Walk-through of long-term utility distribution plans: *Part 1 - Fundamental and grid modernization planning elements*

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GE Energy Consulting

Distribution Systems and Planning Training for Southeast Region
March 11-12, 2020

Goal of distribution planning

- Provide orderly, economic expansion of equipment and facilities to meet future demand with acceptable system performance
  - Deliver power with required frequency (60 Hz)
  - Satisfy voltage requirements (within ±5%)
  - Deliver adequate availability (<2 hours outage/yr)
  - Have capacity to meet instantaneous demand
  - Reach all customers wherever they exist

… and do it all for the lowest possible cost

Need to plan because it takes time to build capacity

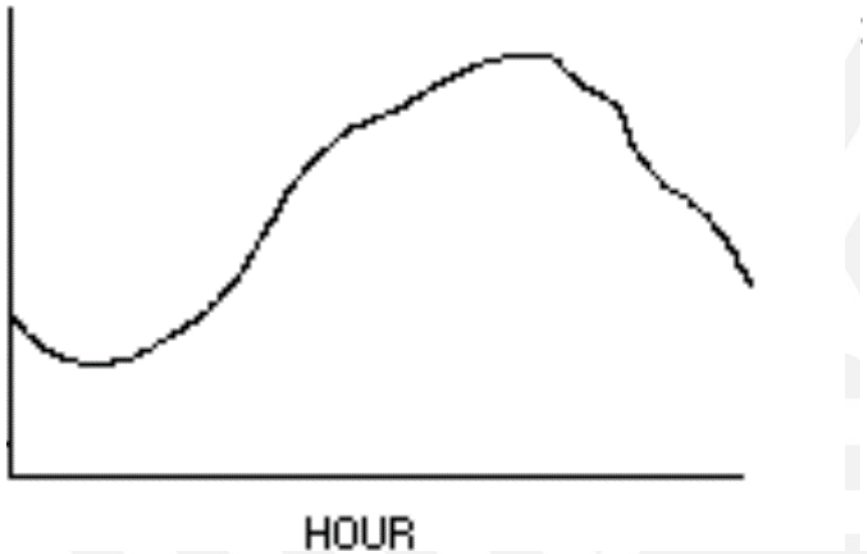
- Effective minimum-cost planning accounts for lead time to deploy T&D assets in developing reasonable alternatives

T&D Level	Lead Time (yrs)
Generation	13
EHV Transmission	9
Transmission	8
Sub-transmission	7
Substation	6
Feeder	3
Lateral	0.5
Service	0.1

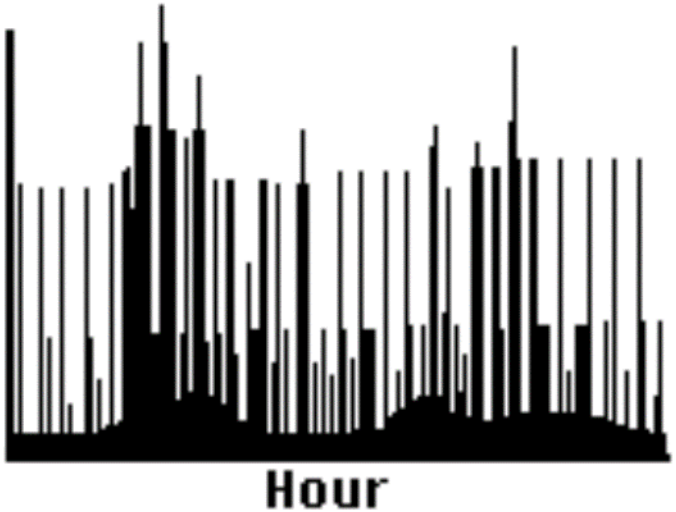
Loads and demand drive distribution planning

- Loads vary over time and space

Typical Feeder Load



Typical Customer Load



Perceived variability depends of level of aggregation and resolution

Example Plan: Xcel Energy's Integrated Distribution Plan (2020-2029)

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Xcel Energy Integrated Distribution Plan (IDP)

Xcel Energy

INTEGRATED DISTRIBUTION PLAN (2020-2029)

NOVEMBER 1, 2019

Docket No. E002/M-19-666

Presents a detailed view of the distribution system and plans to meet customers' current and future needs

- **Five-year action plan** focused on
  - Providing customers with safe, reliable electric service
  - Advancing the distribution grid with foundational and core capabilities:
    - Advanced Metering Infrastructure (AMI)
    - Field Area Network (FAN)
    - Fault Location, Isolation, and Service Restoration (FLISR)
    - Integrated Volt-Var Optimization (IVVO)
  - Procure and implement Advanced Planning Tool (APT) to facilitate:
    - Non-Wires Alternatives (NWA)
    - Distributed Energy Resources (DER)
    - Load forecast scenario analysis
    - Integrated T&D resource planning

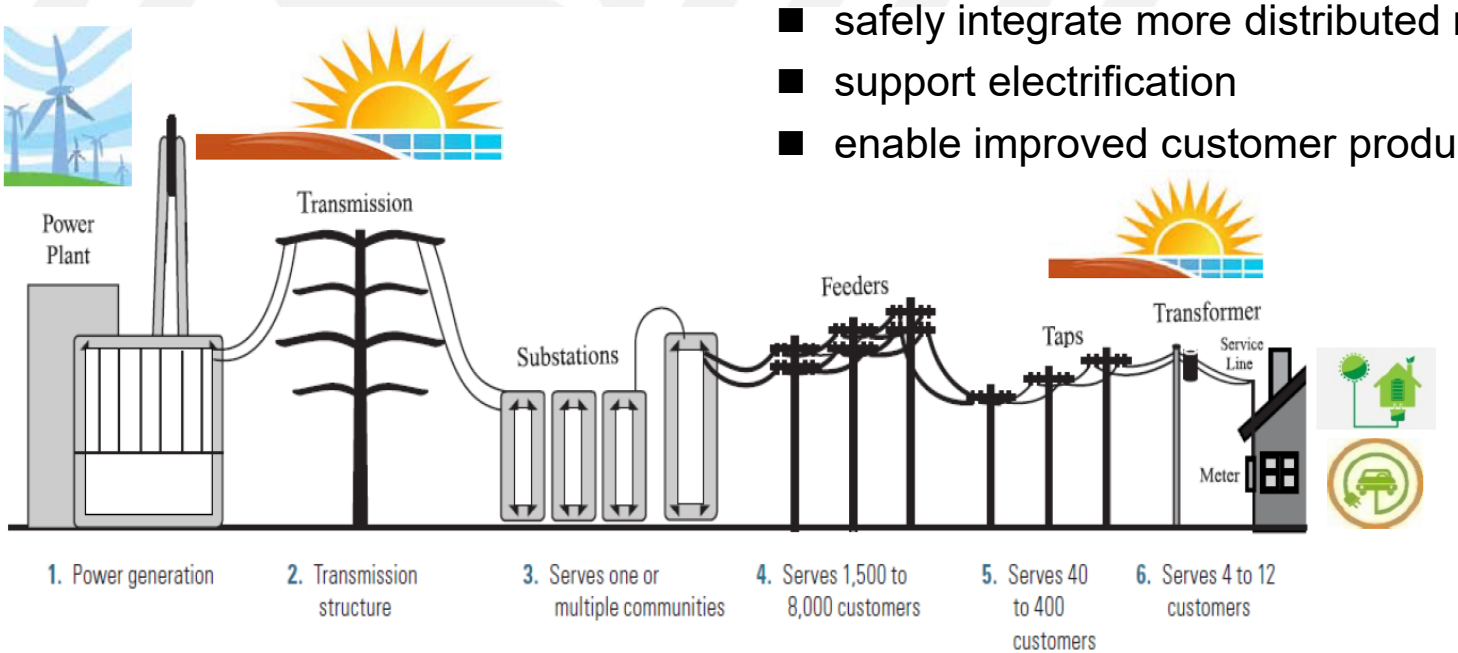
Xcel Energy Strategic Priorities – Applied to Distribution

"strategic priorities … are embedded in everything that we do – including the way that we plan our distribution system"

Distribution Planning Framework

Work performed by the Distribution Department is essential to ensuring that electric service is safe, reliable, and affordable.

