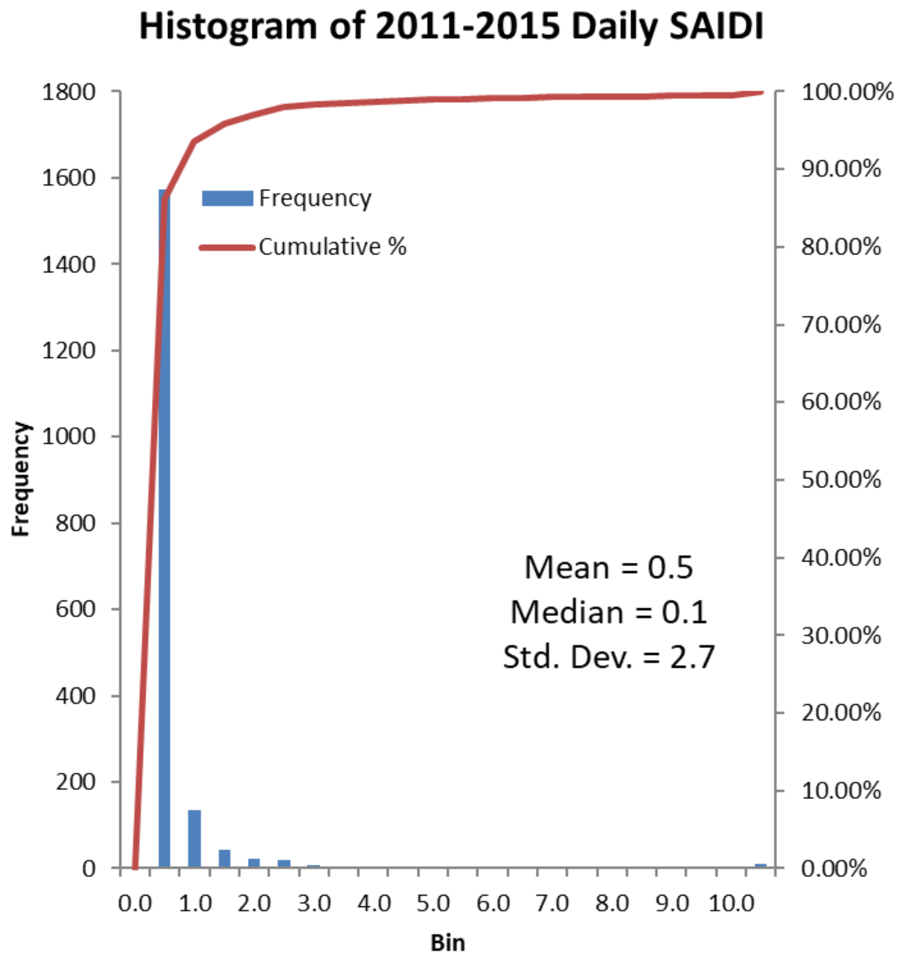
IEEE Standard 1366

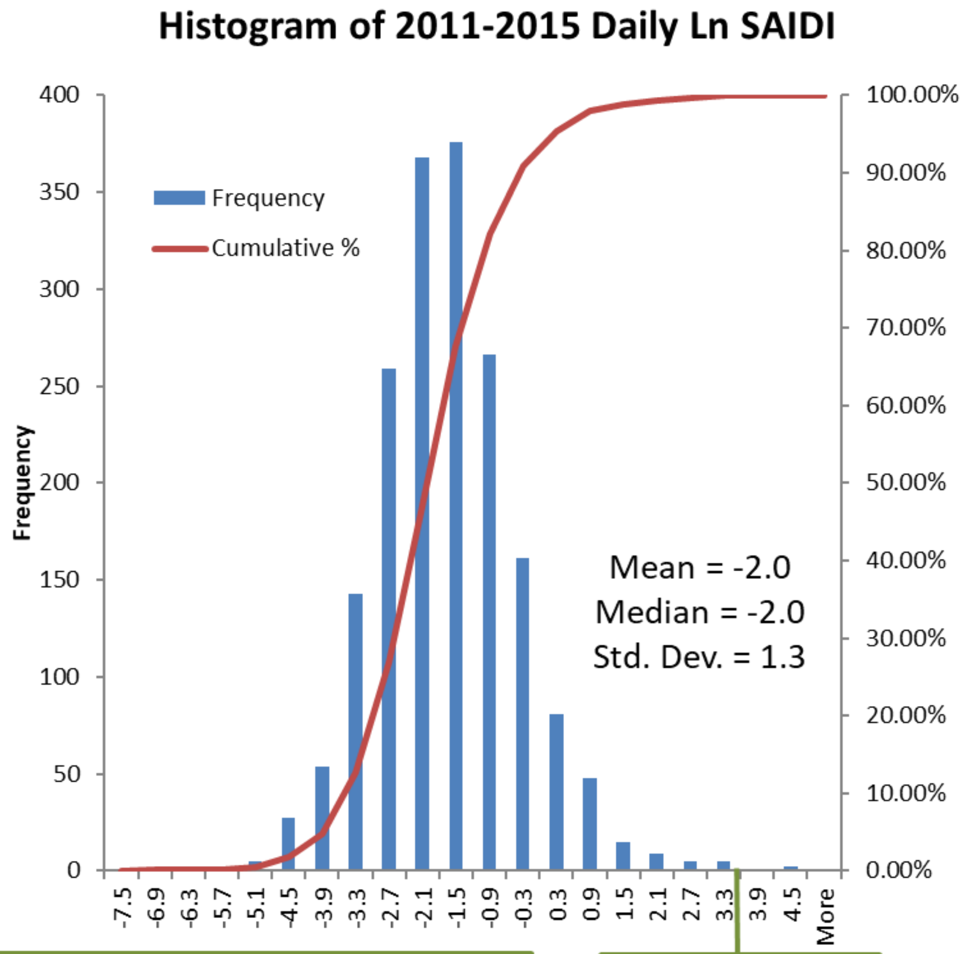
- First developed in 1998 to define reliability indices; amended in 2003 to add a consistent approach for segmenting Major Event Days (amended again in 2012; MED definition unchanged)
- Uses 2.5*beta to estimate a threshold daily SAIDI, Tmed, above which a Major Event Day is identified
  - Tmed = exp (α+2.5β)
  - Beta = log-normal standard deviation
  - Alpha = log-normal statistical mean
- For a ***normal*** distribution:
  - Multiplying beta (the standard deviation) by 2.5 covers 99.379% of the expected observations (assuming a one-sided confidence interval)
  - For a year of daily observations, this translates to an expectation of 2.3 Major Event Days per year
- *But, not all utility daily SAIDI data are distributed “normally”*

Daily SAIDI for 5 years (2011-2015)



Daily SAIDI Re-Ordered from Lowest to Highest

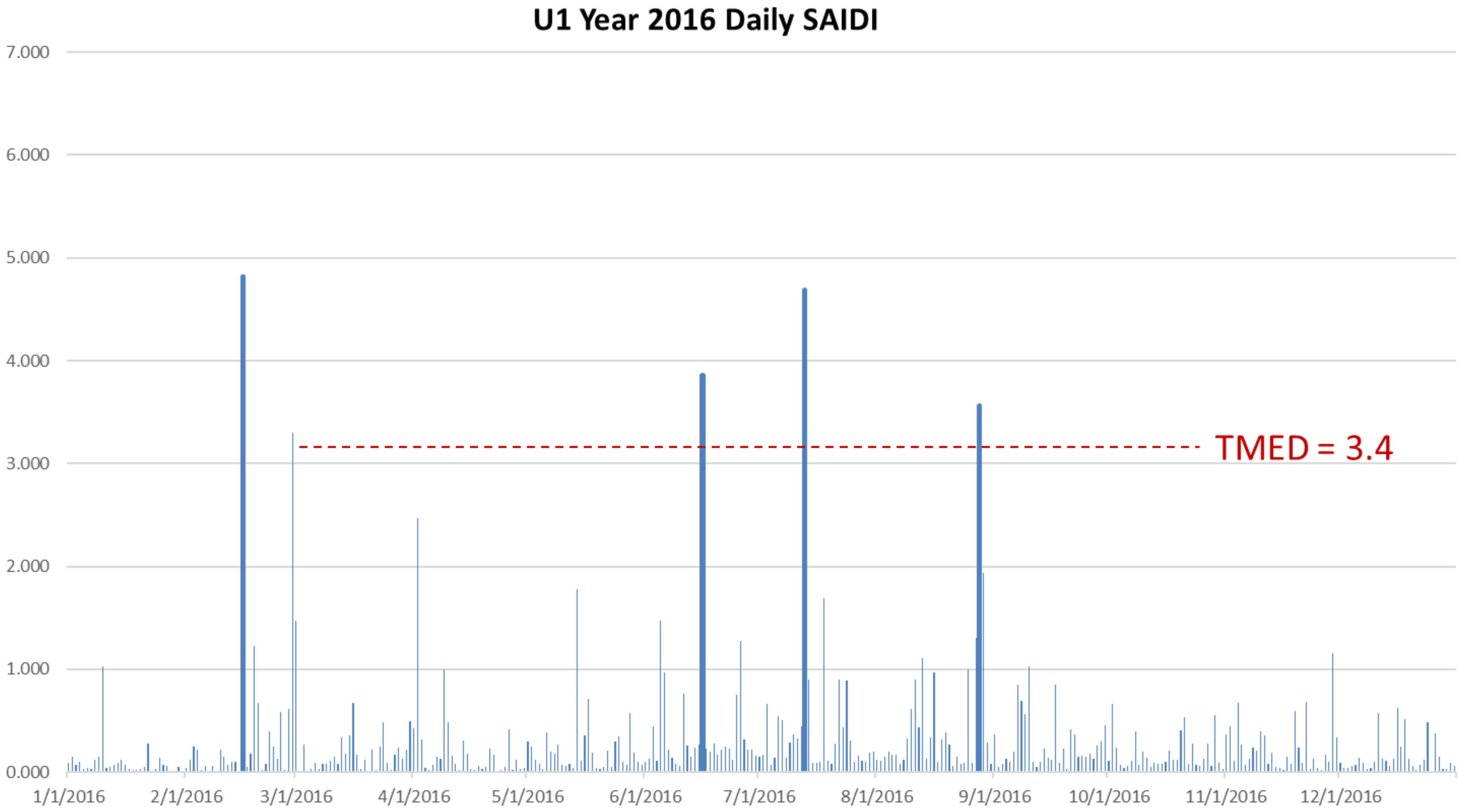




$$\text{Tmed} = e^{(\text{mean} + (2.5 * \text{std. dev.}))}$$

Tmed = 3.4

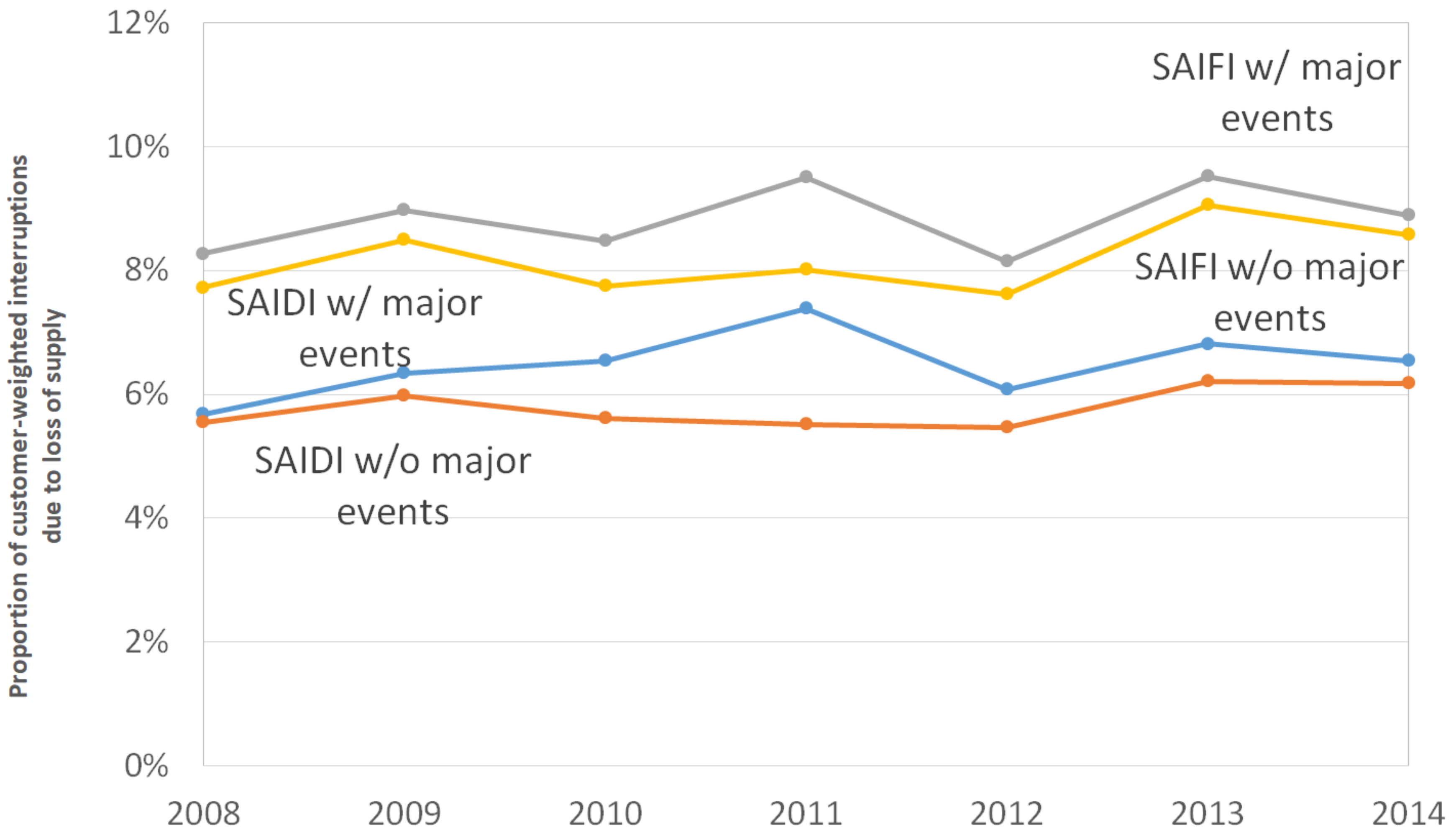
Daily SAIDI for 2016 → 4 MEDs



4 MEDs in year 2016:

1. Feb 16
2. Jun 16
3. Jul 13
4. Aug 28

Reliability oversight is shared between Federal and State regulators



Customer-weighted proportion of SAIDI and SAIFI due to loss of supply (IEEE DRWG data 2008-2014, n = 73)

Source: Eto, J., K. Hamachi-LaCommare, H. Caswell, and D. Till. "Distribution System vs. Bulk Power System: Identifying the Source of Electric Service Interruptions in the U.S." *IET Generation, Transmission, and Distribution, Volume 13, Issue 5,* 12 March 2019, p. 717 – 723

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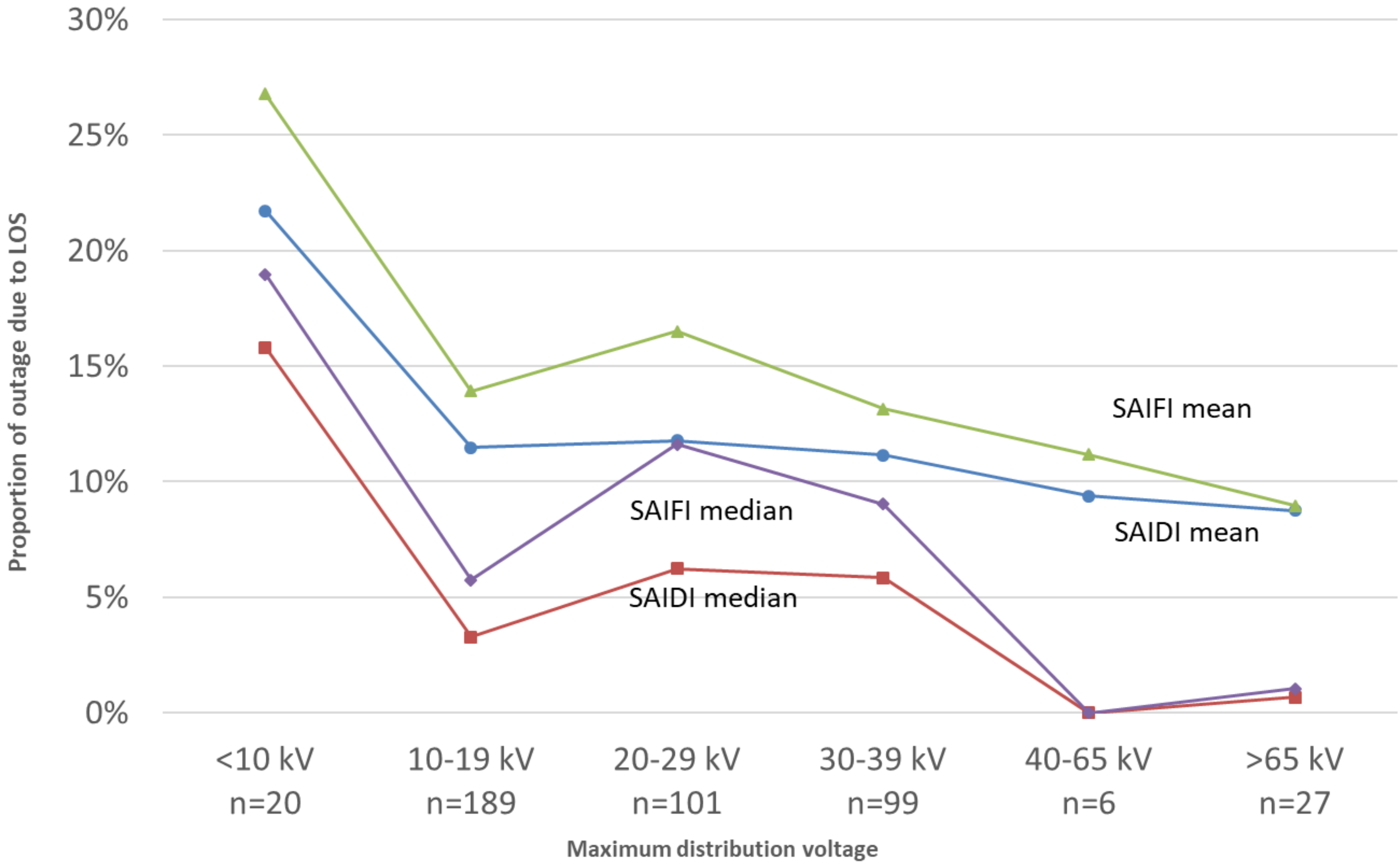


Source: Eto, J., K. Hamachi-LaCommare, H. Caswell, and D. Till. "Distribution System vs. Bulk Power System: Identifying the Source of Electric Service Interruptions in the U.S." *IET Generation, Transmission, and Distribution, Volume 13, Issue 5*, 12 March 2019, p. 717 – 723

