Electric Distribution Investment & Maintenance Plans Stakeholder Meeting #4

Michigan Public Service Commission
Lake Michigan Hearing Room
October 16, 2019
9 AM – 4 PM

Michigan Public Service Commission

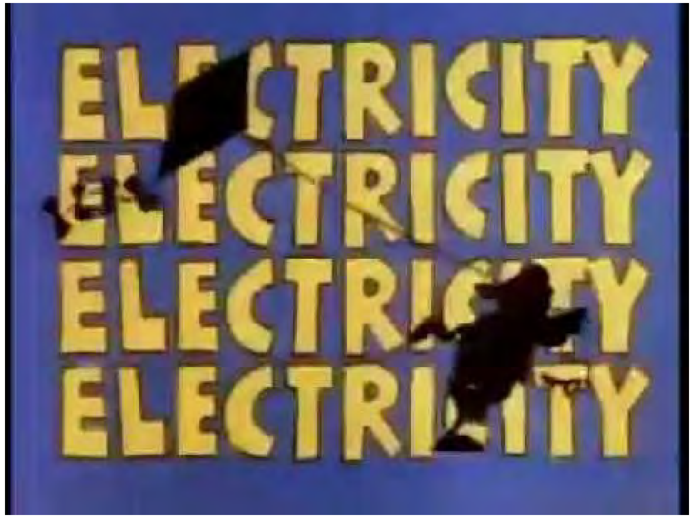
Meeting Agenda

9:00 a.m.	Welcome, Introduction and Recap	Patrick Hudson, Manager, Smart Grid Section
9:10 a.m.	Future Distribution Planning Reports: Consistent Data Across Utilities	Consumers Energy, DTE, and Indiana Michigan Power
9:25 a.m.	Consumers Energy: Benefit Cost Analysis	Consumers Energy
9:50 a.m.	DTE: Benefit Cost Analysis	DTE
10:15 a.m.	Break	
10:30 a.m.	I&M: Benefit Cost Analysis	Indiana Michigan Power
10:55 a.m.	Third-Party Uses of Hosting Capacity Analyses Panelists: Sarah Mills, Senior Project Manager, University of Michigan Mark Cryderman, Business Development/Ed., The Green Panel Ethan Case, Vice President of Policy, Heelstone	Moderator: Laura Sherman, President, Michigan Energy Innovation Business Council
12:00 p.m.	Lunch (restaurants available)	All
1:00 p.m.	DSPx: Distribution Planning Relationship with Grid Modernization and Cost Effectiveness Framework	Paul De Martini, Newport Consulting
1:30 p.m.	Non-Wires Alternatives Analysis, Sourcing Options, and Relative Risks	Paul De Martini, Newport Consulting
2:00 p.m.	Discussion: A Framework for Non-Wire Alternatives	Paul De Martini, Newport Consulting
2:30 p.m.	Break	
2:50 p.m.	DER Coordination as a Non-Wire Solution: Opportunities and Challenges in Michigan	Johanna Mathieu, University of Michigan
3:20 p.m.	Consumers Energy: Response to Pilot Proposal Comments	Consumers Energy
3:30 p.m.	DTE: Response to Pilot Proposal Comments	DTE
3:40 p.m.	I&M: Response to Pilot Proposal Comments	Indiana Michigan Power
3:50 p.m.	Closing Statements / November 19 Stakeholder Session Overview	MPSC Staff
4:00 p.m.	Adjourn	

Distribution Planning Recap

MPSC
Michigan Public Service Commission

- 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
  - Reliability & Resilience Metrics
  - Michigan Utility Reliability Reports
  - Hosting Capacity
  - Integrated Distribution Planning
  - Utility Pilot Proposal Comments
  - Discussion on Resilience in Michigan
- October 16, 2019
- November 19, 2019



Standard Distribution Plan Components

Consumers Energy, DTE, & Indiana Michigan Power

Doug Chapel

October 16, 2019

The joint utilities recommend a set of standardized components for upcoming distribution plan filings

- The standardized components allow Staff and stakeholders to easily compare key elements of each utility distribution plan

- Standardized components are grouped into the following categories and elaborated in the following slides
  - Distribution Plan Outlines
  - Historical System Performance
  - Projects and Programs Details
  - Long-term Strategic Vision and Plan
  - Supporting Components

- Distribution plans will not necessarily follow identical format
  - Differences among utility systems mean each utility may emphasize different strategic areas
  - Company preferences may necessitate different levels of content detail narrative flows in respective reports

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Distribution Plan Outlines

- Investment and Maintenance Spending Projection, 2021-2025
  - Capital spending projection – all areas
  - Key O&M spending projection
- Key Planned Projects and Programs, 2021-2025
  - Scope of work
  - Annual spending projection
- Benefit Cost Analysis
- Beyond 2025, utilities will provide a long-term strategic vision and plan over the next 10 and 15 years

Historical System Performance (2016-2020)

- SAIDI, SAIFI, and CAIDI
  - Each metric broken out by region of service territory
  - Each metric compared to industry benchmarks by quartile

- CEMI and CELID
- Breakdowns of outage causes
- Comparisons of MED vs. non-MED for metrics
- Additional data if identified by upcoming Technical Standards or Service Quality & Reliability Standards workgroups

Projects and Programs Details (2021-2025)

- Asset Assessments and Capital Replacements
  - Asset condition assessments
  - Historical failure analysis (if available)
  - Benefits/drivers
  - Asset replacement forecasts – spending and units

- Capacity Upgrades and Load Relief
  - Project prioritization and selection criteria
  - Program scope
  - Benefits/drivers
  - Projected spending

- Circuit Reliability
  - Project prioritization and selection criteria
  - Program scope
  - Benefits/drivers
  - Projected spending

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Projects and Programs Details (2021-2025) (cont.)

- Grid Modernization
  - Connection to DSPx framework
  - Program scope
  - Benefits/drivers
  - Projected spending

- Reactive/Base Capital Projected Spending
  - New Business
  - Asset Relocations
  - Other reactive programs (trouble/storm/realized failures)

- Key Maintenance Areas
  - Forestry / tree trimming
  - Preventative maintenance programs

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Long-term Strategic Vision and Plan (Beyond 2025)

- Vision of Grid Modernization over the next 10-15 year horizon

- Vision of Advanced Distribution Planning Processes

Supporting Components

- Distribution Design Standards
  - Incorporating recommendations identified by upcoming Technical Standards of Service Quality and Reliability Standards workgroups
  - Reinforcing system Resiliency – further clarification needed on what resiliency means for Michigan customers

- Pilot Updates and New Initiatives
  - Hosting Capacity Analysis
  - Non-Wires Alternatives

- Execution Considerations (e.g. Workforce Adequacy)

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Benefit Cost Analyses

Don Lynd

October 16, 2019

Consumers Energy Positions

- Grid Modernization may be subject to more expansive BCAs
- Least-cost-best-fit is appropriate analysis for investments that address reliability issues and other essential work – "foundational" or "traditional" investments
- Continued discussion needed on definition and value of resilience
- Utility prioritization of investments is incorporated into above topics

Utility-facing Grid Modernization investments

- Technologies to improve efficient operation of distribution system
  - DSCADA, ADMS, GIS, FLISR, VVO, etc. – core "platforms" and discretionary "applications"

- BCAs can be applicable to utility-facing Grid Mod
  - Discretionary – not critical to traditional delivery of electricity
  - Components highly interconnected – comprehensive look across many individual projects better reflects value

- Workgroup can help set definitions and rules

Grid Mod – Defining Costs and Benefits

- Costs of Grid Mod:
  - Incremental CapEx; incremental O&M; other incremental support costs

- Benefits of Grid Mod include:
  - For utility, reduced O&M and generation costs; reduced losses; increased safety & reliability
  - For customers, improved power quality; reduced outage costs; increased satisfaction
  - For society, environmental and economic development benefits

- Michigan should explore adopting minimum evaluation requirements
  - Guidance ultimately needed from the Commission

Grid Mod – BCA Process

- Utilities should have option of using business case approach
  - Benefits can be considered qualitatively when monetization is difficult; particularly relevant to future technologies whose full benefits are unknown
  - Interdependencies of components, costs, and benefits can be qualitatively explained

- “Platforms” should be subject to least-cost-best-fit, “applications” to full BCA

- Interdependency of Grid Mod components should be addressed by bundling components, assigning point values when monetization is difficult

Bundling Example

	1. Platform Components Only	2. Platform Plus FLISR and VVO	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
Qualitative Impacts:	---	---	---
Resilience	1	1	3
Customer choice& flexibility	1	2	3
Findings:	not cost-effective	cost-effective	cost-effective

Source: https://www.synapse-energy.com/sites/default/files/Benefit-Cost-Analysis-of-Utility-Investments-18-098.pdf

Foundational infrastructure investments

- Substations, Poles, Wires, Hardware, etc.
  - Investments that deal with issues that must be addressed to replace infrastructure, maintain reliability, support capacity needs, etc.; may eventually include NWAs
- Least-cost-best-fit continues to be best approach, per DOE recommendation
  - Since investment is necessary, goal is to select project that addresses issue (the “best fit”) at the lowest cost
  - Different potential solutions may be considered by planners, but there is no option to “do nothing”
- Least-cost-best-fit includes prioritization
  - Proposed projects subject to concept review and approval with consideration of alternatives; Company uses system characteristics to further enhance prioritization
  - Rate cases allow Staff and stakeholders to review proposed solutions

Investments to improve resilience

- MPSC's September 11 Order:
  - "The Commission finds it appropriate to have the Staff look at the value of resilience in the distribution planning stakeholder process. The value of resilience also ties into…cost-benefit methodologies as part of this next phase of distribution plans."
- Additional discussion needed with Staff regarding definition and value of resilience
- Proper valuation of resilience will inform prioritization
  - How much resilience should we invest in to provide optimal value for customers?
- Grid Mod investments may provide resilience benefits, depending on how the term is defined

Notes on Prioritization

- The Company allocates money to programs based on areas of system need

- Within programs, planners prioritize projects based primarily on reliability impacts

- Optimal investment solutions for prioritized areas identified with concept approval process, in which problems are defined, alternatives are considered, and justification provided

- Where appropriate, the Company reviews historical investments to evaluate actual reliability improvements

Benefit Cost Analysis

MPSC Collaborative on Electric Distribution Investment and Maintenance Plan

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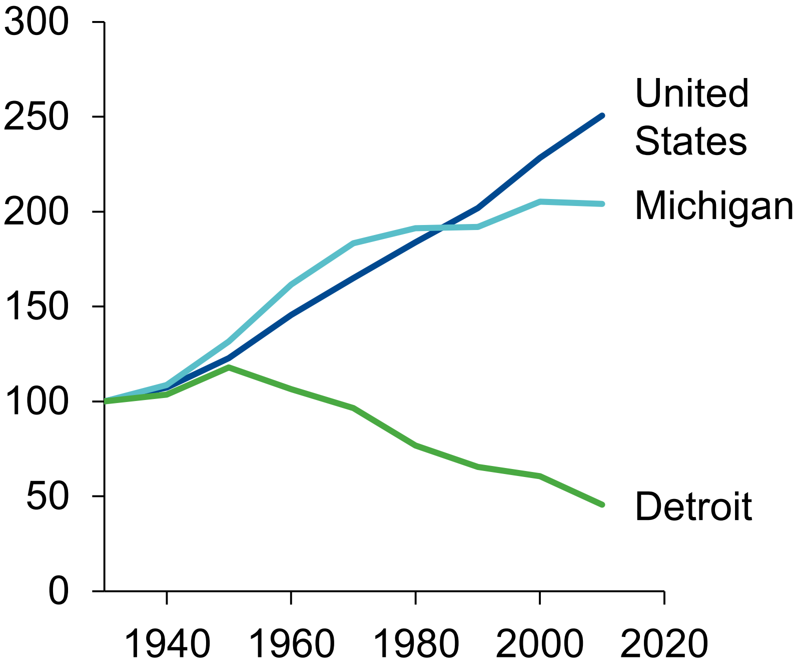
DTE is facing aging infrastructure challenges as much of its infrastructure was built in 1940-1970, when rapid population growth occurred

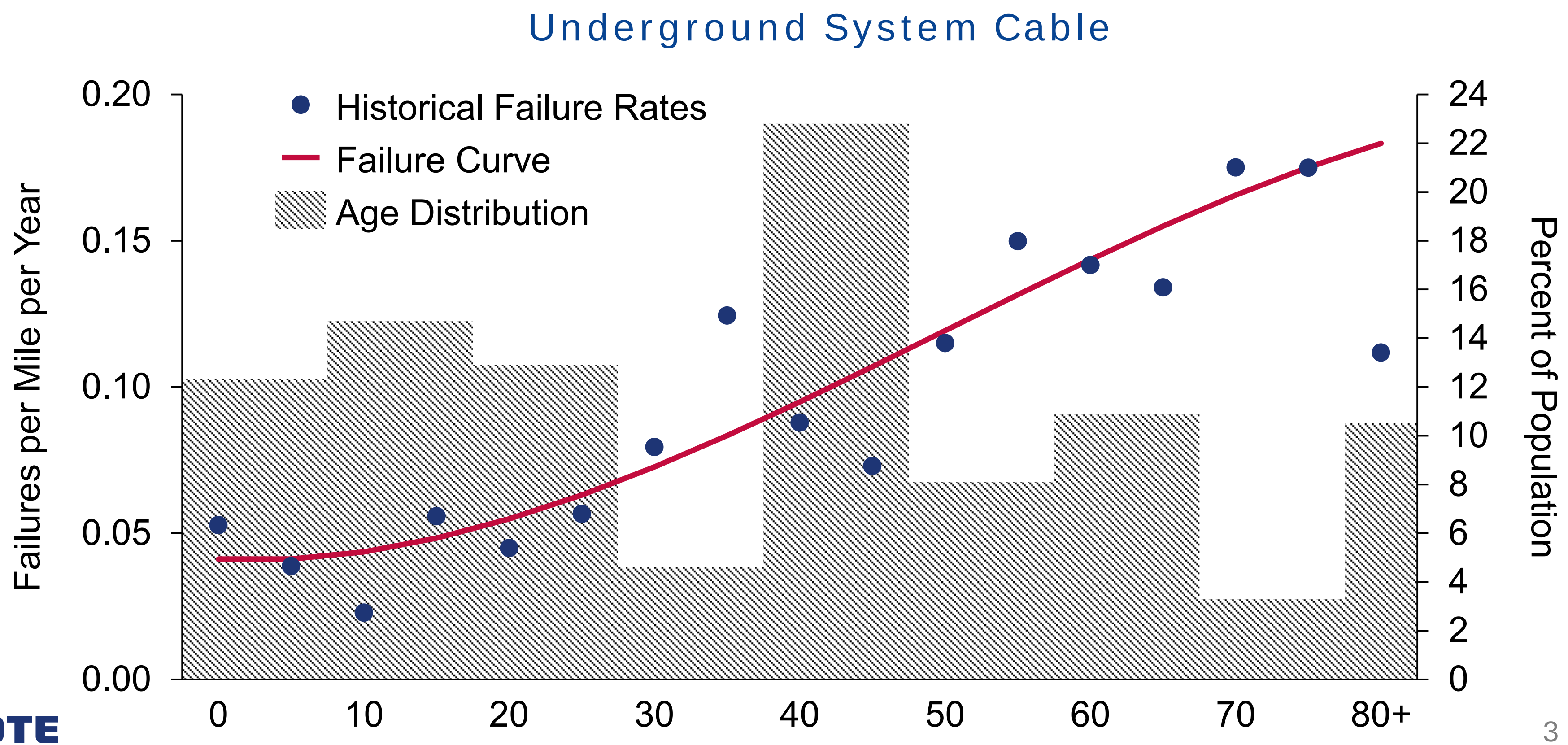
Historical Population Change (Indexed to 1930 Population)



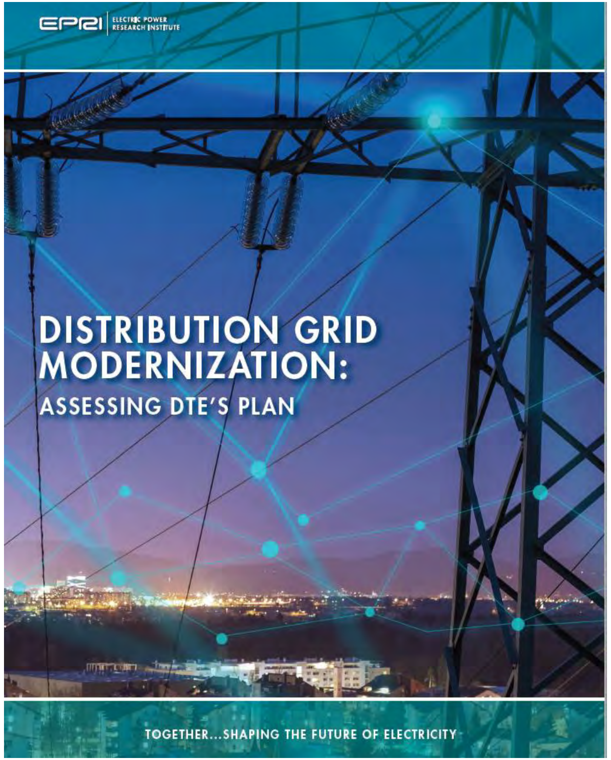
Selected Asset Age Summary (Years)

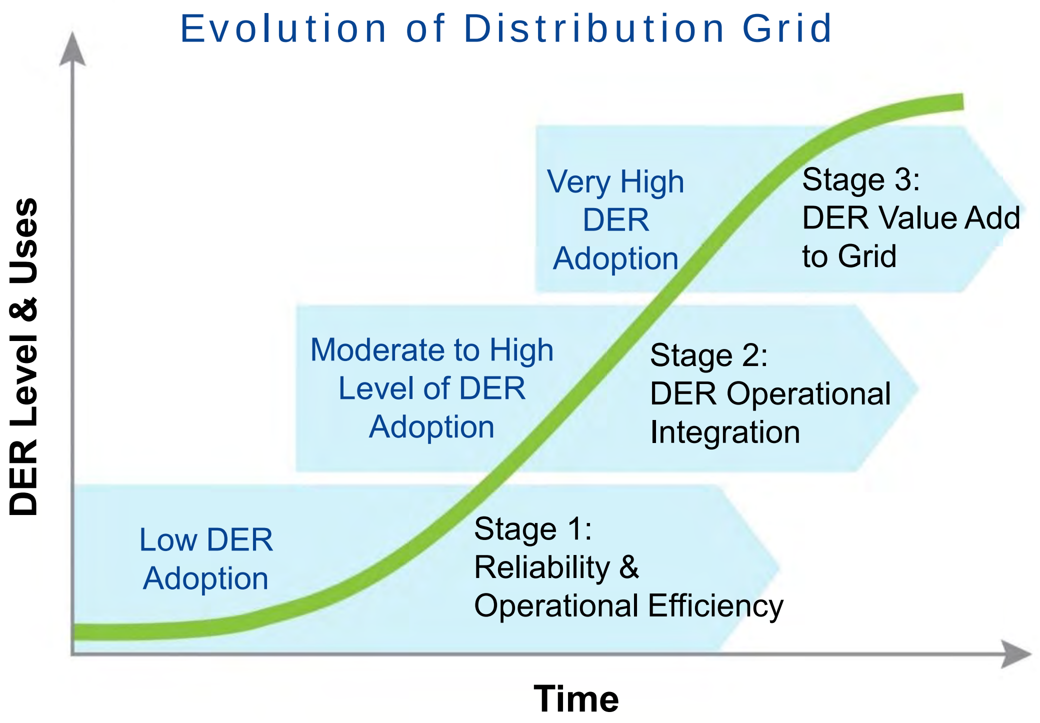
Asset	Average Age	Age Range	Typical Life Expectancy
Substation Transformers	41	0-93	40-45
Circuit Breakers	45	0-88	30-40
Switchgear	36	0-65	35-45
Poles	44	0-90+	40-50
System Cable	46	0-100+	25-40
URD Cable	30	0-50+	25-35

Assets are failing at higher rates, negatively impacting our customers' experience

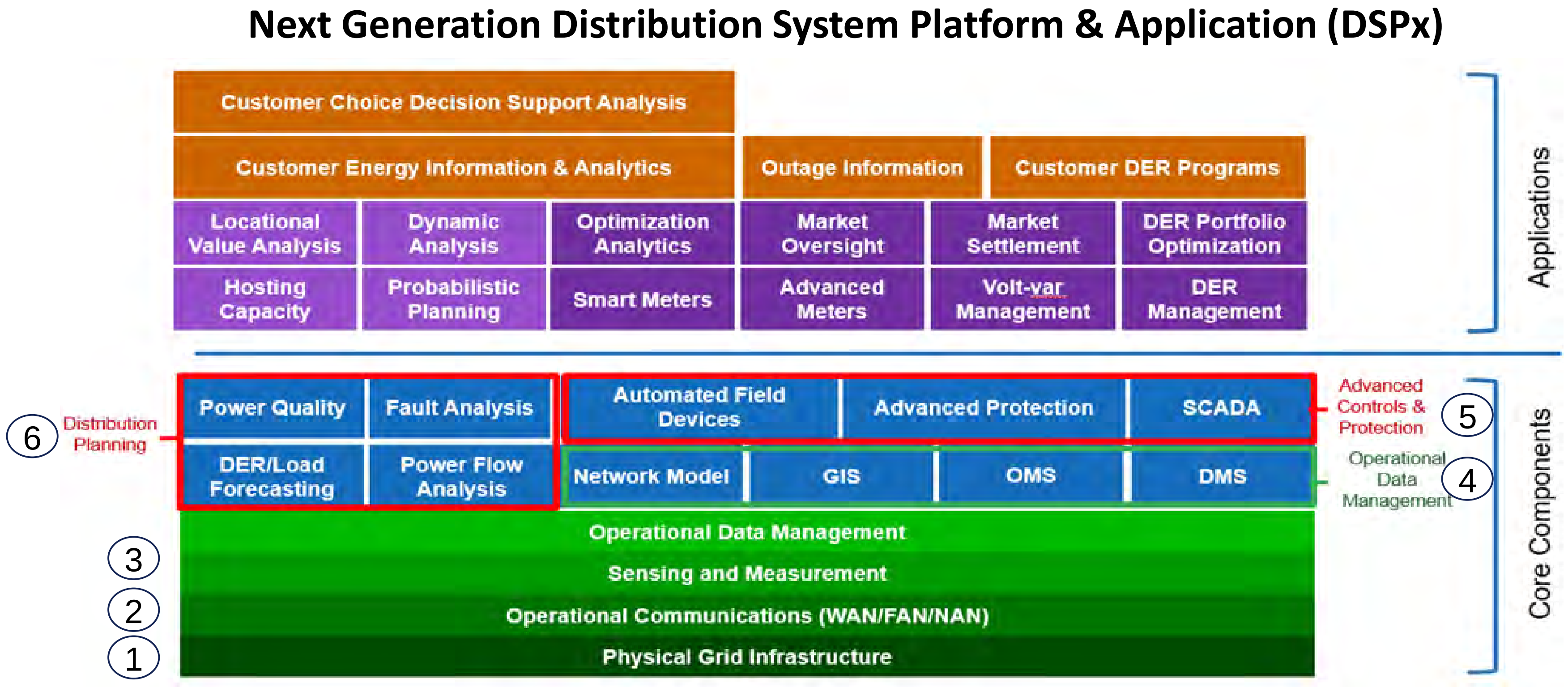


EPRI's recent assessment confirmed that DTE is appropriately focused on Stage 1 of the Distribution Grid evolution





Because it is in Stage 1, DTE has been investing in the Core components identified in the DSPx framework



DTE

DTE's benefit cost analysis, known as the Global Prioritization Model (GPM), has been used to prioritize the majority of DTE's strategic investment portfolio

DTE Investments (Programs in Bold are Analyzed in GPM)

		Investment Programs
	Base	• Trouble / Storm • Customer Connections, Relocations & Others
1	Physical Grid Infrastructure	• Tree Trimming • 4.8kV Hardening • CEMI (Frequent Outages) • Pole/PTM • System Cable Replacements • Breaker Replacements • Switchgear Replacements • URD Replacements • Disconnects & Switcher • Pontiac Vaults • Subtransmission Redesign • CODI • Load Relief • 4.8kV/8.3kV Conversion and Consolidation • Mobile Fleet • Preventive Maintenance

		Investment Programs
2	Operational Communication	• 13.2kV Telecommunication • Ground Detection (4.8kV Relay)
3	Sensing and Measurement	• Line Sensors • PQ Meters • AMI Upgrades
4	Operational Data Management / Support	• ADMS • SOC
5	Advanced Protection and Controls	• Substation Automation • Circuit Automation • 40kV Automatic PTS • CVR/VVO Pilot
6	Distribution Planning Tools and Models	• Non-Wire Alternative Pilot • Hosting Capacity Pilot • Technology Pilots

In the GPM, strategic programs and projects are prioritized against seven impact dimensions – weightings can shift as priorities change

Strategic Spend Prioritization Impact Dimensions

Impact Dimension	Drivers	Current weighting
Safety	• Reduction in wire down events • Reduction in secondary cable manhole events • Reduction in major substation safety events	10
Load Relief	• Elimination of system overload or over firm conditions	4
Regulatory Compliance	• MPSC staff's recommendation (March 30, 2010 report) on utilities' pole inspection program • Service Quality and Reliability Standards	4
Substation Outage Risk	• Reduction in extensive substation outage events that lead to large amount of stranded load for more than 24 hours	4
Reliability	• Reduction in number of outage events • Reduction in restoration duration for outage events	3
O&M Cost	• Avoided costs from trouble event and truck roll reduction • Preventive maintenance spend reduction	3
Reactive Capital	• Avoided costs from lower trouble events and truck roll reduction • Avoided costs in reactive capital replacements during major equipment failures	3

Each program or project is mapped to the applicable set of impact dimensions to evaluate its overall benefits

Selected Programs and Projects' Benefit Mapping

Program	Safety	Load Relief	Regulatory Compliance	Substation Outage Risk	Reliability	O&M Cost	Reactive Capital
ADMS	X	X		X	X	X	X
4.8 kV System Hardening	X		X		X	X	X
Pole / Pole Top Hardware	X		X		X	X	X
Line Sensors					X	X	
Distribution Automation	X			X	X	X	X
Sub-transmission Redesign	X	X			X	X	X
4.8/8.3 Conversion & Consolidation	X	X		X	X	X	X
Frequent Outage (CEMI) Program	X		X		X	X	X
Load Relief		X		X			
System Cable Replacement	X			X	X		X
Breaker Replacement	X			X	X	X	X

The 4.8 kV Hardening program is a key element of DTE's investment plan to improve safety, reliability, and storm resiliency in the city of Detroit and bordering communities

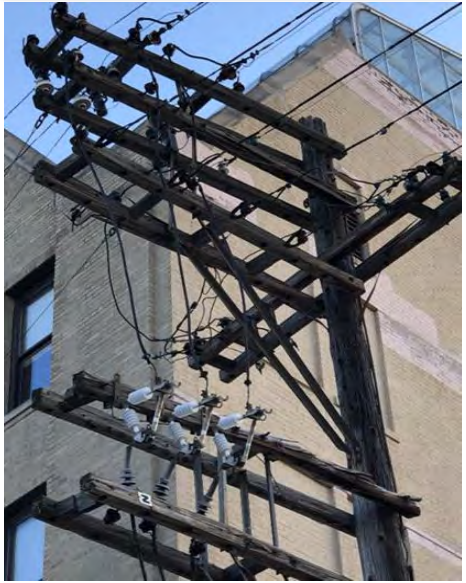
Drivers

- Harden and stabilize the 4.8 kV distribution circuits to improve safety, reliability, and storm resiliency
- Extend the life of the 4.8 kV circuits until DTE completes conversion to 13.2 kV