- Extend service to new customers or increase capacity to accommodate growth
- Repair facilities damaged during severe weather to quickly restore service
- Regularly maintain and repair poles, wires, cables, metering, and transformers
- Transform the distribution grid as part of the larger Advanced Grid Intelligence and Security (AGIS) initiative to:
  - enhance security, efficiency and reliability
  - safely integrate more distributed resources
  - support electrification
  - enable improved customer products and services

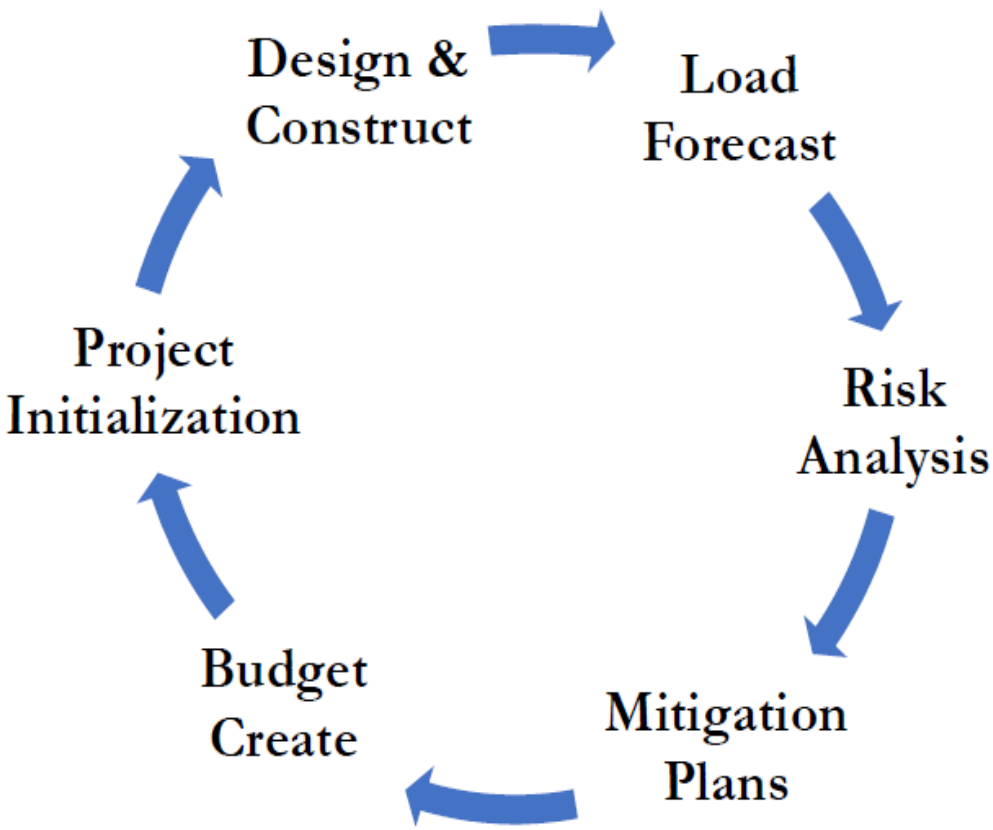


Overall Approach to System Planning

- Proactively identify existing and anticipated capacity deficiencies or constraints that could lead to overloads
  - During *normal* ("system intact" or N-0 operation) operating conditions
  - During *single contingency* (N–1) operating conditions
- Identify corrective actions
  - Traditional distribution expansion
  - Non-wires alternatives
- Develop cost estimates and perform benefit-cost analysis to determine best options based on:
  - Operational requirements
  - Technical feasibility
  - Future year system need

Proposed projects are funded as part of an annual budgeting process, based on a risk ranking methodology

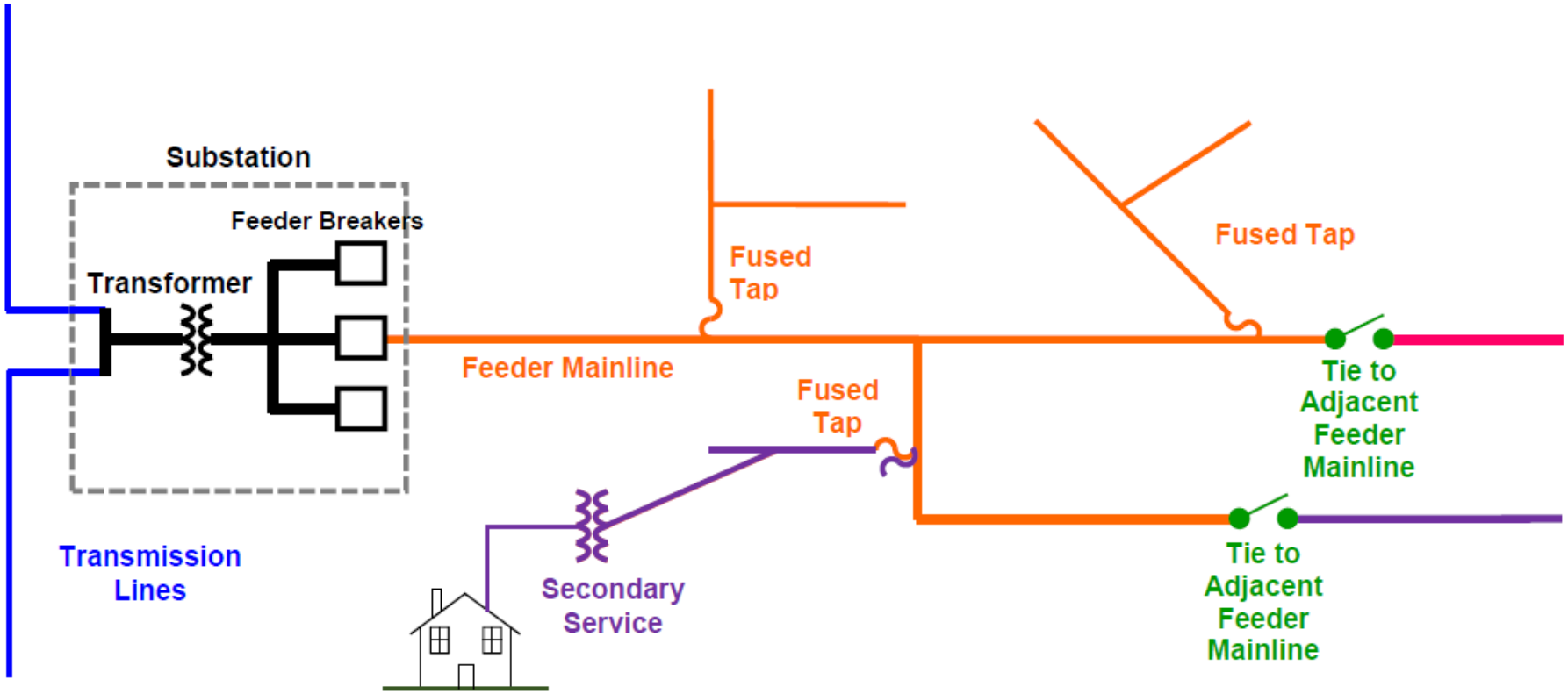
Annual Distribution Planning Process



Review existing and historical conditions, including:

- Feeder and substation reliability performance
- Equipment condition assessments
- Current load versus previous forecasts
- Quantity and types of DER
- Total system load forecasts
- Previous planning studies

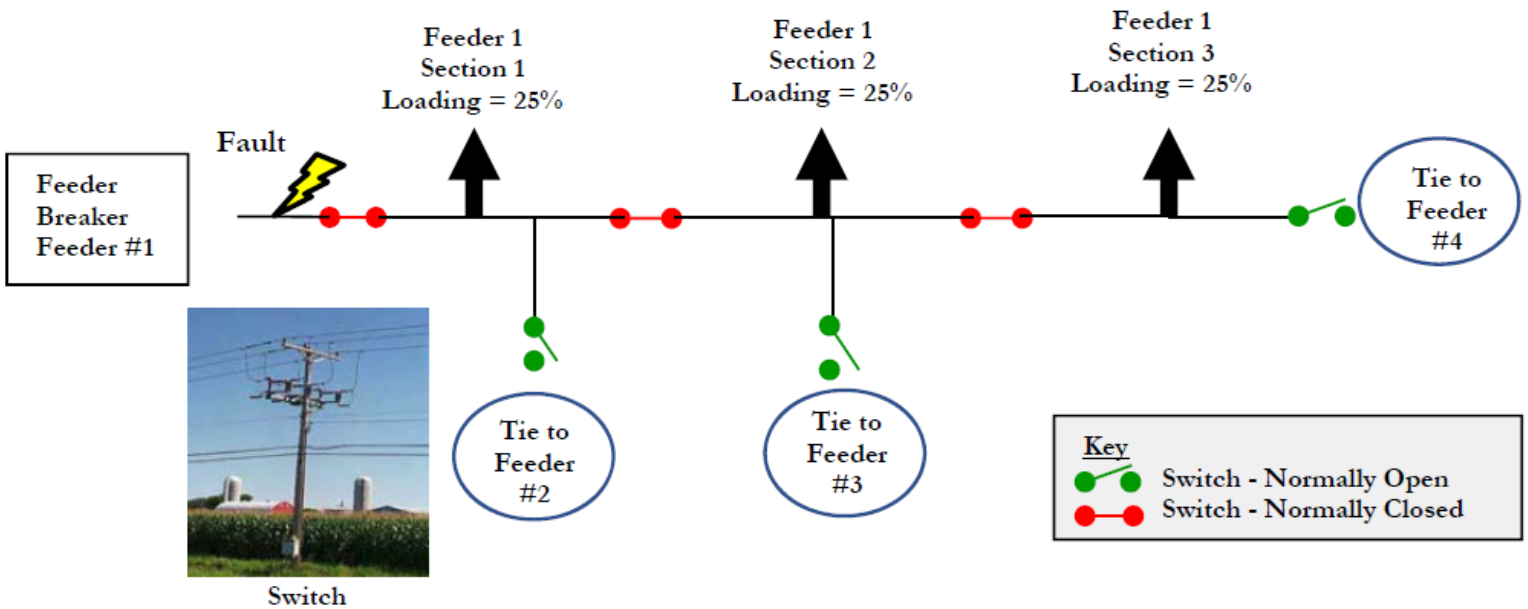
Typical Radial Distribution Circuit Design



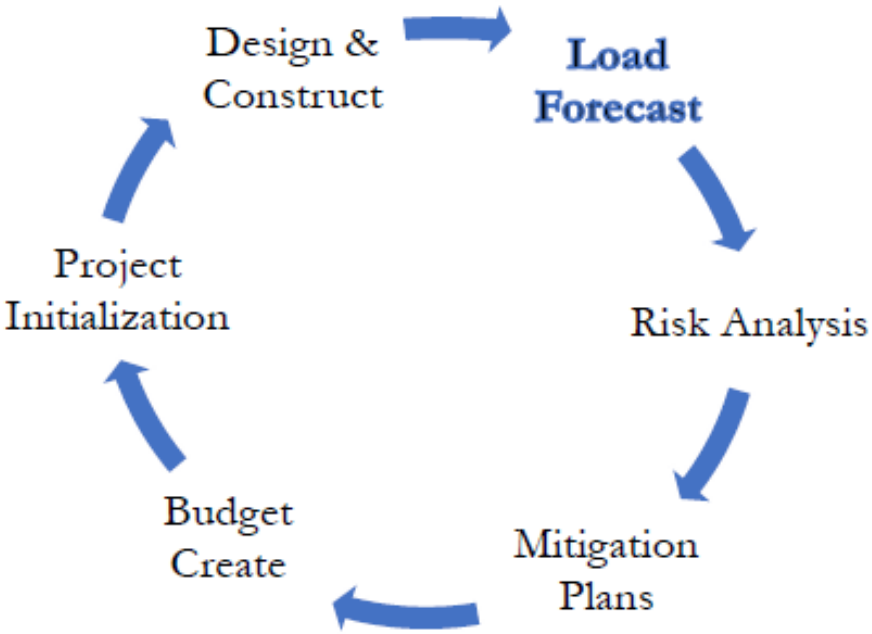
System is planned to facilitate single-contingency switching to restore outages within ~1 hour

Planning Criteria and Design Guidelines

- Voltage at the customer meter **within 5%** of nominal
- Voltage imbalance **less than or equal to 3%**
- Balanced phase current phases (as much as possible) to minimize total neutral current at feeder breaker
- Feeder loading under N-0 (normal) conditions **less than 75%**
- Adequate field tie capabilities for first contingency (N-1) restoration



Distribution Planning Process: Load Forecast



- Performed for both feeders and substations
- Focuses on demand, not energy, to ensure loads can be served during system peaks
- Trending method considering:
  - Historical load growth
  - Weather history
  - Customer planned additions
  - Circuit reconfigurations
  - New sources of demand (e.g., EVs)
  - DER applications
  - Planned development or redevelopment in study area