Concerns Regarding the Resilience of the U.S. Electric Power System are Growing

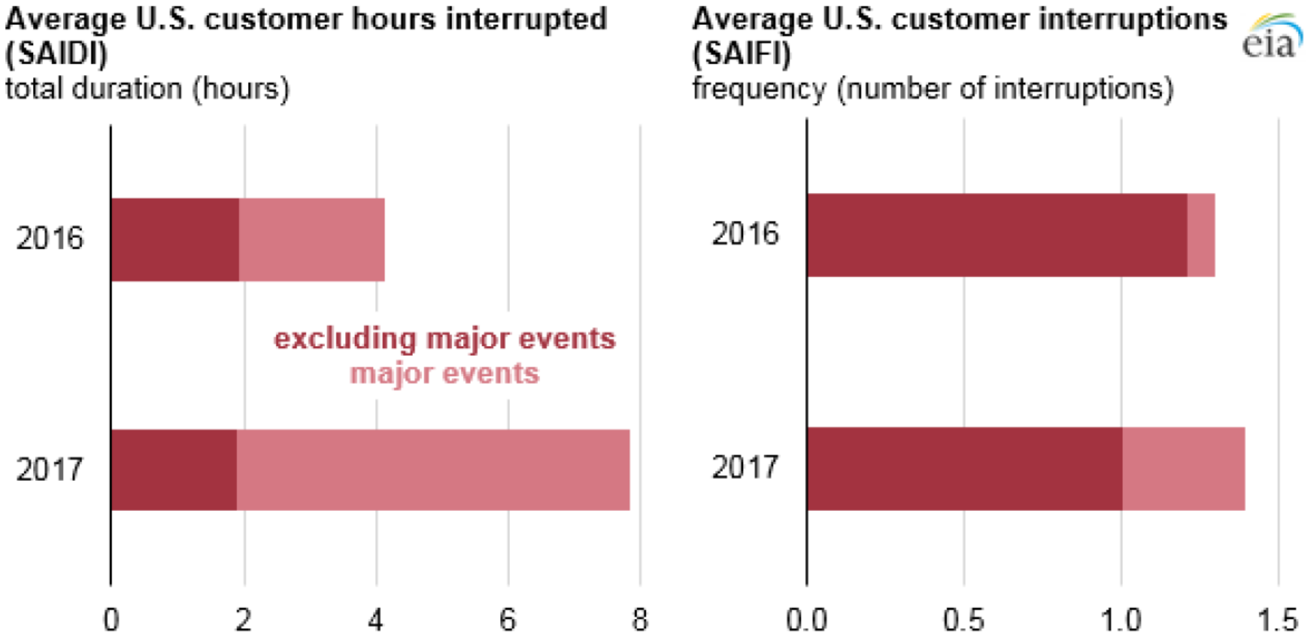
U.S. Energy Information Administration

"More major events such as hurricanes and winter storms occurred in 2017, and the total duration of interruptions caused by major events was longer"

Today in Energy

November 30, 2018

Average U.S. electricity customer interruptions totaled nearly 8 hours in 2017



Source: U.S. Energy Information Administration, *Annual Electric Power Industry Report* (EIA-861 data file)

Reliability vs. Resilience: features, metrics, actions

	Reliability	Resilience
Common features/ characteristics	Routine, expected, normally localized, shorter duration interruptions of electric service Larger events will make it into the local headlines	Infrequent, unexpected, widespread/long duration power interruptions, often with significant corollary impacts Almost always "event" based Always national headline worthy
Metrics	Well-established, annualized (SAIDI, SAIFI, MAIFI), with provisions for "major events" Rarely include non-electricity impacts	Familiar, but non-standardized, and generally event-based (number of customers affected; hours without electric service) Routinely also include non-electricity impacts (e.g., costs to firms; health and safety impacts)
Actions to improve	1. Plan and prepare; 2. Manage and endure event(s); 3. Recover and restore; and 4. Assess, learn, and update plan.	No qualitative difference But generally larger in scope/cost (see below)

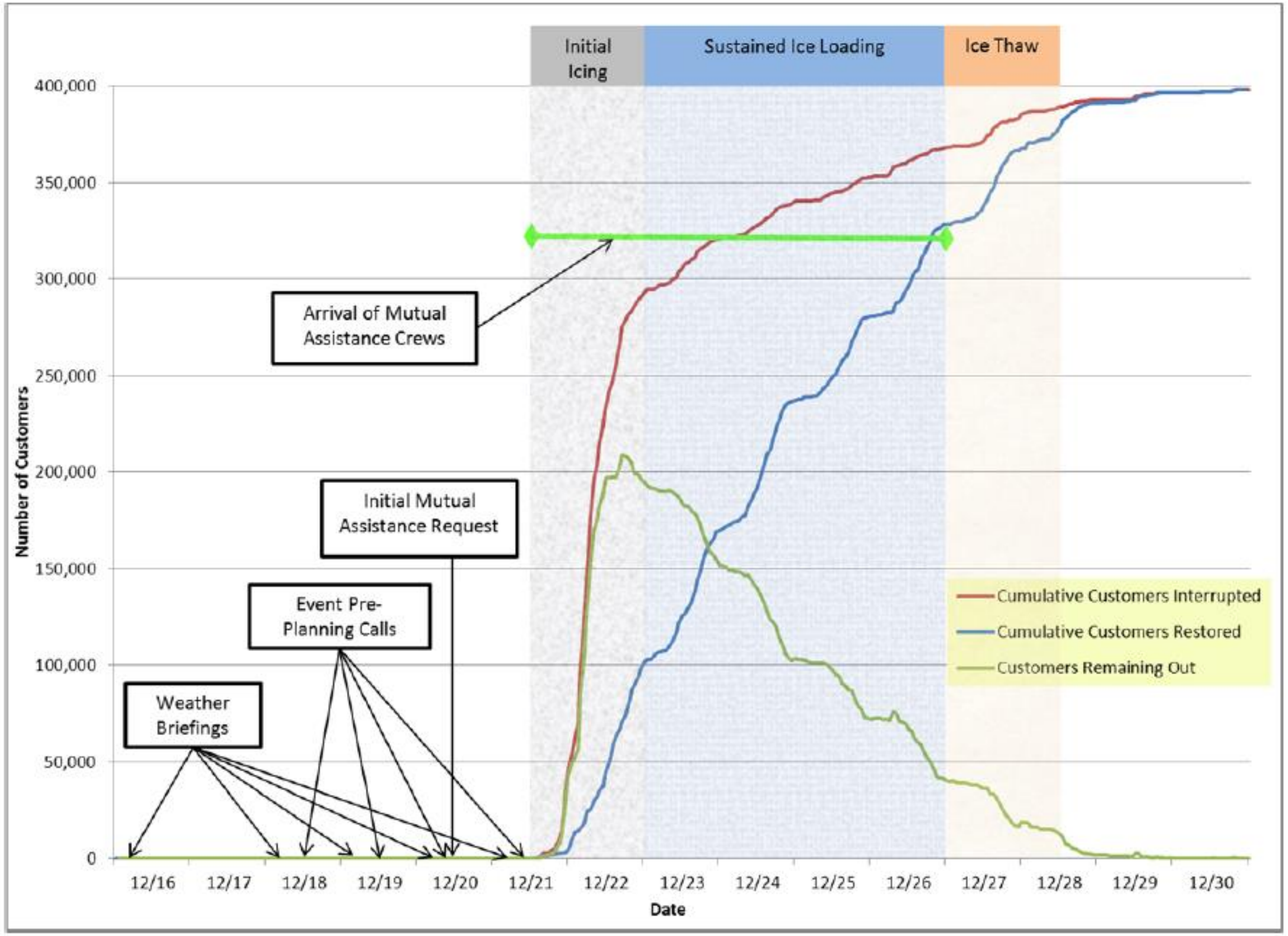
Reliability vs. Resilience: decision-making

	Reliability	Resilience
Entities involved in decision making	Electric utility and its regulator/oversight board, primarily	Electric utility and regulator; sometimes acting in response to State legislative direction or Governor's orders Routinely in conjunction with parties that have responsibilities for other critical infrastructures, including local/regional/state/federal agencies/authorities, and communities/elected officials
Factors affecting decision making	Actuarial records on frequency of exposure – widely understood risks: insurable Well-understood/tested practices/approaches Understood to be an expected cost of doing business	No actuarial basis to establish likelihood of occurrence – widely varying perceptions of risk/exposure: "un-insurable" risk Limited opportunities to test strategies Large dollar amounts/extraordinary expenditures may require special approval/vote Political judgements essential

Grid Modernization Lab Consortium metrics: Resilience

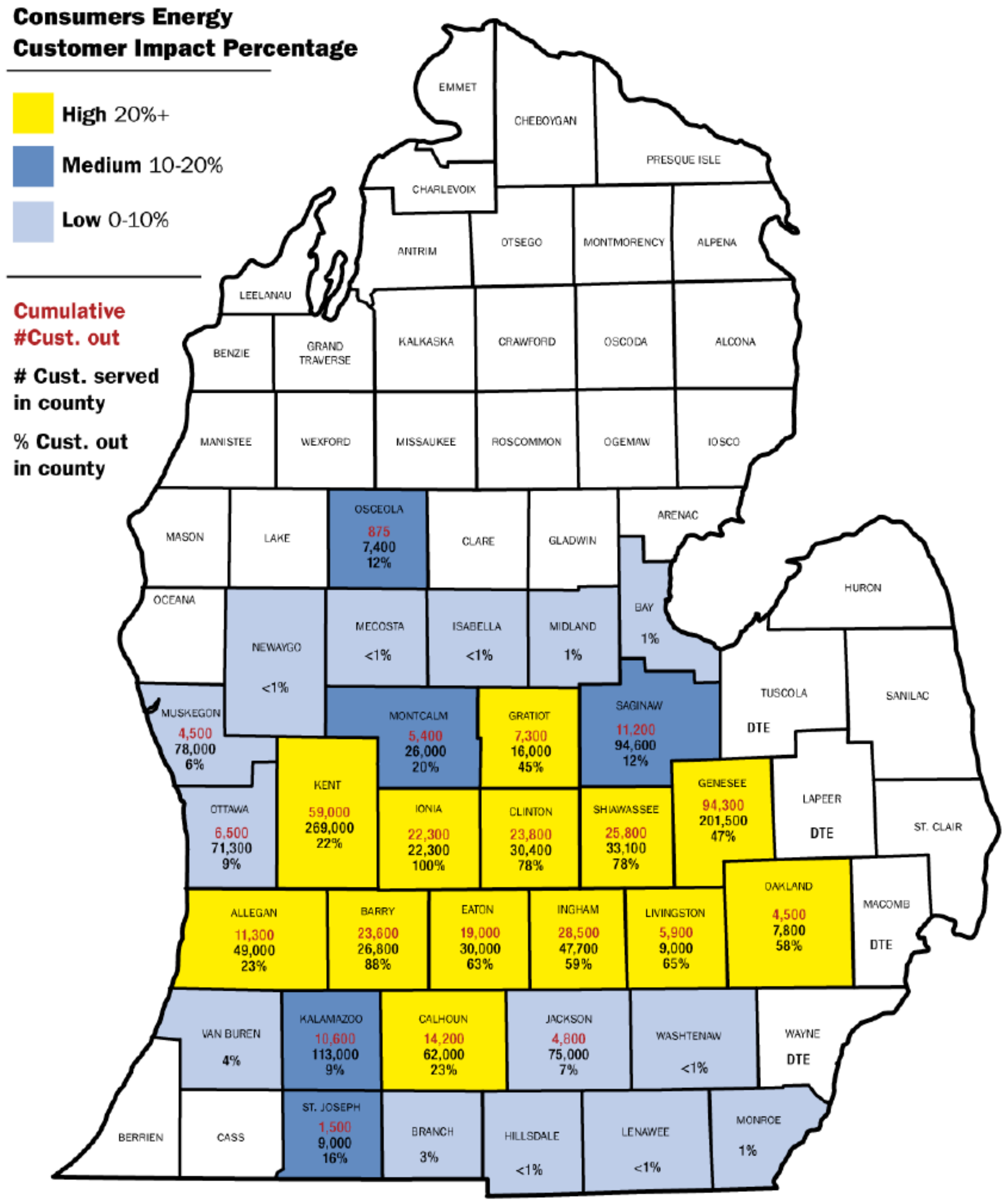
GMLC Resilience Metrics	Data Requirements
Cumulative customer-hours of outages	customer interruption duration (hours)
Cumulative customer energy demand not served	total kVA of load interrupted
Avg (or %) customers experiencing an outage during a specified time period	total kVA of load served
Cumulative critical customer-hours of outages	critical customer interruption duration
Critical customer energy demand not served	total kVA of load interrupted for critical customers
Avg (or %) of critical loads that experience an outage	total kVA of load severed to critical customers
Time to recovery	
Cost of recovery	
Loss of utility revenue	outage cost for utility ($)
Cost of grid damages (e.g., repair or replace lines, transformers)	total cost of equipment repair
Avoided outage cost	total kVA of interrupted load avoided
	$ / kVA
Critical services without power	number of critical services without power
	total number of critical services
Critical services without power after backup fails	total number of critical services with backup power
	duration of backup power for critical services
Loss of assets and perishables	
Business interruption costs	avg business losses per day (other than utility)
Impact on GMP or GRP	
Key production facilities w/o power	total number of key production facilities w/o power (how is this different from total kVA interrupted for critical customers?)
Key military facilities w/o power	total number of military facilities w/o power (same comment as above)

Consumers Energy Company
December 2013 ice storm restoration timeline



Source: Consumers Energy Company's Report in Response to MPSC Order in Case No. U-17452, February 7, 2014

Consumers Energy Company December 2013 ice storm customer impacts by county



Source: Consumers Energy Company's Report in Response to MPSC Order in Case No. U-17452, February 7, 2014

Introducing Value-Based Reliability Planning

- The pace of electricity grid modernization efforts will be determined by decisions made by electric utilities, their customers, and local communities/states to adopt new technologies and practices
- An important motivation for these actions will be maintaining or improving the reliability and resiliency of electric service
- From an economic perspective, the justification for these actions will therefore, depend, at least in part, on:
  - The cost of the actions under consideration;
  - The impact they are expected to have on reliability or resilience; and
  - The value these impacts have to the utility, its customers, and the community/state
- Better information will enable, but does not guarantee, better decisions and remember… we will never have perfect information

Value-Based Reliability Planning is a means for taking the cost of interruptions borne by customers into utility planning decisions

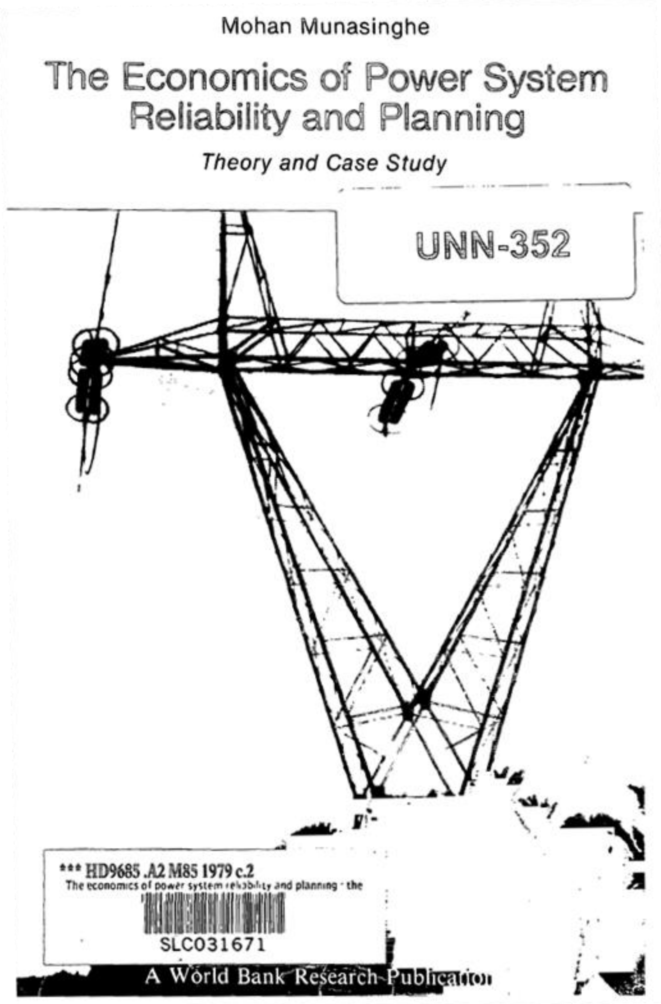
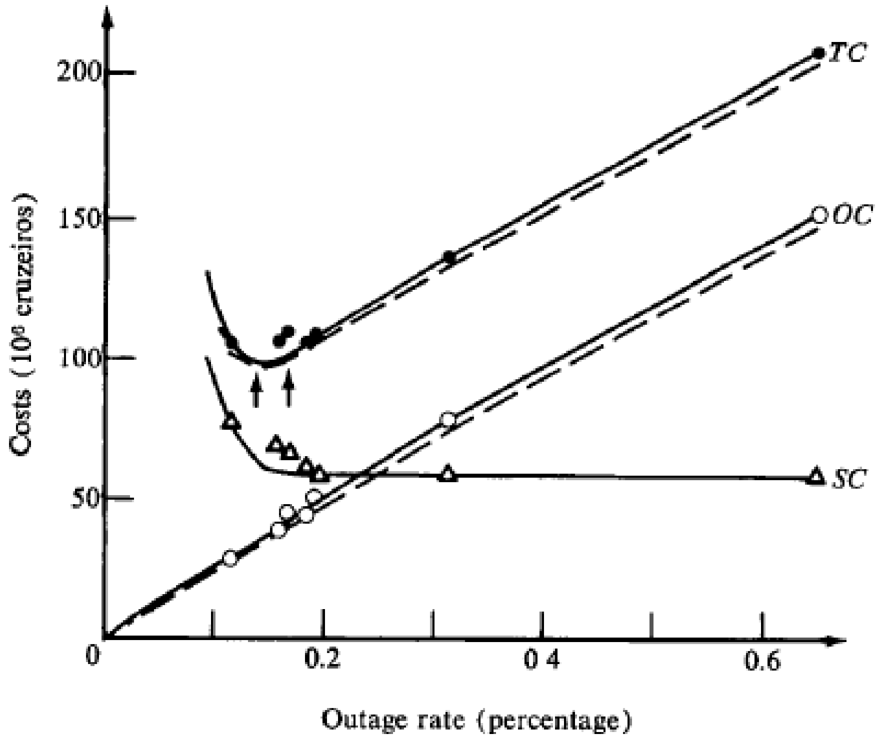


Figure 13.1. *Optimization of the Outage System: Costs Versus Outage Rate*



Note: SC = distribution system supply costs; *OC* = global outage costs; and *TC* = total costs. The plotted data points and solid lines refer to efficiency priced costs; the broken lines indicate the costs in terms of social prices.