Scope of Work

- Replace or reinforce targeted poles
- Replace crossarms
- Remove Detroit Public Lighting Department street light arc wires and some distribution wires
- Remove service lines to abandoned properties
- Trim the trees to enhanced specifications
- Perform any additional necessary work as dictated by field conditions

Before Hardening Work



After Hardening Work

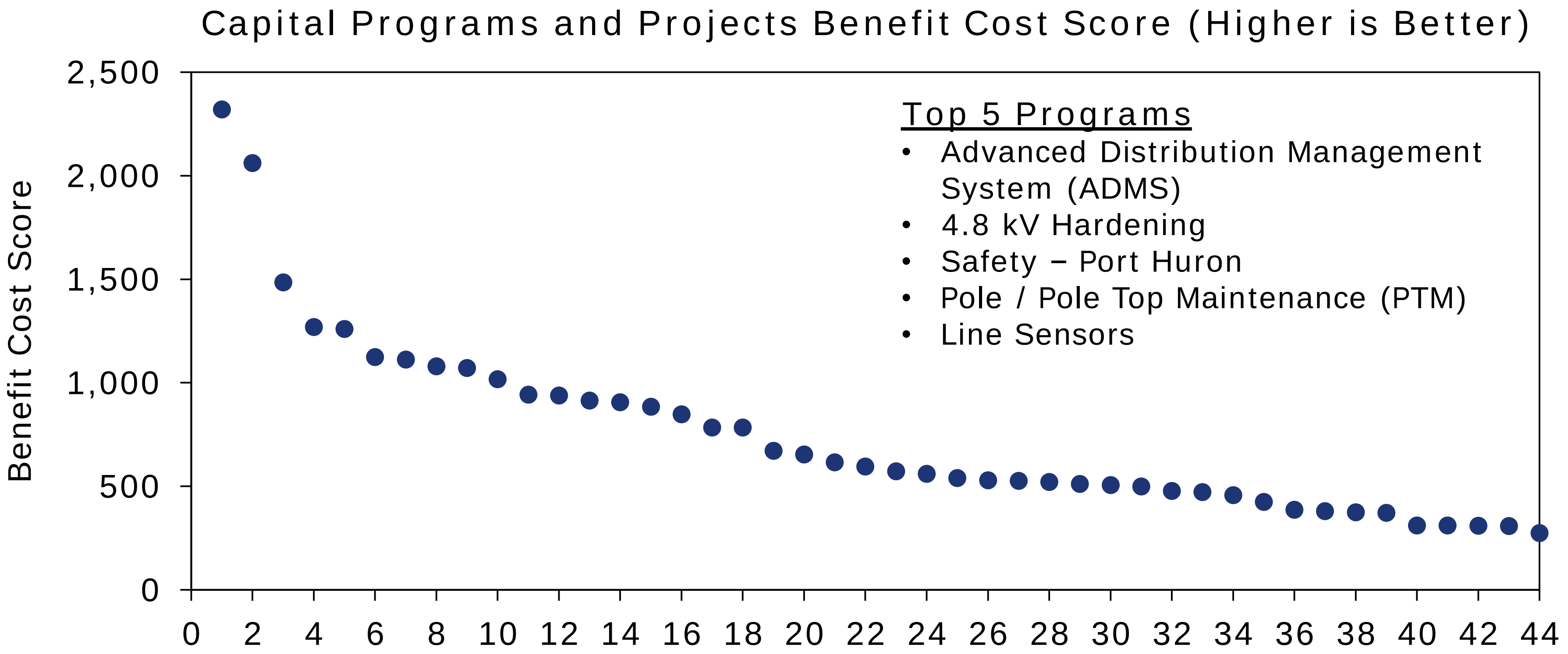
Five of the seven impact dimensions are applicable to the 4.8 kV Hardening Program

Case Study – 4.8 kV Hardening Program

Impact Dimension	Estimated Benefits	Indexed Benefit Cost Ratio	Weight	Weighted Score
Safety	1,871 wire down reduction	55	10 x	545
Regulatory compliance	Yes	100	4 x	400
Reliability	47 million CMI Reduction	49	3 x	148
Avoided O&M	$12 million	278	3 x	833
Avoided Capital	$5 million	45	3 x	135
Total Score				2,061

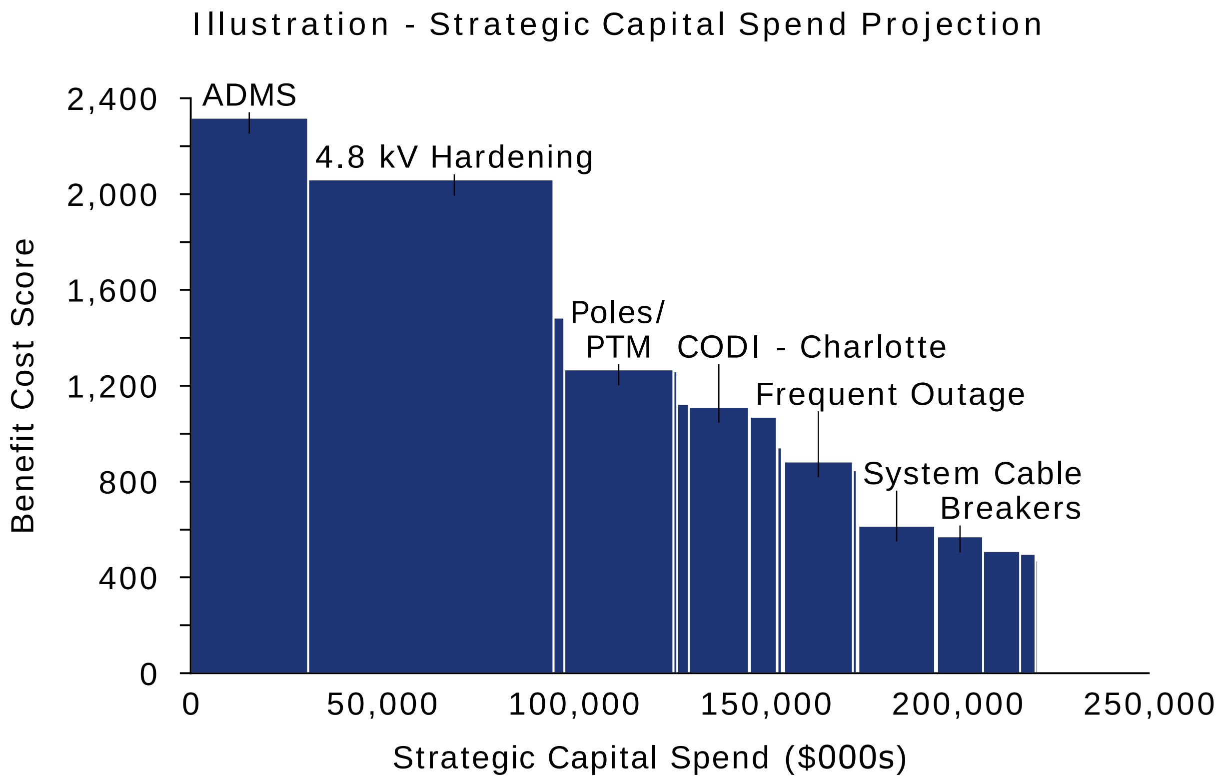
- The indexed benefit cost ratio is to capture each program's relative capability in mitigating an impact dimension
- The indexed benefit cost ratio generally ranges between 0 to 100 with a few exceptions
- The indexed value is defined as the benefit cost ratio of the program at the top 5 percentile in its contribution to respective impact dimension

Strategic capital programs and projects are ranked by their weighted benefit cost scores



DTE

The benefit cost scores of the strategic programs and projects provide the foundation for investment decisions



Other key considerations include:

- Project development milestones
- Resource needs and system constraints
- Need for non-discretionary spend
- Affordability

DTE's non-discretionary spend includes

- Trouble/storm
- Customer connection, relocation
- Tools, equipment and fleet
- Pilot studies
- Operational safety
- AMI / customer billing
- SOC
- Some projects under construction

Questions?

MORNING BREAK
10:15 – 10:30 AM

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Michigan Public Service Commission

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MPSC

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I&M Distribution Planning

Michigan Public Service Commission

October 16, 2019

Circuit Health Index (CHI): Data Analysis Methodologies

CHI
Circuit Health Index

Identify & rank circuits in need of attention

Select the worst performing circuits

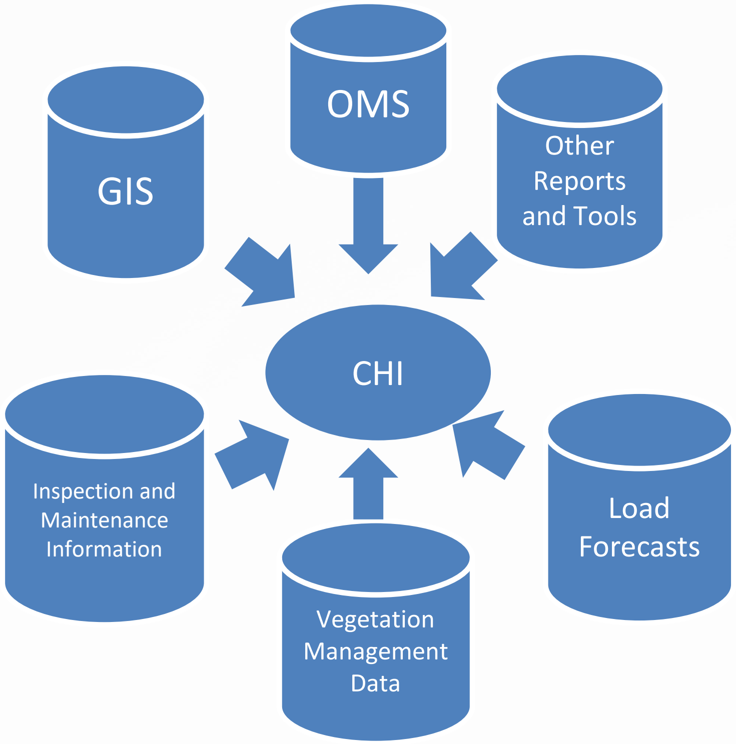
Engineers conceive of projects for improvement

PVR
Project Value Ranking

Evaluate and optimize the portfolio of remedies

Circuit Health Index (CHI)

- Forward looking
- Anticipates issues
- Scoring aligns with PVR
- SAIDI - primary consideration



Project Value Ranking (PVR)

- Ranking based on:
  - Safety
  - Reliability
  - Financial
  - Strategic
  - Compliance

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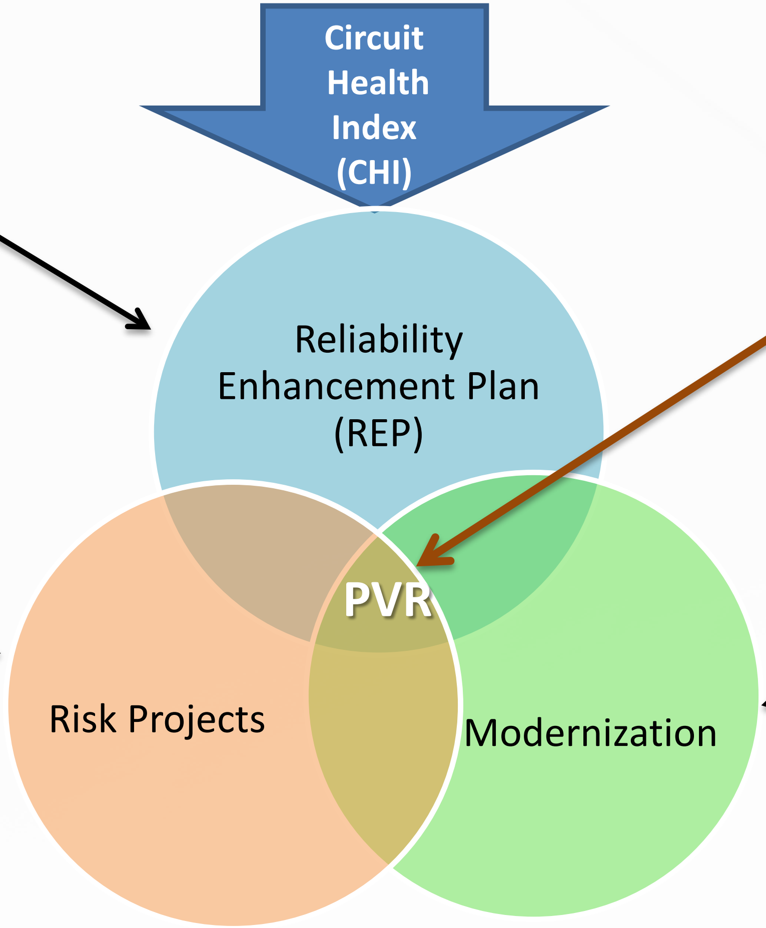
I&M Asset Investment Prioritization

Reliability Enhancement Program:
- OH Renewal
- URD Renewal
- Obsolete Equipment Replacement
- Major Projects



Project Value Ranking (PVR) selects projects based on:
- Safety
- Reliability
- Financial
- Strategic
- Compliance

Risk Management:
- Network Improvements
- Pole Replacement
- URD Inspection
- OH Inspection
- Contact Voltage Inspection

Grid Modernization:
- Distributed Automation
- Intelligent Line Sensors
- SCADA
- AMI Deployment
- Energy Storage
- Microgrids

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- PVR Categories
  - Reliability – Project Improves Reliability of our grid
  - Safety – Project improves the safety for our employees and customers
  - Compliance – Project ensures we are in compliance with our programs
  - Strategic – Project aligns with strategic goals
  - Financial – Project improves financial liability

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PVR Output

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Scheduled Year	Funded	Year of Project	Rank	Project Name	Current Yr Cap. Cost	Current Yr O+M Cost	Total Cost ($1000's)	Ratio (Total Score /Cost)	Reliability	Financial	Strategic	Safety	Compliance	Reputation	Total Project Score
2019	Yes	1	10	Mich19 - 3ph.Pokagon.12kV.C487-96	44.70	0.00	44.70	0.54	23.95	0.00	0.14	0.00	0.00	0.00	24.10
2019	Yes	1	13	Mich19 - 3ph.Niles.South.B657-48	29.80	0.00	29.80	0.44	13.05	0.00	0.10	0.00	0.00	0.00	13.15
2019	Yes	1	20	Mich19 - 3ph.Niles.North.B602-130	26.82	0.00	26.82	0.29	7.59	0.00	0.09	0.00	0.00	0.00	7.68
2019	Yes	1	22	Mich19 - 3ph.Niles.South.B657-28	17.88	0.00	17.88	0.27	4.79	0.00	0.06	0.00	0.00	0.00	4.85
2019	Yes	1	23	Mich19 - Sta Exit.Lakeside.Union Pier	30.24	0.00	30.24	0.24	7.15	0.00	0.00	0.00	0.00	0.00	7.15
2019	Yes	1	30	Mich19 - Sta Exit.Lakeside.New Troy	24.00	0.00	24.00	0.20	4.91	0.00	0.00	0.00	0.00	0.00	4.91
2019	Yes	1	35	Mich19 - 3ph.Pearl St.Fairplain South.B231-20	71.52	0.00	71.52	0.17	11.59	0.00	0.25	0.00	0.00	0.00	11.84
2019	Yes	1	37	Mich19 - 3ph.Buchanan South.Clark.B596-40	50.66	0.00	50.66	0.15	7.57	0.00	0.16	0.00	0.00	0.00	7.73
2019	Yes	1	45	Mich19 - Sta Exit.Colby.West	28.80	0.00	28.80	0.11	3.08	0.00	0.00	0.00	0.00	0.00	3.08
2019	Yes	1	60	Mich19 - 1ph.Sister Lakes.Sister Lakes.VB718-2	47.84	0.00	47.84	0.08	3.28	0.00	0.45	0.00	0.00	0.00	3.73
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
2019	Yes	1	64	Mich19 - Sta Exit.Stevensville.Red Arrow	119.52	0.00	119.52	0.07	8.45	0.00	0.00	0.00	0.00	0.00	8.45
2019	Yes	1	70	Mich19 - Cir Tie.Colby.West.CA250-227	182.70	0.00	182.70	0.06	11.09	0.00	0.70	0.00	0.00	0.00	11.79
2019	Yes	1	71	JMS-DR19F0023-Pigeon River feeder addition	850.00	0.00	850.00	0.06	41.40	0.00	9.78	0.00	0.00	2.86	54.04
2019	Yes	1	74	Mich19 - 1ph.Langley Ave.Park St.B215-179	21.23	0.00	21.23	0.06	1.10	0.00	0.21	0.00	0.00	0.00	1.32
2019	Yes	1	77	Mich19 - 3ph.West St.Coloma.B132-27	74.50	0.00	74.50	0.06	4.26	0.00	0.25	0.00	0.00	0.00	4.52
2019	Yes	1	81	JMS-DR19F0019-Derby-new 138/12kV station	1000.00	0.00	1000.00	0.06	100.75	0.00	30.54	0.00	0.00	6.94	138.24
2019	Yes	1	85	Mich19 - 1ph.Langley Ave.Park St.B215-483	38.64	0.00	38.64	0.05	1.68	0.00	0.37	0.00	0.00	0.00	2.05
2019	Yes	1	86	Mich19 - 1ph.New Buffalo.Grand Beach.B631-25	59.88	0.00	59.88	0.05	2.58	0.00	0.56	0.00	0.00	0.00	3.14
2019	Yes	1	99	JMS-DR19F0016-Scottdale 34 to 69kV conversio	500.00	0.00	500.00	0.05	14.32	0.00	42.34	1E-06	0.00	0.94	57.60

Work Planning

Key Elements - Road Map

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-2 Years from Annual Work Plan

- **+5Y:** Engineering begins Conceptual Scoping
- **Jan:** Eng. & Districts collaborate to develop refined Conceptual scope for the following year
- **Feb:** Eng. Publishes and distributes refined scope
- **Mar:** Analysts distribute information requests for Budget inputs
- **Mar:** Functional Scoping for following year begins
- **Apr:** Engineering analyzes Outage data for CHI input
- **Apr:** Budget Inputs
- **May:** Budget Grid locked down
- **DUE:** Districts' 4+8 Work Plan and budget assumption updates
- **DUE:** Engineering to assist Districts in entering following 2 years' monthly data into work plan
- **DUE:** Major Proj. Engineering to provide updated budget assumptions & In Service Dates for: 4+8, following 2 years [monthly] + 3 more years annual
- **Jun:** Analysts to provide Engineering with any updates to budget
- **Jul:** CHI ran & analyzed for [4] years' data by Circuit & Program
- **Aug:** Analysts update Parametric estimates for REP work
- **Oct:** Engineering develops and enters all projects [from Jun/Jul CHI analysis] into PVR for High level scoping
- **Sep/Oct:** **Due:** Districts to analyze current year & provided scope to develop and submit Final Work Plan Baselines for following year
- **Nov:** Engineering runs PVR for year following next year, for every project I&M Distr. has
- **Dec:** Engineering determines projects "to do" based on Budget, Circuit Health Index (CHI) and Project Value Ranking (PVR)

Timeline: +5Y, Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec

-1 Years from Annual Work Plan

Third-Party Uses of Hosting Capacity Analyses

Distribution System Planning Meeting
October 16, 2019

Laura Sherman, Ph.D., President

Michigan Energy Innovation Business Council

Michigan EIBC's mission is to grow Michigan's **advanced energy economy** by fostering opportunities for **innovation** and **business growth** and offering a unified voice in creating a business-friendly environment for the advanced energy industry in Michigan.

Leadership Council

- APEX Clean Energy
- Cypress Creek Renewables
- Invenergy
- ITC – A Fortis Company
- Michigan CAT
- Ranger Power
- Sunrun
- Varnum Attorneys at Law

Members

- 5 Lakes Energy
- Advanced Battery Concepts – Better Batteries, Better World®
- amazon
- Ameresco – Green • Clean • Sustainable
- Atwell
- aria energy
- BioWorks Energy – Advanced organics processing
- Distributed Power
- Barton Malow
- catalyst partners
- Cardno – Shaping the Future
- CBS Solar – Michigan Made for the World
- chargepoint
- Chart House Energy
- Clarke Energy – A Kohler Company – Engineer - Install - Maintain
- Clark Hill – Legal and Professional Services
- Commonwealth
- Covanta – Powering Today. Protecting Tomorrow.
- Christman – Since 1894
- Dickinson Wright PLLC
- e.on
- ecamion
- ecojiva – Solar Installation Company
- EDF renewables
- edp renewables
- energy sciences
- engie
- evolution – Electric Vehicle Systems
- The Energy Alliance Group of Michigan
- foresight
- Four Elements Energy
- Future Energy Group – Innovation • Systems • Partnership
- GEM Energy – Rudolph Libbe Group
- Generate Capital
- Growth Capital Network
- greenlots
- Geronimo Energy
- The Green Panel
- harvest solar
- Heelstone Energy – Sun powered energy
- Helios Solar Environment Economics Engineering
- HSC Hemlock Semiconductor
- HME Ahrens-Fox
- Homeland Solar – Own Your Own Power – Residential • Commercial • Municipal
- Honeywell – The Power of Connected
- inman solar – A Commercial & Utility Scale Provider

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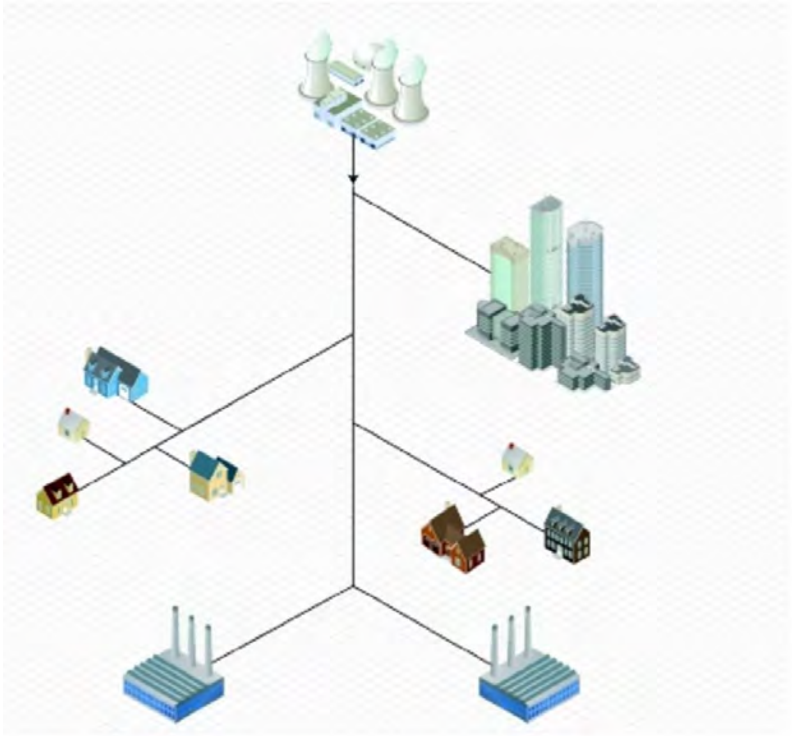
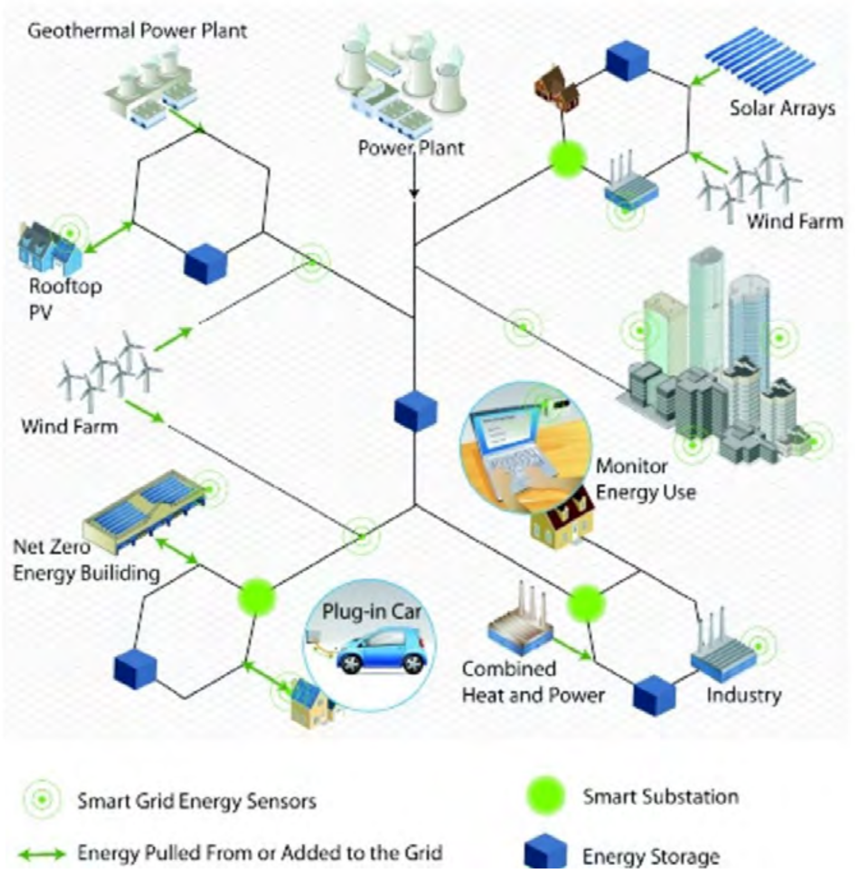
OneEnergy Renewables
NTH Consultants, Ltd. – Infrastructure Engineering and Environmental Services
NCG Newman Consulting Group – Profitable Ideas for High Performance Buildings Since 2002
New Dawn Energy – Commercial Solar Development
Novi Energy
PineGate Renewables
Peninsula Solar
Orion Renewable Energy Group LLC
Phoenix Contact
PLG Pace Loan Group
Plunkett Cooney
PowerHome Solar & Roofing
Petros PACE Finance
plug smart – intelligent energy solutions
PACEnergies – Perfectly | Affordable | Clean | Energy
Q Cells
Renewable Properties
powerley
PSC Public Sector Consultants
Pivot Energy
Sunvest Solar Inc
Skins
Life Is On Schneider Electric
Renergetica – Better Energy Better World
Ryzen Lighting Group
Sempra Renewables
Soltage – Renewable Energy Provider
Southern Current
Samsung Renewable Energy
Spartan Renewable Energy
Srinergy – Live Smart. Live Green.
Trajectory Energy Partners
TRC – Results you can rely on
tradewind energy
toggled
Ventower Industries
Volta Power Systems
walker-miller Energy Services, L.L.C.
WindSecure – www.windsecure.com
Warner Norcross & Judd LLP – Attorneys at Law