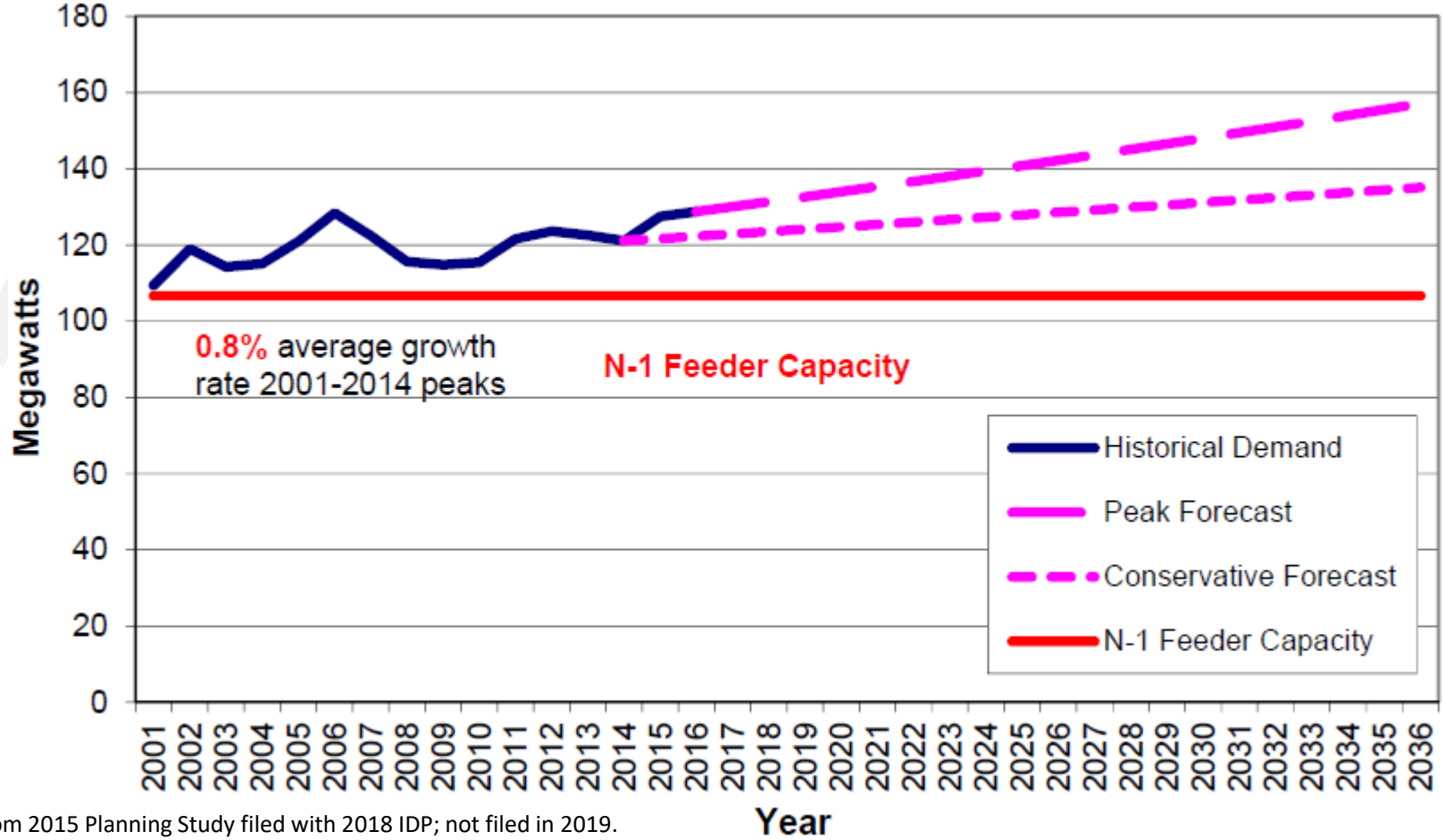
Tools and Processes:

- ITRON DAA (Distribution Asset Analysis)
- SCADA (Supervisory Control and Data Acquisition)
- PI Datalink (Excel add-in providing SCADA information)

Generate five-year forecast, aggregate, and compare with system projections.

Example: Feeder Historical and Forecasted Demand

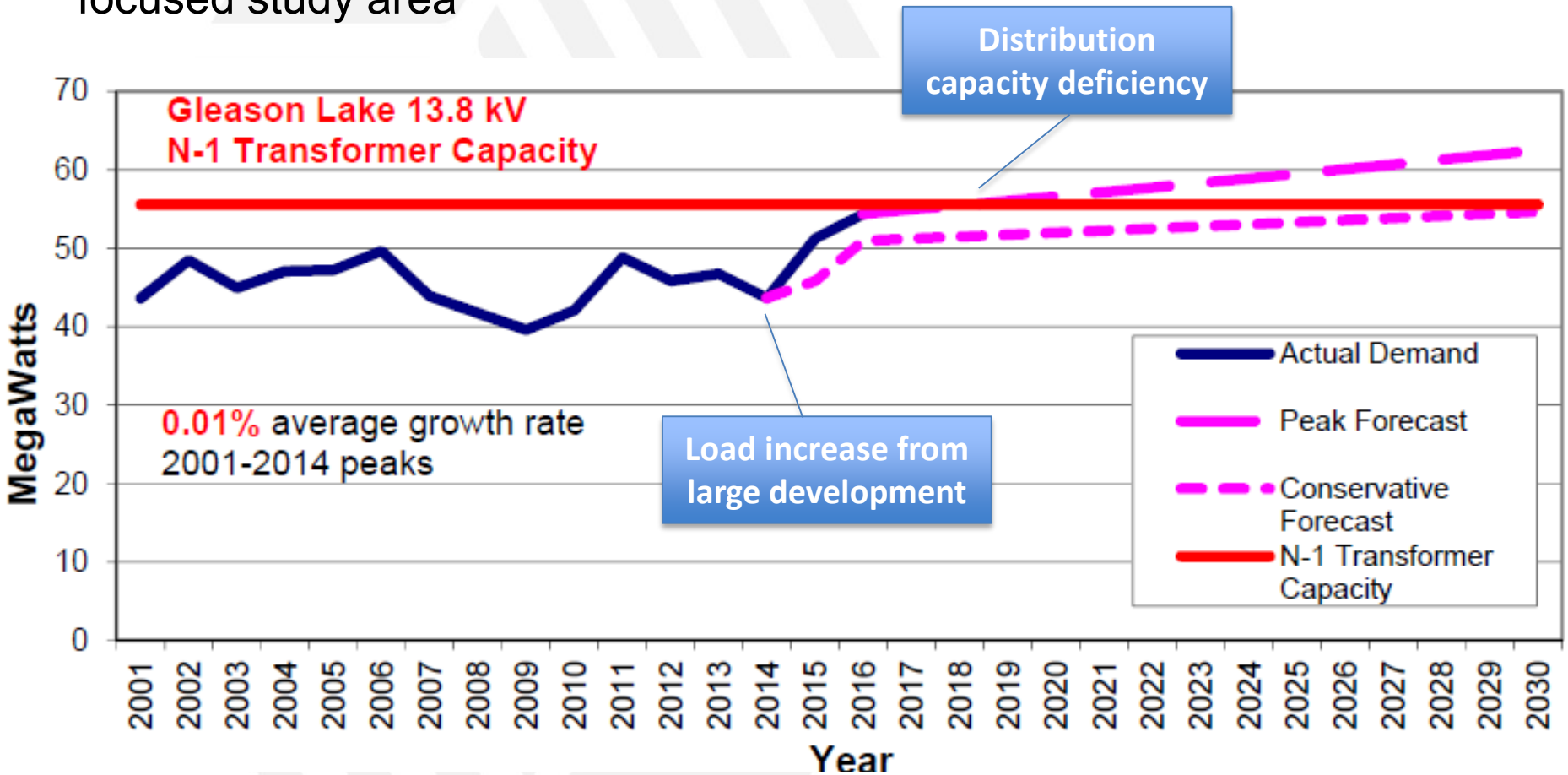
- Summer peak demand forecast for eleven 13.8 kV and two 34.5 kV feeder circuits in focused study area*



*From 2015 Planning Study filed with 2018 IDP; not filed in 2019.