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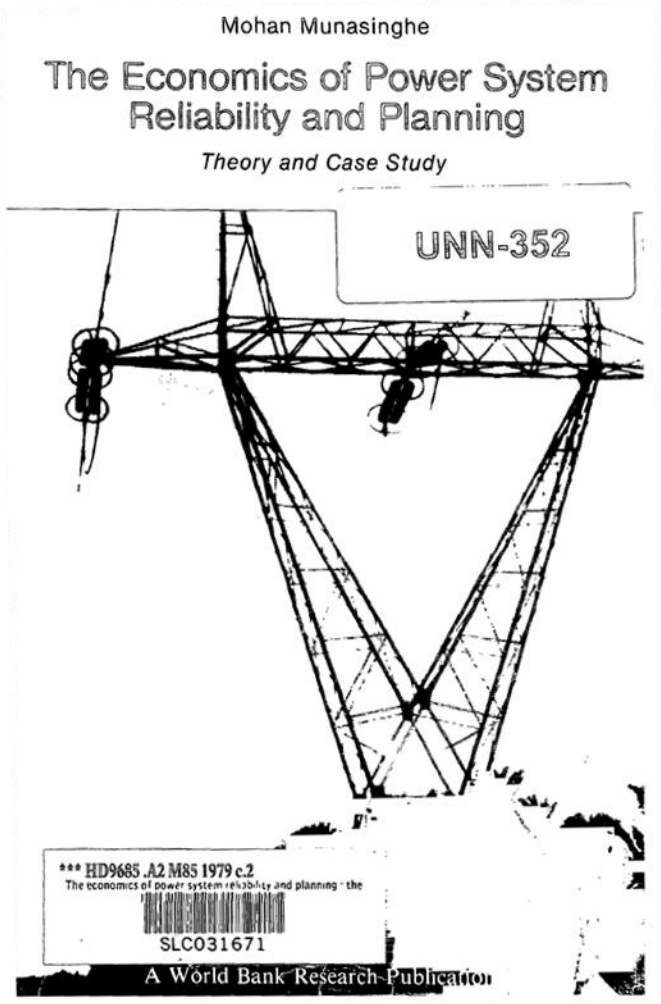

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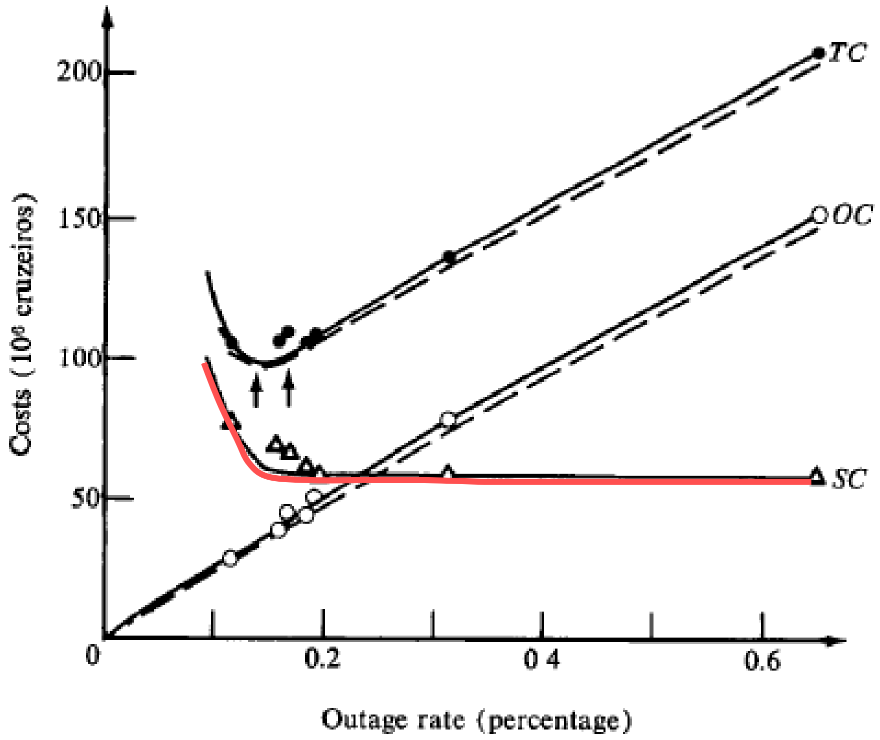

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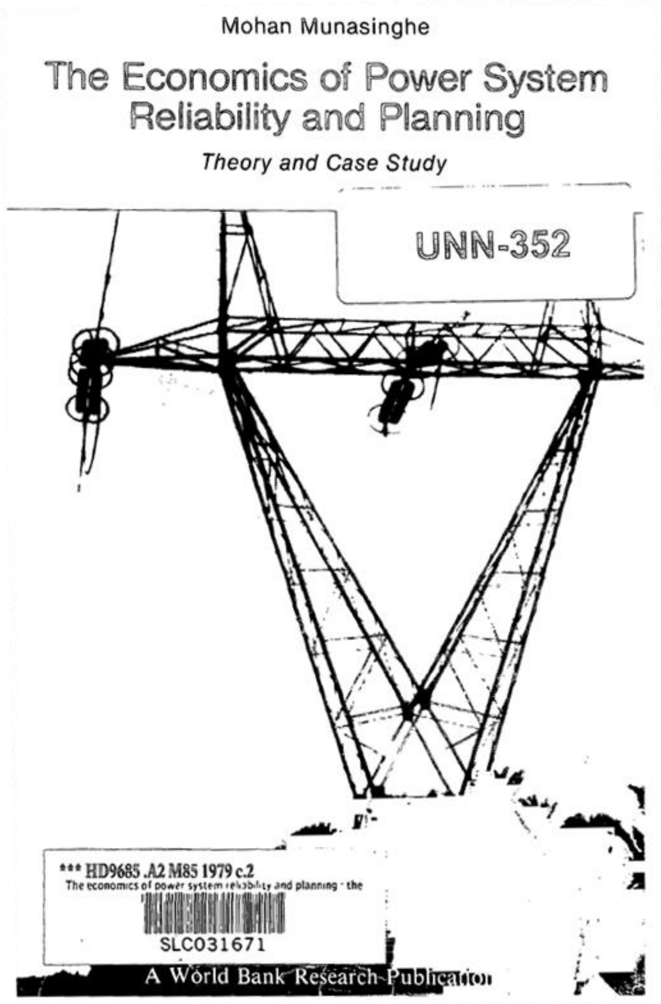

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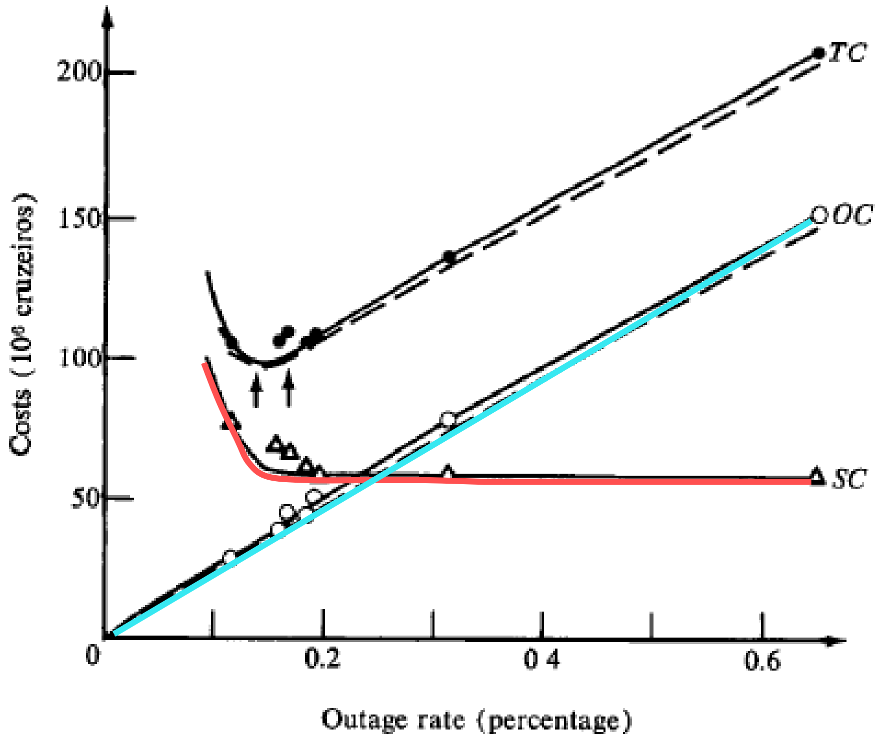

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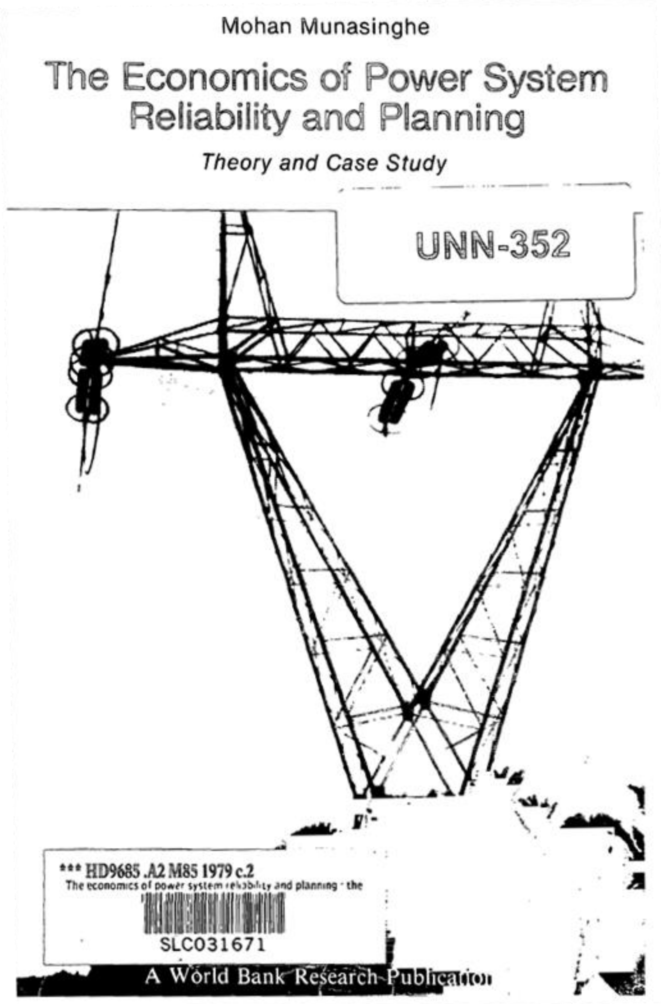

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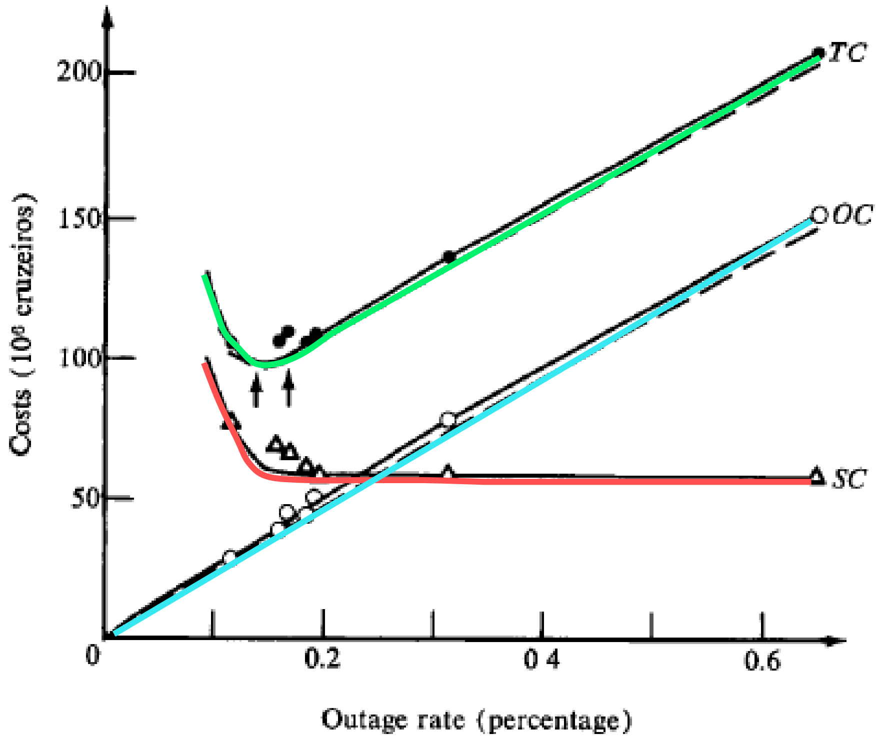

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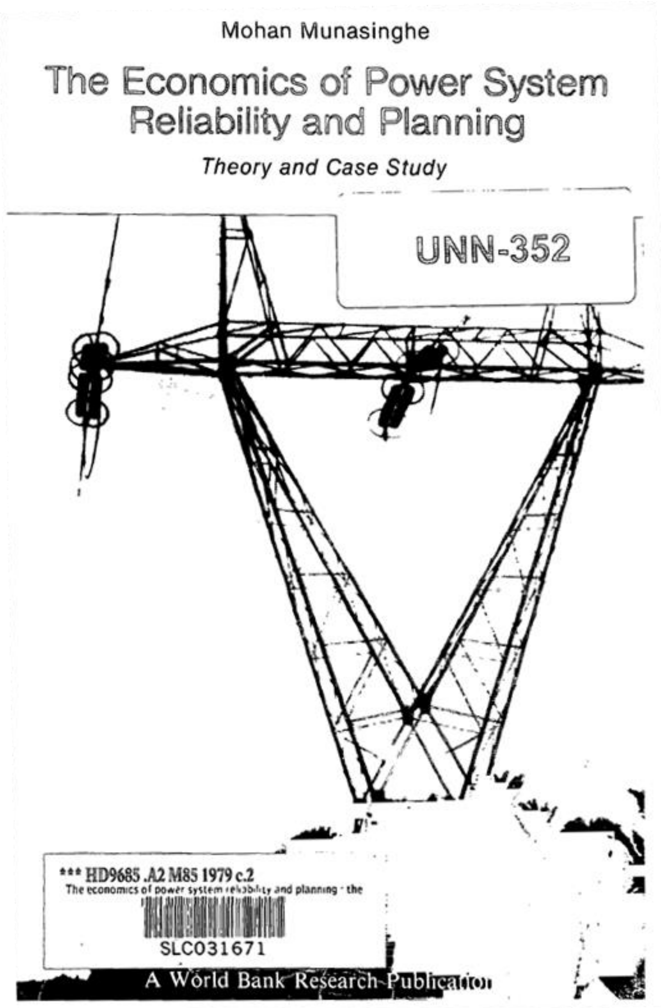

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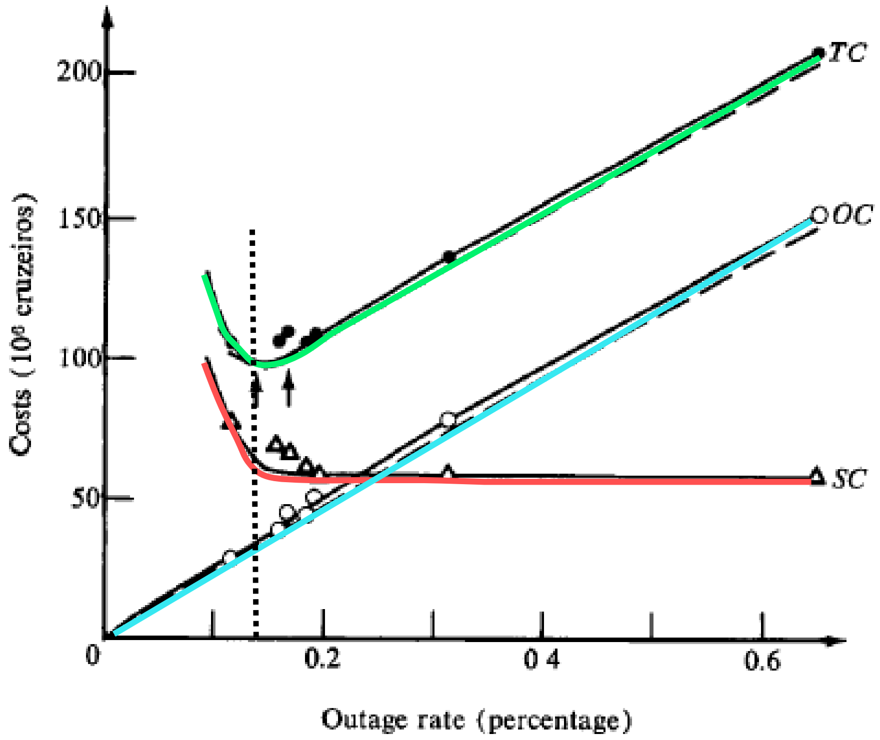

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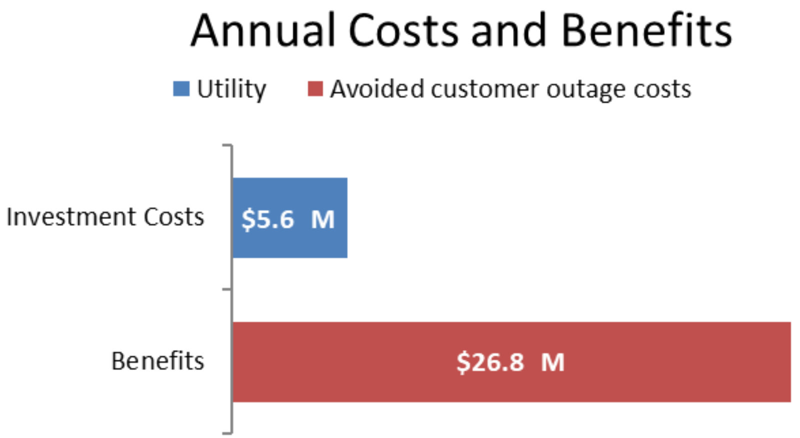
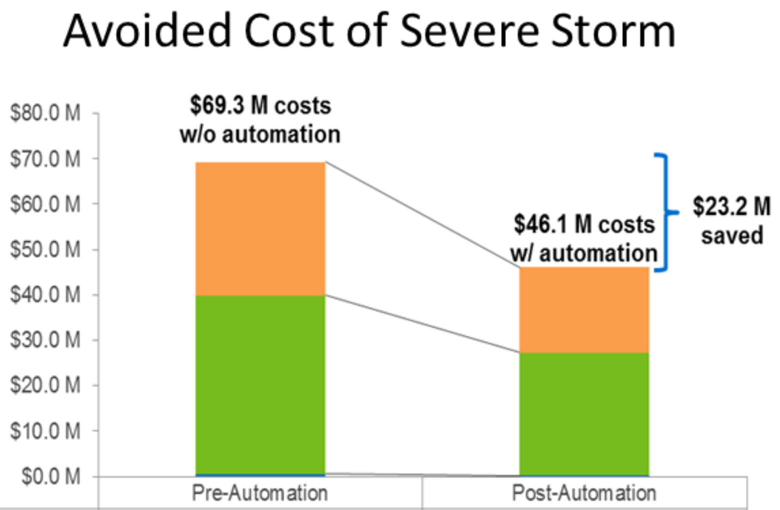
Value-Based Reliability Planning example: Distribution Automation

- Utility: EPB of Chattanooga
- Customers Impacted: 174,000 customers (entire territory)
- Investment: 1,200 automated circuit switches and sensors on 171 circuits
- Reliability Improvement:
  - SAIDI ↓45% (from 112 to 61.8 minutes/year)
  - SAIFI ↓51% (from 1.42 to 0.69 interruptions/year) (between 2010 and 2015)





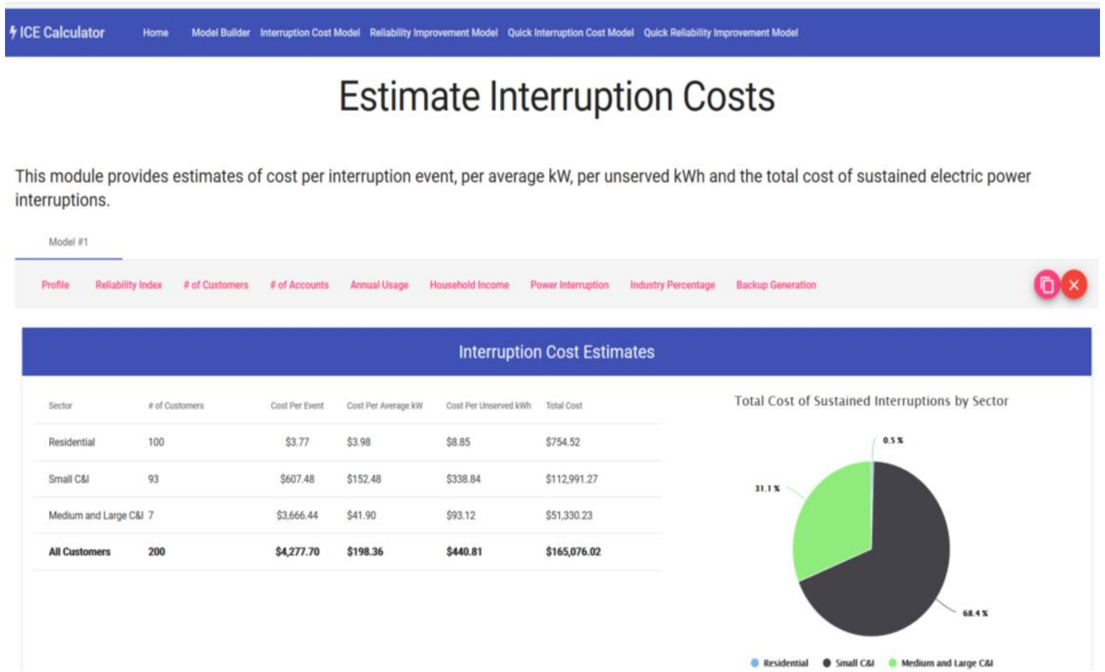
	Pre-Automation	Post-Automation
Large C&I	$29.4 M	$18.8 M
Small C&I	$39.3 M	$27.1 M
Residential	$0.6 M	$0.2 M