U.S. Energy System

Past

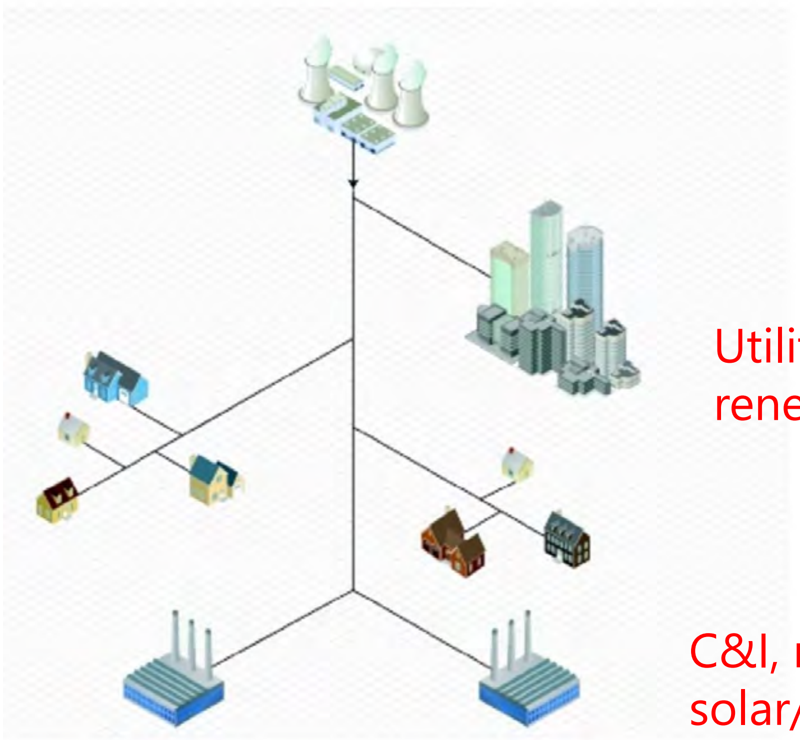


Present and Future

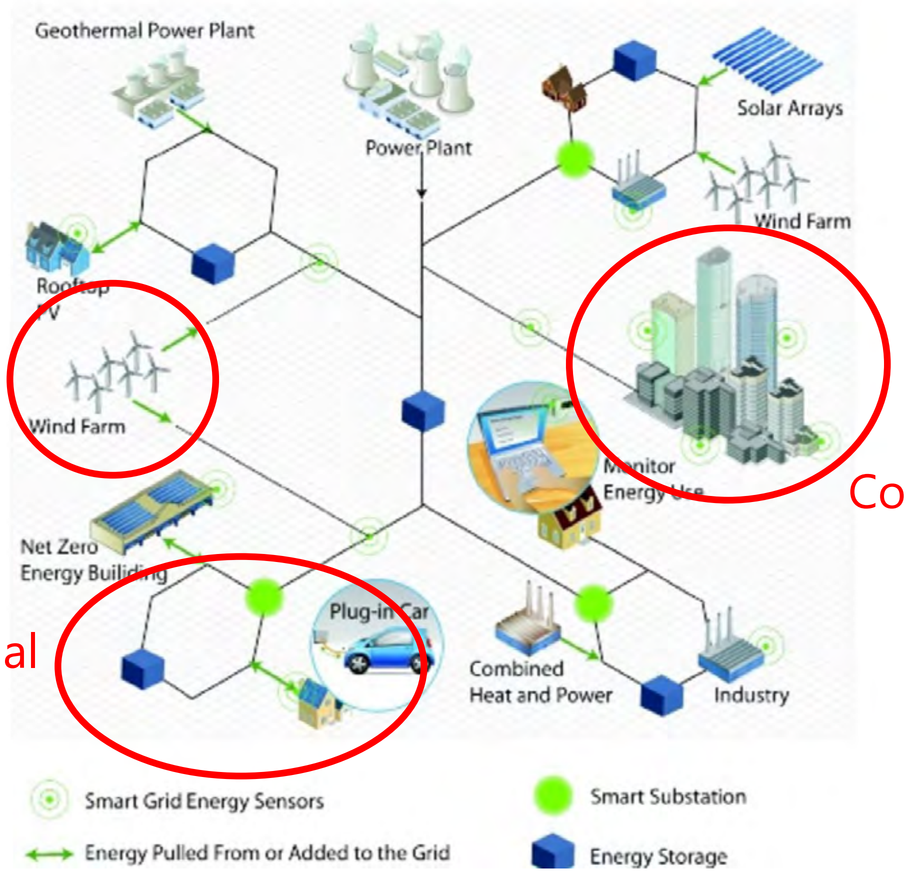


U.S. Energy System

Past



Present and Future



Utility-scale renewables

C&I, residential solar/storage

Communities

michigan EIBC

Panelists

Mark Cryderman, Business Development/Education, The Green Panel

Sarah Mills, Project Manager, University of Michigan

Ethan Case, Vice President of Policy, Heelstone

michigan EIBC

A Utility Scale Developer Perspective on Distribution Interconnection & Information Availability

Prepared for the October 16th Distribution Planning Stakeholder Meeting panel on Third Party Use of Hosting Capacity Analysis at the Michigan Public Service Commission

Heelstone Renewable Energy

Overview

- Heelstone Renewable Energy is a utility-scale solar developer with expertise in developing, financing, constructing and operating solar photovoltaic projects.
- Heelstone was formed in 2012 and is headquartered in Chapel Hill, NC.
- Heelstone has developed and achieved commercial operation on **60 solar projects** with an aggregate generating capacity of approximately **500 MW**.
- Heelstone maintains a robust and diverse pipeline with annual NTP targets of **200 MW.**
- In 2019, Heelstone received an investment from Ares Infrastructure and Power, a subsidiary of Ares Management Corporation (NYSE: ARES).

HEELSTONE RENEWABLE ENERGY

Typical Development of a Solar Farm

General Development Timeline

Step 1: Site Control
Heelstone works with landowner to secure site control and conducts initial due diligence on the site.

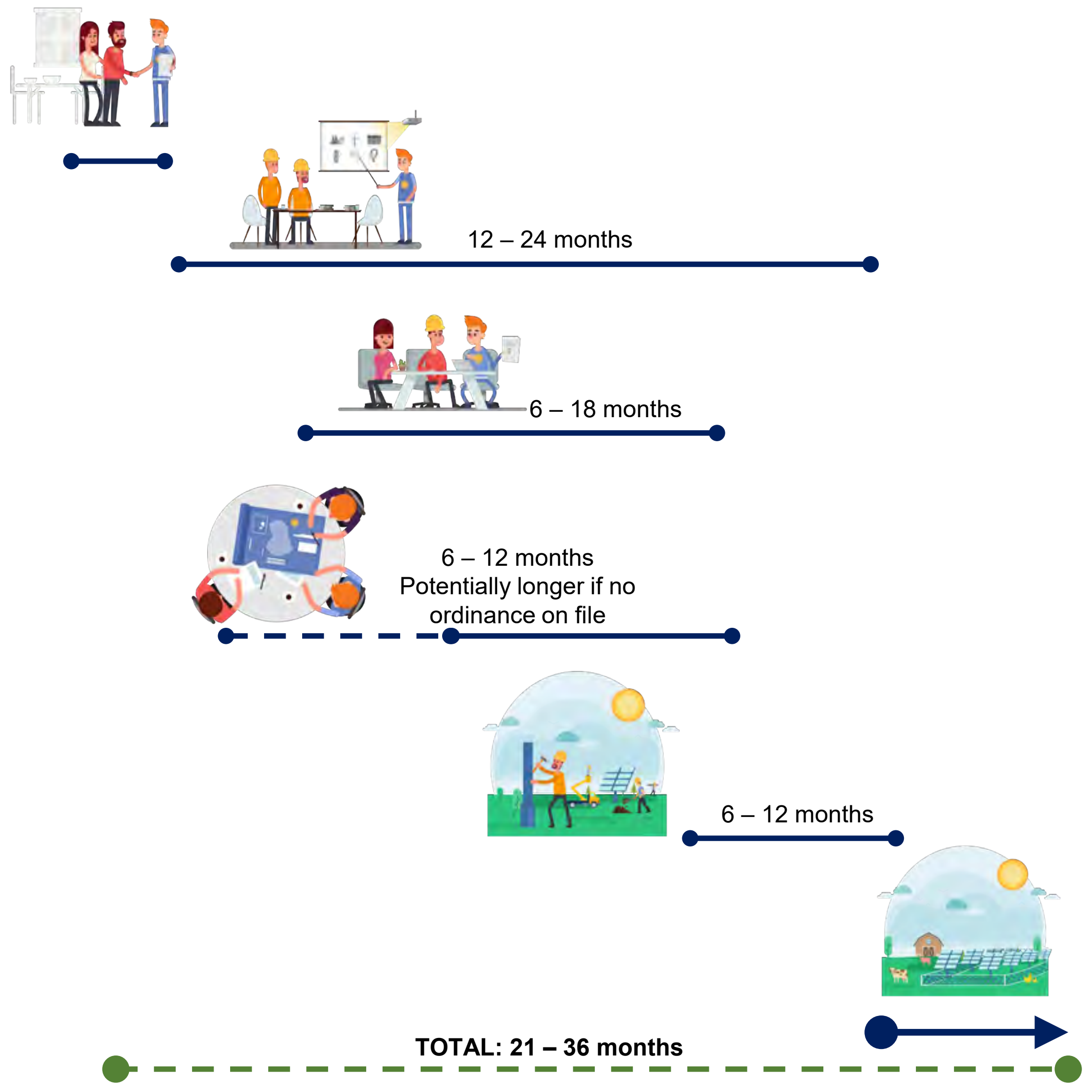
Step 2: Interconnection
Heelstone submits application to utility requesting interconnection to utility's power grid. The utility starts studying possible effects of incorporating the project to utility's other resources.

Step 3: Power Purchase Agreement
Heelstone works with utility to secure a contract to sell electricity from solar facility.

Step 4: Permitting
Heelstone obtains zoning and other required permits from local, state and federal jurisdictions, and otherwise ensures compliance with all applicable rules and regulations.

Step 5: Construction
Heelstone secures all financing required to construct the facility. Heelstone and utility have two separate construction timelines. The utility builds or upgrades the grid infrastructure servicing the site, while the developer installs the actual components (racking, inverters, modules, etc.).

Step 6: COD & Operation
Once the solar facility obtains COD, it will be remotely monitored by wireless communications. Except for the occasional maintenance worker, it is a silent neighbor.



Developer Perspective on Interconnection & Information Availability

Quick Summary

- Interconnection feedback is the **number one** reason why a prospective solar site does not become a solar farm.
- Hosting capacity information available earlier in the interconnection process can save utilities and developers significant time and money.
- Multiple states require that utility hosting capacity information be available to third party businesses, thereby saving utilities and developers significant time and money.
- Adopting a dynamic view of hosting capacity can create opportunities for additional cost savings for utilities, developers, and ratepayers.

Interconnection & Site Selection

- Site selection screens for the known-unknowns of interconnection along with other development factors.
- With limited grid information, solar developers make educated guesses about which sites will yield economically viable costs to upgrade the grid to accommodate a solar project.
- Attractive sites from an interconnection perspective are located near:
  - A substation
  - A distribution line
  - Multiple possible points of interconnection
- Optionality for interconnection decisions, or the possibility to interconnect at multiple points on the grid, increase the probability that a project will have a viable, cost-effective path to be interconnected.

Interconnection Costs & Information Availability

More hosting capacity information earlier in the development process saves utilities and developers time and money

- Cost savings through lower probability of paying for land options for non-viable solar sites
  - Land options required for interconnection applications for grid connected distribution sized sites cost at least thousands of dollars
- Cost savings through lower probability of filing interconnection applications for non-viable solar sites
  - Interconnection application fees for distribution projects cost at least hundreds of dollars to cover utility interconnection team review time
- Cost savings through lower probability of advancing non-viable sites for study in the utility interconnection queue
  - Utility administered interconnection studies cost a minimum of tens of thousands of dollars for larger grid connected distribution systems
- Cost savings through reduced negative impacts upon viable projects
  - Delay arising from wasteful study of non-viable projects costs extra for viable projects and wastes the utility's time
  - Weeding out nonviable projects earlier saves all interconnection stakeholders time and money

Developer Perspective – Information Availability for Site Screening

More information earlier in the site selection process saves time and money

- Information typically available at interconnection application filing
  - High confidence guess of location of grid infrastructure
  - Medium to high confidence guess of existing queue impact upon capacity along with upgrades assigned (projects ahead of us in queue)
  - Low to medium confidence guess of line rating (Voltage)
  - Very low confidence guess of capacity (MVA / MW)
- Information available after application filing
  - Certainty of grid infrastructure locations
  - Medium confidence guess of available capacity from utility interconnection team at scoping meeting
- Information available at system impact study
  - Medium to high confidence estimate* of hosting capacity
    - Confidence is highly dependent upon viability of projects in existing queue
    - *No longer a "guess" after a quantitative study
  - Medium to high confidence estimate of interconnection upgrades and cost required

Hosting Capacity Information – Examples from Other States

Some states make distribution interconnection information available to third parties which saves utilities and clean energy businesses time and money

Minnesota

- Xcel Energy has made distribution level interconnection information available online (link)

Illinois

- ComEd has made similar information available online (link)

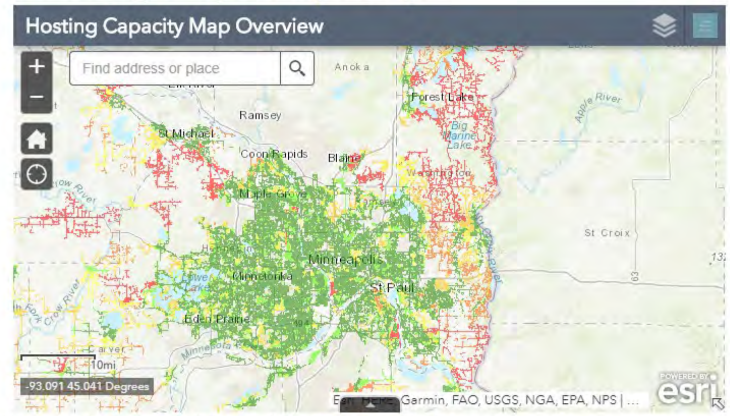
New York

- All major utilities in NY post distribution level hosting capacity maps (link)

California

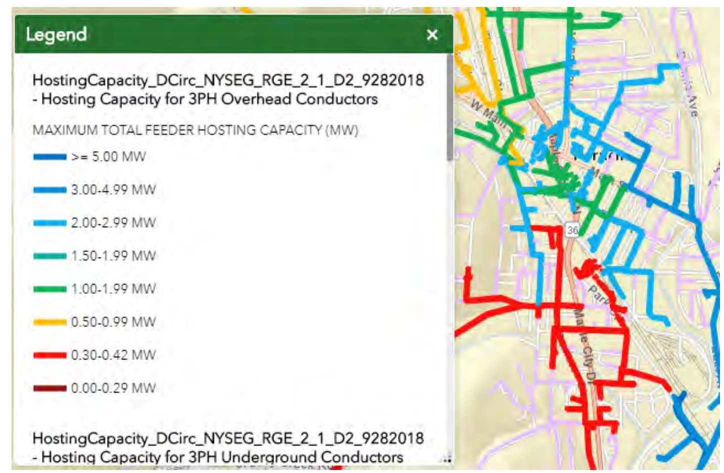
- CA utilities have posted detailed hosting capacity maps and information since 2016 (SG&E map link)

Hosting Capacity Map



Want to utilize the map in full screen? Go here (external link).

Source: Xcel Energy - https://www.xcelenergy.com/working_with_us/how_to_interconnect/hosting_capacity_map



Source: NY Department of Public Service, RG&E Hosting Capacity Map
http://iusamsda.maps.arcgis.com/apps/webappviewer/index.html?id=2f29c88b9ab34a1ea25e07ac59b6ec56

HEELSTONE RENEWABLE ENERGY

Developer Perspective – Static vs. Dynamic Hosting Capacity Views

Dynamic views of hosting capacity can increase amount of DER accommodation over time.

	Static HC	Uncoordinated Dynamic HC	Coordinated Dynamic HC
	• Fit and forget • Worst case static snapshots	• Local autonomous control • No inverter communications • Probabilistic screens	• Communications-based • Resolve multiple DERs and multiple constraints • Curtailment risk
Interconnection Solutions	• Traditional firm interconnection approach	• Firm interconnection with autonomous advanced inverter functionalities (for example, under IEEE 1547-2018 or CA Rule 21)	• Flexible interconnection, where curtailment risk is accepted by the PV developer as an alternative to paying for traditional distribution upgrades
Pros	• An established, simpler static hosting capacity analysis that required less computation and is less data-intensive • No curtailment risk for the PV developer	• Use of advanced inverter functionalities can allow for expansion of the hosting capacity at no cost to the utility • Captures time-dependent behavior of PV, loads, and grid devices	• May allow for the expansion of hosting capacity at a lower cost than traditional upgrades • Coordination between DERs could improve system performance, particularly at high penetration levels • Captures time-dependent behavior of PV, loads, and grid devices
Cons	• Static hosting capacity analysis does not fully capture the behavior of grid devices or controls and cannot be used to evaluate advanced integration solutions involving the dynamic control of PV inverters or grid devices • Some traditional upgrades may not be necessary if based on conservative snapshot power flow scenarios (e.g., if the PV only causes a small and temporary overvoltage)	• Dynamic hosting capacity analysis is more computationally- and data-intensive • Probabilistic screens inherently involve uncertainty	• Involves installation of communications infrastructure, monitoring, and software by the utility and/or the developer • Less predictable curtailment than with pre-defined autonomous functions • Certain principles of access may curtail a generator's output even when that generator isn't contributing to the constraint

Source: "Hosting Capacity Analysis for Policymakers" National Renewable Energy Laboratory https://www.nrel.gov/docs/fy19osti/74383.pdf

Developer Perspective – Summary Recap

Quick Summary

- Interconnection feedback is the **number one** reason why a prospective solar site does not become a solar farm.
- Hosting capacity information available earlier in the interconnection process can save utilities and developers significant time and money.
- Multiple states require that utility hosting capacity information be available to third party businesses, thereby saving utilities and developers significant time and money.
- Adopting a dynamic view of hosting capacity can create opportunities for additional cost savings for utilities, developers, and ratepayers.

Thank You

Ethan Case

Vice President of Policy

emcase@heelstonenergy.com

LUNCH BREAK: 12:00 PM – 1:00 PM

MPSC Michigan Public Service Commission

- Some food/restaurant suggestions

  – Food Truck: Picnic A Food Truck

- 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 and Recap	Patrick Hudson, Manager, Smart Grid Section
9:10 a.m.	Future Distribution Planning Reports: Consistent Data Across Utilities	Consumers Energy, DTE, and Indiana Michigan Power
9:25 a.m.	Consumers Energy: Benefit Cost Analysis	Consumers Energy
9:50 a.m.	DTE: Benefit Cost Analysis	DTE
10:15 a.m.	Break	
10:30 a.m.	I&M: Benefit Cost Analysis	Indiana Michigan Power
10:55 a.m.	Third-Party Uses of Hosting Capacity Analyses Panelists: Sarah Mills, Senior Project Manager, University of Michigan Mark Cryderman, Business Development/Ed., The Green Panel Ethan Case, Vice President of Policy, Heelstone	Moderator: Laura Sherman, President, Michigan Energy Innovation Business Council
12:00 p.m.	Lunch (restaurants available)	All
1:00 p.m.	DSPx: Distribution Planning Relationship with Grid Modernization and Cost Effectiveness Framework	Paul De Martini, Newport Consulting
1:30 p.m.	Non-Wires Alternatives Analysis, Sourcing Options, and Relative Risks	Paul De Martini, Newport Consulting
2:00 p.m.	Discussion: A Framework for Non-Wire Alternatives	Paul De Martini, Newport Consulting
2:30 p.m.	Break	
2:50 p.m.	DER Coordination as a Non-Wire Solution: Opportunities and Challenges in Michigan	Johanna Mathieu, University of Michigan
3:20 p.m.	Consumers Energy: Response to Pilot Proposal Comments	Consumers Energy
3:30 p.m.	DTE: Response to Pilot Proposal Comments	DTE
3:40 p.m.	I&M: Response to Pilot Proposal Comments	Indiana Michigan Power
3:50 p.m.	Closing Statements / November 19 Stakeholder Session Overview	MPSC Staff
4:00 p.m.	Adjourn	

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Office of Electricity

DSPx: Planning for Grid Modernization & C-E/Prioritization Framework

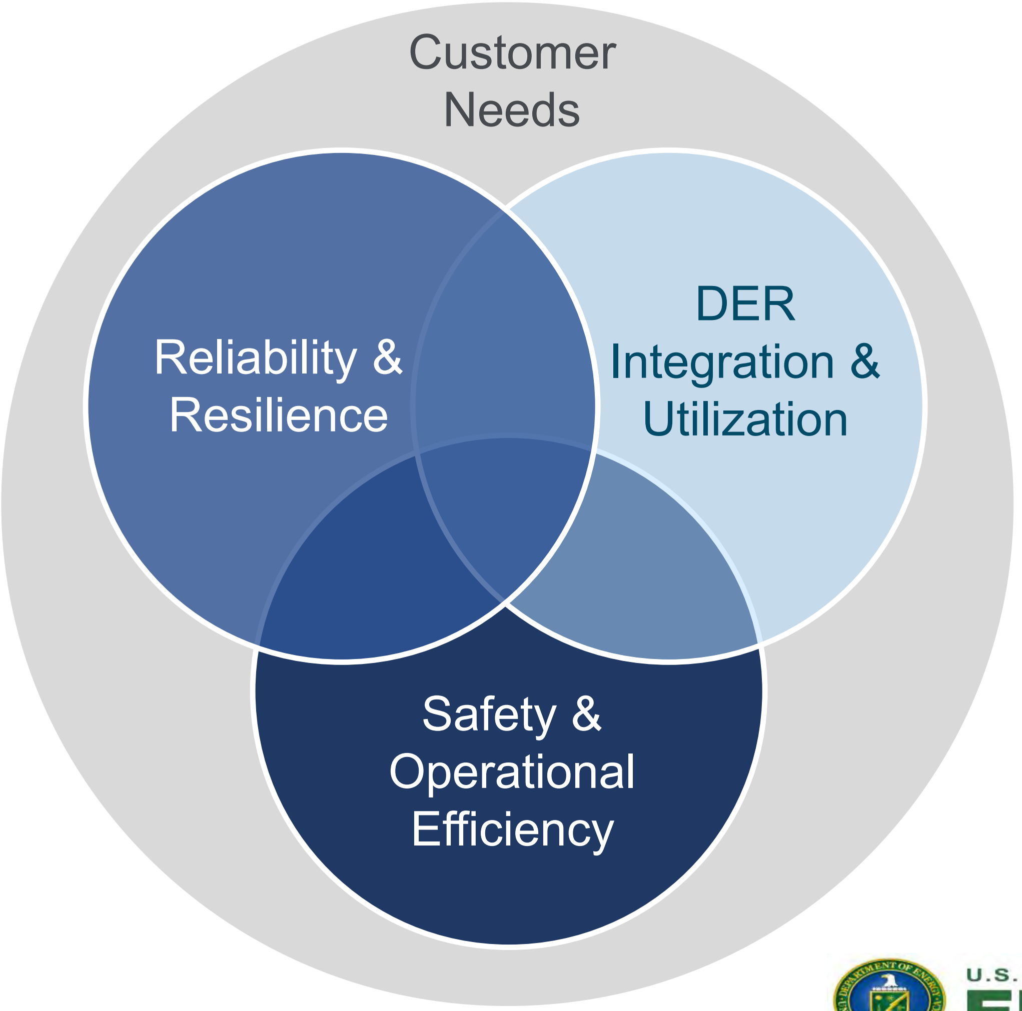
Paul De Martini, Newport Consulting

Michigan PSC
Distribution Planning Stakeholder Meeting

October 16, 2019

Scope of Grid Modernization

Grid Modernization has different definitions & scope across the US, but today most consider various aspects of these three areas



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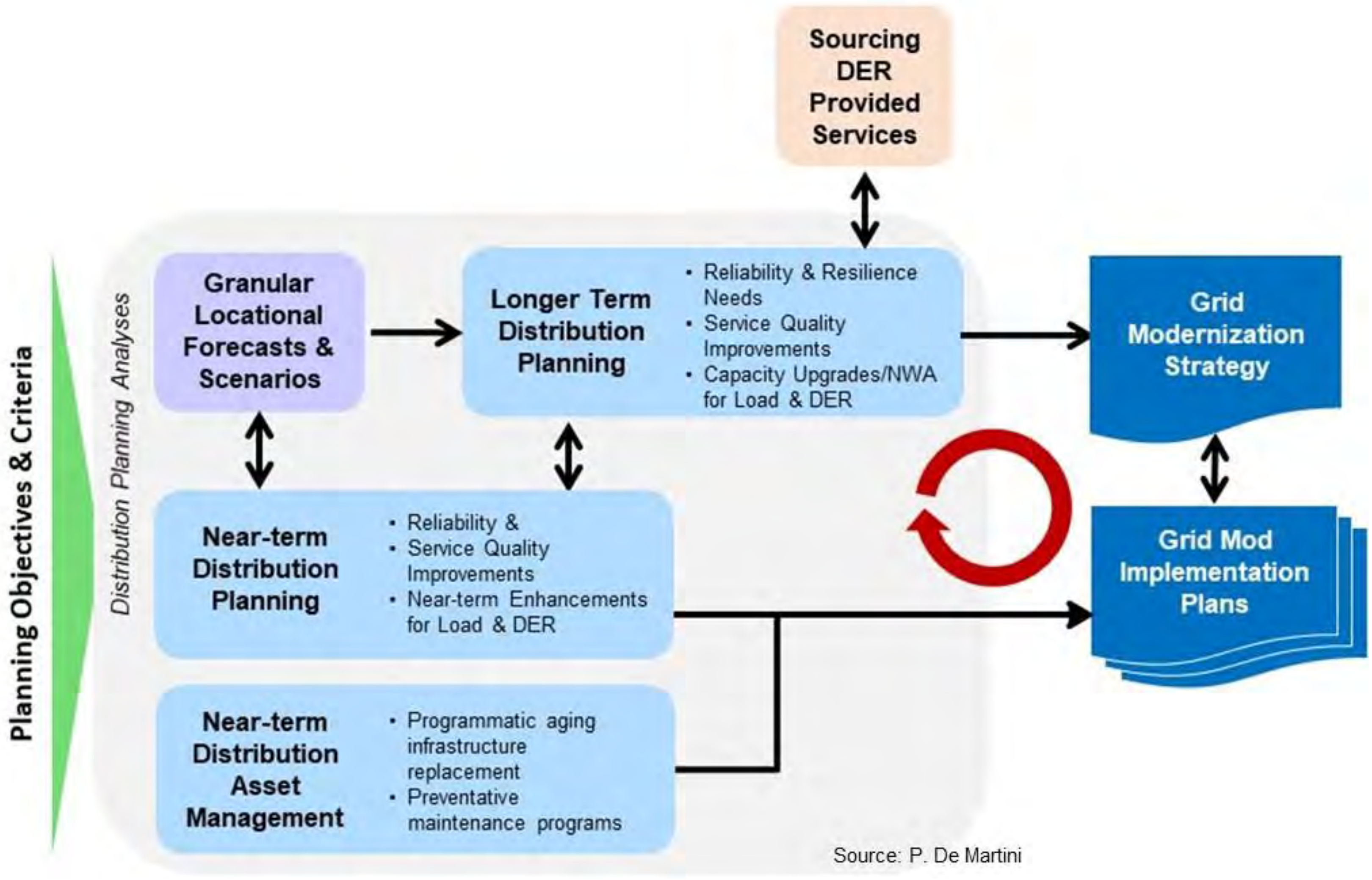
Planning for a Modern Grid