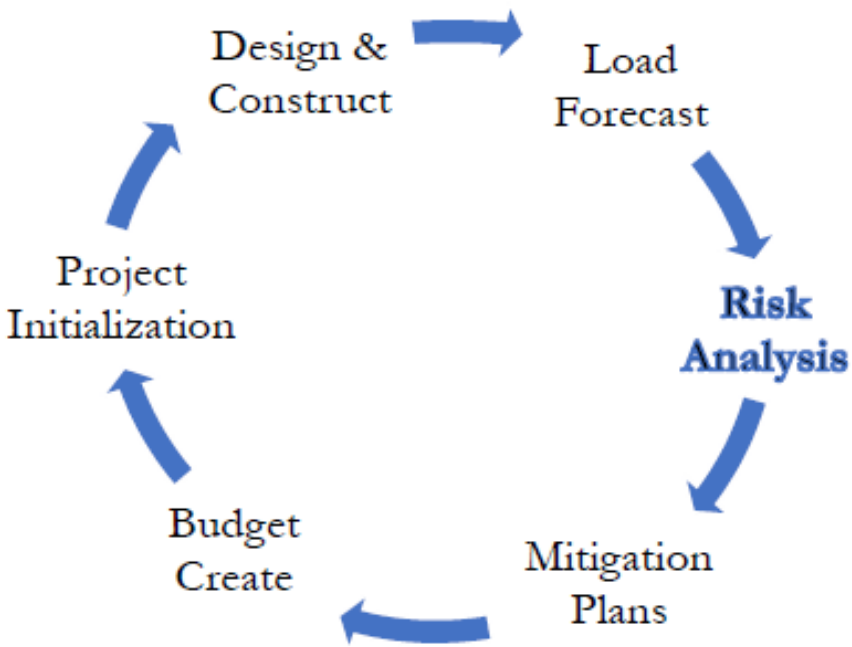
Example: Substation Historical and Forecasted Demand

- Summer peak demand forecast for two 13.8 kV substation transformers in focused study area*



*From 2015 Planning Study filed with 2018 IDP; not filed in 2019.

Distribution Planning Process:
Risk Analysis



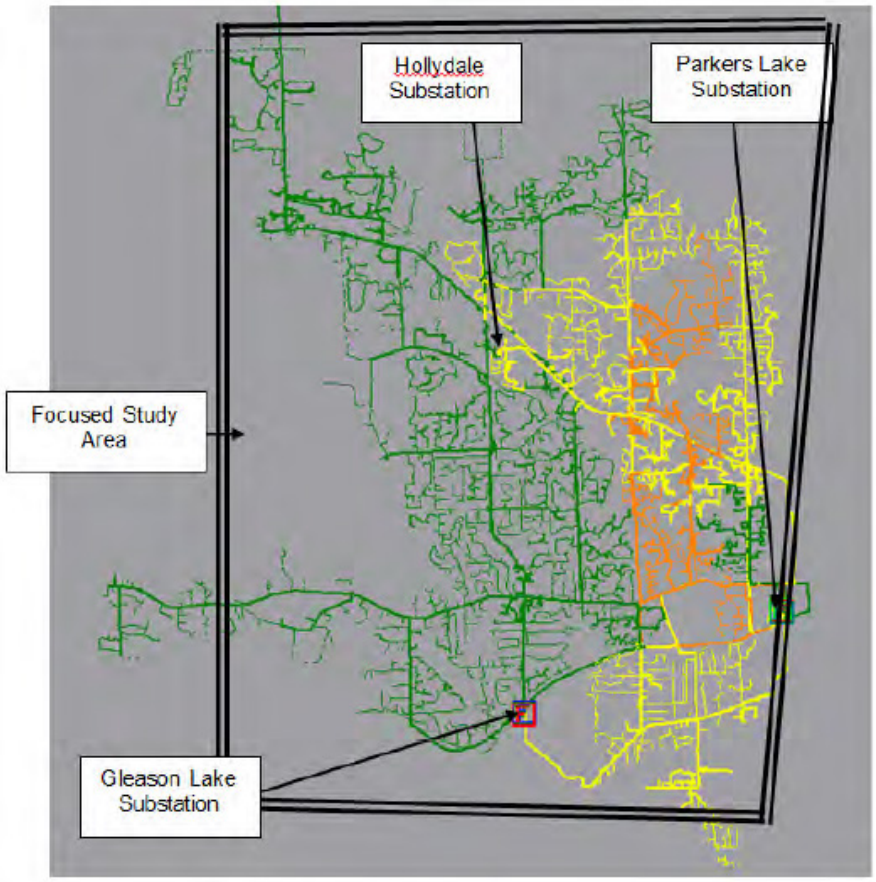
- Identify feeders and substation transformers for which N-0 or N-1 risk is a concern.
- Total number of risks generally exceeds what can be mitigated with available funds.
- Strike a balance between
  - mitigating risks,
  - planning for new customers,
  - addressing aging, and
  - preparing for the future

Tools and Processes:
- ITRON DAA (Distribution Asset Analysis)
- CYMCAP (determines circuit ampacity*)
- WorkBook (internal project prioritization tool)

Xcel's planning process identified these risks:
- N-0 normal overloads on 71 feeder circuits
- N-0 normal overloads on 14 substation transformers
- N-1 contingency risks on 498 feeder circuits
- N-1 contingency risks on 112 substation transformers

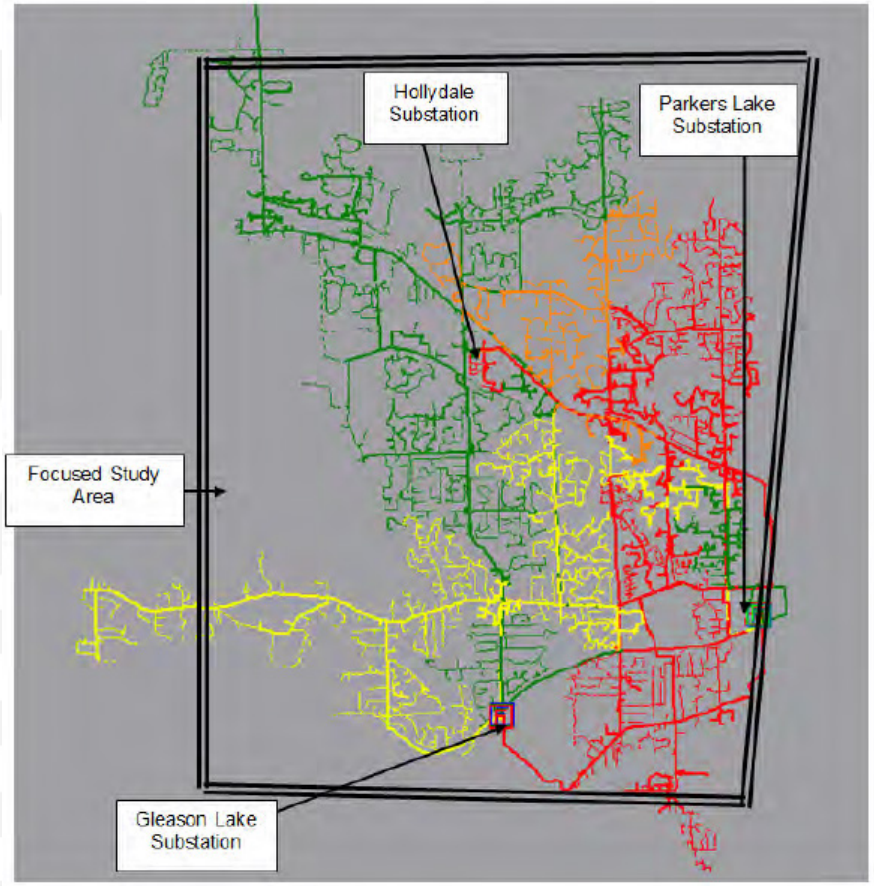
*Ampacity is the maximum current a conductor can carry continuously (safely) before thermal limits are exceeded.