The Costs of Power Interruptions

Varies by type of customer and depends on when and for how long their lights are out

Interruption Cost	Interruption Duration				
	Momentary	30 minutes	1 hour	4 hours	8 hours
Medium and Large C&I					
Morning	$8,133	$11,035	$14,488	$43,954	$70,190
Afternoon	$11,756	$15,709	$20,360	$59,188	$93,890
Evening	$9,276	$12,844	$17,162	$55,278	$89,145
Small C&I					
Morning	$346	$492	$673	$2,389	$4,348
Afternoon	$439	$610	$818	$2,696	$4,768
Evening	$199	$299	$431	$1,881	$3,734
Residential					
Morning	$3.7	$4.4	$5.2	$9.9	$13.6
Afternoon	$2.7	$3.3	$3.9	$7.8	$10.7
Evening	$2.4	$3.0	$3.7	$8.4	$11.9

Interruption Cost Estimate (ICE) Calculator



http://www.icecalculator.com/

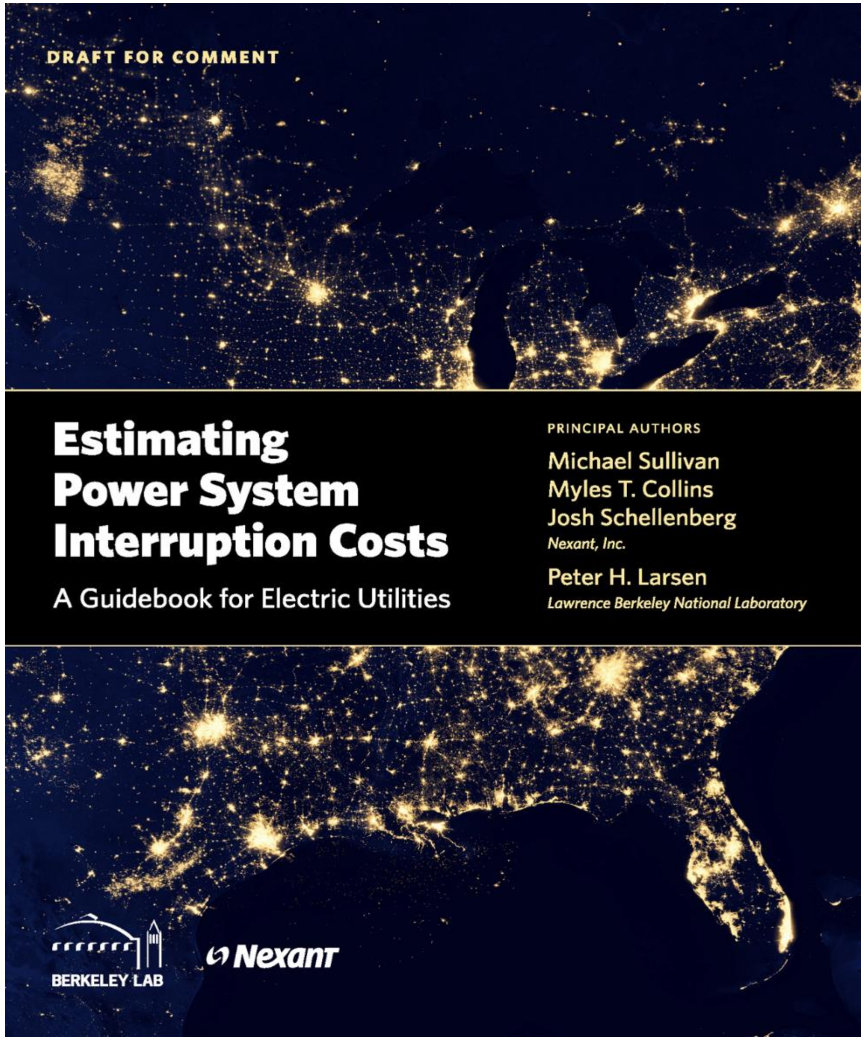
- ICE Calculator is an interactive tool for estimating customer interruption costs for a circuit, region, or utility service territory
- The ICE Calculator was developed using customer survey responses from 34 utility-sponsored Customer Interruption Cost (Value of Loss Load) studies

Utility "Value of Lost Load" surveys used to develop the ICE Calculator are old and not representative of the entire US

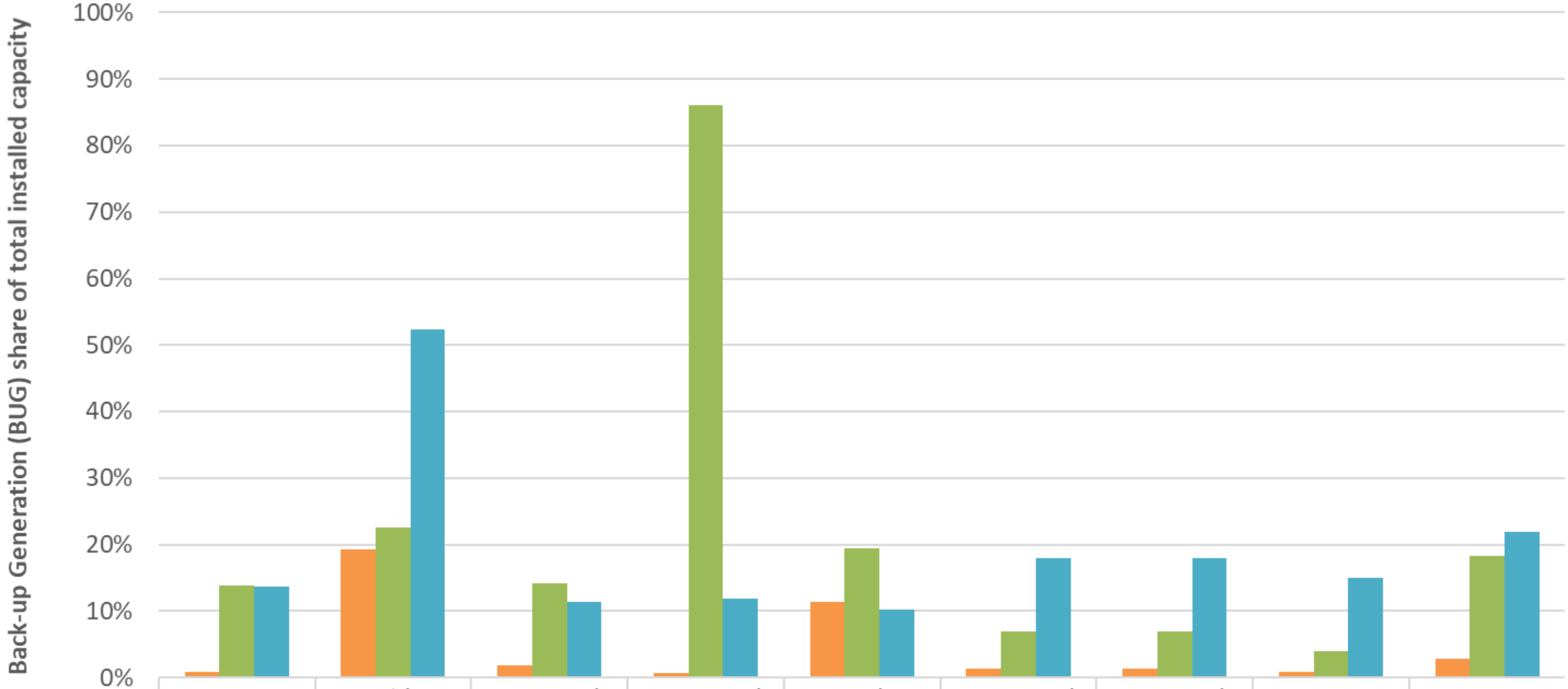
Utility Company	Survey Year	Number of Observations			Max. Duration (hours)
		Med and Large C&I	Small C&I	Residential	
Southeast-1	1997	90			1
Southeast-2	1993	3,926	1,559	3,107	4
	1997	3,055	2,787	3,608	12
Southeast-3	1990	2,095	765		4
	2011	7,941	2,480	3,969	8
Midwest-1	2002	3,171			8
Midwest-2	1996	1,956	206		4
West-1	2000	2,379	3,236	3,137	8
West-2	1989	2,025	5		4
	1993	1,790	825	2,005	4
	2005	3,052	3,223	4,257	8
	2012	5,342	4,632	4,106	24
Southwest	2000	3,991	2,247	3,598	4
Northwest-1	1989	2,210		2,126	8
Northwest-2	1999	7,091		4,299	12

Interruption Cost Guidebook for Utilities

- DOE-funded guidebook for utilities interested in conducting customer interruption cost surveys
- Details how to design and conduct survey(s) of power interruption costs for residential, commercial, and industrial customers
- Coordination with staff from multiple DOE offices, including Energy Information Administration
- https://emp.lbl.gov/publications/estimating-power-system-interruption



Customer adoption of back-up generation "reveals" an aspect of how much they "value" reliability

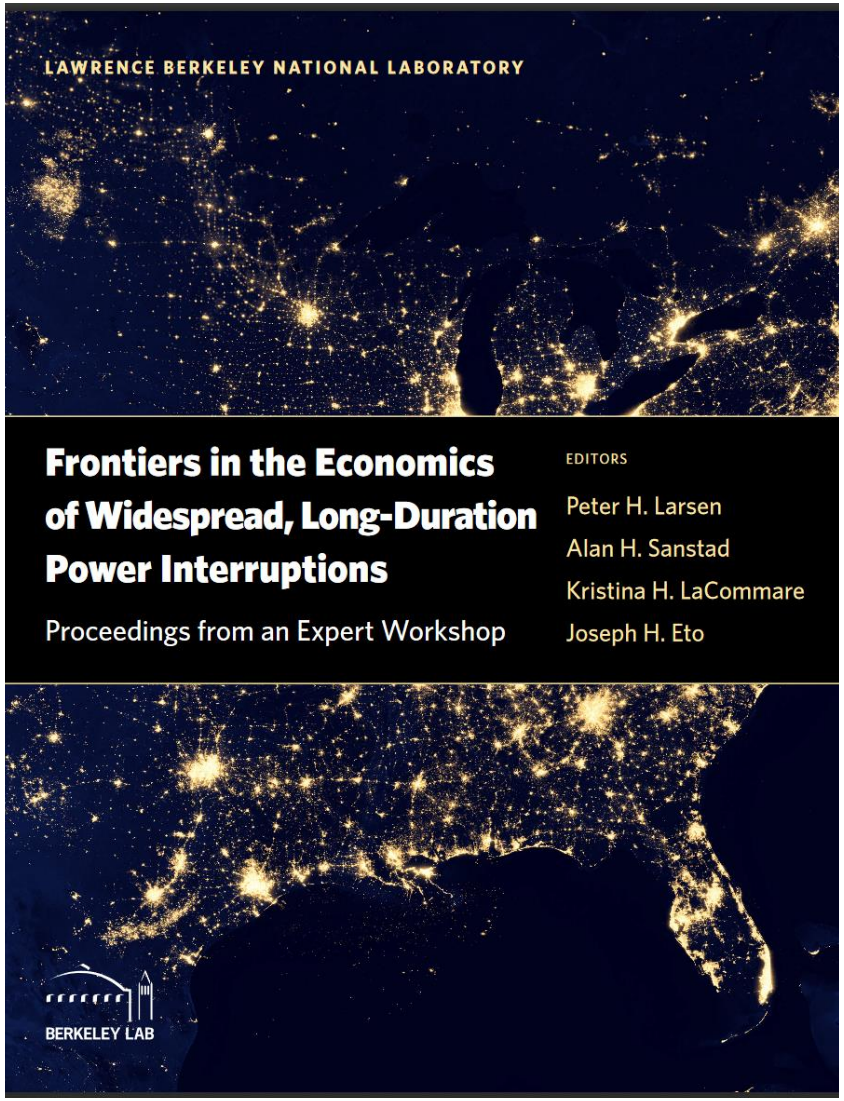


	New England	Mid-Atlantic	East North Central	West North Central	South Atlantic	West South Central	East South Central	Mountain	Pacific
Residential	1%	19%	2%	1%	11%	1%	1%	1%	3%
Commercial	14%	23%	14%	86%	19%	7%	7%	4%	18%
Industrial	14%	52%	11%	12%	10%	18%	18%	15%	22%

Source: Frost and Sullivan. 2015. "Analysis of the US Power Quality Equipment Market." Berkeley California: Lawrence Berkeley National Laboratory. LBNL-1003990. August. Accessible at: http://eetd.lbl.gov/sites/all/files/lbnl-1003990.pdf

Challenges with Estimating Economic Metrics

- ✓ Resilience/reliability **metrics related to economic impacts of power interruptions are necessary** to justify the cost-effectiveness of utility investments in reliability/resilience
- ✓ Customer costs from short-term, limited geographic-scale power disruptions have been estimated by utilities using survey-based elicitation techniques—but **available survey-based information (e.g., ICE Calculator) is dated, possibly biased, and not well-suited for long duration/widespread interruptions**
- ✓ Significant interest in estimating economic impacts from power interruptions that are of longer duration (days, weeks, or longer) and of a larger geographic scope (entire metropolitan areas or regions which may extend across multiple service territories)—but **regional economic models have not be used in regulatory proceedings, are data intensive, can be difficult to interpret, and do not consider non-commercial economic issues**
- ✓ **Improved estimates of the direct and indirect economic impacts of power interruptions will help justify future investments in reliability/resilience**



Some themes to keep in mind

“What's measured improves”
— Peter F. Drucker

“Delegating your accountabilities is abdication”
— Michael E. Gerber

“Not everything that can be counted counts, and not everything that counts can be counted”

— Albert Einstein

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- https://emp.lbl.gov/research/electricity-reliability

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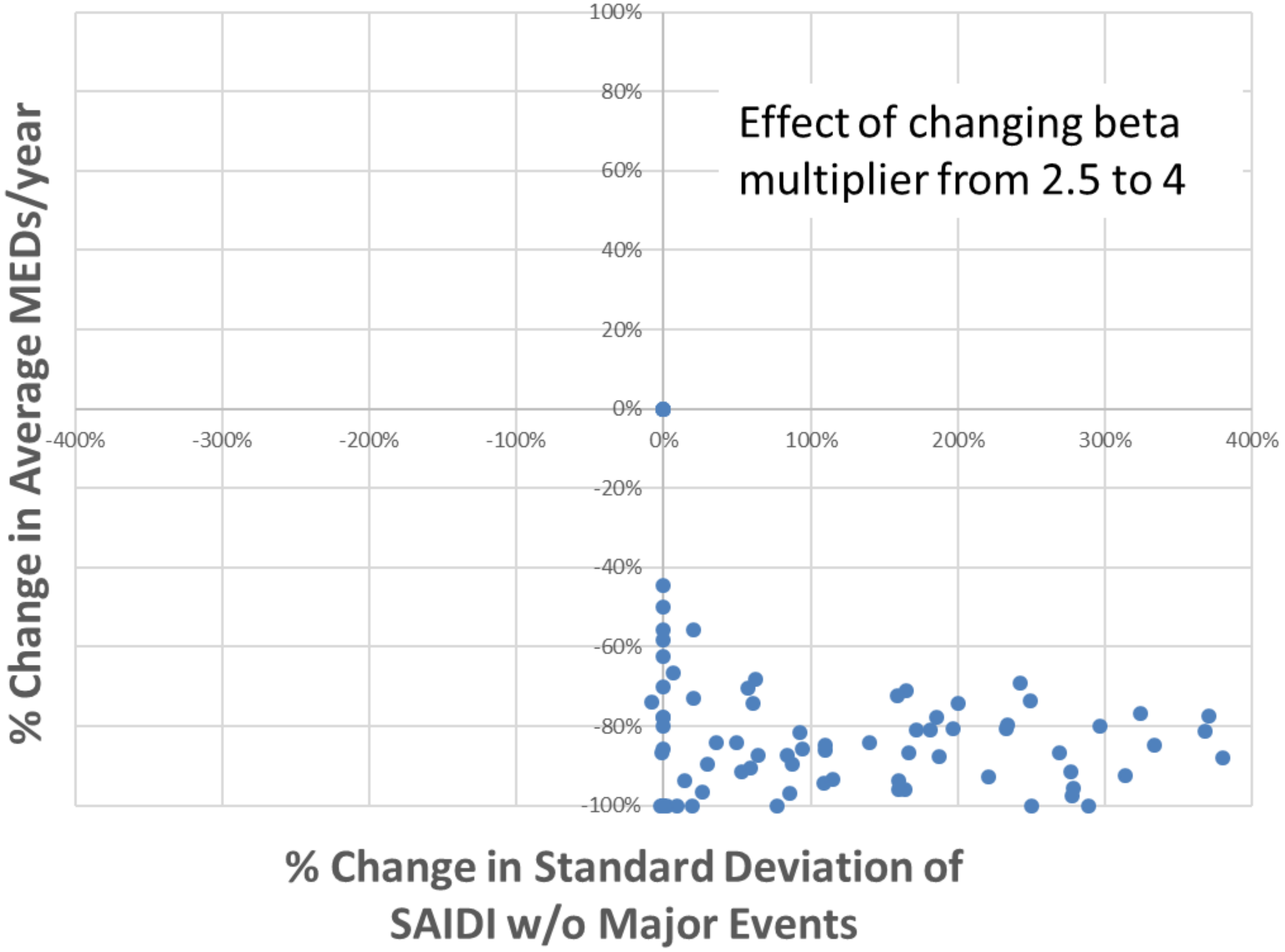
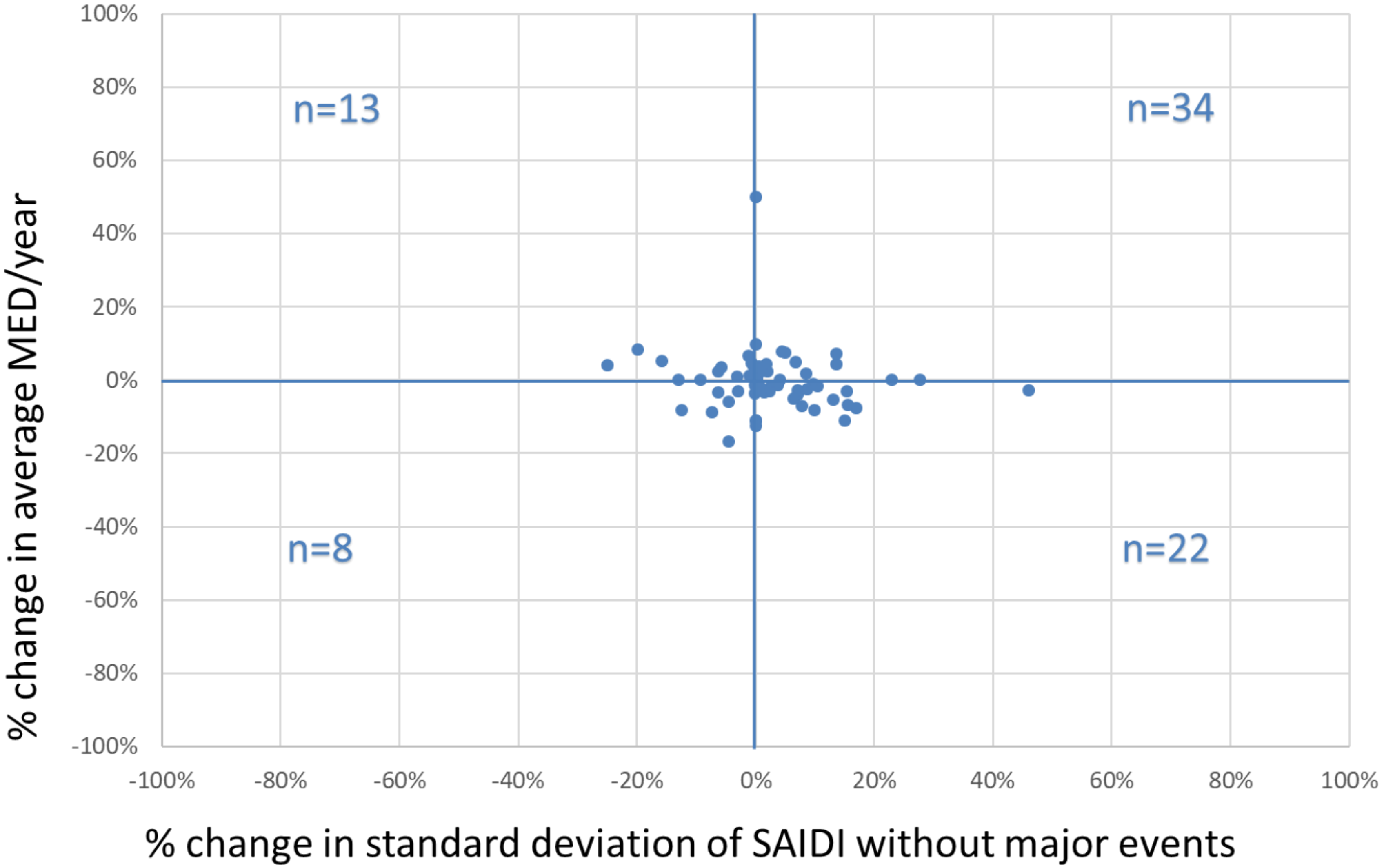
Evaluating the performance of alternatives to the Standard 1366 method



Source: Eto, J., K. LaCommare, M. Sohn, and H. Caswell. "Evaluating the Performance of the IEEE Standard 1366 Method for Identifying Major Event Days View Document." *IEEE Transactions on Power Systems* 32, no. 2 (2016).