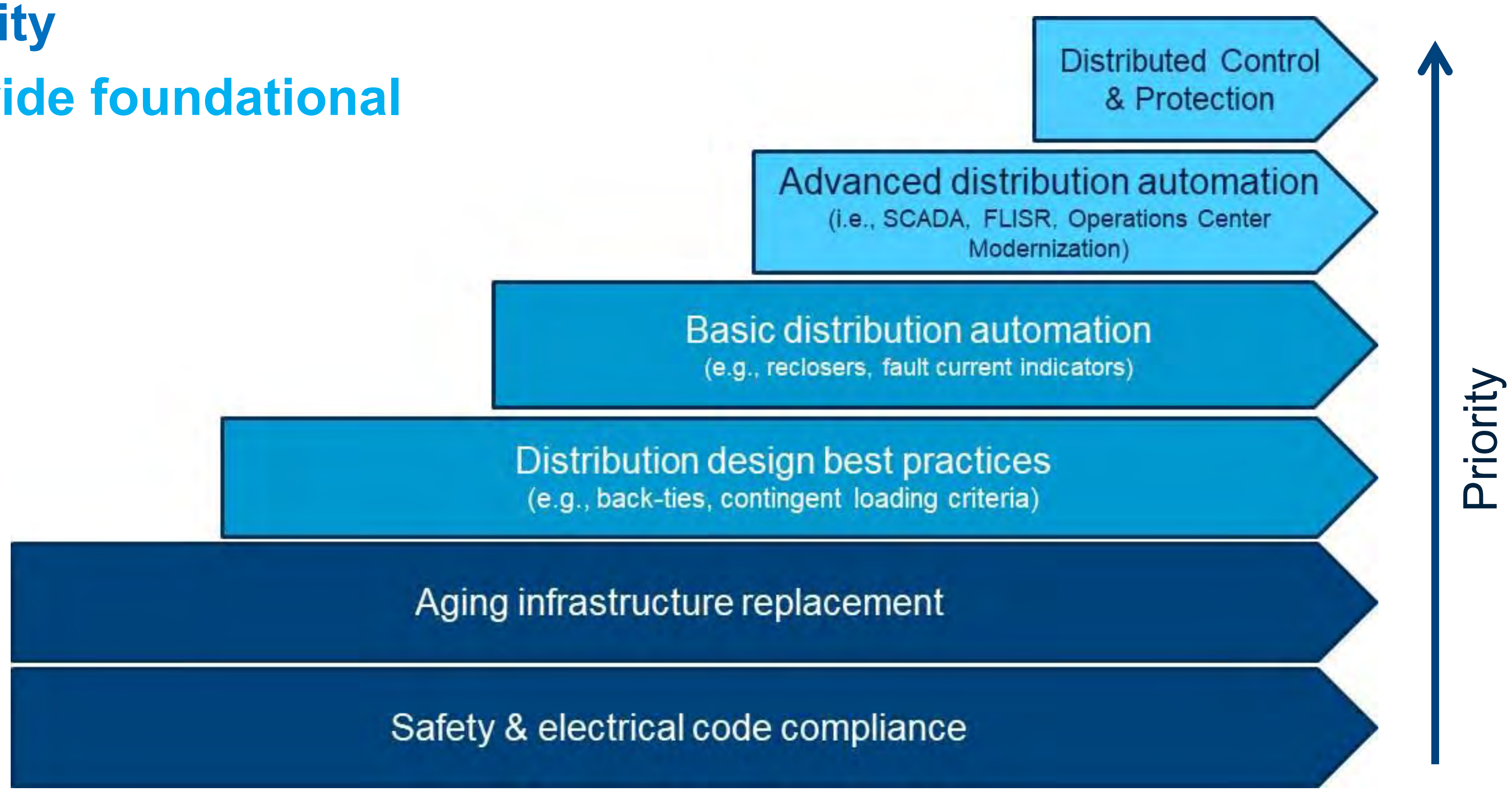


Source: P. De Martini

Distribution Reliability Investment Categories

Typical reliability investment categories:

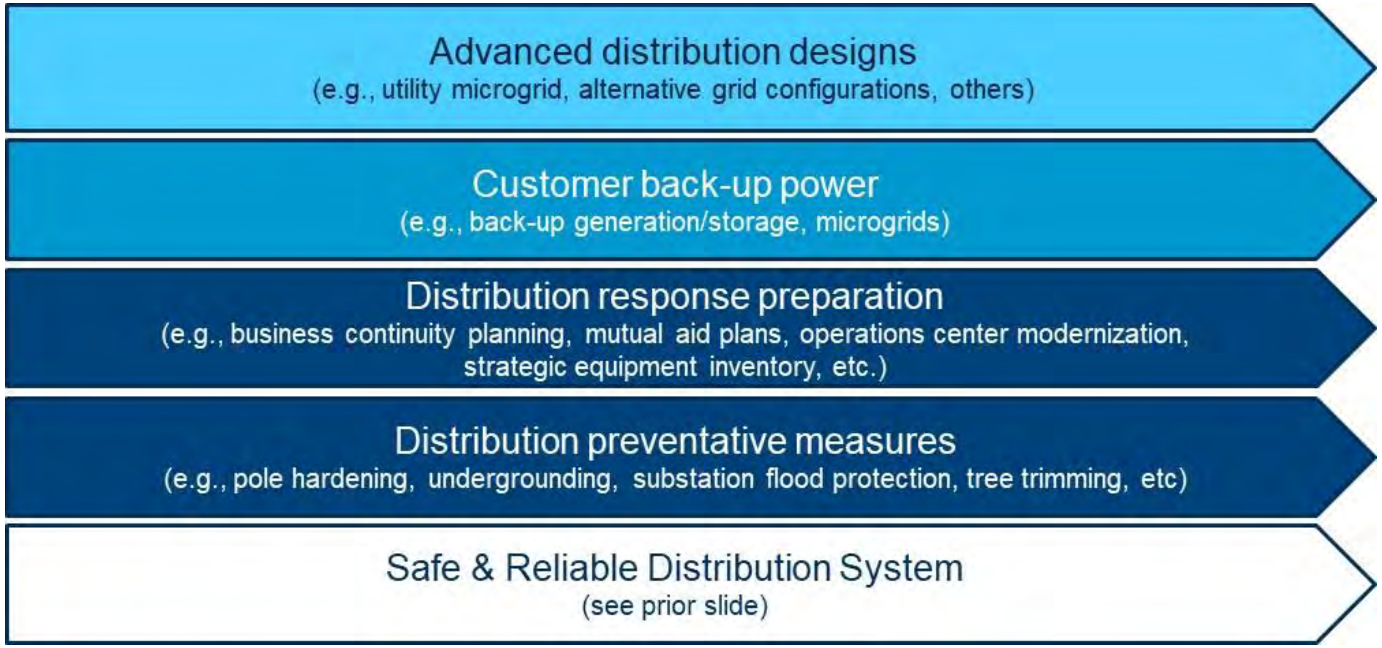
- **Basic safety and reliability requirements**
- **Improve customer reliability**
- **Enhance reliability & provide foundational elements for resilience**



Distribution Resilience Investment Categories

Typical investment categories:

- **Infrastructure hardening to provide foundational resilience**
- **Enhance customer resilience**
- **Enhance distribution local area resilience**



Distribution Reliability-Resilience Lifecycle

Overall process is the fundamentally the same, difference is in addressing the variation, scale and complexity of major events

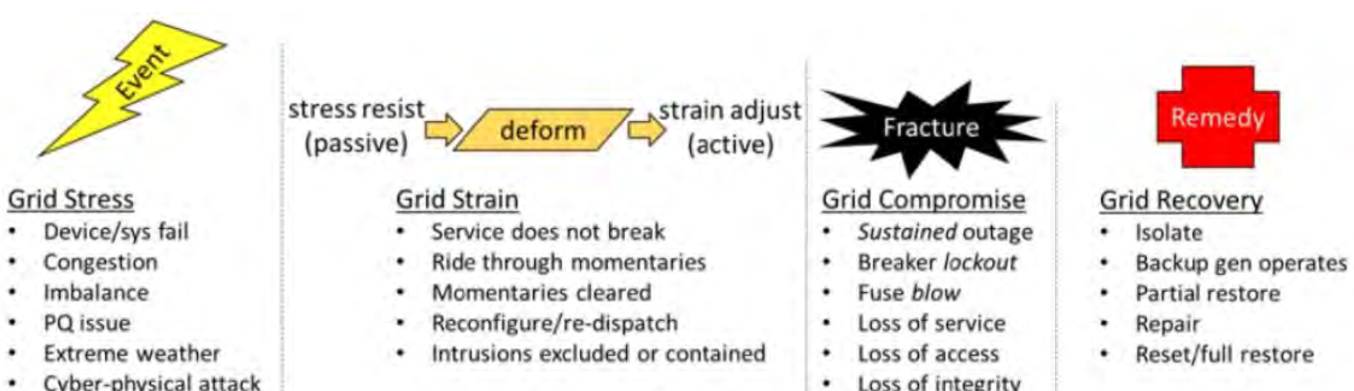
Resilience Events: Large geographic impact on distribution and/or bulk power system with long duration outage (outage typically greater than a day & excluded from IEEE metrics)

Reliability Events: Local impact with short duration outage (generally less than 8 hours measured by IEEE metrics)

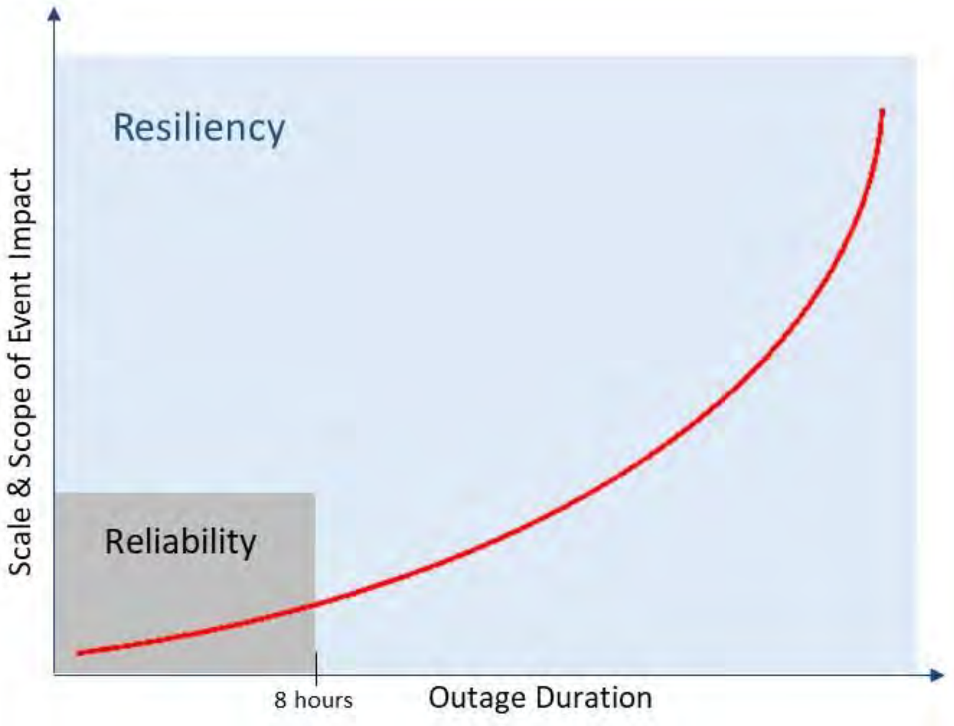
Reliability – Resilience Planning Continuum

A resilient distribution system starts with a safe, reliable distribution system

Distribution resiliency events involve the same types of infrastructure failures (e.g., wire down, poles broken, transformer failure, fuses blown, etc.) involved with reliability events but at a greater scale which creates significant complexity to address

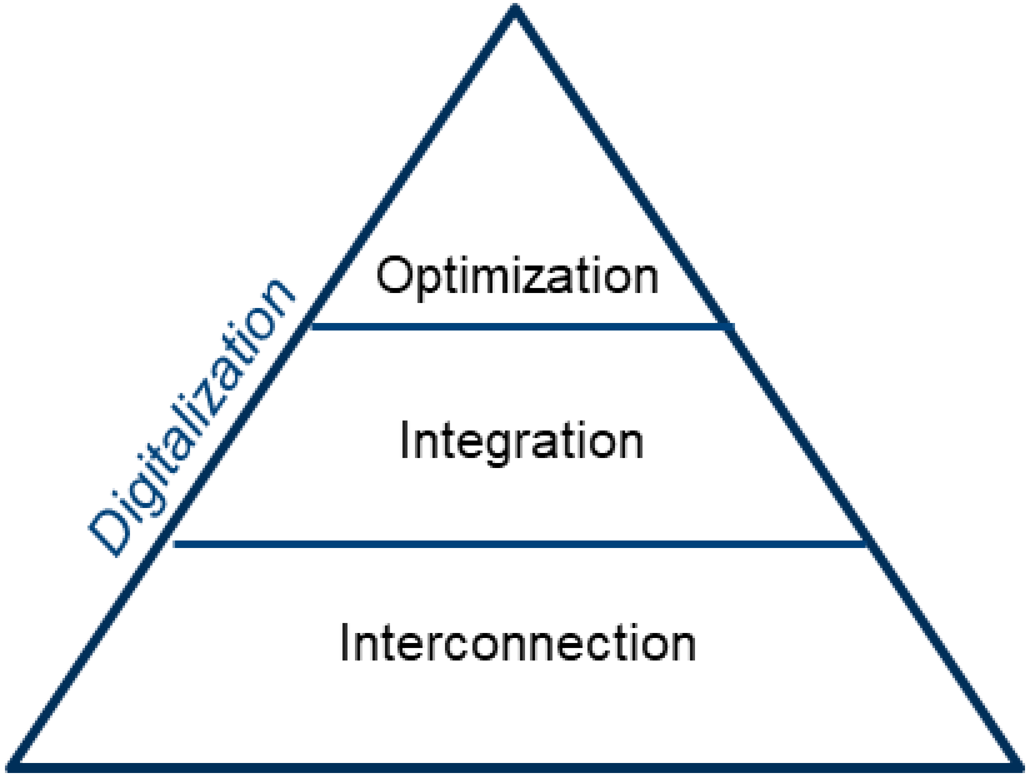


Source: J. Taft, PNNL



Distribution Planning for DER

- DER fundamentally changes the planning and engineering design considerations for distribution networks
- Three degrees of functional sophistication required:
  - Interconnection
  - Integration
  - Optimization
- These 3 are also dependent upon the analog to digital transformation of the grid to support:
  - Visibility
  - Planning & Operational Analytics
  - Protection & Control
  - Operational Coordination



Source: DSPx Future Grid Roundtable Discussion

Architecture Manages Complexity

The engineering issues associated with the scale and scope of dynamic resources envisioned in policy objectives for grid modernization requires a holistic architectural approach

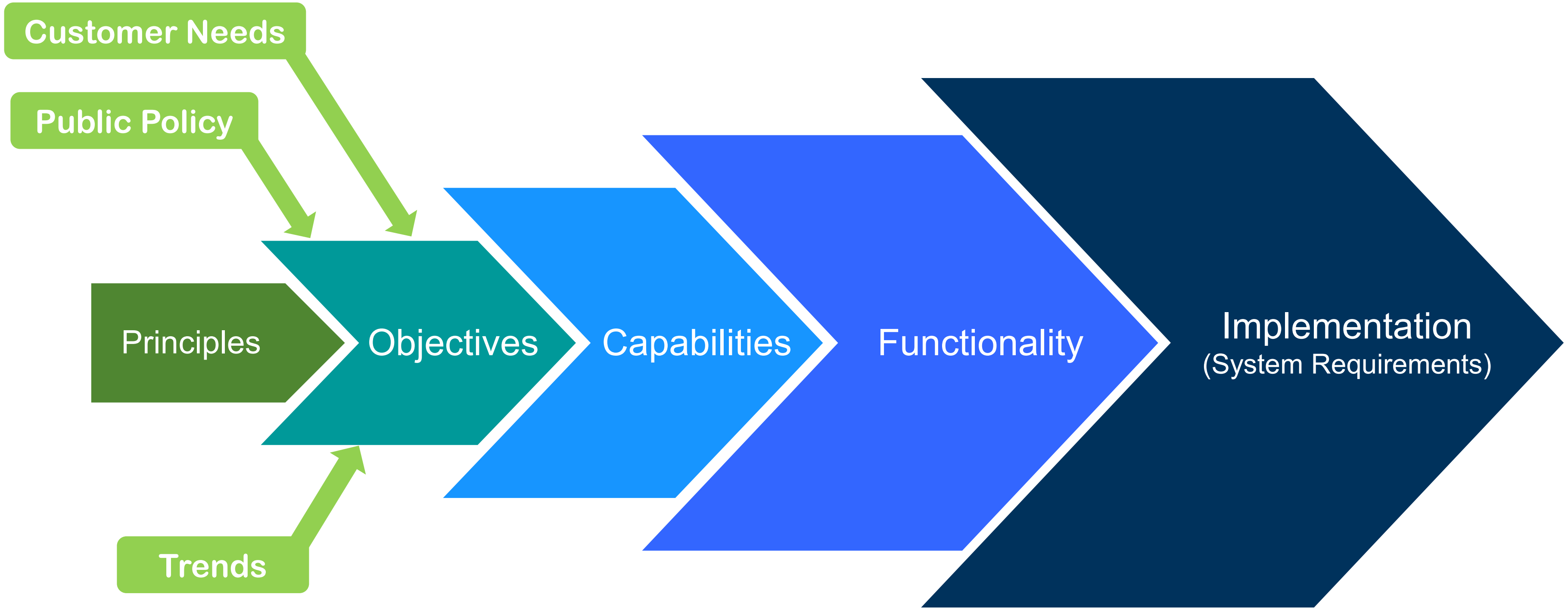
So, pick-up a pencil

Before trying to hang windows

Resist temptation to start with technology choices

DSPx Taxonomy Flow

Customer needs, public policy & trends shape Grid Mod objectives that align to organizational mission & grid mod principles



Grid Modernization

Customer Needs & Policy drive grid capabilities and corresponding enabling business functionality and technology

● New
● Existing

		Objectives		
		Safety & Operational Efficiency	Reliability & Resilience	DER Integration & Utilization
Capabilities	Market Operations	New	New	New
	Grid Operations	Existing	Existing / New	New
	Planning	Existing	Existing / New	New

This analysis helps to identify the core platform functions and related technologies as well as the applications linked to specific policies/customer needs/locational value realization

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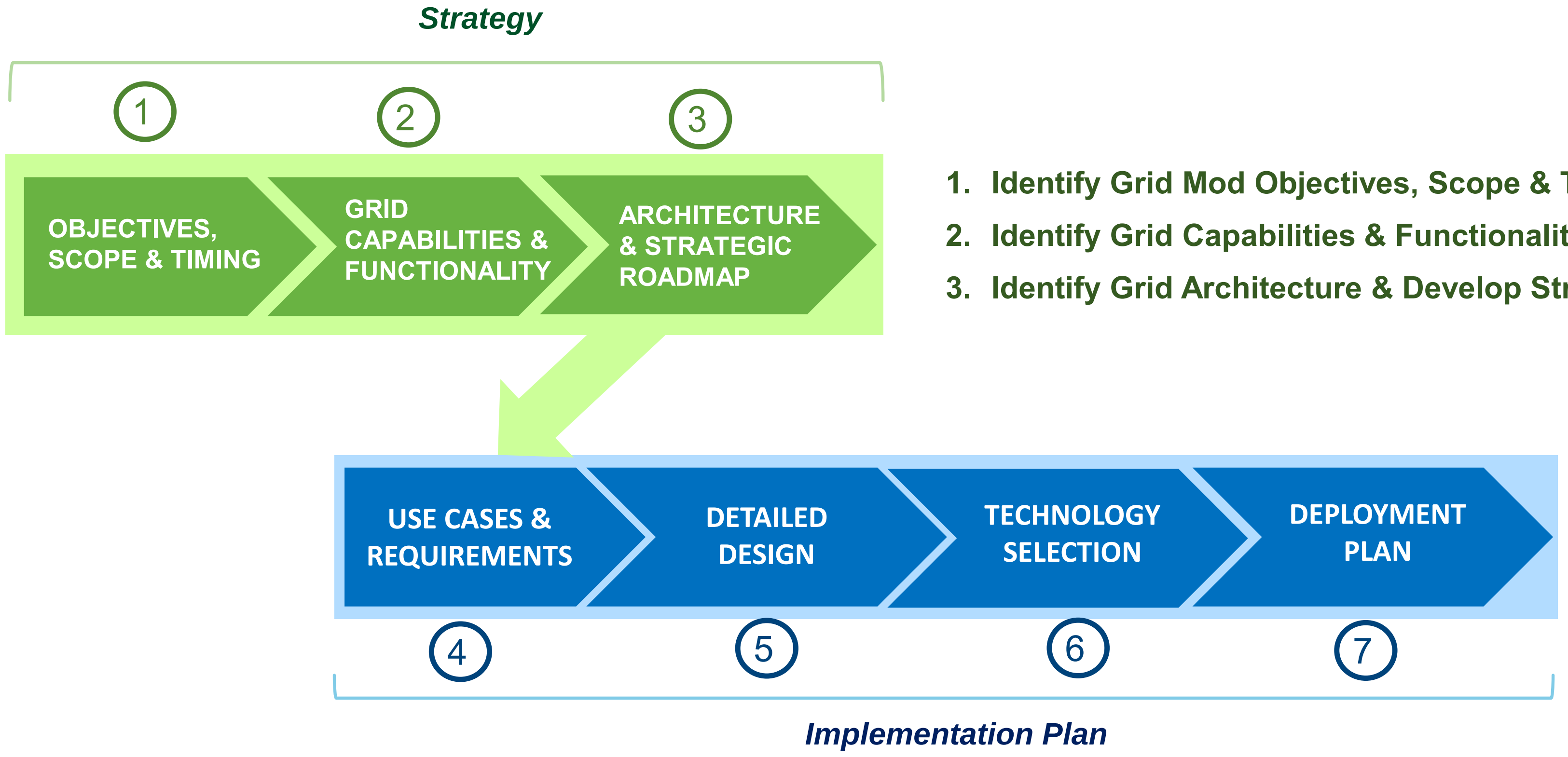
Grid Mod Strategy & Planning Process

What, Why, How, When & How Much



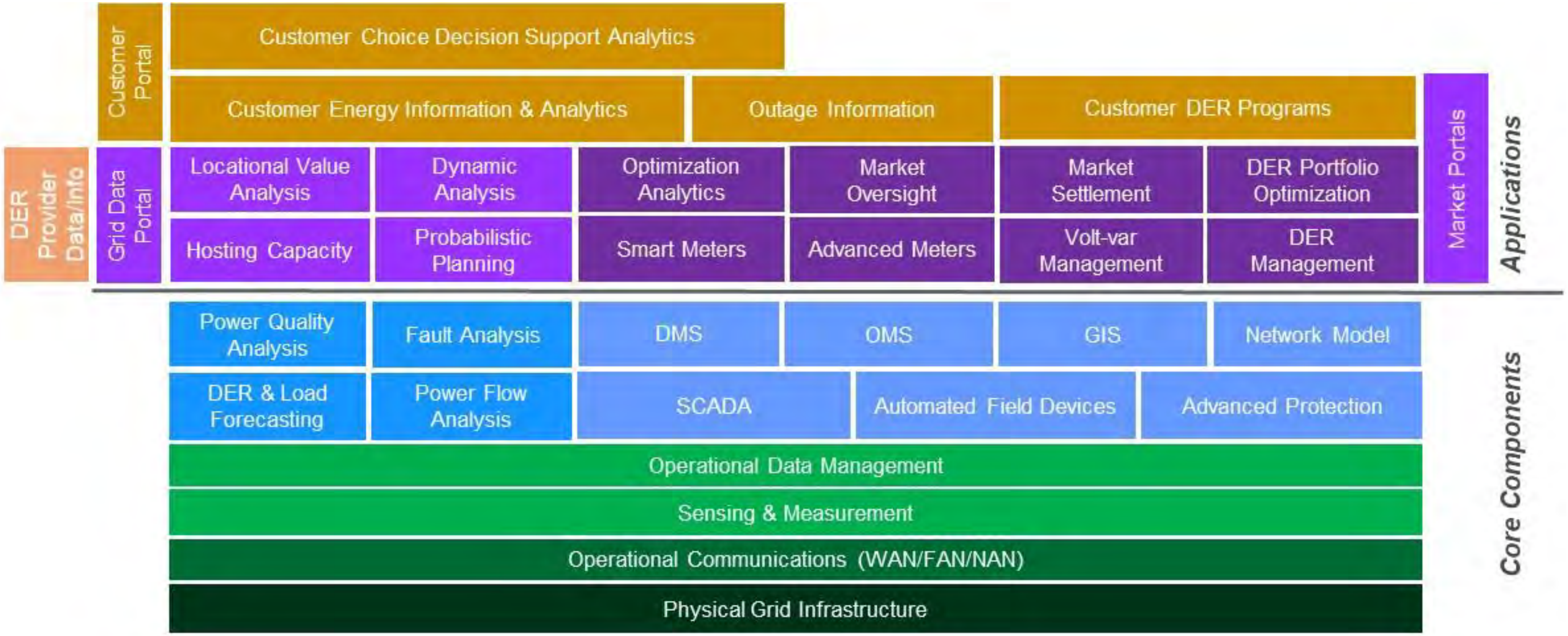
1. **Identify Grid Mod Objectives, Scope & Timing**
2. **Identify Grid Capabilities & Functionality Needed**
3. **Identify Grid Architecture & Develop Strategic Roadmap**

4. **Develop Functional Use Cases to Identify Detailed Business & Technical Requirements**
5. **Develop Detailed Architecture & Design**
6. **Technology Assessment & Selection**
7. **Develop Deployment Plan & Cost Effectiveness Assessment**

Version 4.0 9/30/19

Distribution System Platform

Logical layering of core components

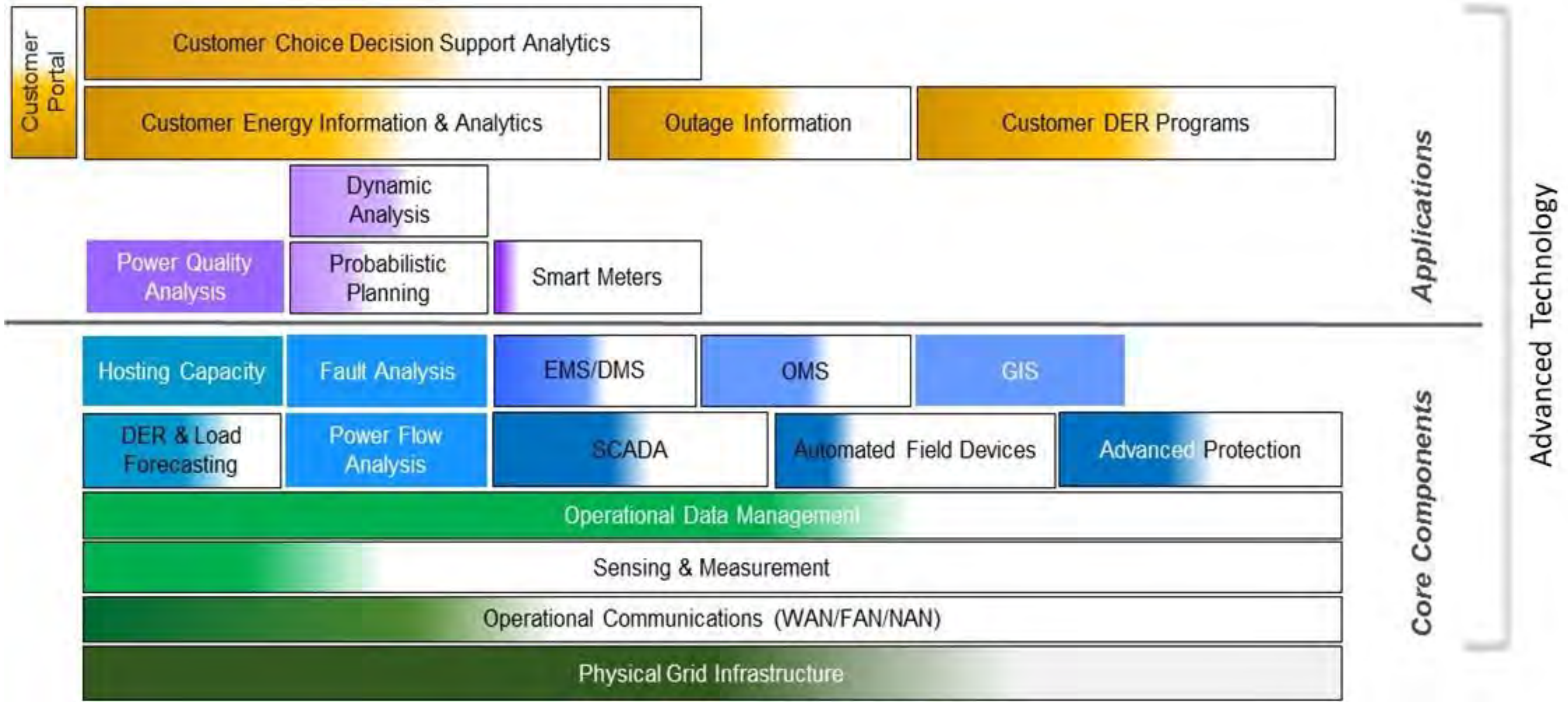


Green - Core Cyber-physical layer
Blue - Core Planning & Operational systems
Purple - Applications for Planning, Grid & Market Operations
Gold - Applications for Customer Engagement with Grid Technologies
Orange - DER Provider Application