Example: Plymouth and Medina N-0 Risk Assessment: 2016 and 2036



2016

Feeder Circuits Colored by N-0 Circuit Loading:		
5 Circuits	<75% or<50%	
6 Circuits	50or75%-100%	
2 Circuits	100%-115%	
0 Circuits	>115%	

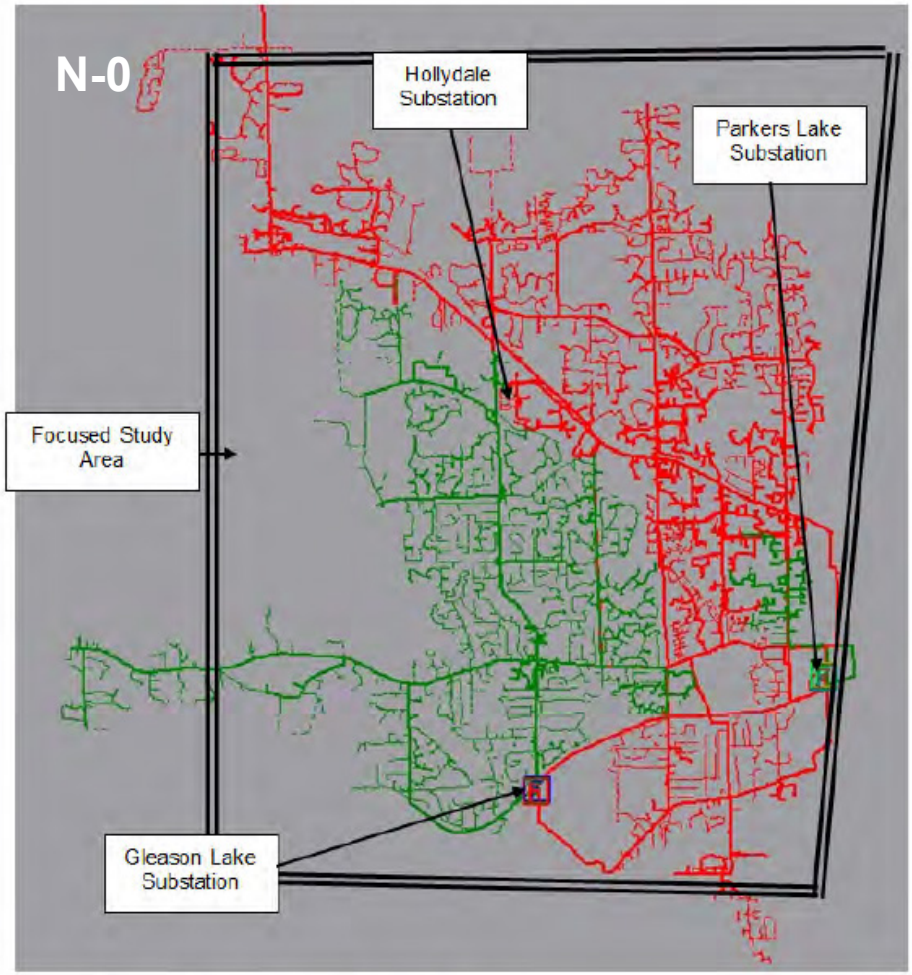


2036

Feeder Circuits Colored by N-0 Circuit Loading:		
3 Circuits	<75%or<50%	
4 Circuits	50or75%-100%	
2 Circuit	100%-115%	
4 Circuits	>115%	

*From 2015 Planning Study filed with 2018 IDP; not filed in 2019.

Example: Plymouth and Medina N-1 Risk Assessment: 2016 and 2036



Feeder Circuits Colored by N-1 Circuit Loading:		
5 Circuits	No N-1 Risk	
8 Circuits	N-1 Risk	

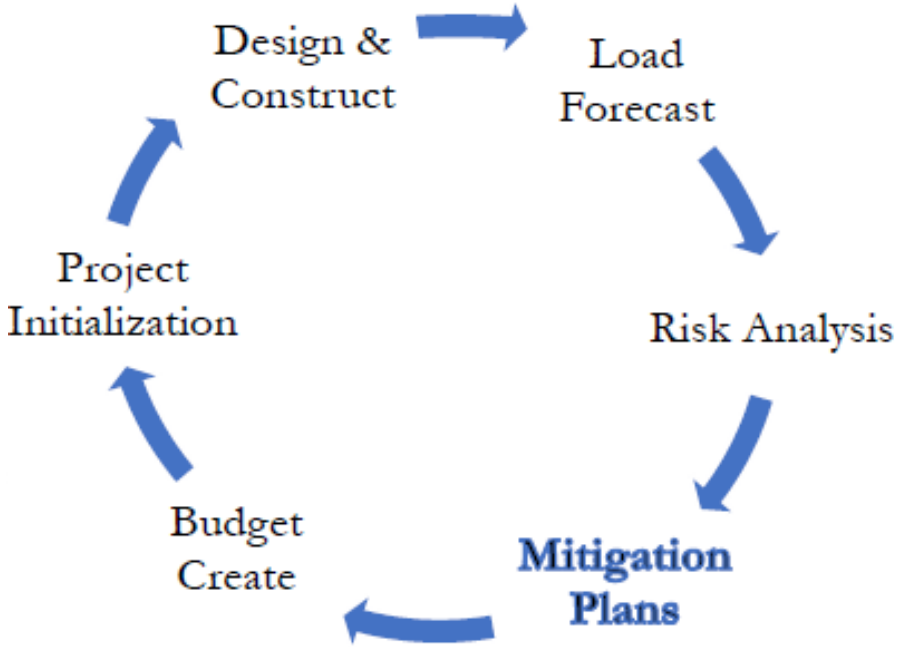
2016

Feeder Circuits Colored by N-1 Circuit Loading:		
3 Circuits	No N-1 Risk	
10 Circuits	N-1 Risk	

2036

*From 2015 Planning Study filed with 2018 IDP; not filed in 2019.