The effect of using fewer historical years to calculate Tmed: 4 years



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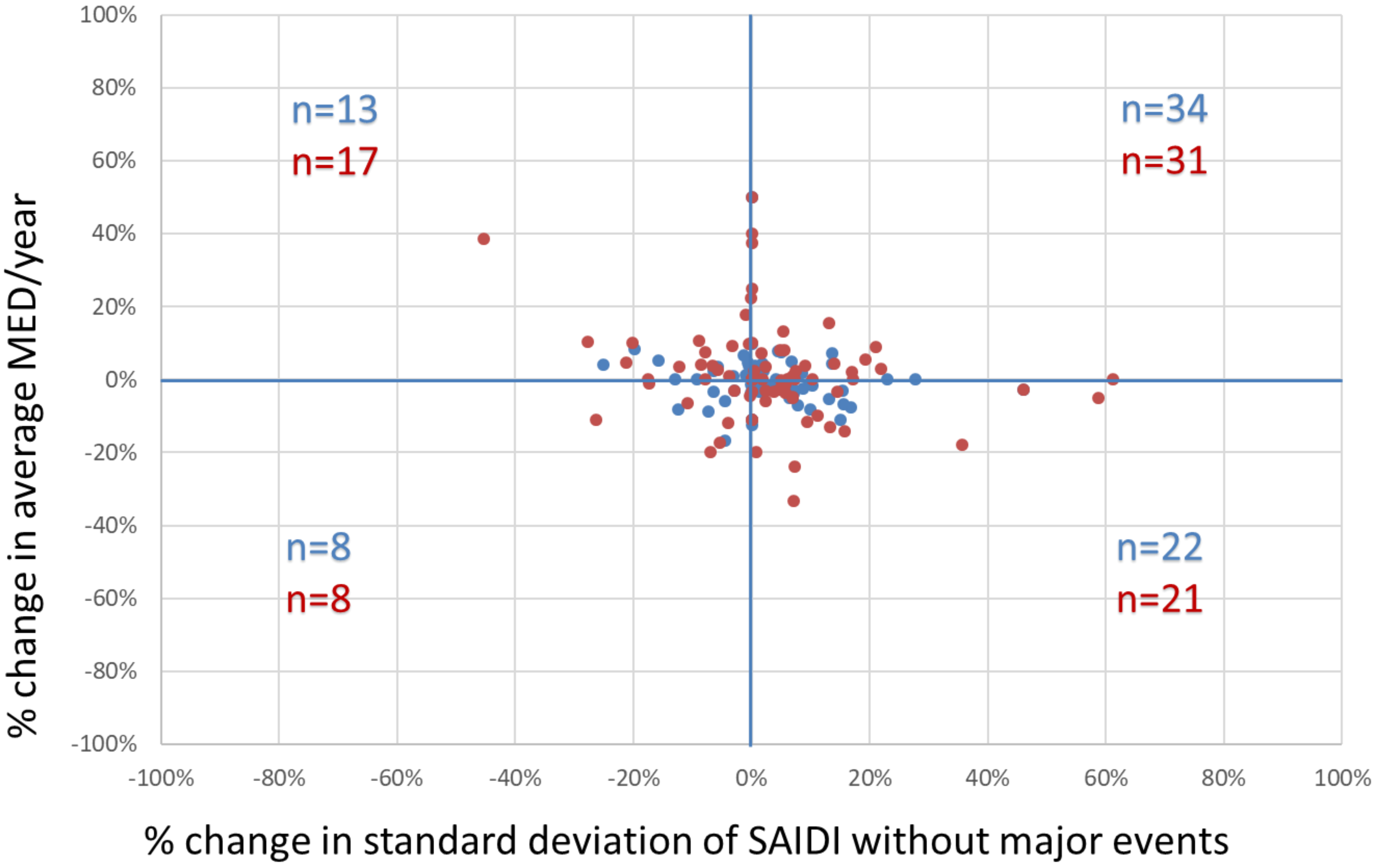
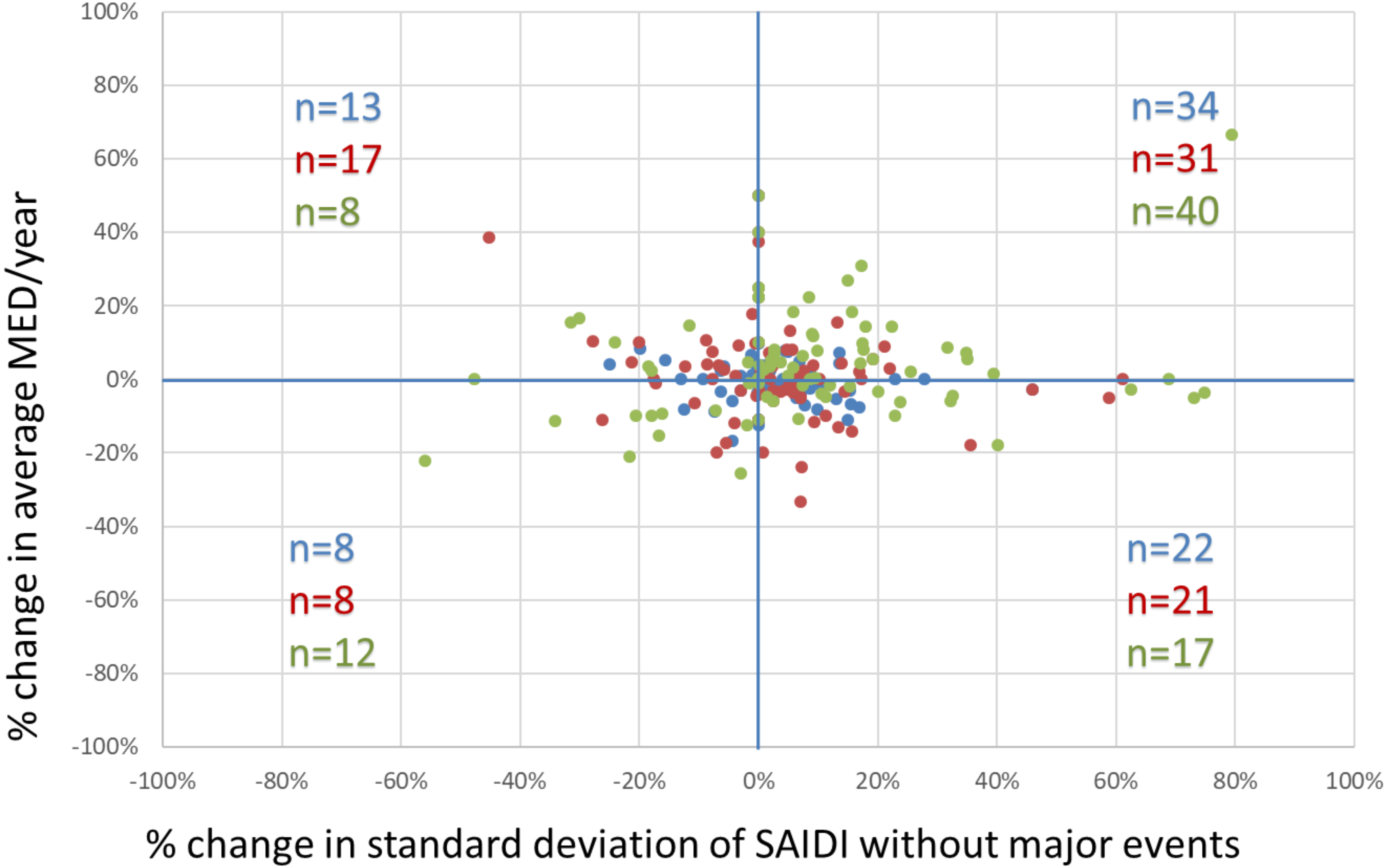
The effect of using fewer historical years to calculate Tmed: 4 years; 3 years



Source: Eto, J., K. LaCommare, M. Sohn, and H. Caswell. "Evaluating the Performance of the IEEE Standard 1366 Method for Identifying Major Event Days View Document." *IEEE Transactions on Power Systems* 32, no. 2 (2016).

The effect of using fewer historical years to calculate Tmed : 4 years; 3 years; 2 years



Source: Eto, J., K. LaCommare, M. Sohn, and H. Caswell. "Evaluating the Performance of the IEEE Standard 1366 Method for Identifying Major Event Days View Document." *IEEE Transactions on Power Systems* 32, no. 2 (2016).

LUNCH BREAK: 12:00 PM – 1:15 PM

- 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

MPSC
Michigan Public Service Commission

9:00 a.m.	Welcome & Introduction	Patrick Hudson, Manager, Smart Grid Section
9:10 a.m.	Hosting Capacity Analyses	Yochi Zakai, IREC
9:40 a.m.	Break	
9:50 a.m.	Tying it All Together - A Vision for Integrated Distribution Planning	Curt Volkmann, GridLab
10:20 a.m.	Break	
10:30 p.m.	Reliability and Resilience Metrics, and Reliability Value-Based Planning	Joseph Eto, Lawrence Berkeley National Lab
12:00 p.m.	Lunch (local restaurants available)	
1:15 p.m.	Consumers Energy: Response to Pilot Proposal Comments	Consumers Energy
1:30 p.m.	DTE: Response to Pilot Proposal Comments	DTE
1:45 p.m.	I&M: Response to Pilot Proposal Comments	Indiana Michigan Power
2:00 p.m.	Michigan Utility Reliability Reports	Joseph Eto, Lawrence Berkeley National Lab
2:45 p.m.	Break	
3:00 p.m.	Stakeholder Discussion: Resiliency in Michigan – What Matters and How Should it be Valued?	Facilitator: Joseph Eto Lawrence Berkeley National Lab
3:50 p.m.	Closing Statements & Docket Responses	MPSC Staff
4:00 p.m.	Adjourn	

Consumers Energy Response to Pilot Proposal Comments

Don Lynd

September 18, 2019

Hosting Capacity Analysis/Solar Zone comments

- Comments called for full HCAs in next filed plan with maps, robust public data, etc.
  - Full HCAs require significant human and computing resources
  - DER penetration is at an early stage, and resources are better prioritized on core reliability issues
  - Interconnection study process is already facilitating integration of proposed solar DERs, which give developers good information
  - If DER penetration increases in future years, the Solar Zone pilot will help put necessary tools and capabilities in place

Hosting Capacity Analysis/Solar Zone comments

- Suggested CBA to help illustrate expected value of Solar Zone
  - Open to further discussion of details of this; CBAs will be discussed October 16th

- Clarifying questions
  - Purpose of mini interconnection study
  - Areas appropriate for solar generation
  - Purpose of collector network
  - Use of utility-owned resources in testing
  - Purpose of socializing interconnection costs

Non-Wires Alternative Comments

- Recommendation for “targeted solicitations”
  - Existing (DR/EE) and new (i.e. behind-the-meter batteries) programs used in a targeted manner on specific customers – similar to targeted procurement
  - Value exists in leveraging existing programs and gaining experience with them
  - Use of utility programs broadly in line with industry

- Recommendation for more discussion of metrics and suitability criteria
  - NWA pilot suitability criteria get refined through lessons learned
  - Metrics – such as targeted load reduction – are refined through pilot lessons learned as well

- Utilities remain in the best position to interface directly with customers

General Pilot Comments

- Proposed MPSC cost limits on pilots
  - Pilots are very diverse, no one-size-fits-all limit is needed; rate cases and other proceedings must approve pilot costs

- Avoiding “perpetual pilots”
  - Correctly designed pilots can be scaled up if successful; if not successful, further testing may be required
  - Past pilots in EE and DR have been scaled up into full programs

- Role of NWA and HCA in planning process
  - Planning explained in 2018 EDIIP; NWA pilots test if solutions can be considered by planners
  - Role of HCA in planning to be determined as capabilities develop

Five-Year Distribution Plan

Perspective on Select Stakeholder Comments on Non-Wire Alternative and Hosting Capacity Pilots

September 18, 2019

Perspective on select stakeholder comments

Hosting Capacity Analysis

- DTE is continuing its work on a Hosting Capacity Analysis pilot and is investigating the cost and potential timing
- The value of full Hosting Capacity Analysis for Michigan has not been proven in light of its likely high cost and complexity

Non-Wire Alternatives

- The ongoing NWA pilots are necessary to determine the cost effectiveness and feasibility of NWAs to address specific situations
- In the long run, DTE envisions that NWAs may become one of the tools available to distribution planning engineers to address system issues should they prove effective from a timing and cost perspective

Perspective on select stakeholder comments (cont.)

Service Procurement

- DTE supports partnering with third-party providers when it is in the best interest of its customers, with due consideration given to the complexity that such partnerships can introduce into planning processes
- Opportunities to develop such partnerships will continue to be evaluated on a case by case basis

Benefit Cost Analysis

- DTE utilizes its Global Prioritization Model, which is similar in nature to the risk-informed decision support system, to prioritize investments in a way that best supports customer and system needs
- DTE is prepared to work with potential BCA frameworks that emerge from the ongoing stakeholder collaborative

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I&M Distribution Pilot Non-Wires Alternative

Michigan Public Service Commission
Five-Year Distribution Planning
September 18, 2019

Planning for the grid of the future

- Hosting Capacity
- Load and Distributed Energy Resources (DER) Forecasting
- Non-Wires Alternatives (NWA)
- Cost Benefit Analysis

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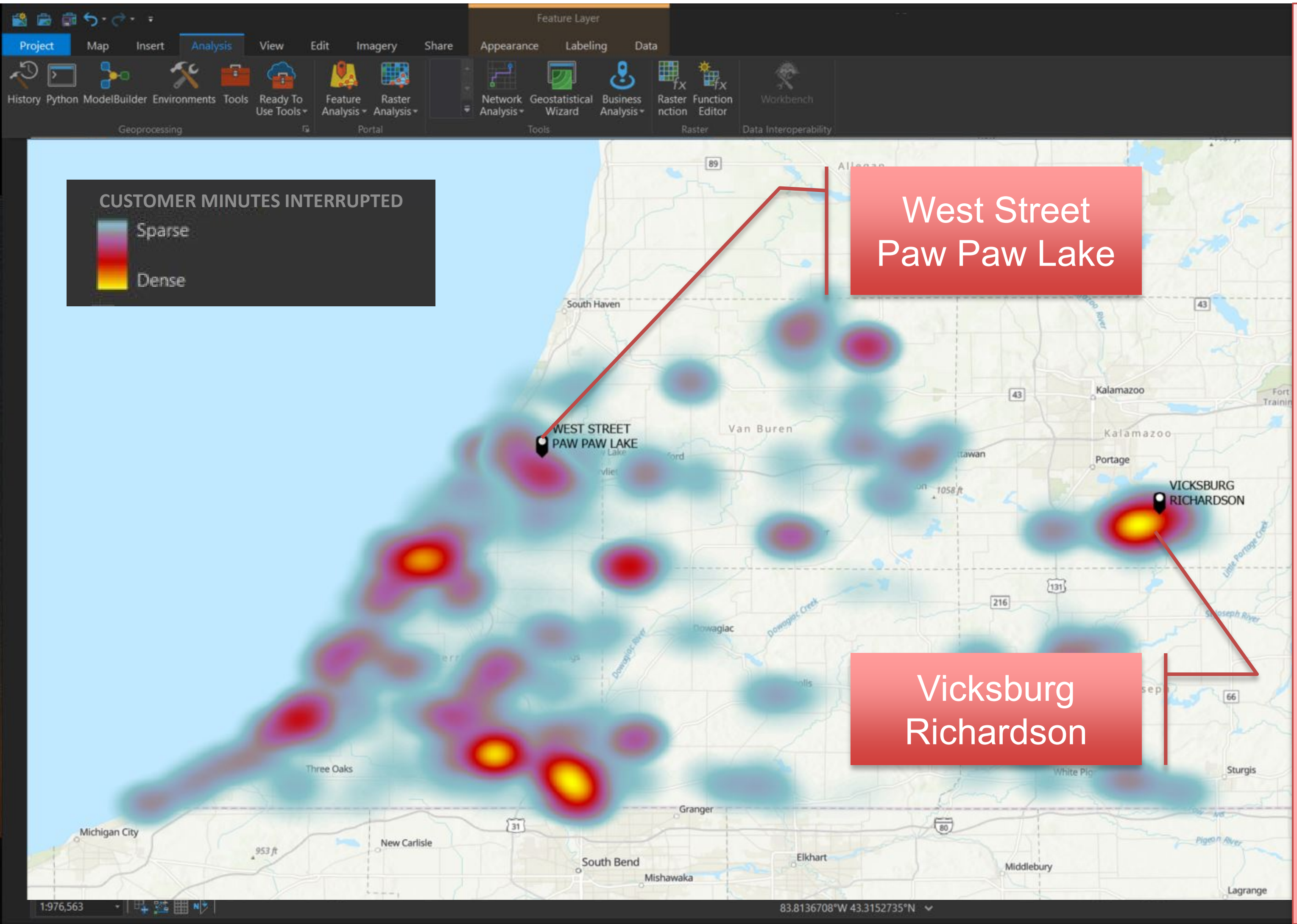
Objectives of NWA pilots

- Solve real world problems: improve reliability (& potentially enhance resiliency)
- Test new approaches
  - Use newer technologies (DER/Microgrid)
  - Include DSM / EE in optimizing NWA component sizing
  - Influence customer behavior
- Leverage learnings and insights to assess costs and benefits of NWA opportunities

Data analytics identified candidate locations



Approach:

- Analyzed recent years of historical outage data
- Leveraged experience of local personnel
- Created heat maps defining outlier outage areas

Selection Criteria:

- Circuit reliability performance (SAIDI, CAIDI, SAIFI, CEMI, CMI, etc.)
- Wide applicability of learnings

Common Attributes of Candidate Locations:

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

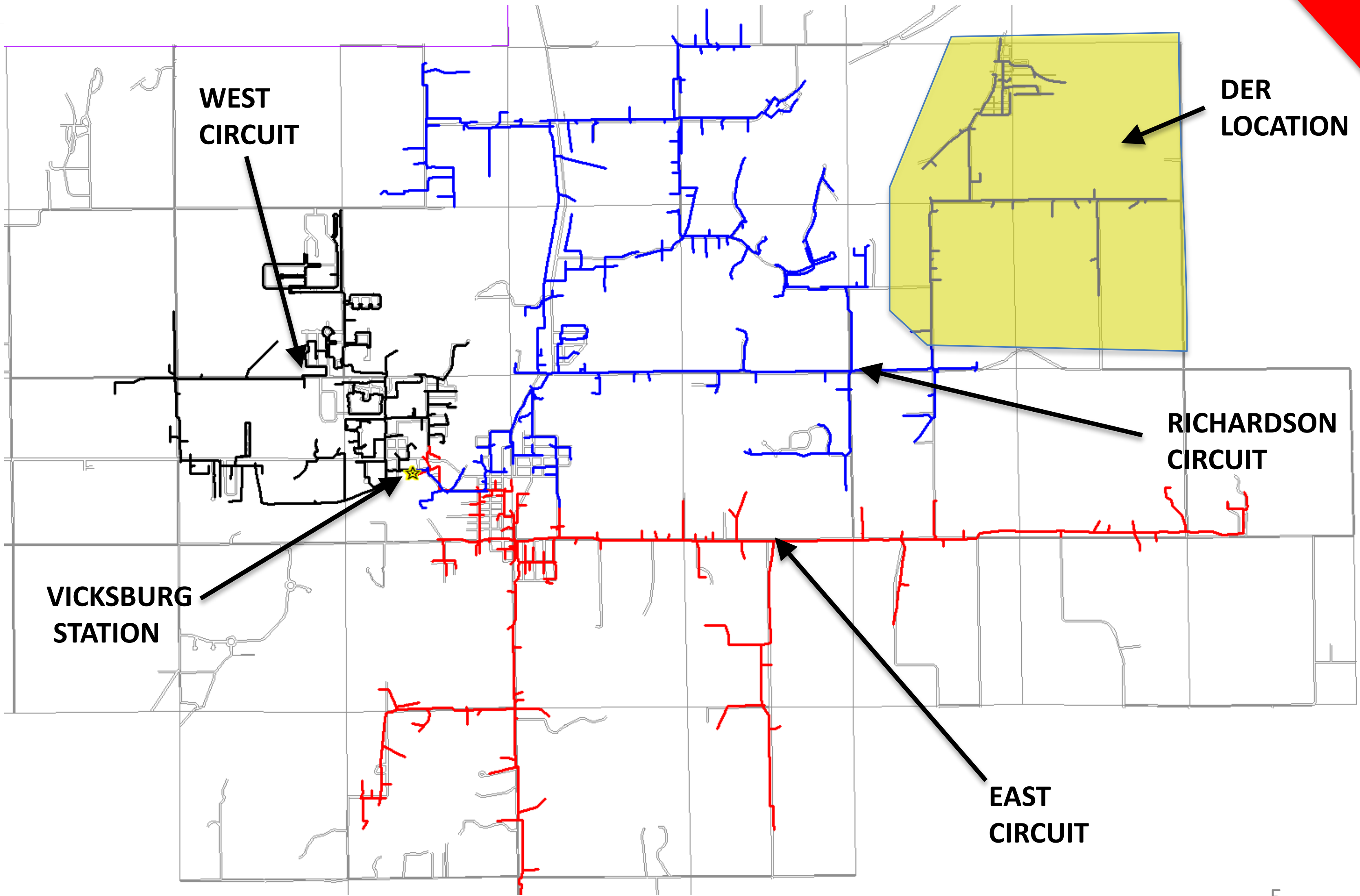
Vicksburg Richardson circuit

PRELIMINARY

Vicksburg Station

- Richardson Circuit
- Serves 383 Premises Downstream of Recloser KA0571000016 (Mostly Residential, 1 Elementary School, 1 Church)

Customer perspective: This solution would have eliminated 4 outages in the last 3 years, representing a total of 20.5 hours



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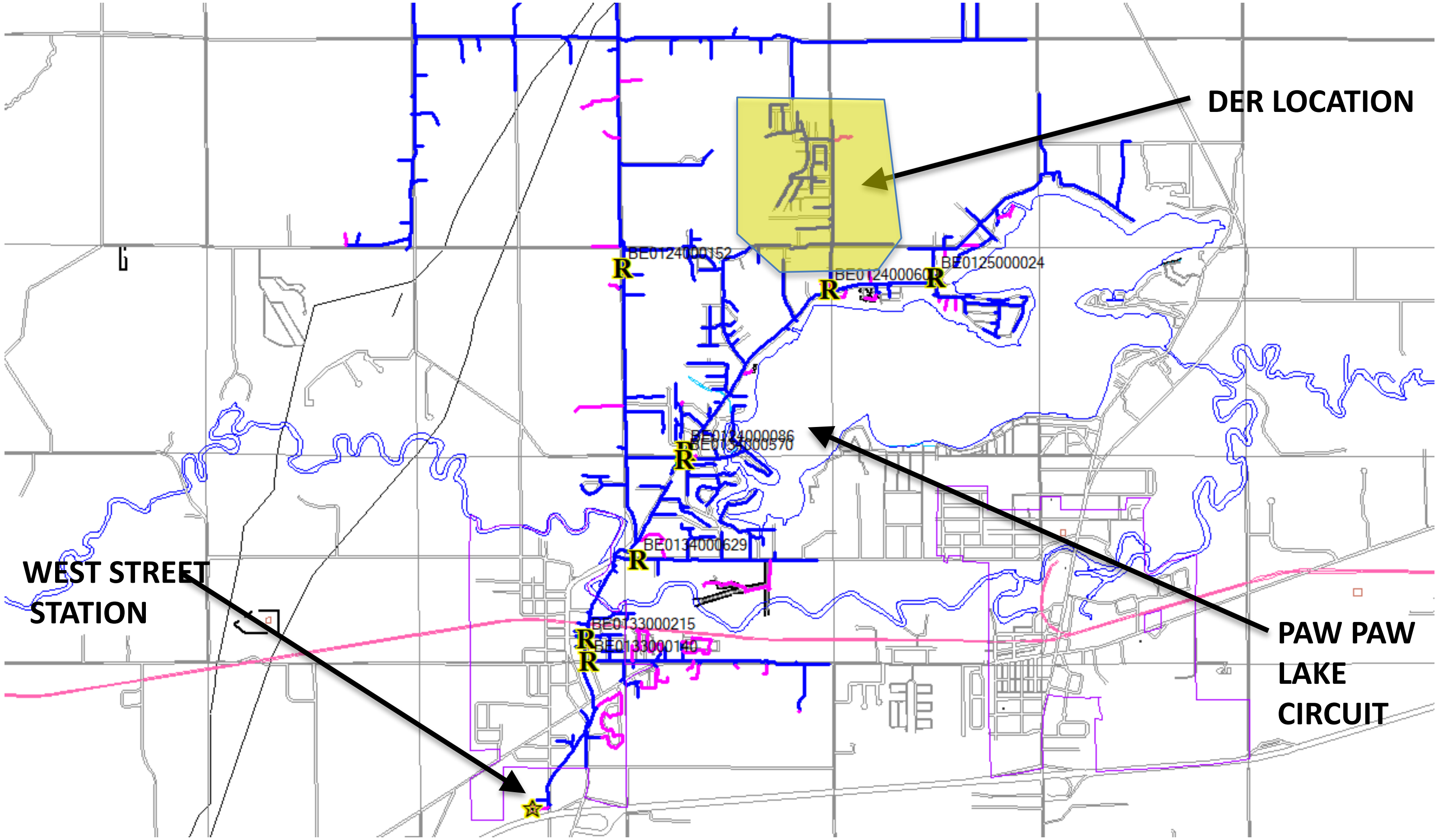
PRELIMINARY

West Street Paw Paw Lake circuit

West Street Station

- Paw Paw Lake Circuit
- Serves 64 Premises Downstream of Fuse BE0114000016 (Mostly Residential)

Customer perspective: This solution would have eliminated 12 outages in the last 3 years, representing a total of 50 hours



Summary of proposed pilot(s)

- Pilot will serve an islanded segment of the grid during outage conditions
- Pilot will consist of a distributed generation source and battery energy storage
- The load served by the DERs will be islanded from the grid by means of Automated Circuit Reconfiguration utilizing smart reclosers
- Demand Side Management (DSM) and Energy Efficiency (EE) will be employed to optimize component sizing
- Implementation of AMI will enable greater operational benefits and customer engagement

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Learning objectives

- Test effectiveness of microgrid / DER technologies in improving reliability and other grid functions (I.E. resiliency, peak shaving, power quality, etc.)
- Validate assessments of data analytics & technical knowledge in optimizing NWA deployment.
- Measure short term and long term performance of the various components of the microgrid. Leverage learning to optimize system performance
- Assess ability to engage customers and improve customer experience with DSM solutions
- Provide information / lessons to the MPSC on impact of pilot(s)

Understanding costs and benefits of new solutions

- The data and experience needed to quantify grid and customer benefits (and costs) are limited
- The proposed pilot(s) will provide baseline data to inform future opportunity assessment

Potential KPIs

- Improved reliability: SAIDI, etc.
- Customer outage reduction %
- DSM customer participation %
- Capital and operating expenses: actual/estimated
- System performance: actual/estimated

Next steps

- Solicit and incorporate feedback on pilots
- Submit fully developed proposal

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Questions?

Michigan Utility Reliability Reports

Joseph H. Eto

Lawrence Berkeley National Laboratory

Five-Year Distribution Planning Stakeholder Meeting

Lansing, MI, September 18, 2019

Overview of this talk

Michigan utilities use reliability metrics to support a variety of reliability-related activities, including:

- Establishing and assessing utility performance relative to targets
- Establishing a basis for customer payments when utility performance is below a threshold
- Understanding reliability delivered to specific groups of customers
- Benchmarking utility performance
- Providing a basis for identifying, prioritizing, and directing utility actions to improve reliability
- Measuring utility performance resulting from smart grid investments

This talk illustrates how Michigan utilities have supported these activities through the use of reliability metrics by presenting examples drawn from various reports they file with the Michigan PSC

This talk is not an assessment of the reliability performance of Michigan utilities

Review of these current practice establishes a basis for discussing of how they might or could evolve to support focus on utility efforts to address the resilience of the electric distribution system

Chronology of reporting on reliability metrics by Michigan electric utilities

2002 Regulated utilities and cooperatives begin filing annual service quality and reliability reports

2004 MPSC "Service Quality and Reliability Standards for Electric Distribution Systems" prescribes reliability metrics, performance targets, and customer payments based on performance

2009 Annual reporting expanded for Consumers and DTE: IEEE Standard 1366 adopted, power quality (PQ) events affecting primary service customers

2013 Governor Snyder articulated reliability goals: SAIFI (1.0) and SAIDI (150 min), both excluding major events

2014 Following a major storm in Dec 2013, annual reporting expanded for all utilities; Consumers and DTE directed to report additional reliability information

2018 Consumers, DTE, and I&M began filing 5-year distribution investment and maintenance plans and annual reports on smart grid metrics

Michigan utility reporting following U-12770

Type of Measurement	Meter Reading	New Service Installation	Complaint Response	Average Call Answer Time	Call Blockage	Outage Restoration: Normal Conditions	Outage Restoration: Catastrophic Conditions	Outage Restoration: All Conditions	Same Circuit Repetitive Interruption	Wire-Down Relief
Performance Measurement	Percentage of meters read	Percentage of new services installed in 15 business days or less	Percentage of formal complaints responded to in 3 business days or less	Average call answer time (Seconds)	Percentage of calls blocked	Percentage of customers restored in 8 hours or less	Percentage of customers restored in 60 hours or less	Percentage of customers restored in 36 hours or less	Percentage of circuits experiencing 5 or more outages per 12 months	Percentage of response to wire down relief requests in 6 hours or less
January	96.1%		100%	40	3.35%	100%	100%	100%		100%
February	96.0%		100%	39	3.52%	100%	100%	100%		100%
March	95.3%		100%	35	3.20%	100%	100%	100%		100%
April	95.4%		100%	34	3.01%	100%	100%	100%		100%
May	98.0%		100%	39	3.86%	95.9%	100%	100%		100%
June	98.2%		100%	38	3.87%	99.2%	100%	100%		100%
July	98.2%	99.6%	100%	36	3.71%	99.4%	100%	100%	0.3%	100%
August	98.6%		100%	35	3.55%	96.3%	100%	100%		100%
September	98.5%		100%	35	3.62%	92.9%	100%	100%		100%
October	98.4%		100%	34	3.59%	100%	100%	100%		100%
November	97.5%		100%	34	3.55%	94.8%	100%	100%		100%
December	97.5%		100%	34	3.53%	100%	100%	100%		100%
YTD Average	**97.3%**	**99.6%**	**100%**	**34**	**3.53%**	**97.7%**	**100%**	**100%**	**0.3%**	**100%**
MPSC Proposed Annual Target	85% or more	90% or more	90% or more	90 seconds or less	5% or less	90% or more	90% or more	90% or more	5% or less	90% or more
Annual Target Met	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Comments (see below)	1	2		3	4				5	6

Customer Credits	Number	Total Dollars
Repetitive Outages - more than 7 outages in the last year	8	$200.00
Outage Restoration - greater than 16 hours under normal conditions	0	$0.00

Catastrophic Conditions	Date	% Cust. Outaged
Flood - State of Emergency Declared	6/17/2018	2%

Source: Electric Performance Measurements Report of Upper Peninsula Power Co., March 29, 2019

Catastrophic storms are generally captured as major event days, but not all major event days involve catastrophic storms

Year	# MEDs During DTE Catastrophic Storms	# MEDs During DTE Non-Catastrophic Storms And Normal Conditions
2009	3	3
2010	3	9
2011	7	10
2012	8	2
2013	9	1
2014	9	0
2015	1	2
2016	2	0
2017	6	3
2018	4	5

Source: DTE Electric Co. 2018 Report to MPSC Regarding Electric Distribution System Power Quality, May 6, 2019

Causes of interruption must sometime be interpreted w/r/t an initiating cause (e.g., weather)

	Percent of Customers Interrupted				
Conditions	**Trees**	**Equipment**	**Ice**	**Wind**	**All Other**
Catastrophic Storms	54.1 %	5.5 %	16.7 %	10.4 %	13.3 %
Small Storms	61.1 %	18.9 %	1.3 %	8.3 %	10.3 %
Non-Storm	47.0 %	35.5 %	0.3 %	0.6 %	16.6 %
All Conditions	51.1 %	26.3 %	3.8 %	4.1 %	14.7 %

Source: DTE Electric Co. 2018 Report to MPSC Regarding Electric Distribution System Power Quality, May 6, 2019

CEMIn and CELIDt measure impacts of power interruptions on individual customers

Index	Full Name	Calculation
CEMIn	**C**ustomers **E**xperiencing **M**ultiple **I**nterruptions of **n** or More	Count of the number of Customers with n or more interruptions
CELIDt	**C**ustomers **E**xperiencing **L**ong **I**nterruption **D**uration of **t** or More Hours	Count of the number of Customers with interruptions lasting t or more hours

Source: DTE Electric Company's Distribution Operations Five-Year (2018-2022) Investment and Maintenance Plan Final Report, January 31, 2018

CEMIn measures the number of repeated interruptions experienced by individual customers

Table 6 – Customers Experiencing Multiple Interruptions by Year

CEMI by Year											
	% of Customers experiencing X interruptions										
Year	0	1	2	3	4	5	6	7	8	9	10+
2013	30%	30%	19%	11%	6%	2%	1%	1%	0%	0%	0%
2014	38%	32%	18%	7%	3%	1%	0%	0%	0%	0%	0%
2015	40%	30%	15%	8%	4%	2%	1%	0%	0%	0%	0%
2016	40%	30%	15%	7%	4%	2%	1%	0%	0%	0%	0%
2017	37%	29%	17%	8%	4%	2%	1%	1%	0%	0%	0%

Source: Consumers Energy Company's Electric Distribution Infrastructure Investment Plan, April 13, 2018

CELIDt measures the amount of time customers are without power during an interruption

TABLE 7 – CUSTOMERS EXPERIENCING LONG INTERRUPTION DURATION

CELID by Year								
Year	% of Customers experiencing interruptions less than or equal to...							
	8 Hrs	24 Hrs	36 Hrs	48 Hrs	60 Hrs	72 Hrs	96 Hrs	120 Hrs
2013	71%	86%	90%	93%	95%	96%	98%	99%
2014	84%	95%	97%	99%	100%	100%	100%	100%
2015	85%	94%	96%	98%	99%	99%	100%	100%
2016	88%	99%	100%	100%	100%	100%	100%	100%
2017	79%	90%	96%	97%	99%	99%	100%	100%

Source: Consumers Energy Company's Electric Distribution Infrastructure Investment Plan, April 13, 2018

CELIDt measures the amount of time customers are without power during an interruption

CELID - Single Interruption Duration	# Customers
CELID 8 hours - MPSC Normal Conditions	220,502
CELID 16 hours - MPSC Normal Conditions	85,329
CELID 60 hours - MPSC Catastrophic Conditions	10,060
CELID 120 hours - MPSC Catastrophic Conditions	98

Source: DTE Electric Co. 2018 Report to MPSC Regarding Electric Distribution System Power Quality, May 6, 2019

Identification of worst performing circuits provides a more granular view of the reliability experienced by customers

2A. Reliability Performance - 5 Worst Performing SAIDI Circuits - System Basis

	Circuit Name and Number	Substation	Location	Circuit Miles	Customers Served	SAIDI All Wthr Sys Basis	SAIDI ex MEDs Sys Basis	SAIDI All Wthr Cct Basis	SAIDI ex MEDs Cct Basis	Last Tree Trimming
1	WEBST1948	Webster	Royal Oak	10.4	1,586	2.88	0.0115	3,977	16	2013
2	WAYNE9421	Wayne	Canton Twp	32.8	2,475	2.27	0.0263	2,011	23	2015
3	APPOL1270	Appoline	Detroit	8.3	1,491	2.25	0.0361	3,306	53	2018
4	CASVL8805	Caseville	Caseville Twp	53.2	1,986	2.06	0.2150	2,276	237	2014
5	NEFF 0314	Neff	Sand Beach Twp	62.7	1,075	2.03	1.0761	4,137	2,194	2016

2B. Reliability Performance - 5 Worst Performing SAIDI Circuits - Circuit Basis

	Circuit Name and Number	Substation	Location	Circuit Miles	Customers Served	SAIDI All Wthr Sys Basis	SAIDI ex MEDs Sys Basis	SAIDI All Wthr Cct Basis	SAIDI ex MEDs Cct Basis	Last Tree Trimming
1	TAYLR9483	Taylor	Taylor	15.1	613	1.62	0.0626	5,775	224	2012
2	TIRMN1368	Tireman	Detroit	6.5	946	2.00	0.4621	4,637	1,070	2012
3	CRTIS1330	Curtis	Detroit	3.4	510	1.04	0.0684	4,453	294	2011
4	BERKY2681	Berkley	Berkley	5.4	833	1.65	0.0229	4,332	60	2009
5	APPOL1383	Appoline	Detroit	6.3	936	1.82	0.0105	4,268	24	2018

Source: DTE Electric Co. 2018 Report to MPSC Regarding Electric Distribution System Power Quality, May 6, 2019

Outage management systems (OMS) are designed to record information on every power interruption