Source: U.S. Department of Energy-Office of Electricity Delivery and Energy Reliability, 2017. *Modern Distribution Grid, Volume III: Decision Guide.* Available online at: https://gridarchitecture.pnnl.gov/media/Modern-Distribution-Grid-Volume-III.pdf

What is the Starting Point for Grid Investment

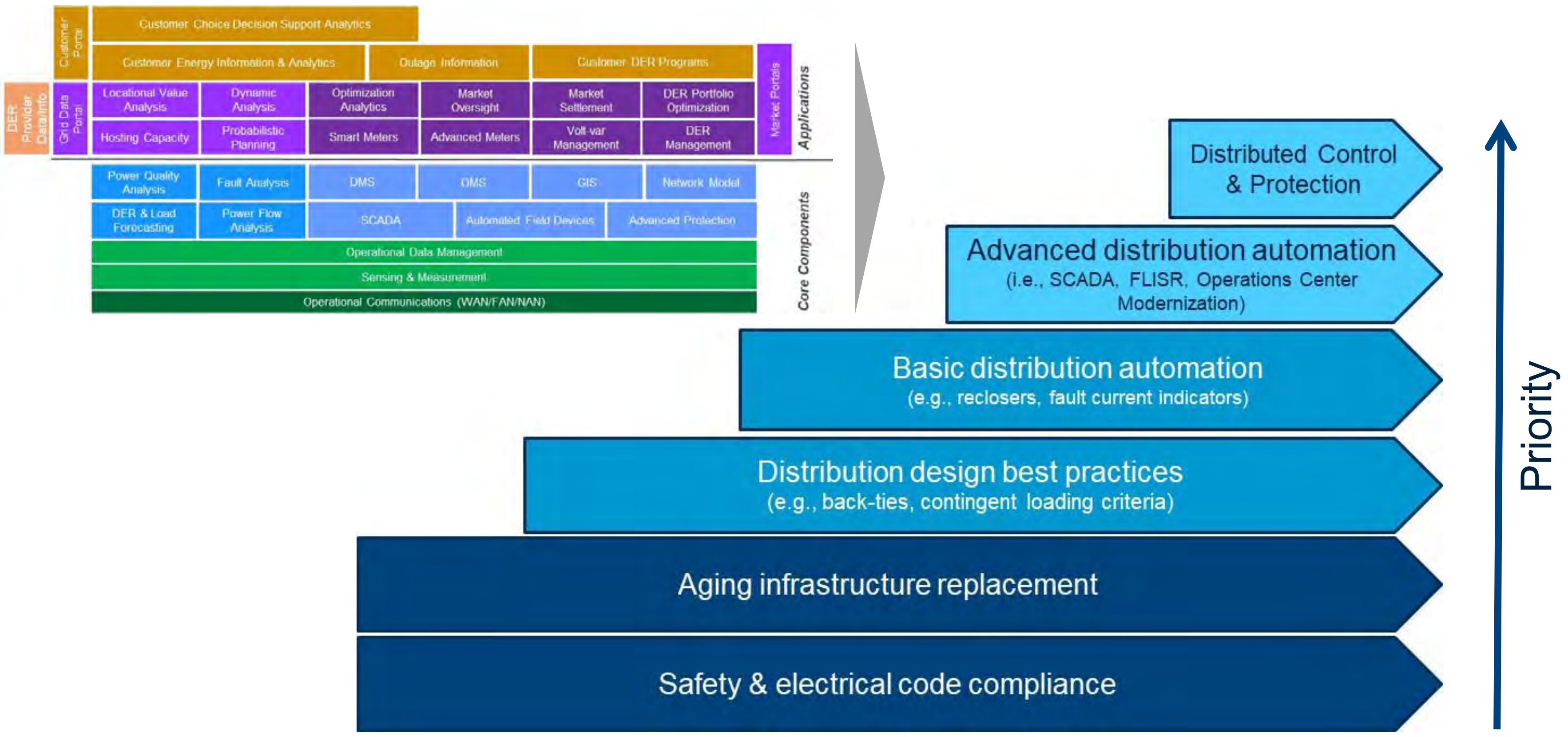
This graphic is a summary illustration of a more complete assessment documented in narrative and tables to enable a gap analysis against objectives and identified capabilities & functionalities



Source: Hawaiian Electric 2017

Distribution & Modernization Investment Categories

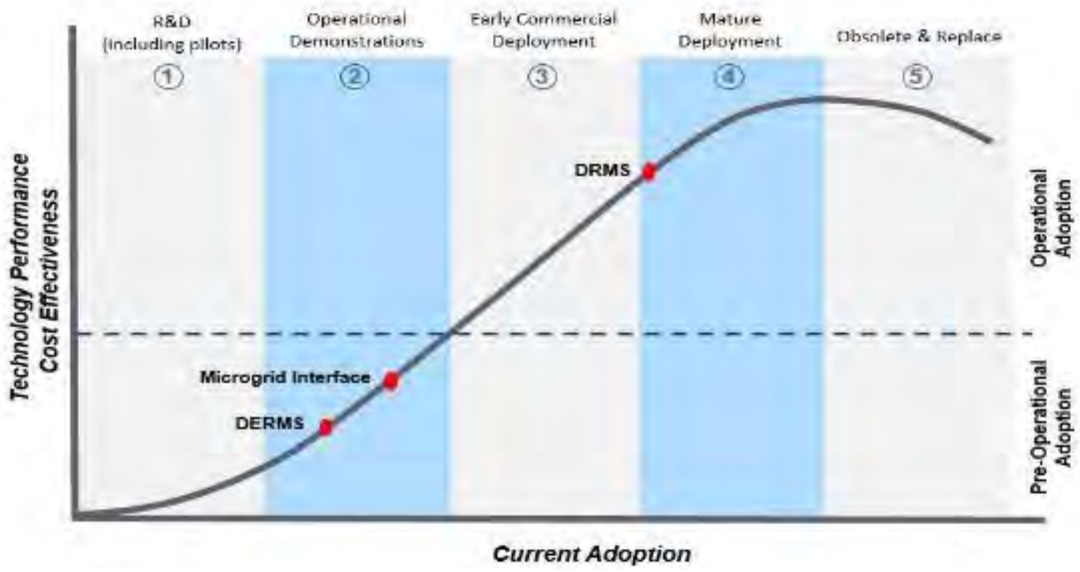
Grid Modernization technologies layer on top of & integrate with foundational physical grid infrastructure



Technology Adoption Considerations

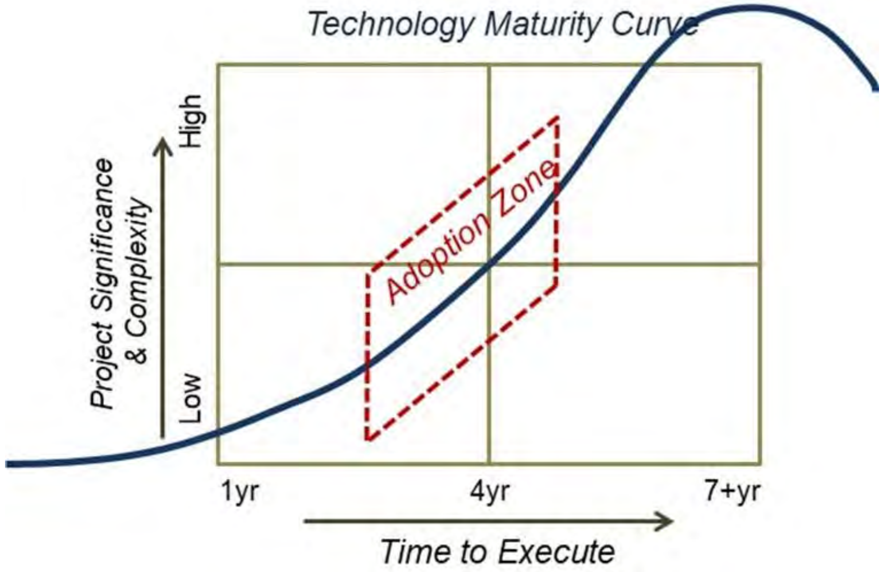
Deciding when to adopt grid technologies involves several factors: technology maturity, time to deploy, implementation complexity & functional criticality

Technology Maturity Assessment



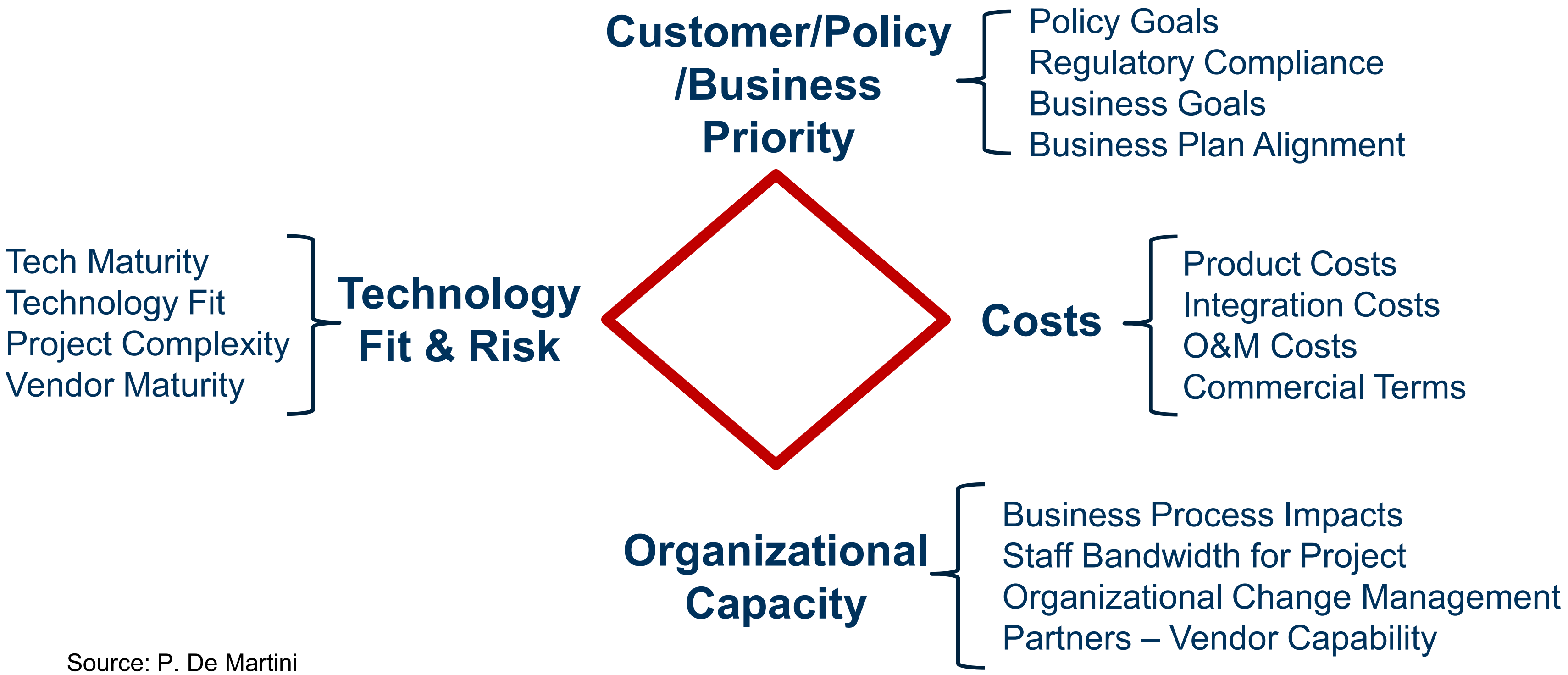
Source (above): U.S. Department of Energy-Office of Electricity Delivery and Energy Reliability, 2017. *Modern Distribution Grid, Volume II: Advanced Technology Maturity Assessment. Link*: https://gridarchitecture.pnnl.gov/media/Modern-Distribution-Grid-Volume-II.pdf

Technology Adoption Strategy



Technology Implementation Decision Criteria

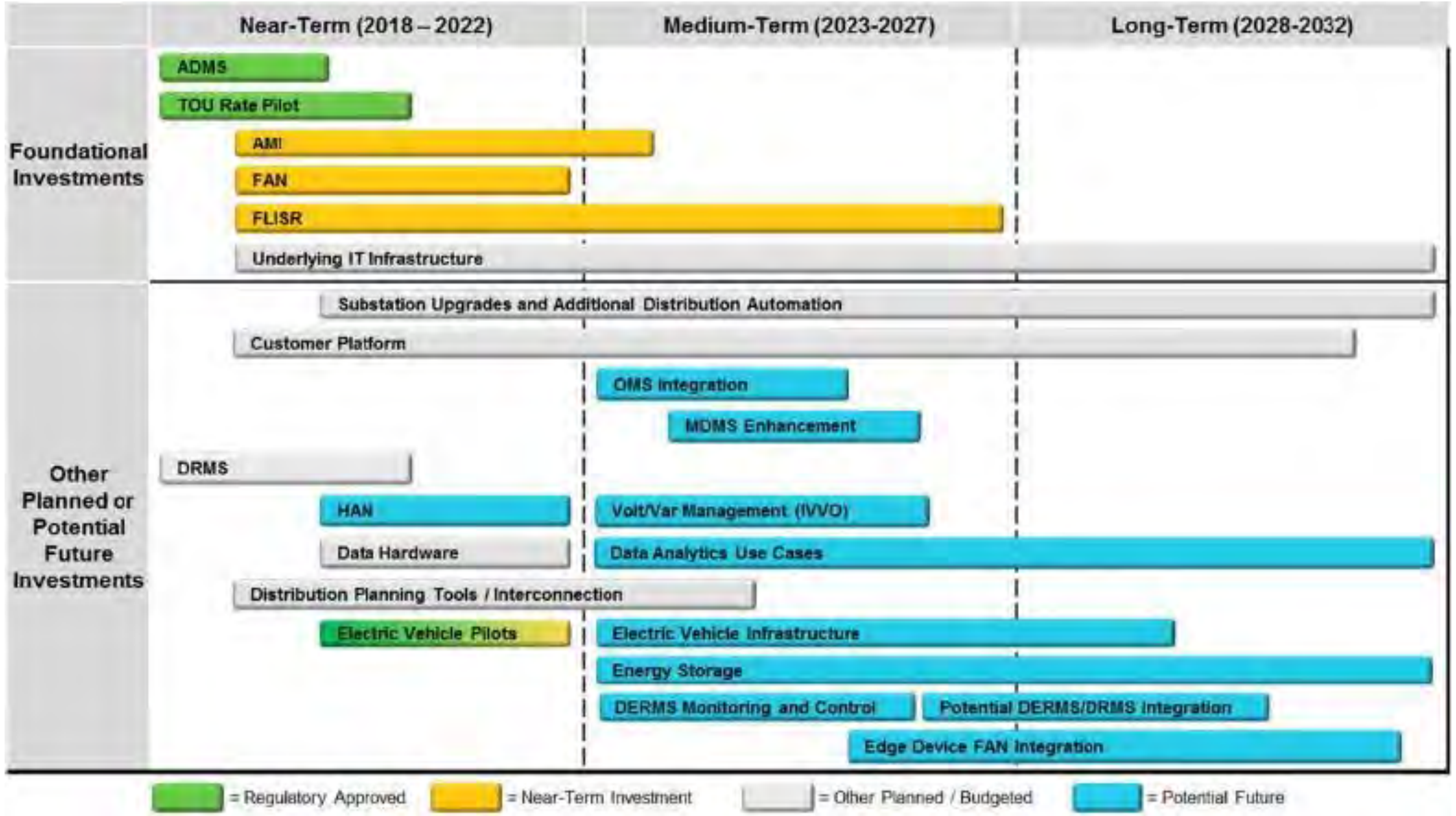
General framework for technology assessment within a stage gate sequence where the evaluation begins with conceptual screening on a set of these criteria and increasingly becomes more detailed and definitive in terms of the quantitative and qualitative assessment



Source: P. De Martini

Sequencing of Investments

Long-term strategic plan of distribution grid investments



From the Xcel Energy 2018 Integrated Distribution Plan. Link: https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={E098D466-0000-C319-8EF6-08D47888D999}&documentTitle=201811-147534-01

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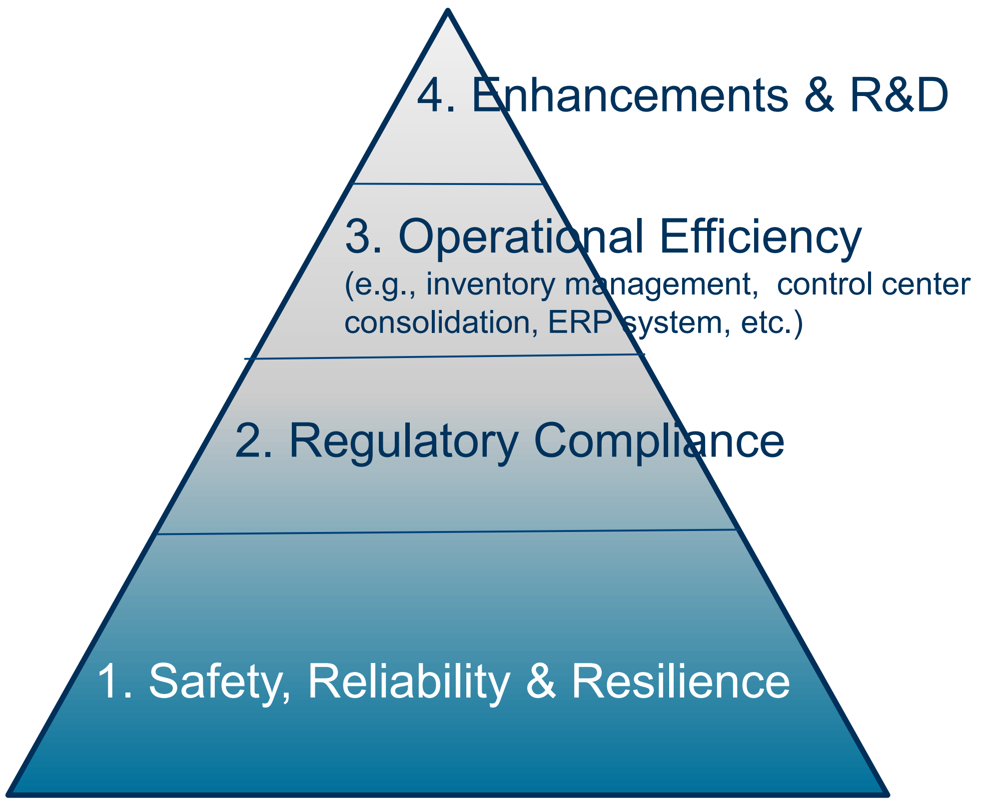
T&D Investment Prioritization

What is the budget allocation hierarchy?

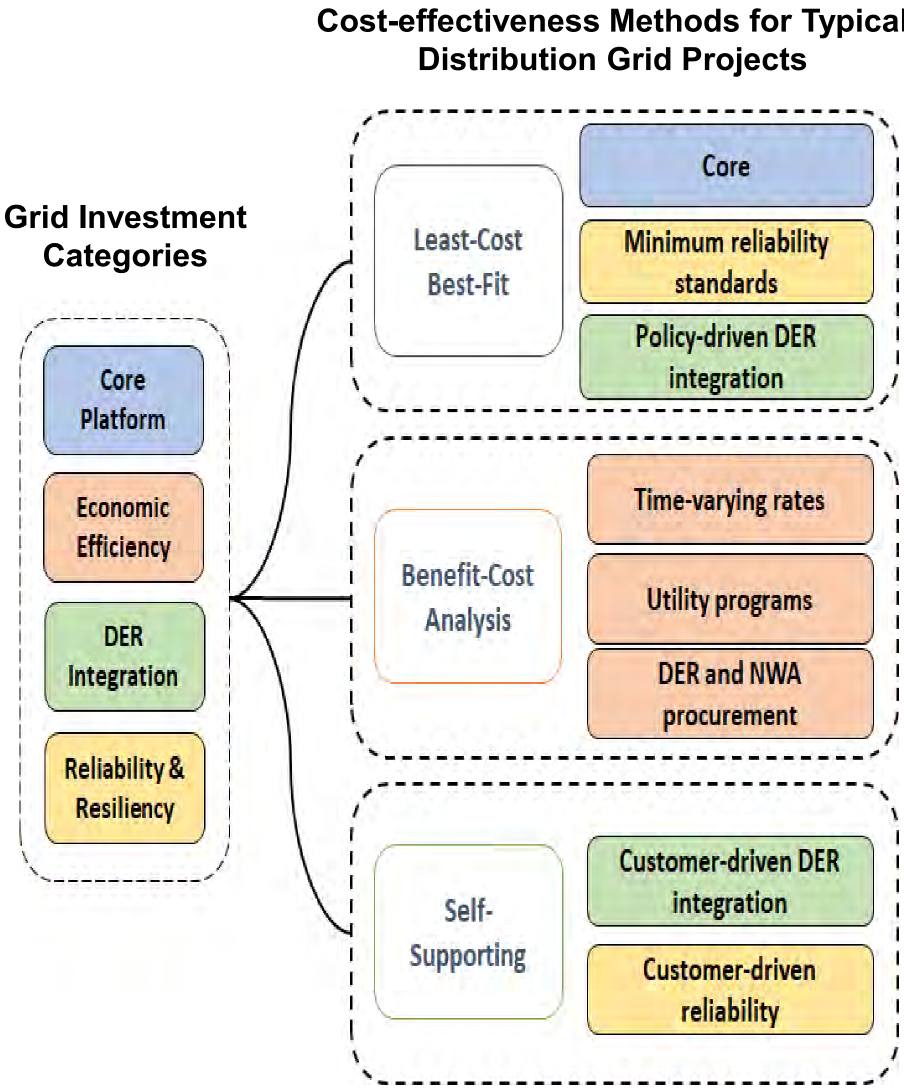
The greatest value for customers is often derived from addressing the base needs and working up the pyramid as capital budgets allow



"Maslow's Hierarchy" for Utility Investment Planning

Source: P. De Martini

Grid Investment Cost-Effectiveness Framework



Least-cost, best-fit for core grid platform and grid expenditures required to maintain safe, reliable, resilient operations as well as integrate distributed resources connected behind and in front of the customer meter that may be socialized across all customers.

Benefit-Cost Analysis for grid expenditures proposed to enable public policy and/or incremental system and societal benefits to be paid by all customers. Grid expenditures are the cost to implement the rate, program or NWA. Various methods for BCA may be used.

Customer Self-supporting costs for projects that only benefit a single or self-selected number of customers and do not require regulatory benefit-cost justification. For example, DER interconnection costs not socialized to all customers. Also, undergrounding wires at customers' request.

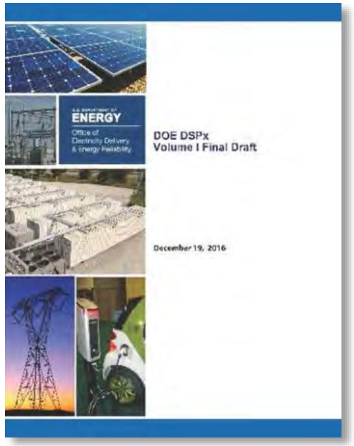
Thank You

Contact:

Joe Paladino, joseph.paladino@hq.doe.gov

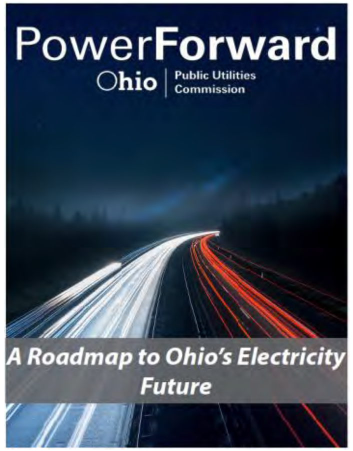
References:

Modern Distribution Grid Report



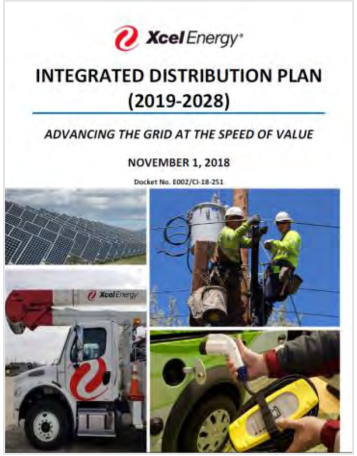
https://gridarchitecture.pnnl.gov/modern-grid-distribution-project.aspx

PUCO Grid Mod Roadmap



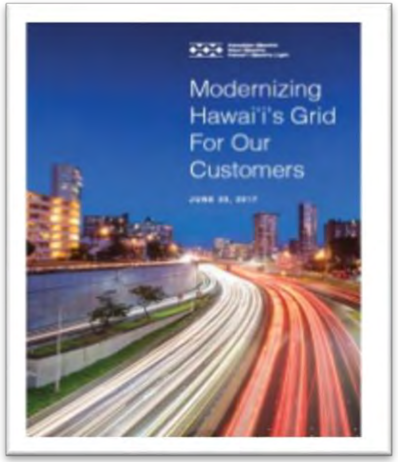
https://puco.maps.arcgis.com/apps/Cascade/index.html?appid=59a9cd1f405547c89e1066e9f195b0b1

Grid Modernization Strategy Using DSPx



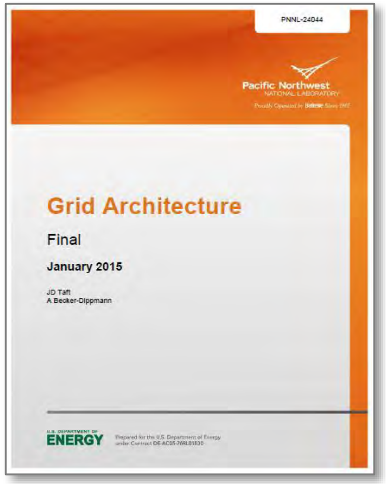
https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={E098D466-0000-C319-8EF6-08D47888D999}&documentTitle=201811-147534-01

Grid Modernization Strategy Using DSPx



www.hawaiianelectric.com/gridmod

Grid Architecture



http//gridarchitecture.pnnl.gov

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Non-Wires Alternatives Framework
(Evaluation, Sourcing Options, and Relative Risks)

Paul De Martini, Newport Consulting

Michigan PSC
Distribution Planning Stakeholder Meeting

October 16, 2019

T&D Non-Wires Alternative Definition

NWA Definition:

An electricity grid project that uses non-traditional transmission and distribution (T&D) solutions, such as distributed generation (DG), energy storage, energy efficiency (EE), demand response (DR), and grid software and controls, to defer or avoid the need for conventional transmission and/or distribution infrastructure investments.