Distribution Planning Process: Mitigation Plans

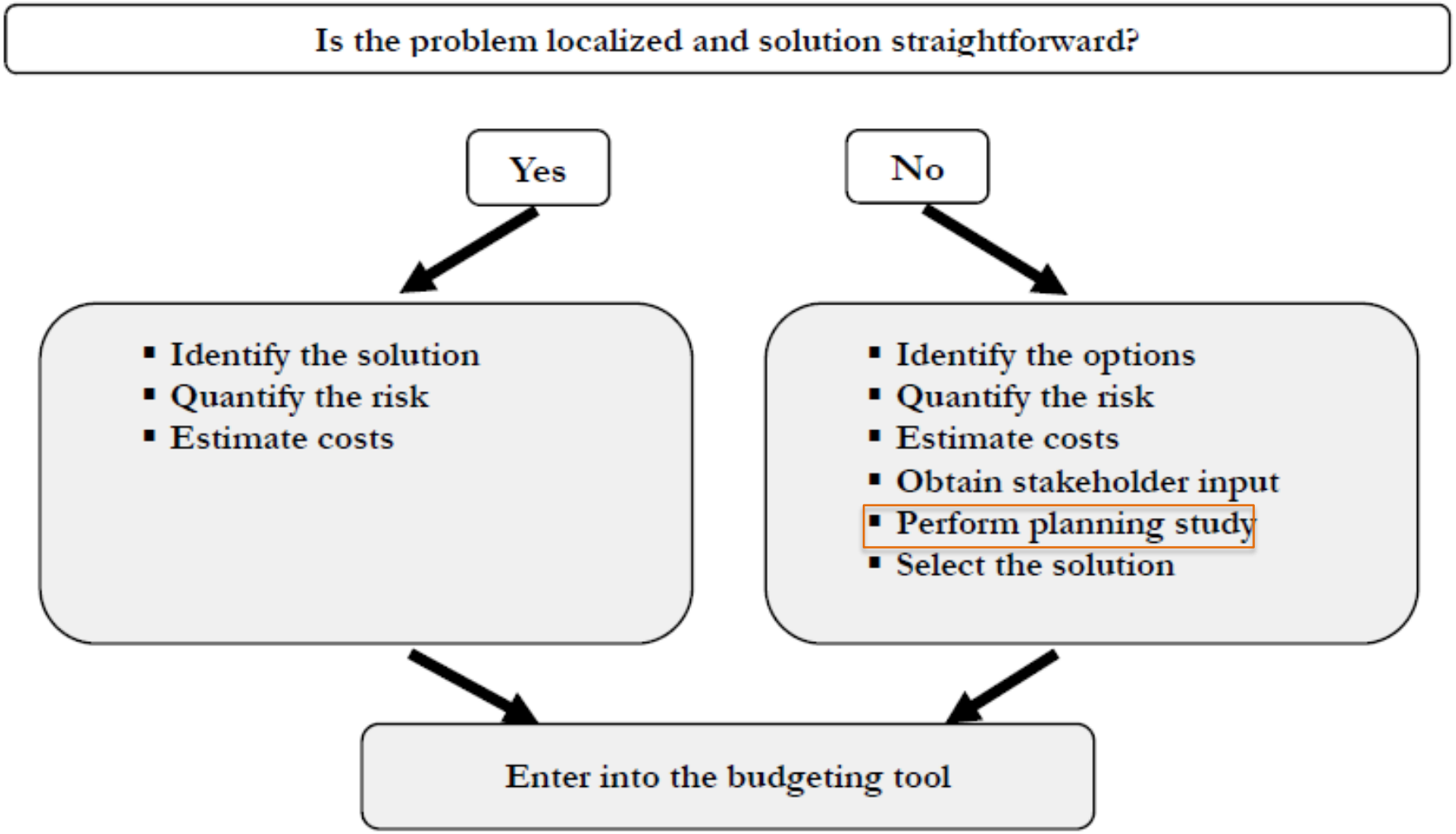


- Identify potential solutions to provide additional capacity needed to address identified system deficiencies
- Risk thresholds that trigger mitigation plan:
  - N-0 conditions: overload > 106%
  - N-1 conditions: load at risk > 3 MVA

Tools and Processes:
- GIS (Geographical Information System)
- Synergi Electric (power flow)
- WorkBook (internal project prioritization tool)

Many mitigation solutions are straightforward, but others require detailed analysis

Solution Identification Process



Distribution Planning Location-Specific Studies to Evaluate Alternatives

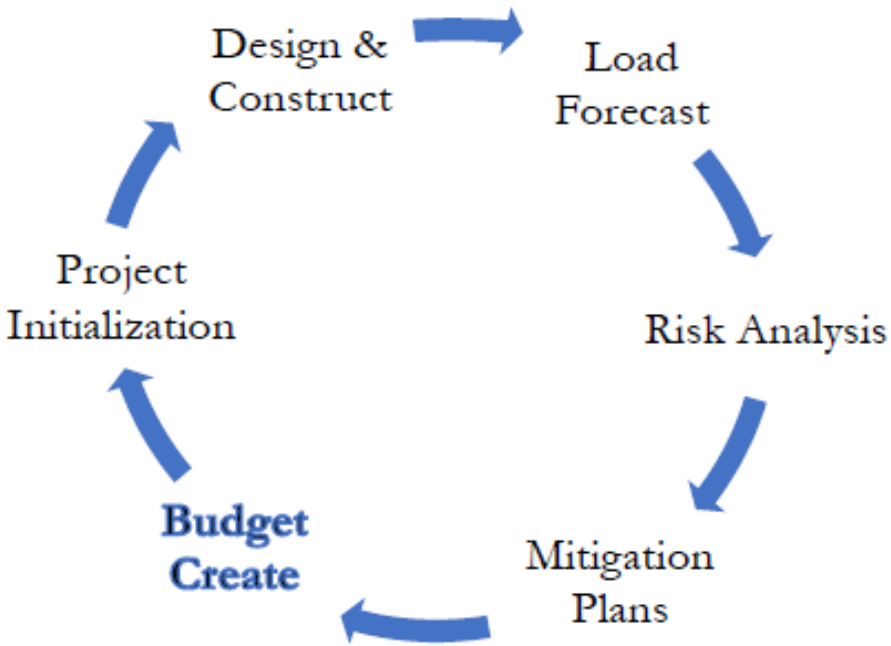
1. Identify the study area
2. Project future loads
3. Estimate the saturation of the area
4. Coordinate with transmission planning
5. Generate options
6. Study and compare economics and reliability of the alternatives

Potential Solutions:

- Reinforce existing feeder circuits to address isolated feeder circuit overloads
- Add or extend new feeder circuits
- Expand existing substations to address more widespread overloads
- Evaluate alternatives to bring new distribution sources to the area
- **DER** not historically considered a viable alternative … changing due to maturing technology, operational experience, and regulatory requirements

Distribution Planning Process: Budget Creation

Budget-constrained planning:
Not all projects identified in the previous step will be able to be funded



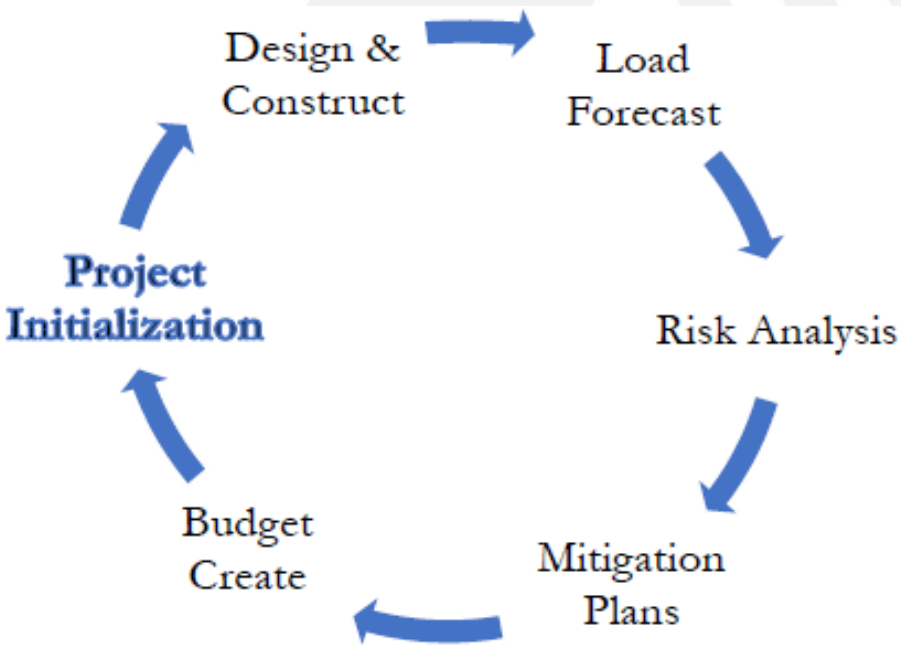
- Factors used to prioritize investments include:
  - *Reliability*
  - *Safety*
  - *Environmental*
  - *Legal*
  - *Financial*
- Each project assessment is ranked against the others
- Highest priority given to regulatory and environmental compliance and projects to connect new customers