Ref #	Metric	Rank	Circuit Name and Number	MED	Storm	Interruption Date/Time	Customers Interrupted	Customer Minutes Interrupted	Cause
2A-1	SAIDI	1	WEBST1948	-		01/08/18 19:03	1	18	Equipment
2A-1	SAIDI	1	WEBST1948	-	Small	01/12/18 16:00	1	1,145	Equipment
2A-1	SAIDI	1	WEBST1948	-		01/27/18 10:56	1	8	Equipment
2A-1	SAIDI	1	WEBST1948	-		02/16/18 09:21	1	87	Equipment
2A-1	SAIDI	1	WEBST1948	-		02/24/18 08:44	1	392	Equipment
2A-1	SAIDI	1	WEBST1948	MED	Large	03/01/18 21:19	1	2,493	Other
2A-1	SAIDI	1	WEBST1948	-		03/29/18 21:02	1	39	Equipment
2A-1	SAIDI	1	WEBST1948	MED	Catastrophic	04/15/18 09:55	1,555	4,733,483	Ice
2A-1	SAIDI	1	WEBST1948	-		04/30/18 14:21	1	57	Other
2A-1	SAIDI	1	WEBST1948	MED	Catastrophic	05/04/18 13:47	1,570	1,546,994	Other
2A-1	SAIDI	1	WEBST1948	MED	Catastrophic	05/04/18 15:29	1	16	Equipment
2A-1	SAIDI	1	WEBST1948	-	Small	05/10/18 07:40	18	4,807	Equipment
2A-1	SAIDI	1	WEBST1948	-		05/16/18 17:40	1	131	Equipment
2A-1	SAIDI	1	WEBST1948	-	Large	05/29/18 15:17	63	10,821	Loading
2A-1	SAIDI	1	WEBST1948	-	Large	05/29/18 16:21	1	33	Equipment
2A-1	SAIDI	1	WEBST1948	-		06/02/18 10:29	1	160	Other
2A-1	SAIDI	1	WEBST1948	-		06/16/18 11:18	13	1,990	Unknown
2A-1	SAIDI	1	WEBST1948	-	Large	06/26/18 22:33	3	1,306	Tree
2A-1	SAIDI	1	WEBST1948	-		07/14/18 11:10	1	57	Equipment
2A-1	SAIDI	1	WEBST1948	-	Small	07/16/18 03:11	1	555	Equipment
2A-1	SAIDI	1	WEBST1948	-		07/31/18 18:04	1	8	Equipment

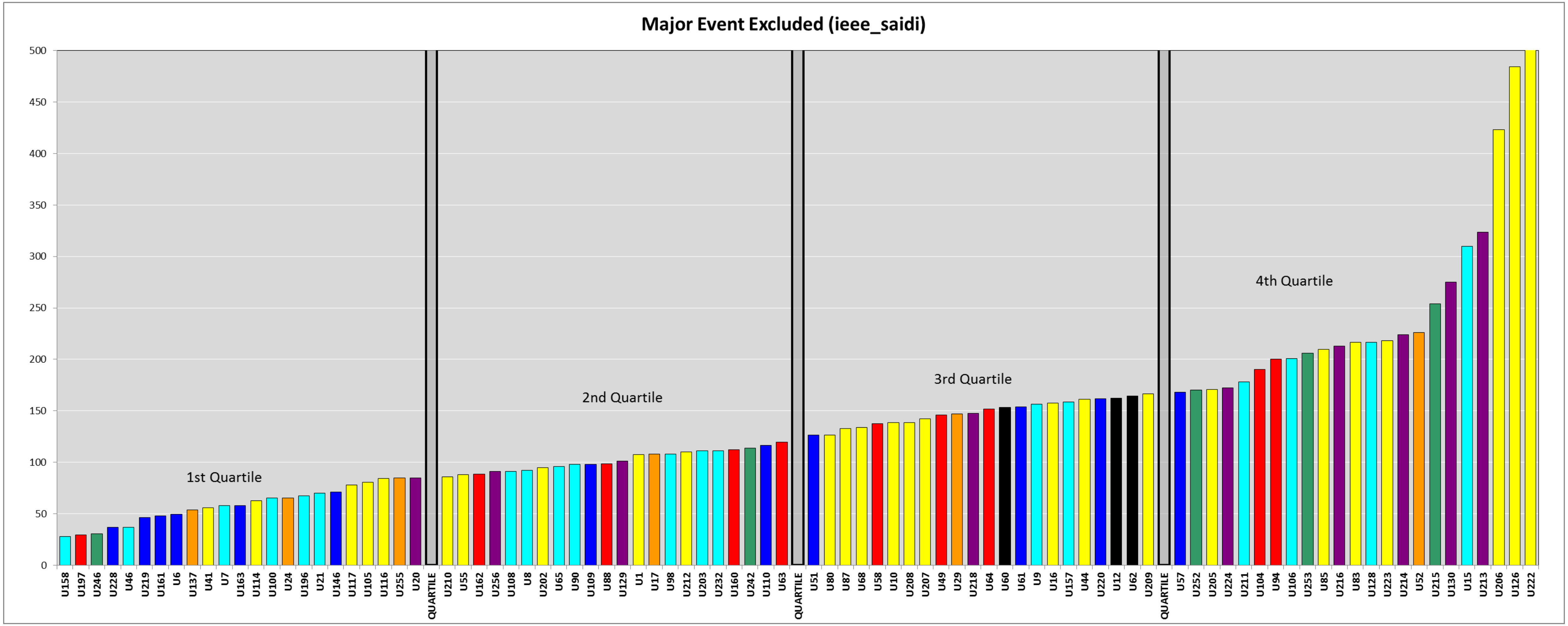
Source: DTE Electric Co. 2018 Report to MPSC Regarding Electric Distribution System Power Quality, May 6, 2019

Power quality events and primary service customers

Inquiries			Power Quality Event [4]							Source of PQ Event			Outcomes		
Event	Date	Locations Impacted [5]	Transient	Voltage Sag	Voltage Swell	Interruption	Overvoltage	Under voltage	Other (inc. Harmonics)	Consumers Energy [6]	Transmission Provider [7]	Customer [8]	Customer Contact [9]	Modifications [10]	Description
03	05/04	1		x						x			x	x	46 kV line fault due to failed insulator; replaced failed equipment.
04	05/12	1		x							x		x		138 kV line fault due to a lightning strike; cleared fault and restored system.
05	06/17	1		x						x			x	x	46kV line fault due to failed lightning arrestors; replaced failed equipment.
06	07/03	1							x			x	x		Customer reported voltage imbalance, but PQM showed voltage to be within limits.

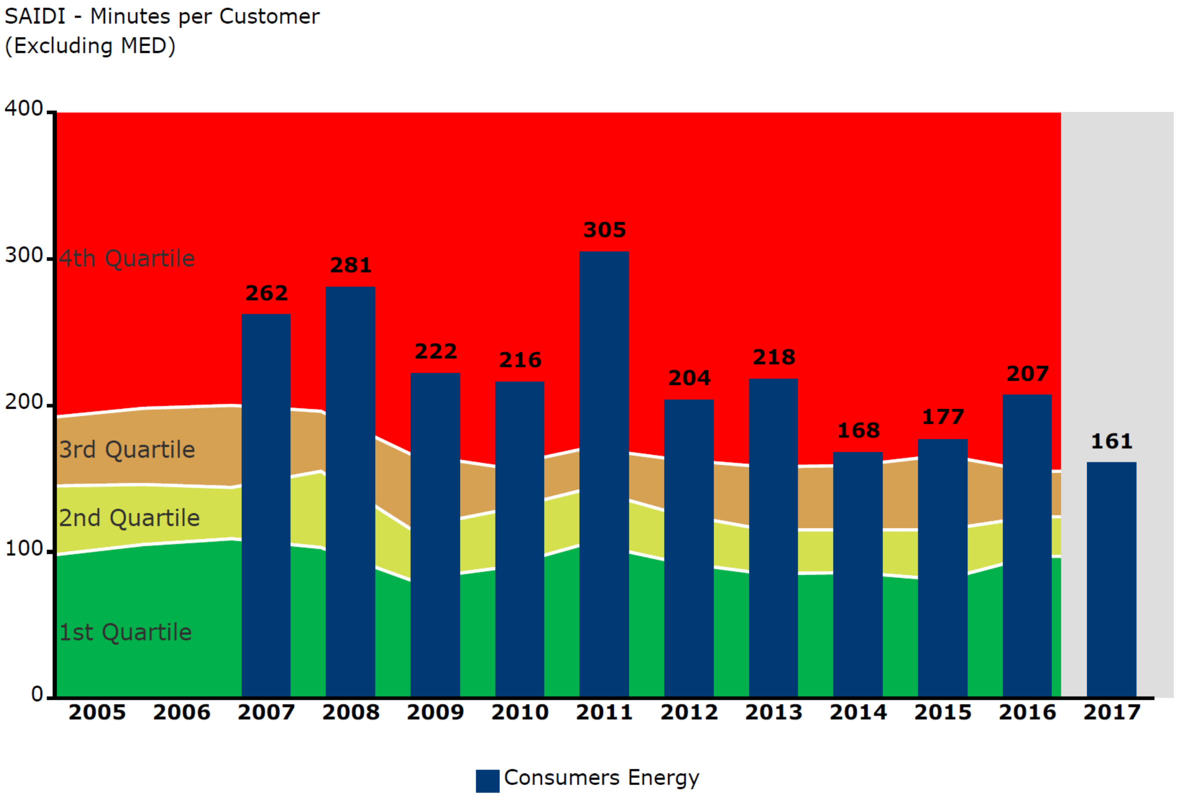
Source: Consumers Energy Annual Power Quality Report, April 2, 2019

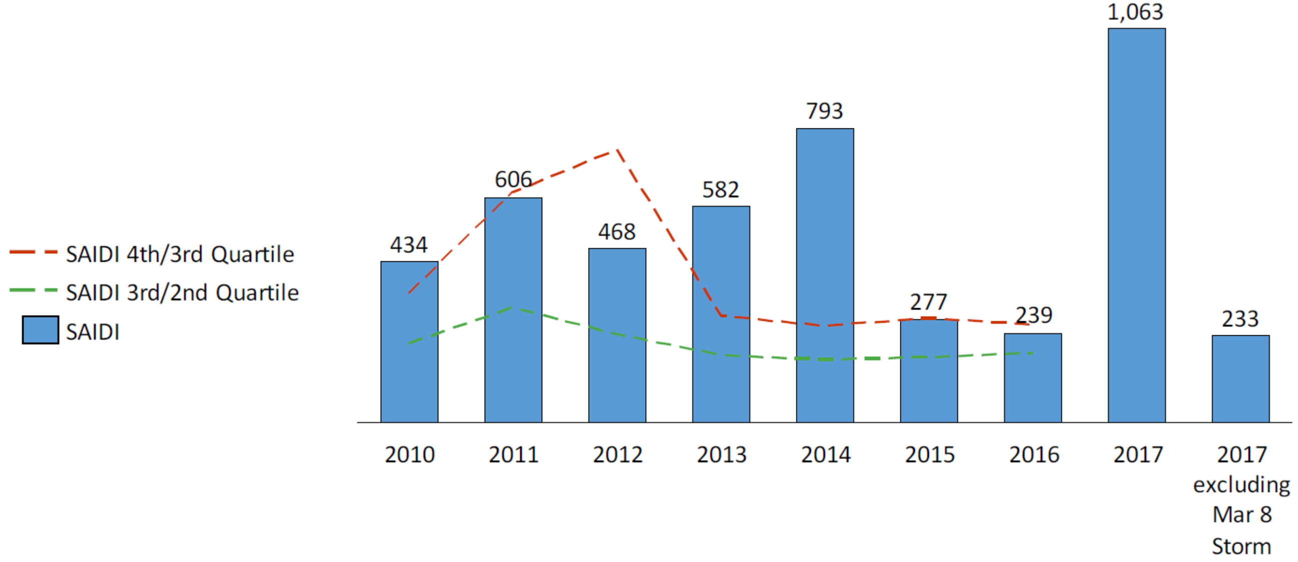
IEEE Distribution Reliability Working Group conducts a voluntary reliability benchmarking survey annually



Source: IEEE Distribution Reliability Working Group "IEEE Benchmark Year 2019, Results for 2018 Data"
2019 IEEE PES General Meeting, Atlanta, GA

Michigan utilities are using the IEEE DRWG benchmark survey to assess their reliability performance

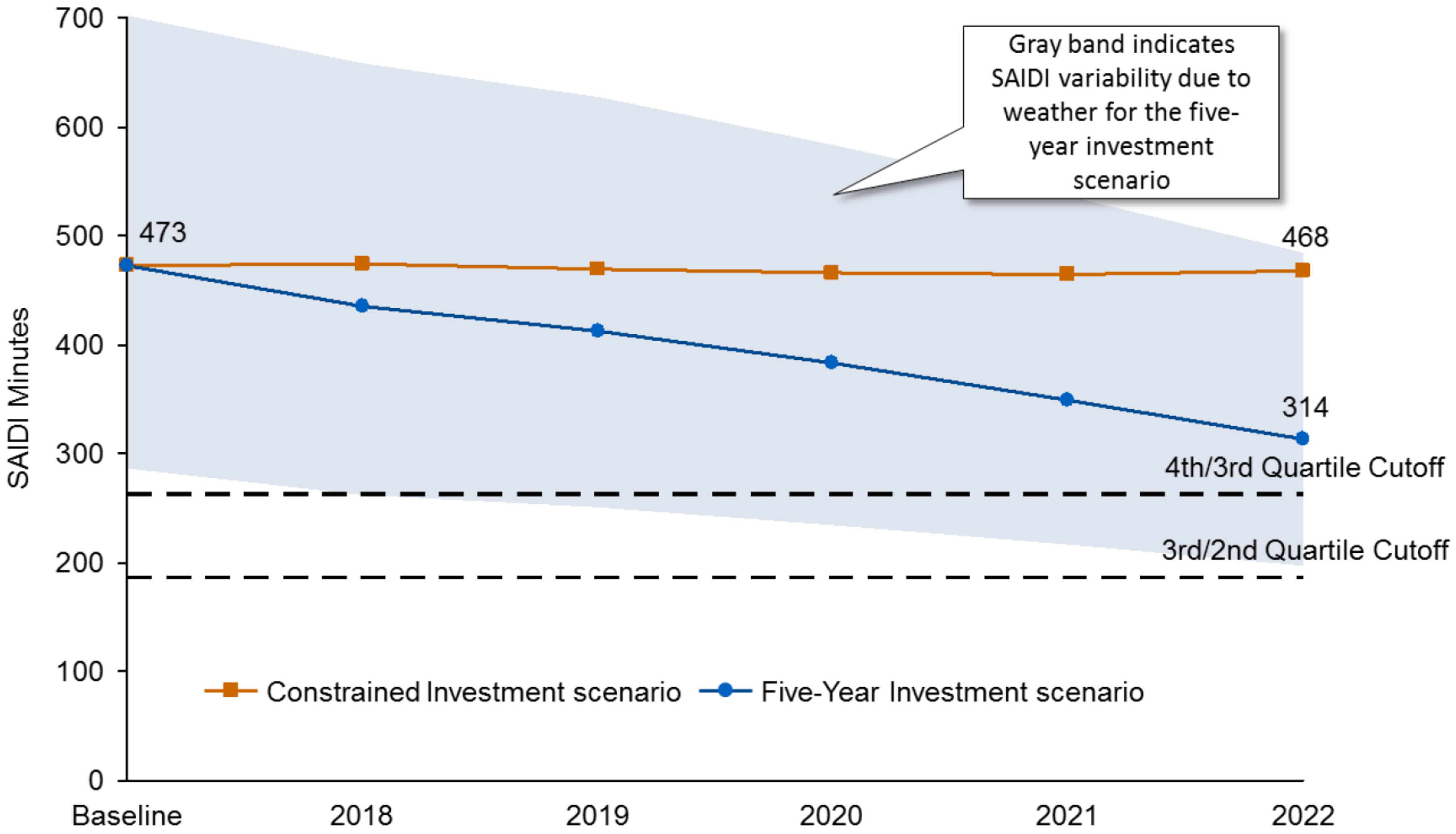




# of DTE Catastrophic Storms	2	3	4	6	7	1	2	2	1
# of DTE Non-Catastrophic Storms	16	19	8	10	12	21	20	28	28
WEI – 30 (Hours)	123	183	211	151	185	154	138	230	206

Sources: Consumers Energy Company's Electric Distribution Infrastructure Investment Plan, April 13, 2018, and DTE Electric Company's Distribution Operations Five-Year (2018-2022) Investment and Maintenance Plan Final Report, January 31, 2018

Michigan utilities are developing performance targets based on reliability metrics



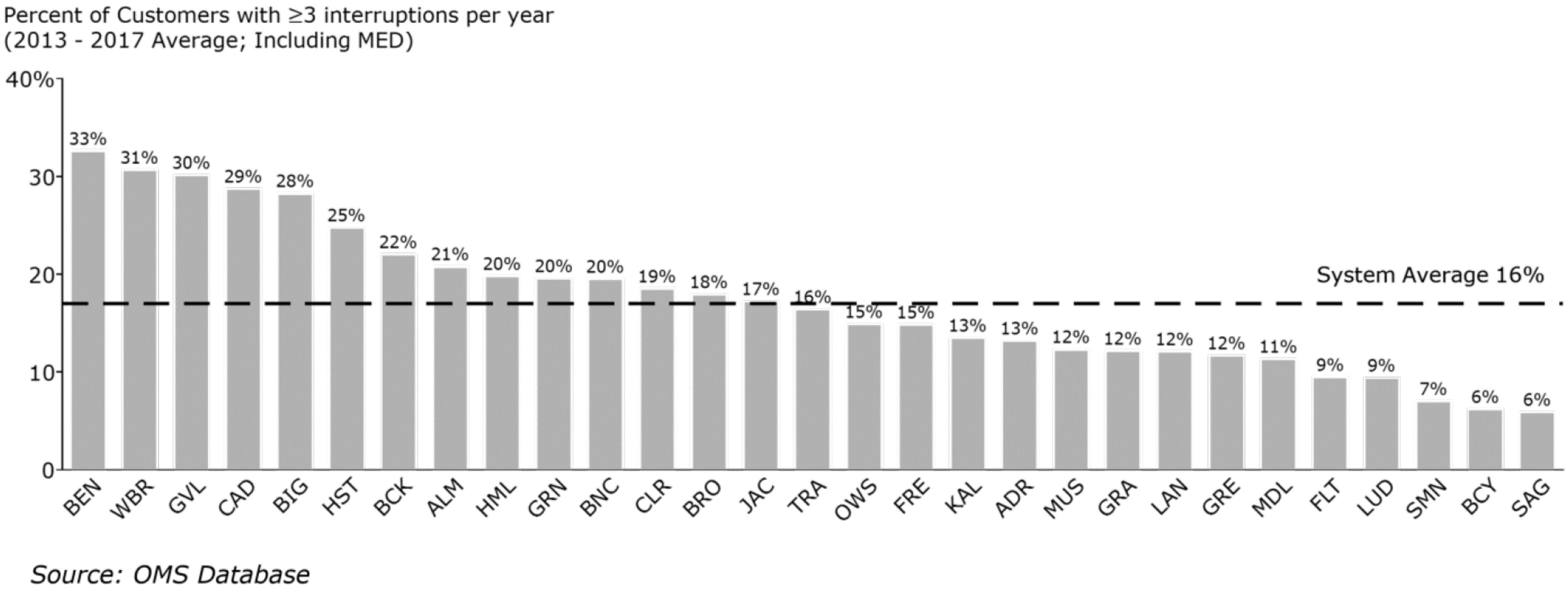
Source: DTE Electric Company's Distribution Operations Five-Year (2018-2022) Investment and Maintenance Plan Final Report, January 31, 2018

Michigan utilities are developing performance targets based on reliability metrics