Sources: Adapted from Navigant, DOE and E4TheFuture, PLMA & SEPA, Non-wires Alternatives: Case Studies from Leading US Projects

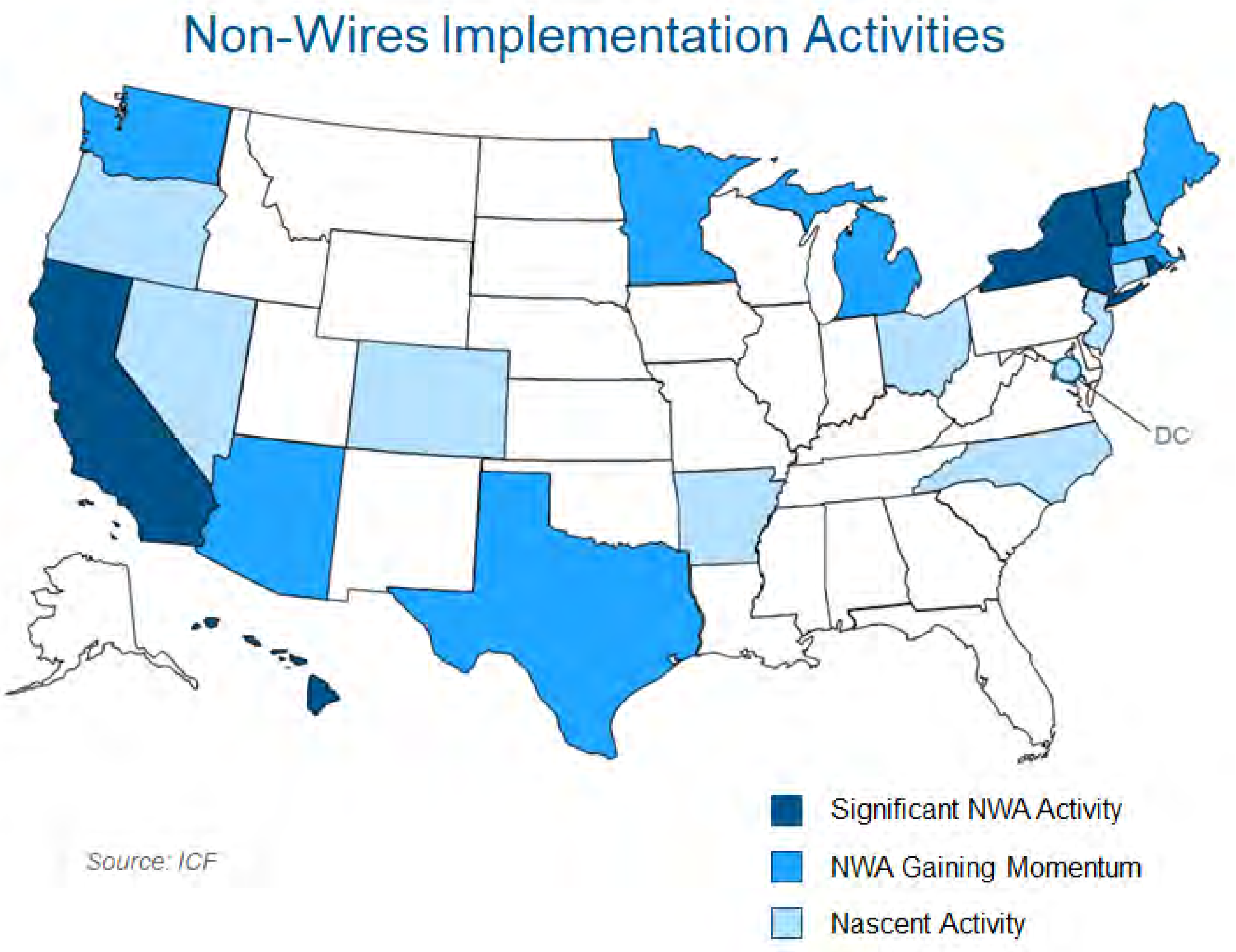
Non-Wires Alternatives

A Customer-centric approach to NWA is an important perspective

- **Why are NWAs being pursued?**
  - What are the pressing issues?
- **What are the desired outcomes?**
  - Optimize utility T&D expenditures?
  - Enable greater value for customer/developer DER investments?
  - Enable greater adoption of DER to meet renewable/customer choice goals?
- **What are the range of potential solutions?**
  - Pricing, Programs & Procurements (3P's)
- **What is the role of customers, DER developers, utilities, aggregators and others?**

NON-WIRES ALTERNATIVES TODAY

- NWAs are in pilot phase
- Growing numbers of utilities are working on NWA projects
- Propelled by regulatory mandates, internal utility decisions, and public/stakeholder input
- Initial NWA learnings are informing next stage of development
- Integrated Distribution Planning learnings are being generated



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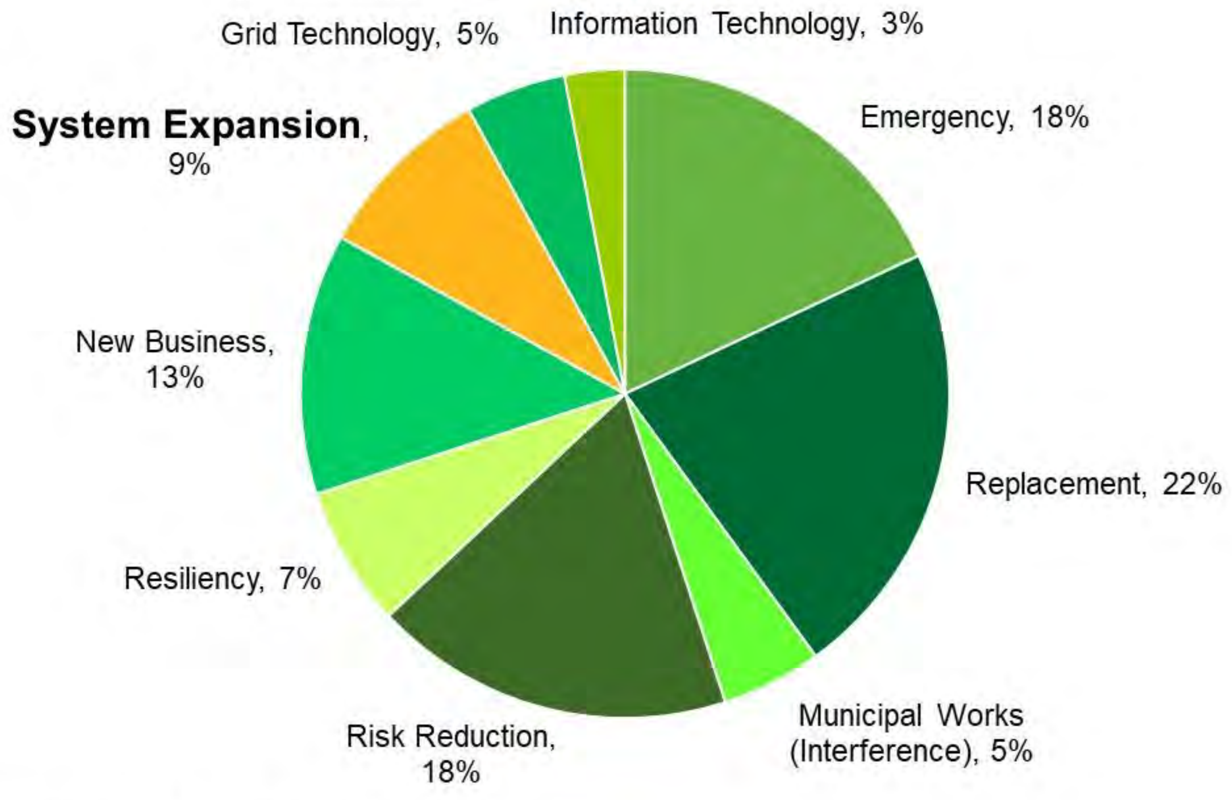
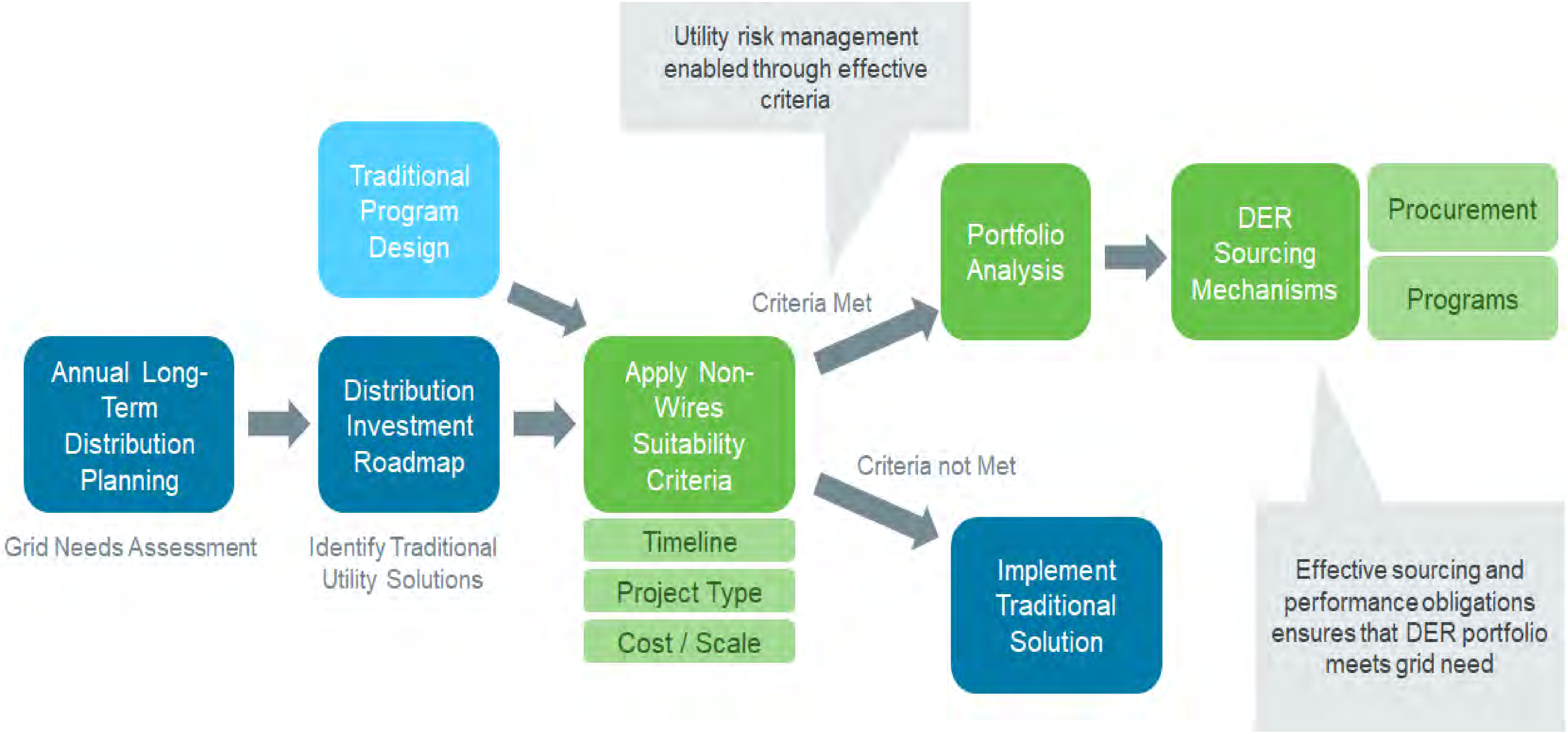
Utility Investments (CapEx Illustration)

To-date NWAs nationally have focused on System Expansion projects driven by load growth and/or increasing hosting capacity



Illustrative Example of Utility 5-year T&D Capital Plan

IDP & NWA Opportunities



Distribution NWA Service Definitions

Distribution Capacity Service:

A supply and/or a load modifying service that DERs provide as required via the dispatch of power output for generators and electric storage, and/or reduction in load that is capable of reliably and consistently reducing net loading on desired distribution infrastructure. Distribution Capacity service can be provided by a single DER resource and/or an aggregated set of DER resources that reduce the net loading on a specific distribution infrastructure location coincident with the identified operational need in response to a control signal from the utility.

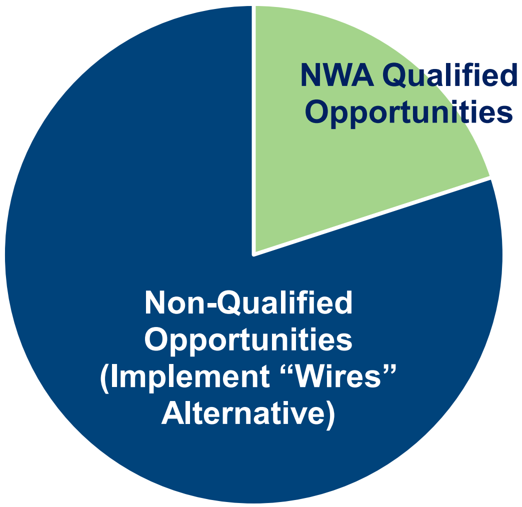
Reliability (Back-Tie) Service:

A supply and/or load modifying service capable of improving local distribution reliability under abnormal conditions. Specifically, this service reduces contingent loading of grid infrastructure to enable operational flexibility to safely and reliably reconfigure the distribution system to restore customers.

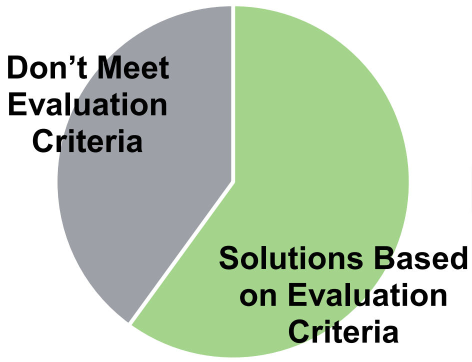
Sources: Hawaii DPWG adapted from California PUC IDER & DRP Dockets

T&D NWA Opportunity Assessment

T&D opportunities are typically filtered through a defined process to identify qualified opportunities and appropriate sourcing approach or determine “wires” alternative is best course of action



Step 1: T&D NWA Opportunity Screen



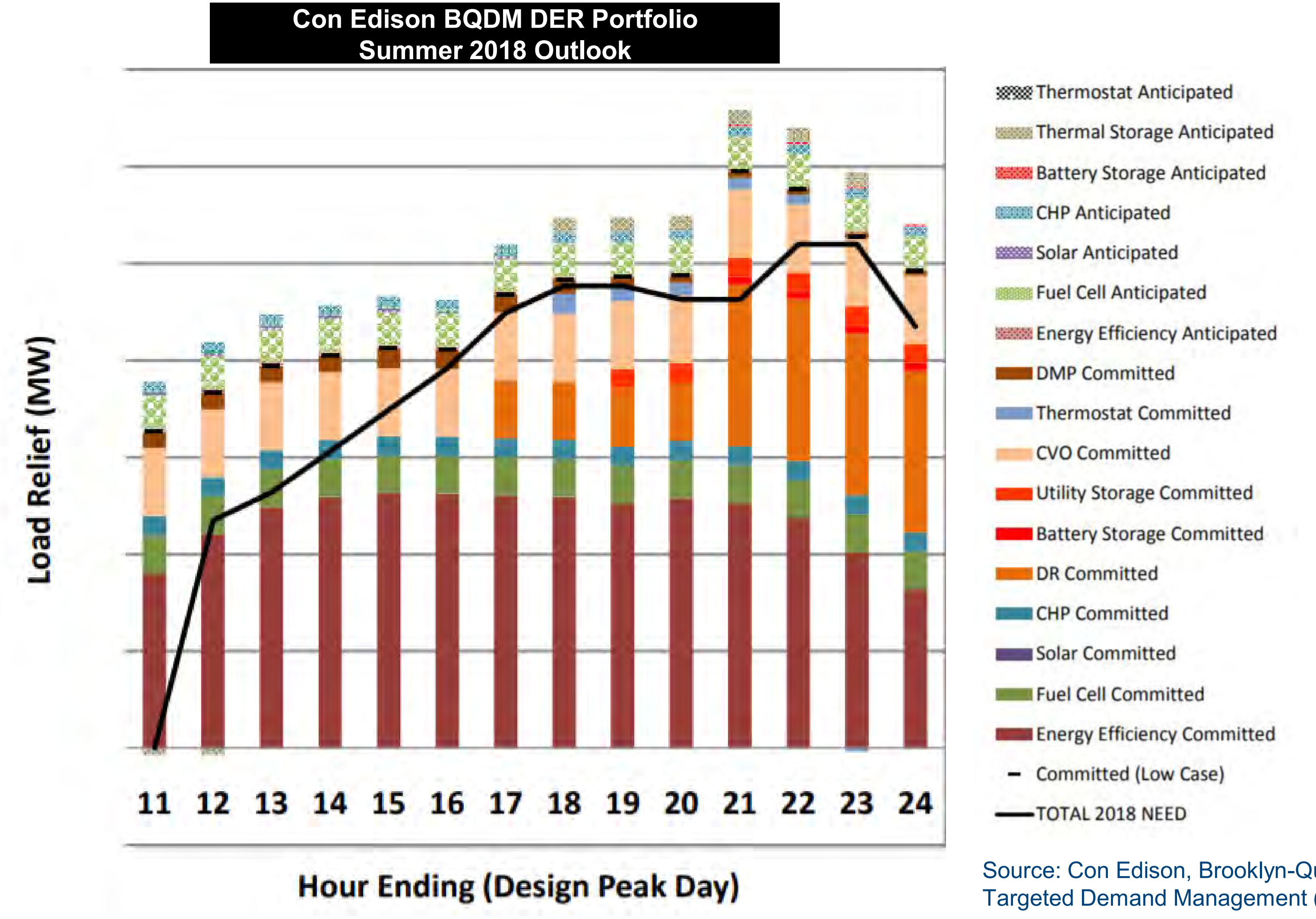
Step 2: NWA Opportunity Sourcing Evaluation

Potential Alternatives

- Alt 1: Operational Changes
- Alt 2: Pricing or DSM Program
- Alt 3: NWA Procurement
- Alt 4: NWA not suitable, Implement “Wires”

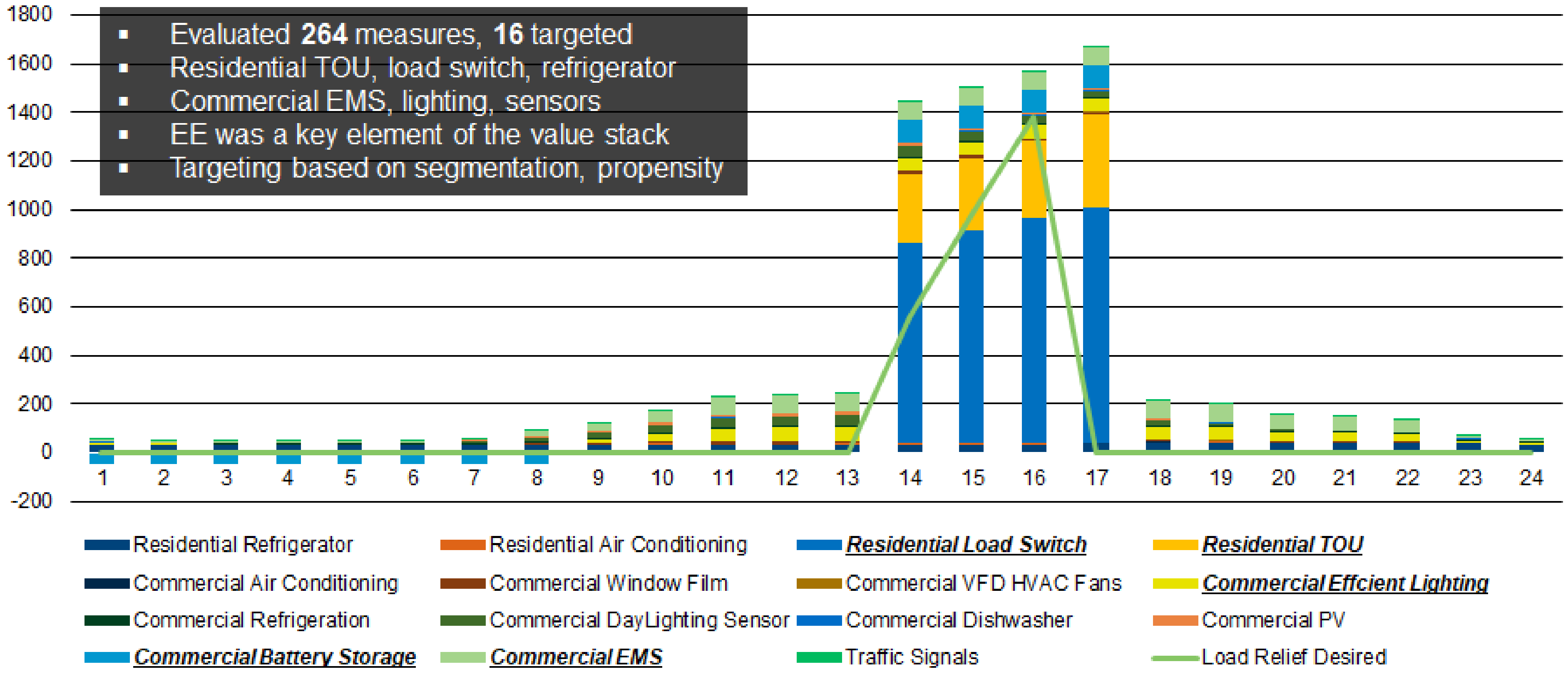
Step 3: Action Plan

Example: Con Edison Brooklyn Queens Demand Management Program



Source: Con Edison, Brooklyn-Queens Demand Management, Targeted Demand Management (April, 2017)

Example: NWA Consumers Energy (MI)



Source: Consumers Energy, Non-Wires Alternative Pilot, PLMA (November 2017)

NWA Experience To-Date

NWA Procurements are Challenging, Programs Should Also Be Considered

Case study spotlight: REV CONNECT

NWA Opportunities Listed	Listed and Successful	Successful, Using Targeted DSM	No Resolution Listed	Average Size Load Reduction
47	6	6	39	5-10 MW

Case study spotlight: E4THE FUTURE, PLMA Load Management Leadership, Smart Electric Power Alliance

NWA Case Studies	Using EE	Using DR	Using Storage	Average Size Load Reduction
10	4	7	5	1-85 MW

Key takeaway: *procurements need ample lead time, lots of work on contracting process*

NWA Opportunities
(Source: RMI Best Practices Paper)

- **Traditional planning processes can better support NWAs, if screening criteria are used to determine when NWA should be considered for a given need.**
  - Effective evaluation processes should *"Identify high-confidence recommendations for DER solicitations that are likely to result in successful, cost-effective investment deferrals."* CPUC
  - Opportunity evaluation screens *"should screen out the deferral opportunities that have a low probability of success."* CPUC
- **Planners can apply criteria related to need characteristics like cost, timing, and type to screen if a non-wires solution project is likely to be viable.**
- **This screening encourages productive market engagement by helping utilities and developers efficiently allocate resources to the best non-wires solution opportunities.**
- **While a helpful prioritization tool for a nascent non-wires solution market, as utilities gain more NWA experience screening criteria can evolve to be more inclusive of a wider universe of potentially viable NWA.**

NWA Lessons Learned

- **NWA opportunities require alignment of utility needs and DER service capabilities, costs and financing considerations to be successful**
- **Lessons learned from initial NWAs across the US are that not all T&D projects are suited for cost-effective DER deferral.**
  - States currently conducting NWA sourcing do not include distribution capital projects involving break-fix, outage replacements, aging infrastructure replacement, infrastructure relocation or customer service connections in scope as these do not meet suitability criteria.
  - For potential deferral projects:
    - Long duration operational needs limits feasible technologies and increase costs. The long duration needs (hours, months) also limits the counterparty's ability to monetize other revenue streams.
    - DER providers need sufficient contract length to enable financially viable offers – this needs to be balanced with the uncertainty of the length of time for grid need to avoid stranded costs

NWA Lessons Learned (cont.)

- **Procurements may not be best suited for all NWA opportunities (e.g., smaller value projects and/or reaching certain customer classes)**
  - Targeted EE/DSM Programs are employed
  - DER Services tariffs are under discussion in a few states
- **Other NWA procurement lessons learned that can be used going forward are:**
  - It can be complicated to combine multiple small offers to meet the distribution deferral need,
  - Negotiating contract terms remains a learning exercise for both parties (i.e., utility and the counterparties), and
  - Streamlining regulatory approvals process may help improve DER viability and reduce uncertainty.
- **States/utilities do consider low cost operational and technology alternatives to traditional capital projects as part of the "alternatives" analysis**
  - Circuit reconfiguration, phase balancing, etc.
  - Sensing & analytics, power flow controllers

NWA Opportunity Assessment Survey
(CA, HI, ME, NH, RI)

New York NWA Opportunity Screens

Criteria	Potential Elements Addressed	
Project Type Suitability	Project types include Load Relief and Reliability. Other types have minimal suitability and will be reviewed as suitability changes due to State policy or technological changes.	
Timeline Suitability	Large Project	36-60 months
	Small Project	18-24 months
Cost Suitability	Large Project	Greater than or equal to $1M
	Small Project	Greater than or equal to $500K

Source: National Grid 2017

Criteria	Potential Elements Addressed	
Project Type Suitability	• Project types include Load Relief or Load Relief in combination with Reliability. Other categories have minimal suitability and will be periodically reviewed for potential modifications due to State policy or technological changes.	
Timeline Suitability	**Large Project** (Projects that are on a major circuit or substation and	• 36 to 60 months
	Small Project (Projects that are feeder level and below)	• 18 to 24 months
Cost Suitability	**Large Project** (Projects that are on a major circuit or substation and	• No cost floor
	Small Project (Projects that are feeder level and below)	• Greater than or equal to $450k

Source: ConEdison 2017

Con Edison:

- Does not have a cost floor for the large projects, all the large projects that had sufficient time to be implemented were selected as potential opportunities and shown in the table above.
- For small projects, the $450K cost floor was used in addition to the need date to determine the non-wires alternative opportunities.