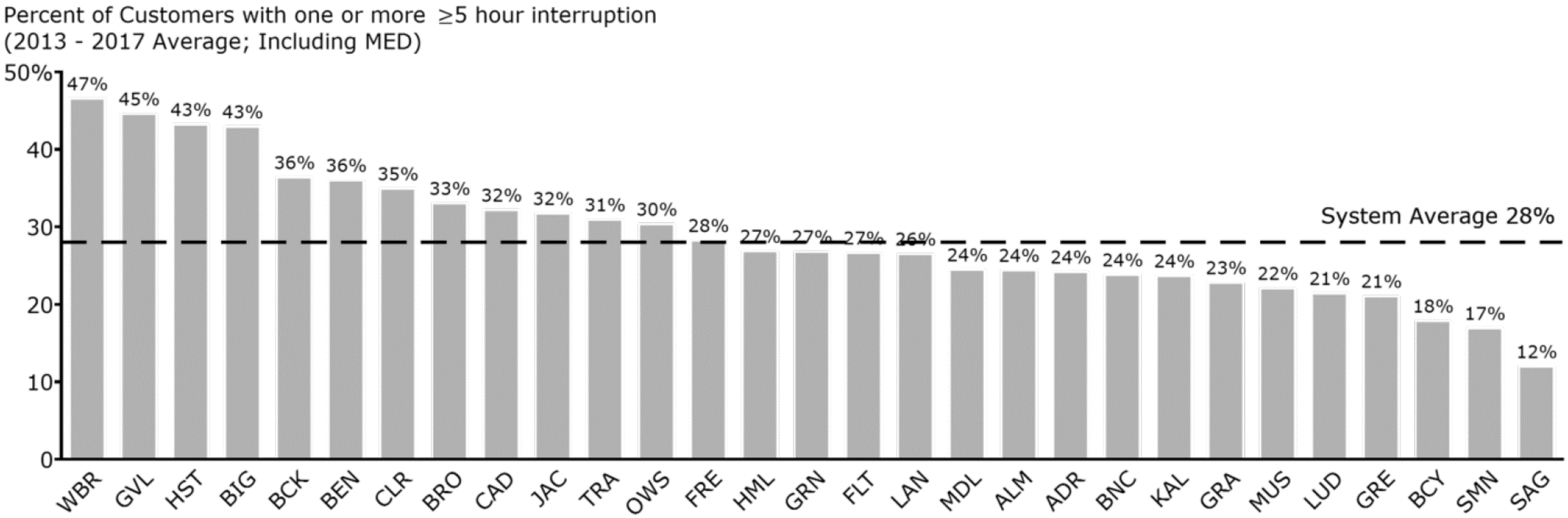
Metric		2013-2017	2017	2022 Target	Rationale for Target
Safety & Security	Recordable incident rate (for work in electric operations)	2.47 *(2014-17)*	1.02	0.58	Electric operations portion of defined corporate targets
	Wire down relief factor (% of police/fire-guarded wire downs relieved in 4 hours inside MMSAs, 6 hours outside MMSAs)	93% *(inside MMSA)* 94% *(outside MMSA)*	87% *(inside MMSA)* 93% *(outside MMSA)*	>90%	Compliance level set in MPSC Electric Distribution Performance Standards MPSC Case No. U-12270
Reliability	SAIDI (excluding MED)	186	161	120	Per Section VII
	SAIFI (excluding MED)	0.96	0.89	0.8	
	% of customers with ≥3 interruptions	16%	16%	14%	Improvements in line with SAIDI and SAIFI reliability targets
	% of customers with one or more interruption of ≥5 hours	28%	31%	20%	
	% of customers restored within 24 hours of a MED interruption	72%	71%	80%	
	Service restoration O&M				Improvements in line with cost and incident reduction targets. Work

Source: Consumers Energy Company's Electric Distribution Infrastructure Investment Plan, April 13, 2018

Analysis of reliability by service region identifies where reliability is lower/higher within a service territory

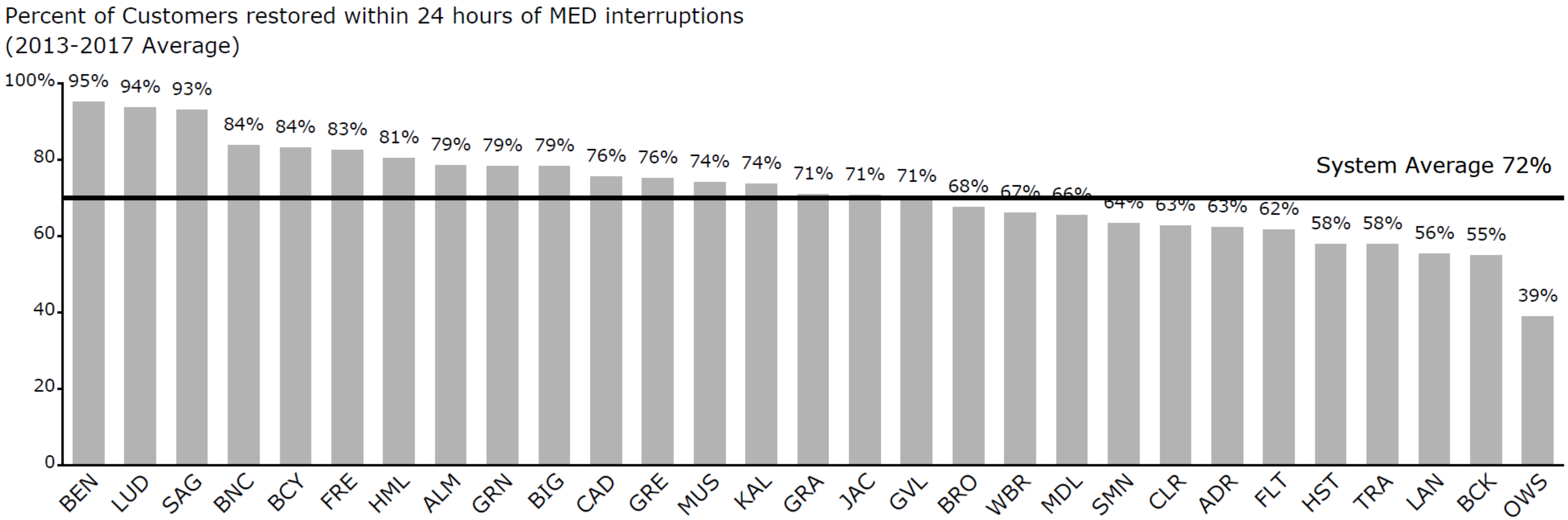


Analysis of reliability by service region identifies where reliability is lower/higher within a service territory



Source: Consumers Energy Company's Electric Distribution Infrastructure Investment Plan, April 13, 2018

Analysis of reliability by service region identifies where reliability is lower/higher within a service territory



Source: Consumers Energy Company's Electric Distribution Infrastructure Investment Plan, April 13, 2018

Analysis of interruption causes identifies opportunities to improve reliability

Interruption Cause	2014	2015	2016	2017	2018	5-Year Average
Vegetation	45.21%	37.44%	48.80%	37.55%	49.5%	43.9%
Equipment Failure	17.5%	19.6%	12.8%	16.3%	15.5%	16.2%
Transmission Line	6.3%	13.7%	7.2%	13.6%	6.0%	9.3%
Station	9.8%	13.3%	5.5%	10.9%	7.2%	9.2%
Vehicle Accident	4.9%	4.5%	9.7%	5.8%	5.0%	6.1%
Unknown	4.1%	3.8%	7.4%	4.3%	4.6%	4.9%
Lightning	4.8%	3.7%	3.7%	2.8%	2.1%	3.4%
Scheduled	1.2%	1.7%	2.9%	3.6%	5.3%	3.0%
Remaining	4.2%	1.1%	1.0%	3.8%	3.8%	2.7%
Animal	2.1%	1.2%	1.0%	1.4%	1.0%	1.3%

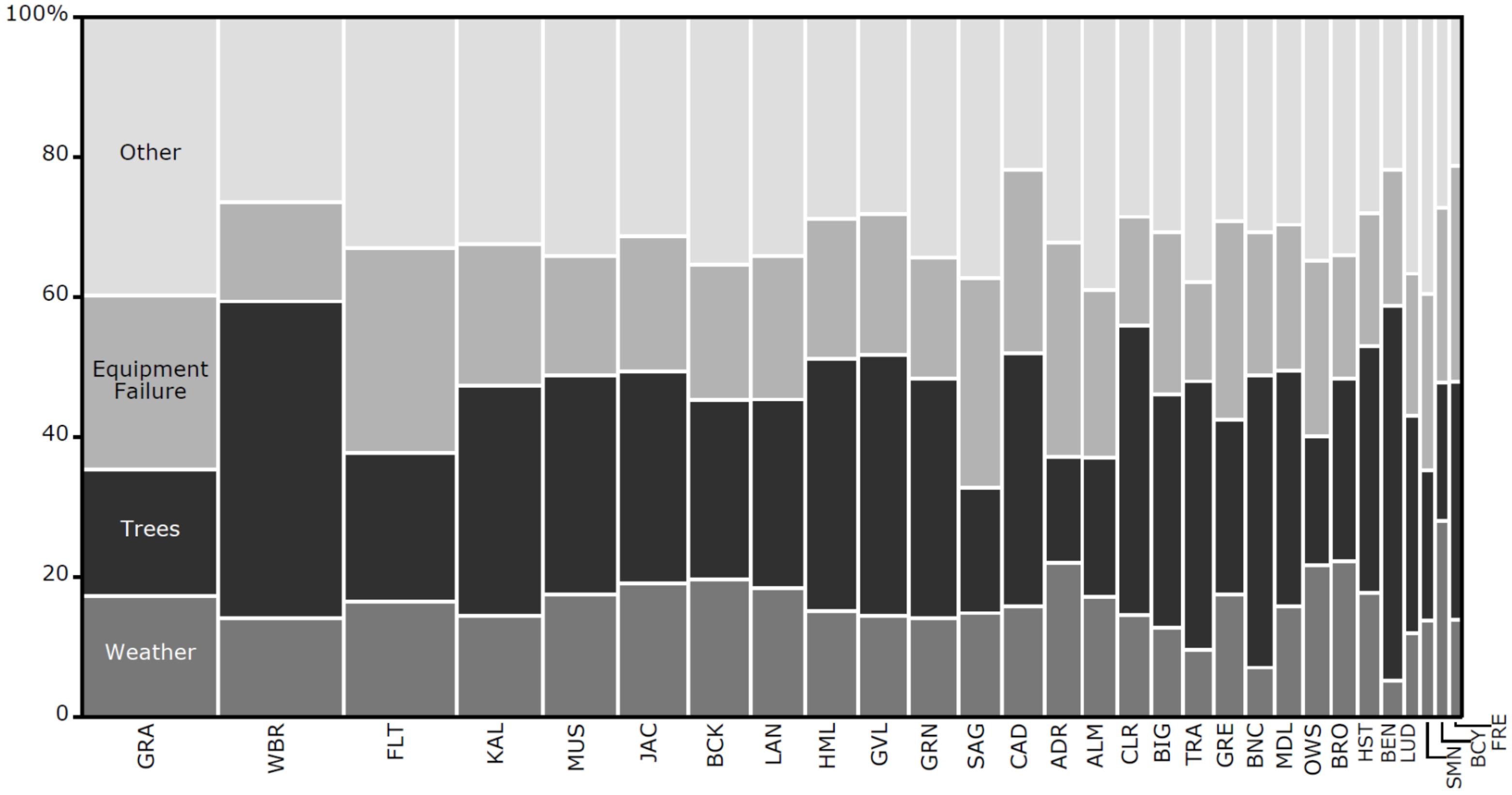
Source: Indiana Michigan Power Company's Fiver Year Distribution Plan (2019-2023), April 3, 2019

Analysis of interruption causes identifies opportunities to improve reliability

Distribution Line Equipment Failure Cause	2014	2015	2016	2017	2018
Arrester	0.7%	2.4%	3.1%	1.9%	1.5%
Capacitor	0.0%	5.7%	0.0%	0.0%	0.0%
Conn/Clamp	5.5%	8.4%	10.3%	3.2%	8.0%
Crossarm	14.2%	10.1%	23.3%	18.7%	9.9%
Cutout	24.1%	27.0%	24.6%	30.8%	38.8%
Insulator	8.4%	9.6%	4.0%	16.7%	19.4%
Jumper/Riser	4.4%	7.7%	6.0%	3.1%	0.7%
Overhead Conductor	9.1%	2.6%	7.8%	6.7%	6.7%
Overhead Transformer	4.3%	2.6%	6.6%	2.2%	4.0%
Pole	1.4%	1.5%	1.7%	0.5%	3.6%
Recloser	0.2%	1.5%	3.1%	3.0%	1.5%
Remaining Equipment	5.9%	1.2%	6.4%	8.0%	2.7%
Underground Cable	21.7%	19.6%	3.3%	5.2%	3.2%

Analysis of interruption causes by region identifies opportunities to improve reliability

SAIFI Contribution by Incident Cause
(2013-2017 Avg; MED Excluded)



Source: OMS Database
Note: Other includes: Wildlife, Trans. & Gen., Planned, Lightning, Car pole, Public damage, Trees from outside right of way, other unique incidents and when no specific cause was found

Source: Consumers Energy Company's Electric Distribution Infrastructure Investment Plan, April 13, 2018

Annual reporting on smart grid metrics, includes existing reliability metrics

Q33 (A/B) Customers experiencing long interruption duration (CELIDx)

Customers Experiencing Long Interruption Duration (CELIDx)	
8 hour	225,770
60 hr duration	6,430

Q34 (A-K) Customers experiencing multiple interruptions (CEMIx)

Customers Experiencing Multiple Interruptions X (CEMIx)	
0	671,706
1	530,302
2	315,976
3	151,503
4	70,106
5	34,644
6	19,750
7	8,845
8	4,746
9	3,170
10+	2,613

Q35 (A/B) System average interruption duration index (SAIDI)

System Average Interruption Duration Index (SAIDI)	
Excluding major event days	200.85
Including major event days	406.82

Q36 (A/B) System average interruption frequency index (SAIFI)

System Average Interruption Duration Index (SAIDI)	
Excluding major event days	1.017
Including major event days	1.295

Source: Consumers Energy Company's 2018 Year-End Report to the Michigan Public Service Commission Regarding Smart Grid Metrics, March 29, 2019

Annual reporting on smart grid metrics also includes additional reliability-related metrics

Q37 (A-F) Outage minutes avoided due to AMI meters

The Company measures outage minutes avoided due to AMI meters by evaluating the CAIDI minutes associated with three separate notification conditions - (1) AMI notification only, (2) customer notification only, and (3) both AMI and customer notification.

Outage minutes avoided due to AMI meters	
CAIDI excluding major event days for AMI notification only	116
CAIDI excluding major event days for customer notification only	242
CAIDI excluding major event days for AMI and customer notification	189
CAIDI including major event days for AMI notification only	124
CAIDI including major event days for customer notification only	541
CAIDI including major event days for AMI and customer notification	237

Q38 Number of outage minutes avoided due to automated switches

6,090,723 customer outage minutes avoided due to automated switches

Q39 Number of customer outages avoided due to automated switches

15,829 customer outages avoided due to automated switches

Source: Consumers Energy Company's 2018 Year-End Report to the Michigan Public Service Commission Regarding Smart Grid Metrics, March 29, 2019

Summary and next steps

Michigan utilities use reliability metrics to support a variety of reliability-related activities, including:

- Establishing and assessing utility performance relative to targets
- Establishing a basis for customer payments when utility performance is below a threshold
- Understanding reliability delivered to specific groups of customers
- Benchmarking utility performance
- Providing a basis for identifying, prioritizing, and directing utility actions to improve reliability
- Measuring utility performance resulting from smart grid investments

This talk has illustrated how Michigan utilities have supported these activities through the use of reliability metrics by presenting examples drawn from various reports they file with the Michigan PSC

Going forward, Michigan utilities, PSC, and stakeholders should assess whether the current suite of metrics is meeting their reliability (and evolving resilience-related) information needs adequately or whether the metrics should be modified to better serve these purposes

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AFTERNOON BREAK
2:45 – 3:00 PM

Distribution Planning Stakeholder Meeting

Michigan Public Service Commission
Lake Michigan Hearing Room
September 18, 2019

MPSC
Michigan Public Service Commission

Meeting Agenda

9:00 a.m.	Welcome & Introduction	Patrick Hudson, Manager, Smart Grid Section
9:10 a.m.	Hosting Capacity Analyses	Yochi Zakai, IREC
9:40 a.m.	Break	
9:50 a.m.	Tying it All Together - A Vision for Integrated Distribution Planning	Curt Volkmann, GridLab
10:20 a.m.	Break	
10:30 p.m.	Reliability and Resilience Metrics, and Reliability Value-Based Planning	Joseph Eto, Lawrence Berkeley National Lab
12:00 p.m.	Lunch (local restaurants available)	
1:15 p.m.	Consumers Energy: Response to Pilot Proposal Comments	Consumers Energy
1:30 p.m.	DTE: Response to Pilot Proposal Comments	DTE
1:45 p.m.	I&M: Response to Pilot Proposal Comments	Indiana Michigan Power
2:00 p.m.	Michigan Utility Reliability Reports	Joseph Eto, Lawrence Berkeley National Lab
2:45 p.m.	Break	
3:00 p.m.	Stakeholder Discussion: Resiliency in Michigan – What Matters and How Should it be Valued?	Facilitator: Joseph Eto Lawrence Berkeley National Lab
3:50 p.m.	Closing Statements & Docket Responses	MPSC Staff
4:00 p.m.	Adjourn	

Stakeholder Discussion

Resilience in Michigan:
What Matters and How Should it be Valued?

Joseph H. Eto (facilitator)

Lawrence Berkeley National Laboratory

Five-Year Distribution Planning Stakeholder Meeting

Lansing, MI, September 18, 2019

Resilience in Michigan: What Matters and How Should it be Valued?

1. What types of resilience "events" are of concern to Michigan stakeholders?
   Ice storms?
   High wind/lightning events?
   Extreme cold/coupled with a gas supply disruption event
   Others?
2. To what extent are utility-led actions to address these events – at least to some degree - already considered in reliability planning by Michigan's utilities? For those that are not, why not?

Resilience in Michigan: What Matters and How Should it be Valued?

3. For those actions that are already considered in reliability planning (again, at least to some degree), what, if anything, more or different should be done as part of current development and review processes for utility reliability plans?

   Different spending levels?

   Different spending targets/objectives?

   Different performance metrics?

4. What should be the basis for these suggested changes? What objectives should they serve?

Resilience in Michigan: What Matters and How Should it be Valued?

5. What information or perspectives are currently missing from today's discussions that would be helpful in informing future decisions on these suggested changes?

   Specifically, does or should information on the value of activities to improve reliability/resilience be incorporated in these discussions?

   What values? To whom? How should they be estimated? How should they be incorporated?

Resilience in Michigan: What Matters and How Should it be Valued?

5. Following on Q2—for warranted actions that are not currently considered in reliability planning—what (if any) additional factors should be taken into account in order to plan for them?

   How should they be incorporated into or considered in relation to current utility reliability planning activities?

Closing Comments

Michigan Public Service Commission
Lake Michigan Hearing Room
September 18, 2019
9 AM – 4 PM

MPSC
Michigan Public Service Commission

October 16, 2019 Stakeholder Session

- Topics include:
  - Consistent data/formatting across the utilities for future distribution plans
  - Additional discussion on utility pilot programs resulting from docket filed comments
  - Additional discussion on utility cost-benefit analysis framework
  - Paul De Martini DSPx presentation: NWA analysis, sourcing options & relative risks
- Oct. 16 agenda will be forthcoming and announced through the listserv
- Additional stakeholder responses addressing proposed utility NWA and hosting capacity: submitted to the docket by Oct. 7 for utility responses at the next stakeholder session on Oct. 16
- Nov. 19 session – staff is working on the details