Rhode Island NWA Opportunity Screens

NWA Suitability Criteria in Rhode Island	
1.	The need is not based on asset conditions
2.	The wires solution will cost more than $1 million
3.	If load reduction if necessary, it is expected to be less than 20 percent of the relevant peak load in the area of defined need
4.	Start of wires alternative construction is at least 36 months in the future
The utility may propose a project that fails to meet one or more of the above criteria if it has reason to believe that a viable NWA solution exists, assuming the benefits justify the costs	

Source: Rhode Island System Reliability Procurement Law

Maine NWA Law LD 1181

Annual Distribution Plan

- **Analyze system needs for the next 5 years and provide a schedule of proposed projects and associated costs;**
- **Identify corresponding planned and anticipated growth-related investments.**
- **Shall investigate non-wires alternatives if the project is a small transmission project or is a distribution project estimated to cost $500,000 or more; and**
- **May investigate non-wires alternatives if the project is a distribution project estimated to cost less than $500,000 if there is a reasonable likelihood that a non-wires alternative would be more cost-effective than the proposed distribution project.**

Excluded Projects Criteria

- **The commission, by rule, shall develop criteria to exclude from investigation small transmission projects and distribution projects best suited to transmission and distribution investments, including but not limited to projects that are:**
  - Necessary for redundant supply to a radial load;
  - Necessary to address maintenance, asset condition or safety needs;
  - Necessary to address stability or short circuit problems; or
  - Required to be in service within one year based on the controlling load forecast.

New Hampshire NWA Opportunity Screen

Liberty's NWA Evaluation Process[15]	
Step	**Description**
Review Demand Forecast	Review demand forecasts prepared for each substation, sub-transmission line, and feeder under extreme weather scenarios to determine if capacity is adequate to meet demand under normal and contingency configurations
Review T&D Deficiencies	Develop a list of distribution deficiencies based on planning criteria.
Screen Projects based on Screening Criteria	• Distribution deficiency is not based on asset condition; • Distribution deficiency needs to be addressed in no less than two years, allowing for development of a NWA solution; • Wires solution, based on engineering judgement, will likely cost more than $0.5 million, providing sufficient cost savings to evaluate and implement a NWA solution; • Wires solution will likely start construction at least 24 months in the future, providing sufficient time to evaluate and implement a NWA solution; and • A NWA solution would be for less than 20 percent of the total load in the area of the distribution deficiency.
Evaluate NWA solutions for technical feasibility	Review potential NWA solutions for technical feasibility: alternatives that have successfully reduced, avoided or deferred a wires solution in the region

California NWA Opportunity Evaluation

Screens used to "Identify which projects are most likely to result in successful, cost-effective deferrals that provide needed grid services." CPUC adopted Timing and Technical screens for prioritizing potential NWA opportunities into a short list for procurement:

Timing:

- Minimum project lead-times are primarily driven by the CPUC prescribed RFP, proposal evaluation and approval process, and not necessarily by the time needed to deploy modular DER solutions.
- CPUC expects the Timing screen to evolve as the IDER proceeding develops non-RFO based DER sourcing mechanisms (e.g., DER services tariff or programs).

Technical: 3 Prioritization metrics are used:

- Economic/Financial: "a deferral project would likely result in net ratepayer benefits"
- Forecast Certainty: "forecast grid need underlying a potentially deferrable investment is likely to materialize"
- Market Assessment: "potential DER marketplace within the electrical footprint provides an adequate market opportunity to host DER solutions."

Hawaii NWA Opportunity Evaluation

Proposed adaptation of CA NWA opportunity assessment model using a 3 step approach.

- **Initial suitability screen to identify potential opportunities**
- **2nd evaluation with detailed requirements analysis to assess viable solution sourcing alternatives**
    - Procurements for opportunities >$1,000,000 and in-service date requirement of greater than 2 years
- **HI's approach also identifies the potential use of Programs as an alternative to Procurement**

Thank you

Paul De Martini
paul@newportcg.com

Discussion: A Framework for Non-Wire Alternatives

Electric Distribution Investment & Maintenance Plans Stakeholder Meeting

Michigan Public Service Commission

Lake Michigan Hearing Room

October 16, 2019

MPSC

Michigan Public Service Commission

AFTERNOON BREAK
2:30 – 2:50 PM

Electric Distribution Investment & Maintenance Plans Stakeholder Meeting

Michigan Public Service Commission
Lake Michigan Hearing Room
October 16, 2019

MPSC
Michigan Public Service Commission

Meeting Agenda

9:00 a.m.	Welcome, Introduction and Recap	Patrick Hudson, Manager, Smart Grid Section
9:10 a.m.	Future Distribution Planning Reports: Consistent Data Across Utilities	Consumers Energy, DTE, and Indiana Michigan Power
9:25 a.m.	Consumers Energy: Benefit Cost Analysis	Consumers Energy
9:50 a.m.	DTE: Benefit Cost Analysis	DTE
10:15 a.m.	Break	
10:30 a.m.	I&M: Benefit Cost Analysis	Indiana Michigan Power
10:55 a.m.	Third-Party Uses of Hosting Capacity Analyses Panelists: Sarah Mills, Senior Project Manager, University of Michigan Mark Cryderman, Business Development/Ed., The Green Panel Ethan Case, Vice President of Policy, Heelstone	Moderator: Laura Sherman, President, Michigan Energy Innovation Business Council
12:00 p.m.	Lunch (restaurants available)	All
1:00 p.m.	DSPx: Distribution Planning Relationship with Grid Modernization and Cost Effectiveness Framework	Paul De Martini, Newport Consulting
1:30 p.m.	Non-Wires Alternatives Analysis, Sourcing Options, and Relative Risks	Paul De Martini, Newport Consulting
2:00 p.m.	Discussion: A Framework for Non-Wire Alternatives	Paul De Martini, Newport Consulting
2:30 p.m.	Break	
2:50 p.m.	DER Coordination as a Non-Wire Solution: Opportunities and Challenges in Michigan	Johanna Mathieu, University of Michigan
3:20 p.m.	Consumers Energy: Response to Pilot Proposal Comments	Consumers Energy
3:30 p.m.	DTE: Response to Pilot Proposal Comments	DTE
3:40 p.m.	I&M: Response to Pilot Proposal Comments	Indiana Michigan Power
3:50 p.m.	Closing Statements / November 19 Stakeholder Session Overview	MPSC Staff
4:00 p.m.	Adjourn	

DER Coordination as a Non-Wire Solution: Opportunities and Challenges in Michigan

Johanna Mathieu

Assistant Professor

Department of Electrical Engineering & Computer Science

University of Michigan, Ann Arbor

Research supported by NSF 1837680 & 1845093, ARPA-E, DOE Solar Energy Technologies Office & Building Technologies Office, Sloan Foundation

Distributed Energy Resource (DER) Coordination

Aggregations of flexible electric loads and small/medium-scale storage systems can be coordinated to provide a variety of services to the grid

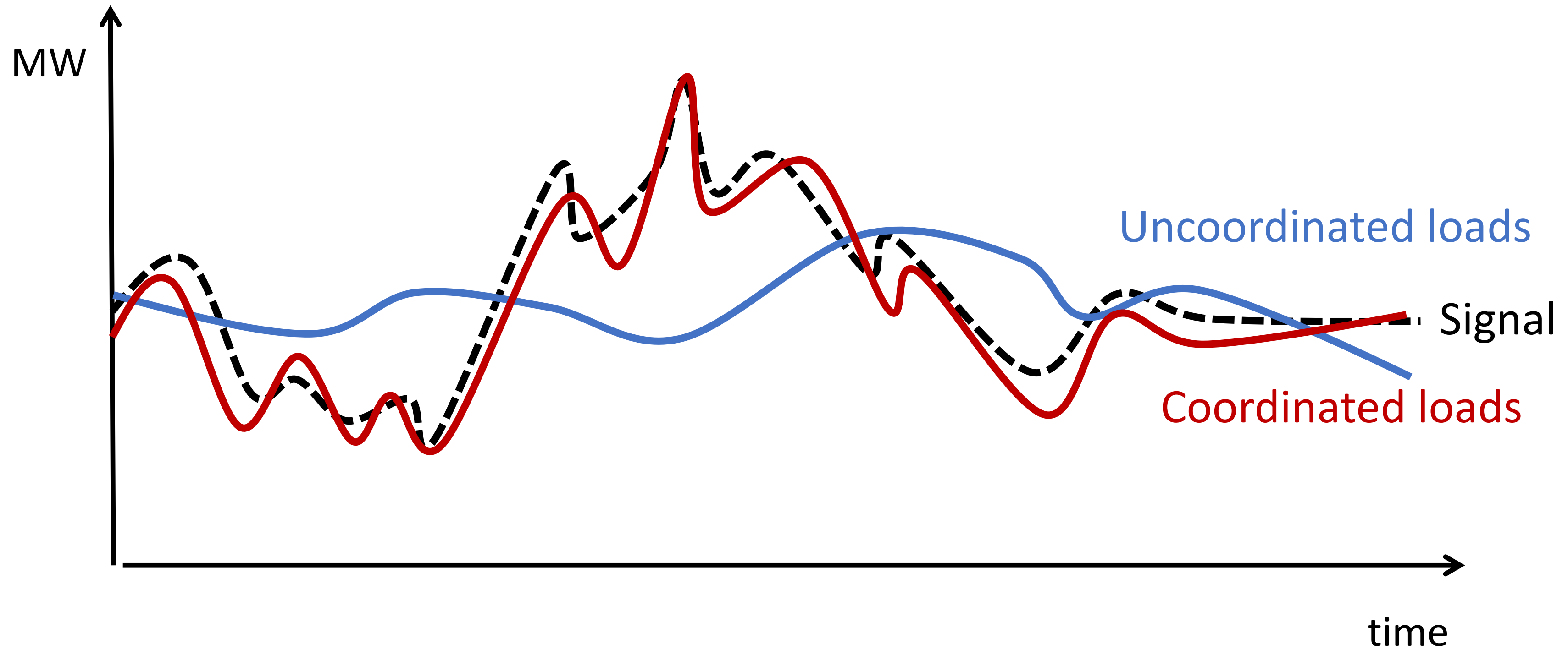
- Non–wire solutions for distribution networks
  - Load shifting to manage peaks
  - Constraint management, especially in the presence of solar PV and electric vehicles
- Frequency regulation and other ancillary services
- Synthetic inertia and droop control

Research in DER Coordination

- Algorithmic approaches to achieve DER coordination that
  - Don’t annoy electricity customers
  - Minimize implementation and operational costs
  - Work with practical (i.e., imperfect) sensors and communication networks
  - Work in highly uncertain environments
  - Maximize the value to the customers, utility, and system
  - Do no harm

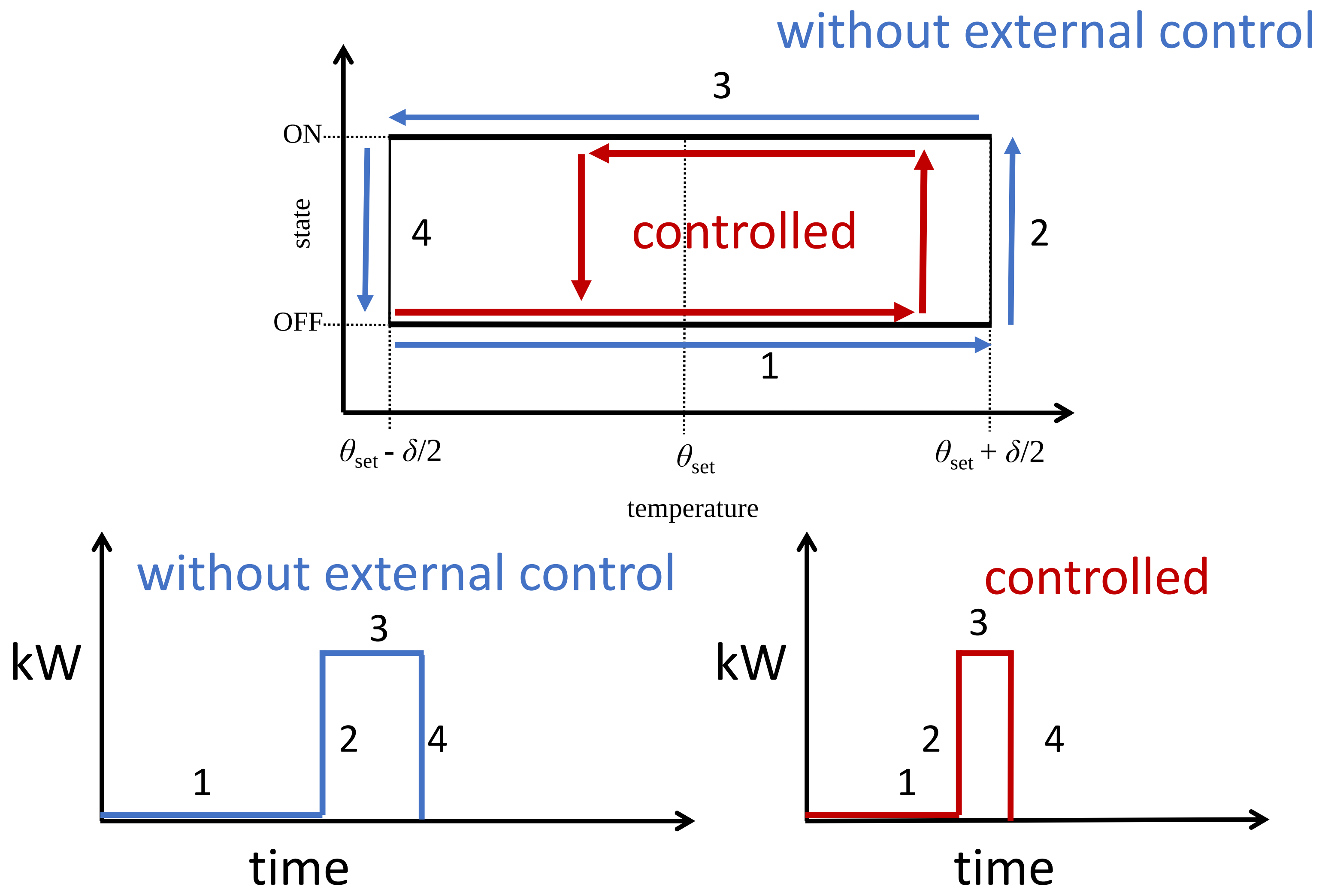
- Expertise: real-time control, stochastic optimization
- Current projects: theory, application, implementation

Example: An aggregation of thousands of loads tracking a signal



Thermostatically Controlled Loads

Air conditioners, refrigerators, heat pumps, electric water heaters



Simulation Results for 1000 Air Conditioners

What happens when we coordinate DERs with more vs. less information?

Scenario 1:

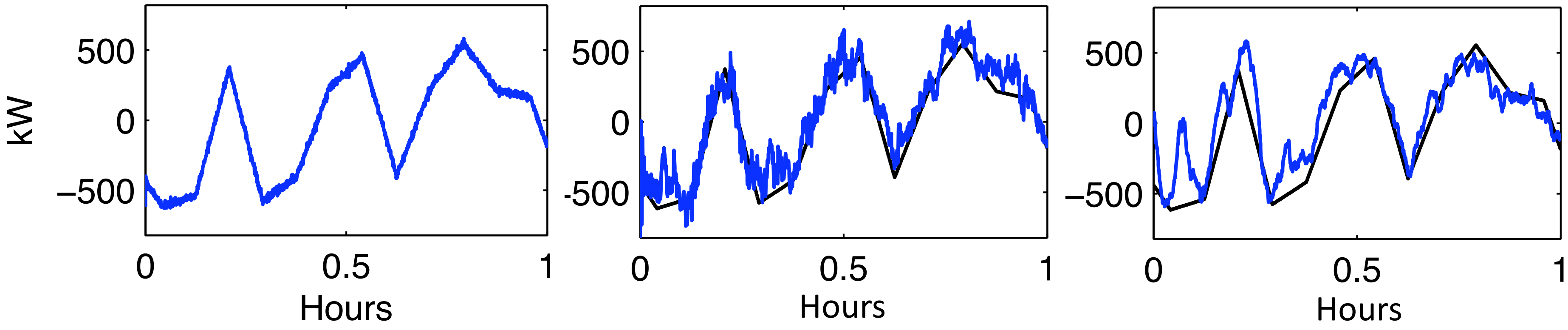
- Identify model with historical data
- Measure/communicate state in real-time

Scenario 2:

- Identify model with historical data
- Estimate state from substation power measurements

Scenario 3:

- Model learned in real-time
- Estimate state from substation power measurements



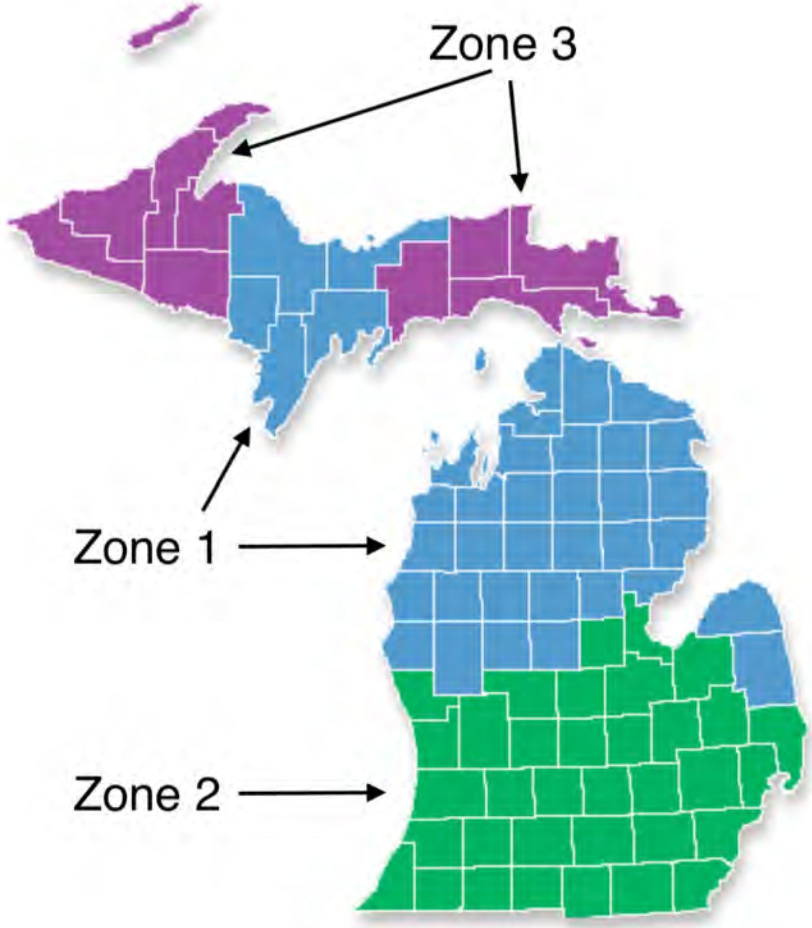
Studies to Quantify the Technical Potential

- Assume only non-disruptive control (temperatures stay within dead-bands)
- Aggregations of TCLs can be modeled as *time-varying thermal batteries*
- How big is the *thermal battery*?
  - California – how does the *thermal battery* compare to California's Energy Storage Mandate?
  - Denmark
  - Michigan

Approach

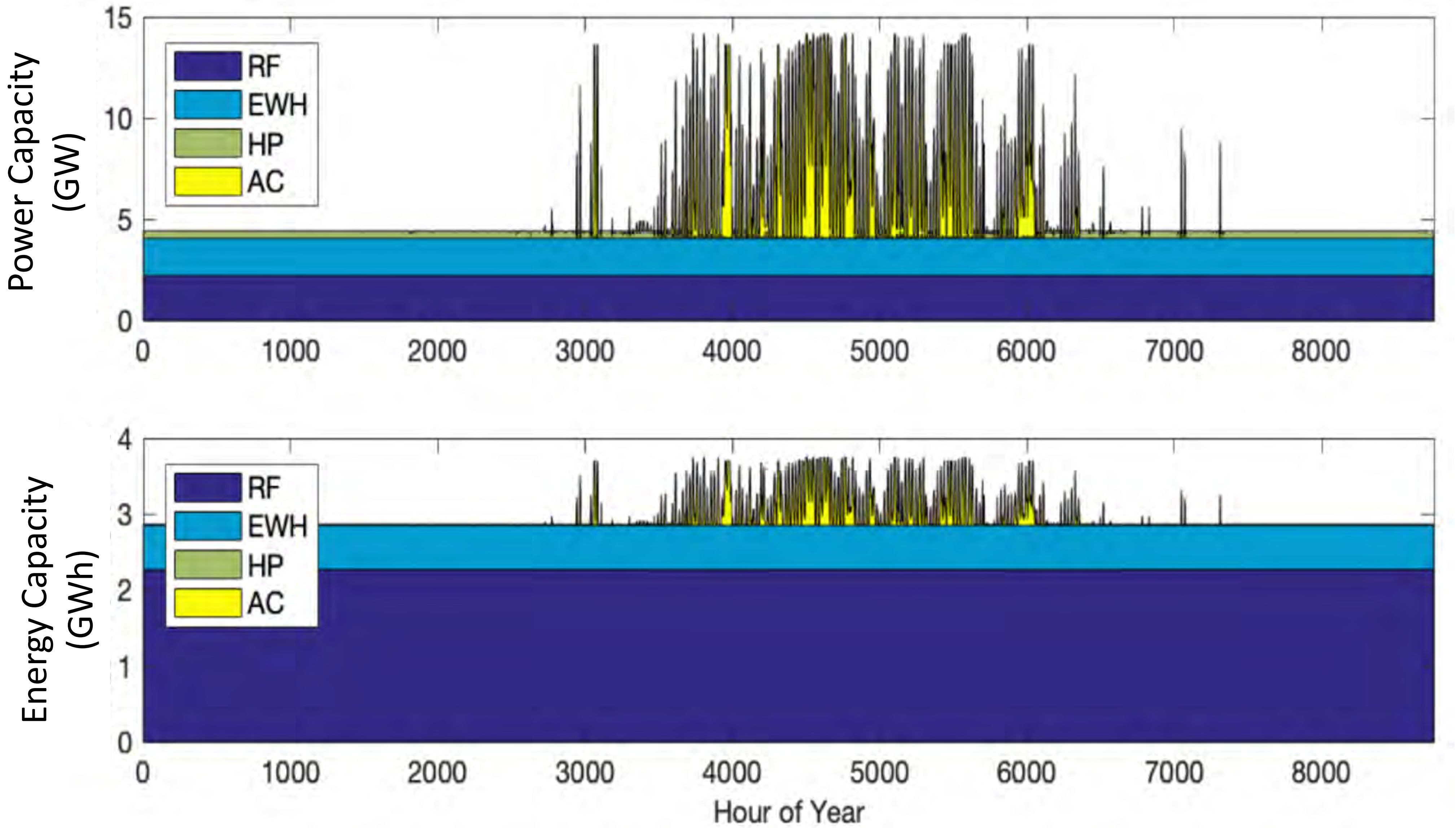
- Load models with parameters tuned to match real data
- EIA/Census data to calculate state-wide potential

See: Farquhar & Mathieu, "Demand Response Potential of Residential Thermostatically Controlled Loads in Michigan" IEEE Power & Energy Society General Meeting, 2019.



Results: Capacities over Typical Year

Refrigerators (RF) and Electric Water Heaters (EWH) provide stable, reliable capacity throughout the year.
Air Conditioners (AC) provide significant power capacity in the summer.



Take-aways from the Michigan Technical Potential Study

- Michigan State-wide power & energy capacities:

  Power: ~15 GW in summer, 4-5 GW in winter

  Energy: Up to 4 GWh in summer, 3 GWh in winter

- Limitation: Non-disruptive TCL control only provides *short-duration* services; it does not provide diurnal or seasonal storage
- Future research: estimate the economic potential, compare the life-cycle impacts of controlling TCLs to installing grid-scale batteries

And what about California?

- See: Mathieu, Dyson, & Callaway, "Resource and revenue potential of California residential load participation in ancillary services," Energy Policy, 2015.
- California's energy storage mandate requires 1.324 GW of energy storage by 2020 PLUS 500 MW of BTM storage.
- California's residential loads could provide 10-40 GW/8-12 GWh of storage.

Small/Medium-Scale Battery Storage

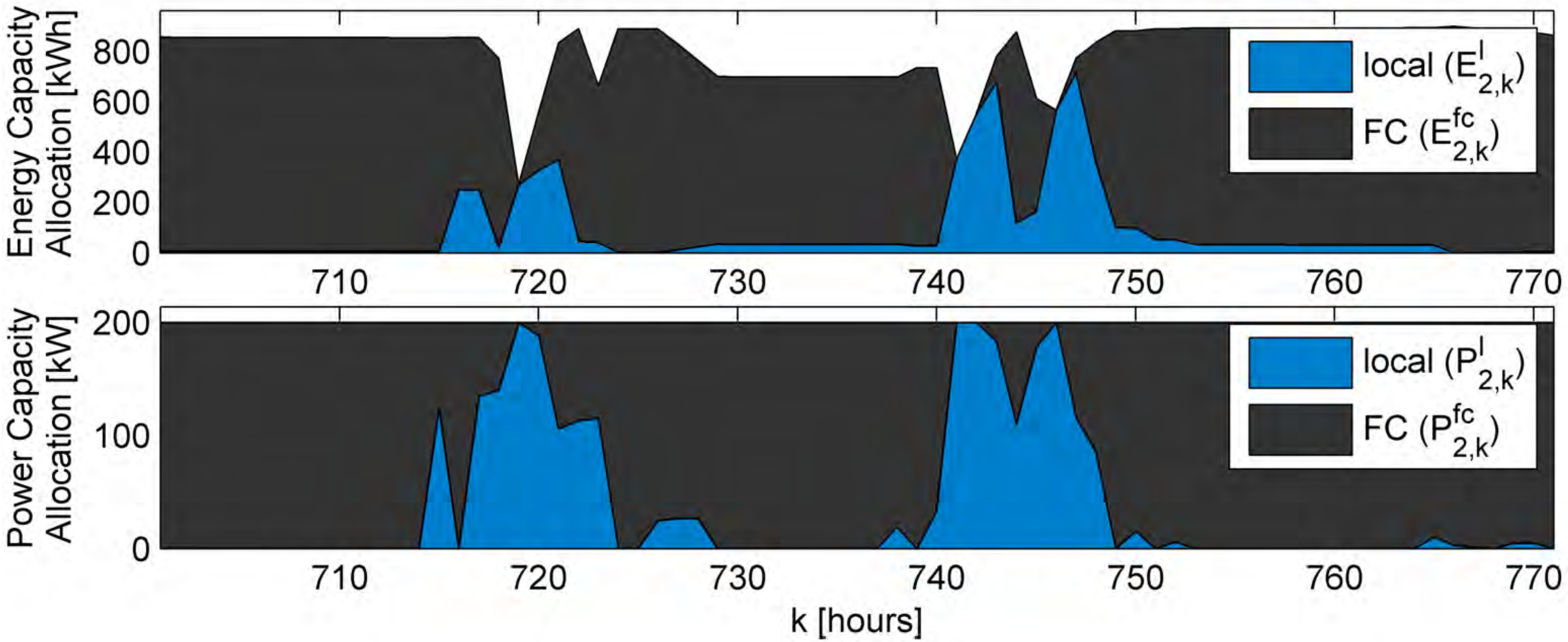
...not yet as pervasive but coming?

- Challenge: Storage is expensive!
- Opportunity: Most storage devices are only used a fraction of the time...

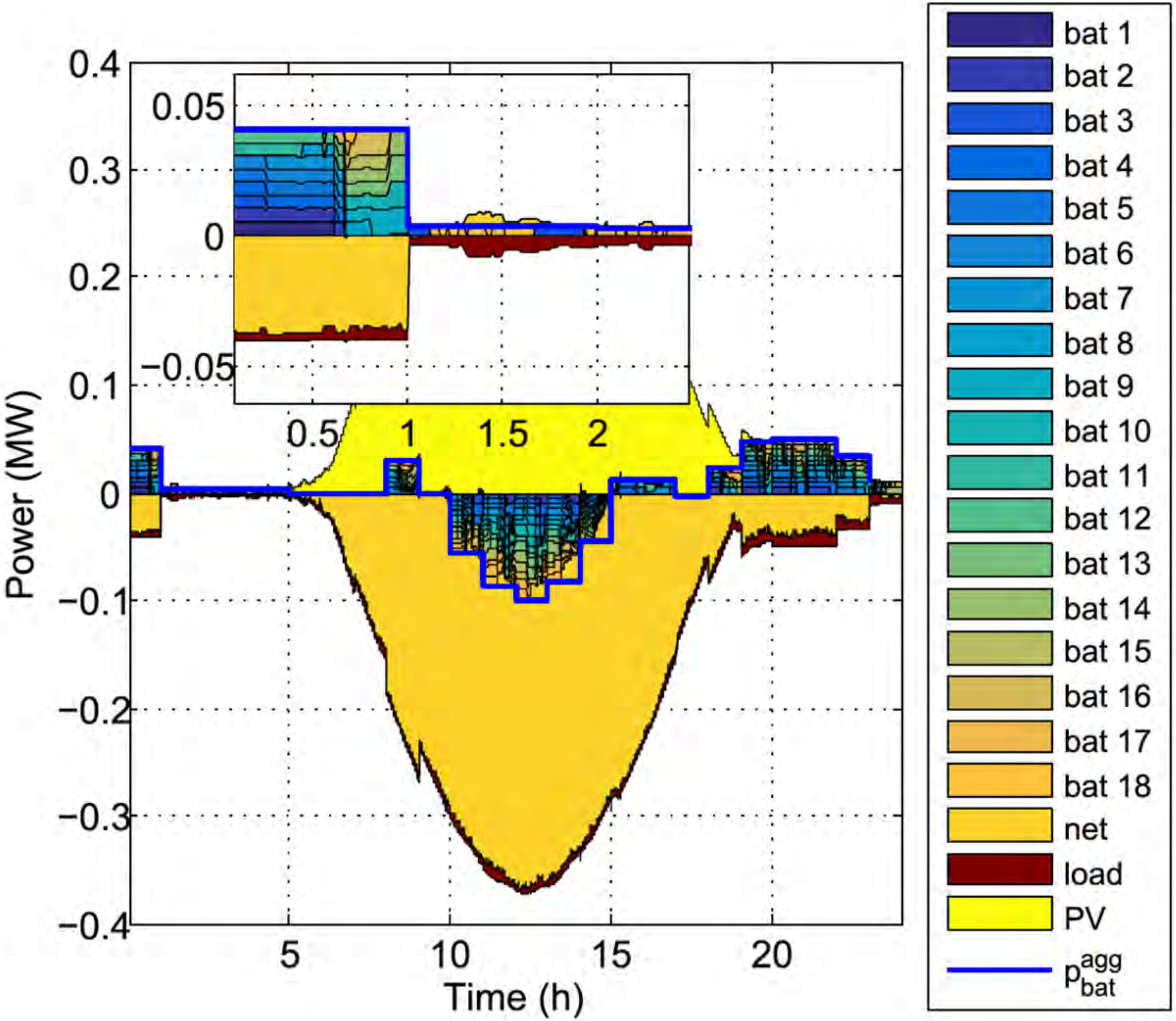
Storage Aggregation + Multitasking Leads to Two Challenging Problems

- Scheduling
  - Determine the proportion of each storage device that should be dedicated to local services versus grid services
  - Challenge: the need for local services is stochastic
- Control
  - Given the schedule, control storage devices to provide local services and/or grid services, while minimizing cost
  - Challenge: storage capacity degrades with control

Scheduling Storage Capacity



Controlling Storage in Real-Time



Many Real-World Challenges

- Load/Storage Aggregators?
  - How should aggregators and utilities coordinate?
- A lot of resources, a little revenue?
  - How do we keep implementation costs low
- Most DER coordination work focused on ancillary services, not non-wire solutions.
  - Why? Markets? How to value/monetize non-wire solutions?

And many, many more…

Contact: Johanna Mathieu, jlmath@umich.edu

Hosting Capacity Analysis “Solar Zone” Pilot Proposal

Doug Chapel

October 16, 2019

Consumers Energy Positions

- Consumers Energy maintains that full-system HCAs in upcoming distribution plans are not a high-value proposition for all stakeholders
  - Extensive human and computing resources are required
  - Michigan is experiencing low DER penetration to date
  - Current interconnection request trends indicate that DERs do not need incentivizing
  - The interconnection process, being revamped, provides interconnectors with necessary information
  - Impacts to all utility customers must be considered

- The Commission ordered parties to explore pilots for HCAs
  - Pilots should function as experiments to evaluate new concept
  - Proposed "phased" implementation of HCAs does not function as a pilot in this sense
  - The Company's Solar Zone provides better opportunities to learn useful information

Pilot Proposal: Solar Zone

- Issues 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?
  - How does proactive provision of hosting capacity on circuits impact DER interconnections?

- Hypothesis
  - If the Company identifies a sufficient amount of hosting capacity on a given circuit, solar developers will apply to interconnect resources to that circuit

Pilot Proposal: Solar Zone

- 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 a single HVD interconnection

Beyond the Pilot Phase

- Definition of "success"
  - The pilot could demonstrate more value of broader HCAs if
    - Developers do seek to locate in the area(s) with identified hosting capacity
    - The process indicates utility value in managing the interconnection process

- Operationalization
  - If HCAs are demonstrated to have sufficient value, the phased approach may represent a reasonable way to expand HCAs to the broader distribution system

DTE: Response to Pilot Proposal Comments

- No responses to additional pilot proposal comments at this time.

INDIANA MICHIGAN POWER

An AEP Company

BOUNDLESS ENERGY

I&M Distribution Pilot Non-Wires Alternative

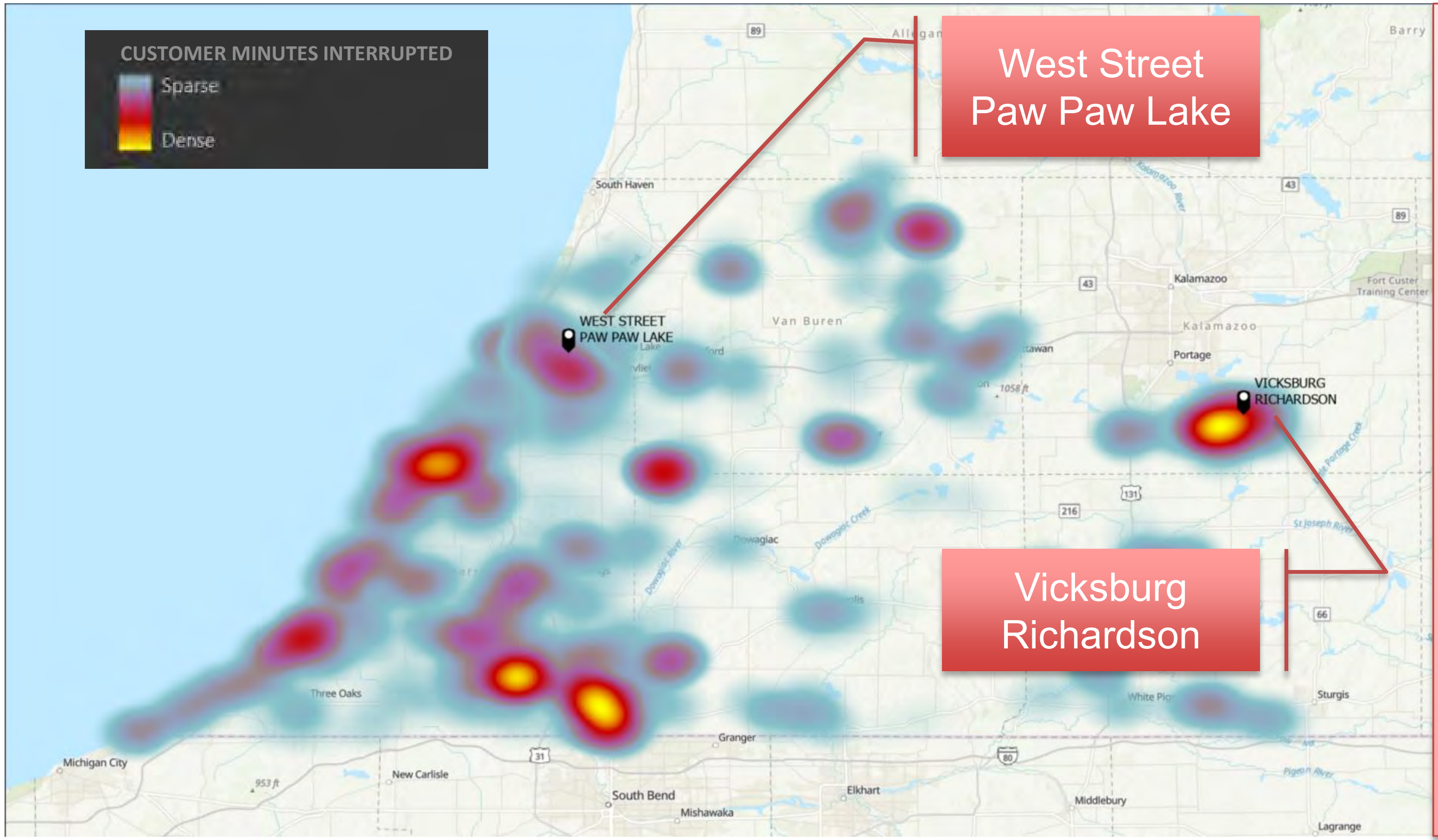
Michigan Public Service Commission
Five-Year Distribution Planning
October 16, 2019

Response to Pilot Proposal Comments

- I&M is preparing a written response to proposal comments submitted by
  - Michigan Energy Innovation Business Council and Advanced Energy Economy Institute
  - Environmental Law & Policy Center, the Natural Resources Defense Council, and Vote Solar
  - Association of Businesses Advocating Tariff Equity

(List includes comments submitted as of October 14)

Candidate Pilot Updates



- 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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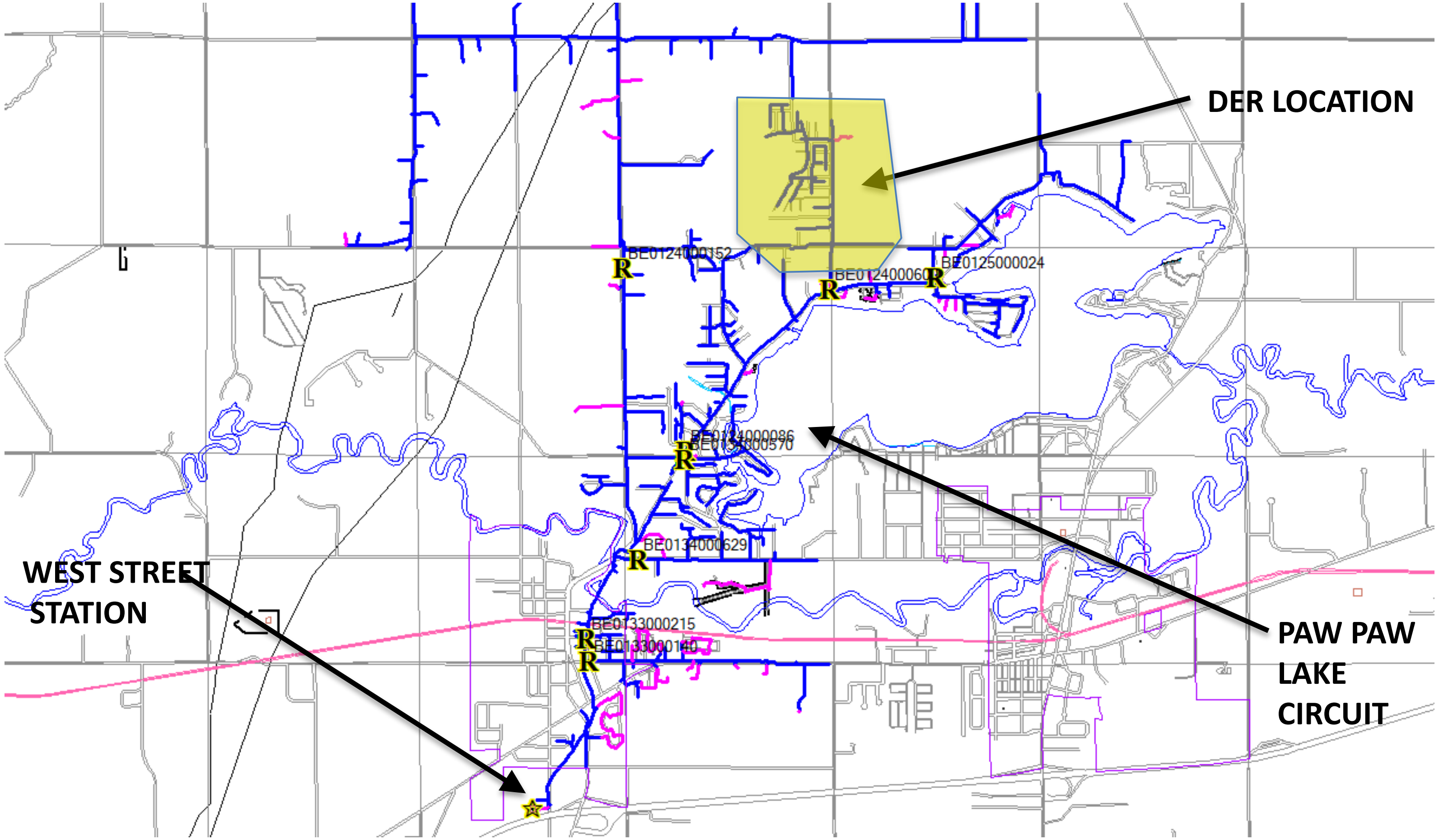
PRELIMINARY

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



PRELIMINARY

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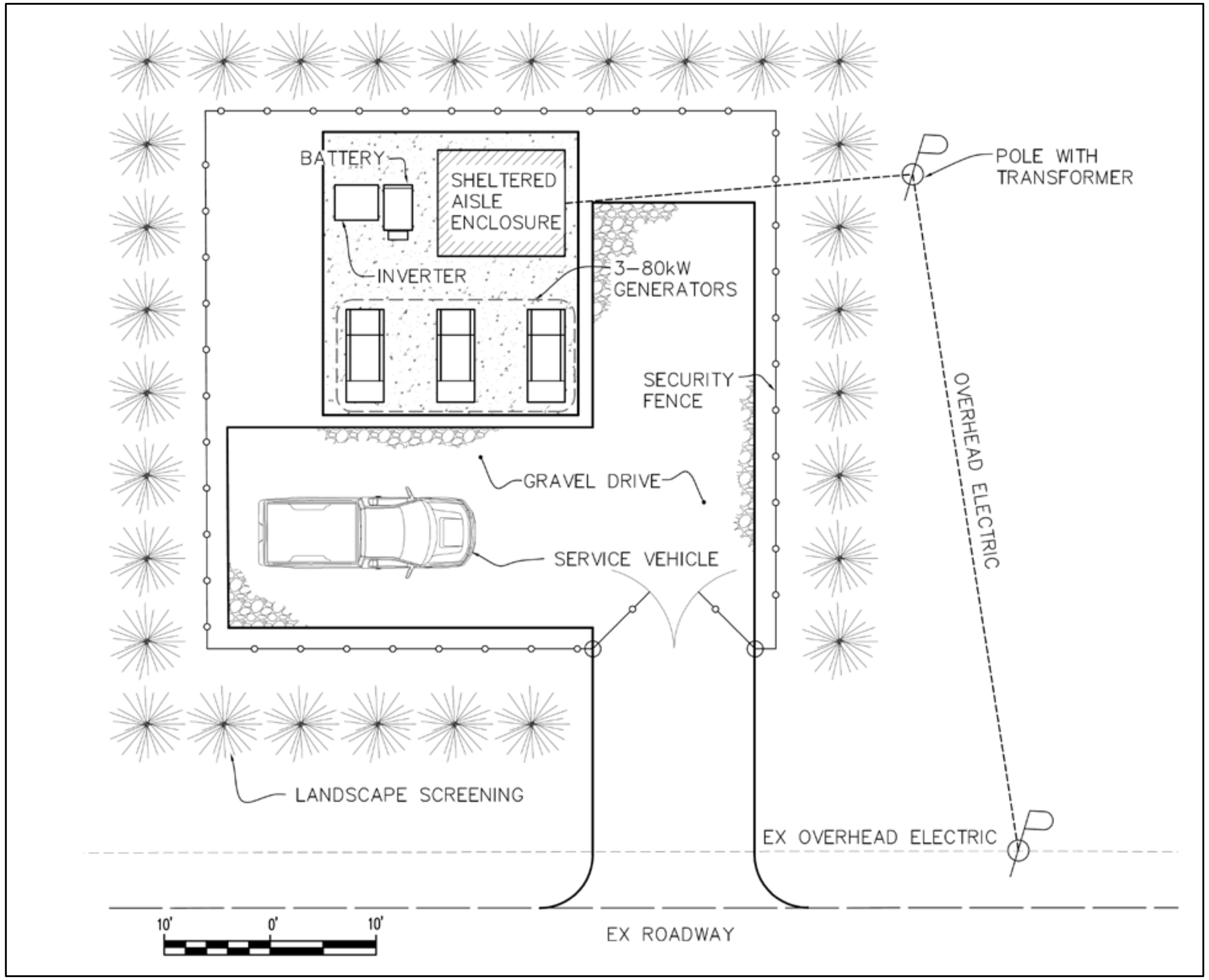
Paw Paw Lake Pilot Layout

- Approx. 80’ x 80’ plot
- 3 x 80 kW generators, natural gas
- Battery and inverter
- Enclosure



Paw Paw Lake Demand Side Management (DSM) and Energy Efficiency (EE) Opportunities

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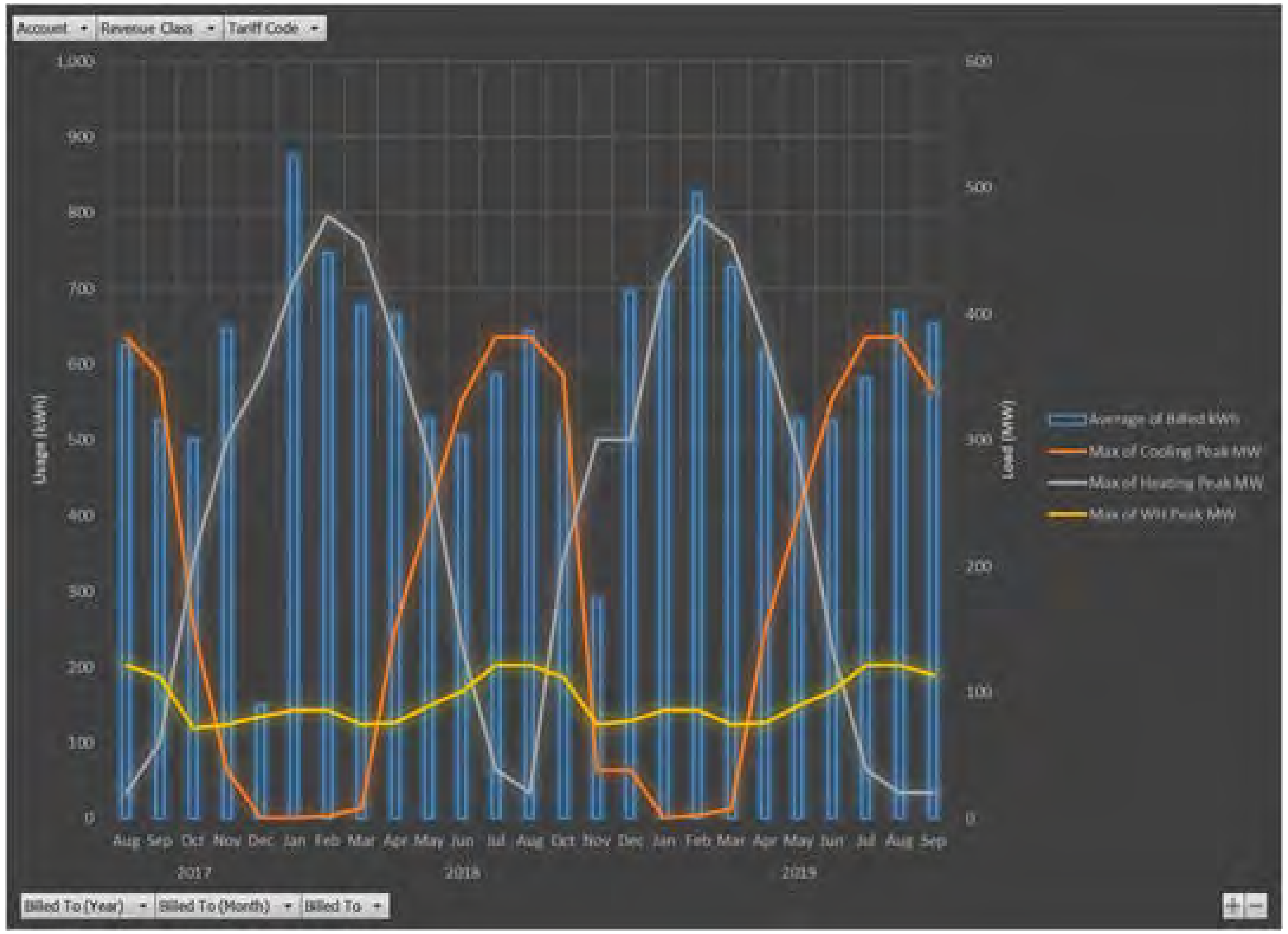
- Heating season peaking
- Vast majority is not electric space heat
- 35% electric water heat



I&M is a summer peaking system, so our traditional demand response does not complement the pilot customer base's winter peaking profile.

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PRELIMINARY

Paw Paw Lake DSM and EE Strategy

1. Electric water heat efficiency options, either more efficient resistance element units or heat pump water heaters
2. Mini split ductless heat pumps replacing electric resistance space heating
3. Air source heat pump upgrades from older less efficient ones, or from electric resistance ducted furnaces
4. Home Audits for electric heat home weatherization (home shell) improvements such as insulation and air sealing
5. Older, less efficient refrigerator recycling

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Paw Paw Lake Next Steps

- Continue refining the details
- Begin property search
- Prepare preliminary schedule and cost estimates
  - Risk items such as land and ROW acquisition and gas infrastructure improvements can impact cost estimates and schedule significantly.

Vicksburg Richardson Circuit

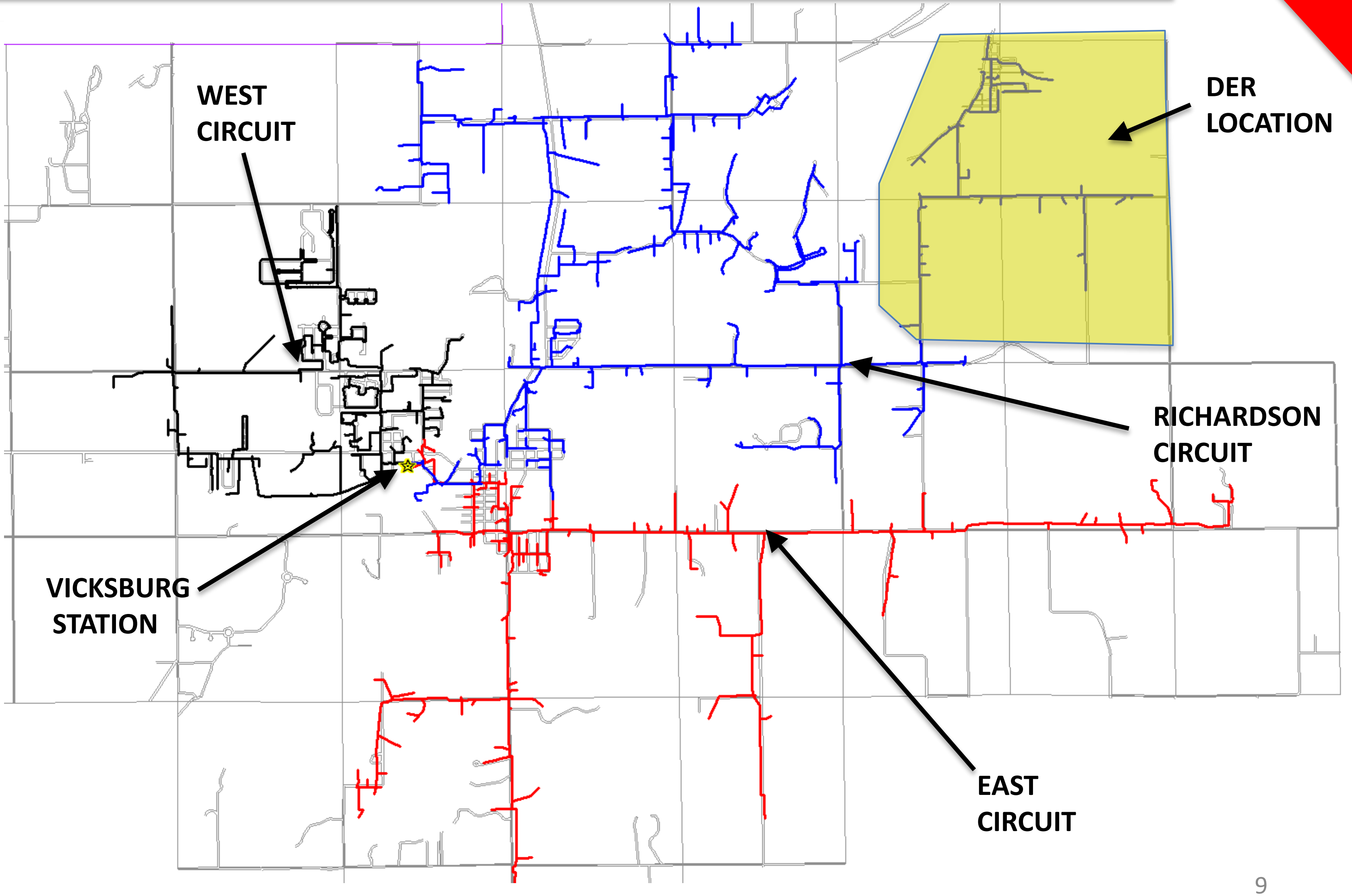
Equipment sizing and layout is underway

PRELIMINARY

Vicksburg Station

- Richardson Circuit
- Serves 358 Premises Downstream of Recloser KA0571000016 (Mostly Residential, 1 Elementary School, 1 Church)

Customer perspective: This solution would have eliminated 11 outages in the last 3 years, representing a total of 64 hours



Next steps

- Submit written response to pilot proposal comments

- Submit fully developed proposal

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Questions?

Closing Comments

Electric Distribution Investment & Maintenance Plans Stakeholder Meeting

Michigan Public Service Commission

Lake Michigan Hearing Room

October 16, 2019

MPSC

Michigan Public Service Commission

November 19, 2019 Stakeholder Session

- Morning session only (9 AM – 12 PM)
- Topics include:
  - Any further discussion or responses to docket comments on:
    - Consistent data across utilities for future distribution plans
    - Utility pilot proposal responses resulting from
    - Utility cost-benefit analysis framework
  - Staff report outline and timeline

Thank you!

Electric Distribution Investment & Maintenance Plans Stakeholder Meeting

Michigan Public Service Commission
Lake Michigan Hearing Room
October 16, 2019

MPSC
Michigan Public Service Commission