Tools and Processes:
- WorkBook (internal project prioritization tool)

Ranked proposed project list

See "Extra Slides: Distribution Budgets"

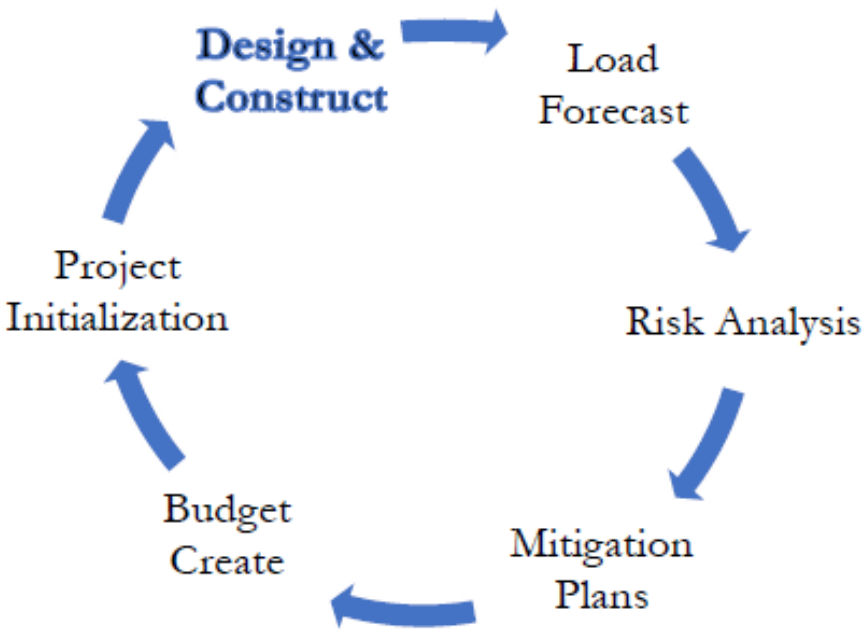
Distribution Planning Process:
Project Initialization



- Electric Distribution Planning memos are written to initiate the design and construction part of the project.
  - High level, step-by-step description of the project that will mitigate an identified risk
- Describes:
  - The problem being mitigated
  - Any substation design/construction steps to take
  - Any distribution line design/ construction steps to take

Tools and Processes:
- WorkBook (internal project prioritization tool)

Distribution Planning Process:
Design and Construct



Often an iterative process with planning engineers

Selected projects are communicated to substation engineering and distribution engineers and designers:

- Substation Engineering:
  - Detailed engineering, design and construction for a new feeder bay at an existing substation or a new substation entirely
- Distribution Design and Construction:
  - Permitting, design and construction of new feeder circuits or modifications of existing circuits

Planning Tools

- Current forecasting tools only analyze annual peak load for distribution assets — e.g., feeders and transformers
- With increasing DER adoption, distribution system becomes more dynamic and annual peak view is no longer adequate
- Need advanced planning tools and capabilities to:
  - facilitate targeted and granular distribution forecast analyses
  - systematically evaluate NWAs
  - enable better assessment of potential customer-driven DER growth through DER scenario forecasting
  - integrate forecast with other resources and planning processes (AMI, Integrated Resource Planning)

Need more granular load forecasts, in terms of both time intervals and proximity to customer end-points

Planning Tools Evolution

Walk | Jog | Run

	TOOLS	Current Process Steps					Future Planning Actions				
		Forecast	Risk Analysis	Mitigation Plans	Budget Create	Design and Construct / EDP Memo	Long Range Plans	Interconnection Processing**	Scenario Planning	Integrated Resource Planning	Locational Net Benefit Analysis
Current Tools	Synergi Electric		X	X			X	X			X
	~~Distribution Asset Analysis*~~	~~X~~	~~X~~	-	-	-	-	-			
	MS Excel		X		X		X				
	CYMCAP		X								
	GIS			X			X	X	X		X
	SCADA	X									X
	Workbook (internal)		X	X	X	X					X
	DRIVE***		X	X				X			
Expanded Tools	Advanced Planning Tool*	X					X	X	X	X	X
	ADMS	X							X		
	SAP					X					

Notes:

* New Advanced Planning Tool replaces Distribution Asset Analysis system and adds more functionality

** Planning has larger role in interconnection process

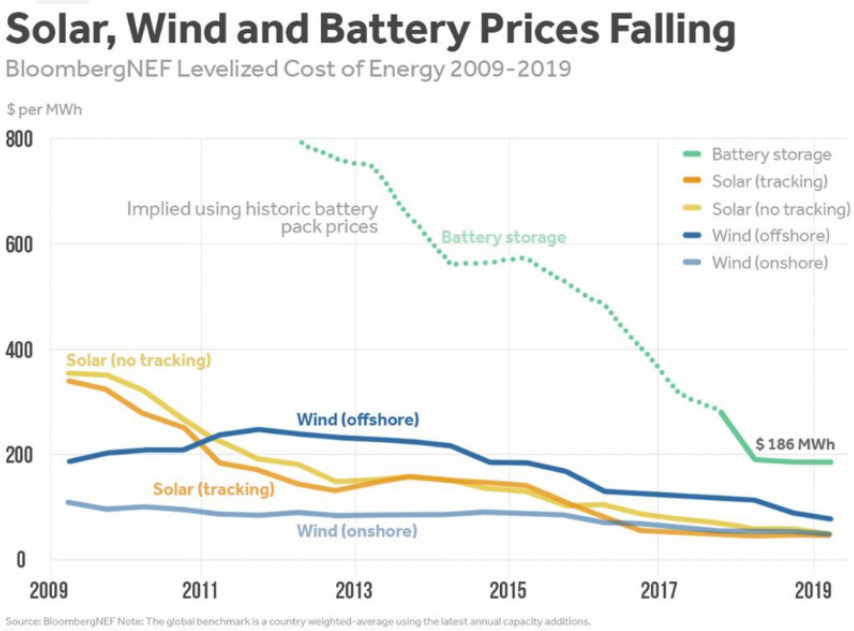
*** Hosting Capacity becomes integrated into planning process

Non-Wires Alternatives

Non-Wires Alternatives

- Emerging as another advanced distribution planning application
- Significant rise in NWA projects proposed/implemented
- States with high DER penetration and/or regulatory reform measures leading the way
- Decreasing DER costs may present opportunities to address pockets of load growth using DER
- **Traditional buildout solutions:**
  - Fixed capacity at known locations: substations, feeders, laterals, etc.
- **Non-traditional solutions:**
  - Operational characteristics based on technology, location, time of day

Niche applications with potential to quickly become cost-competitive



https://www.kqed.org/science/1951005/the-cost-of-battery-storage-plummets-at-the-right-moment-for-california

Viability of NWAs by Project Type (*Xcel's View - from 2019 IDP*)

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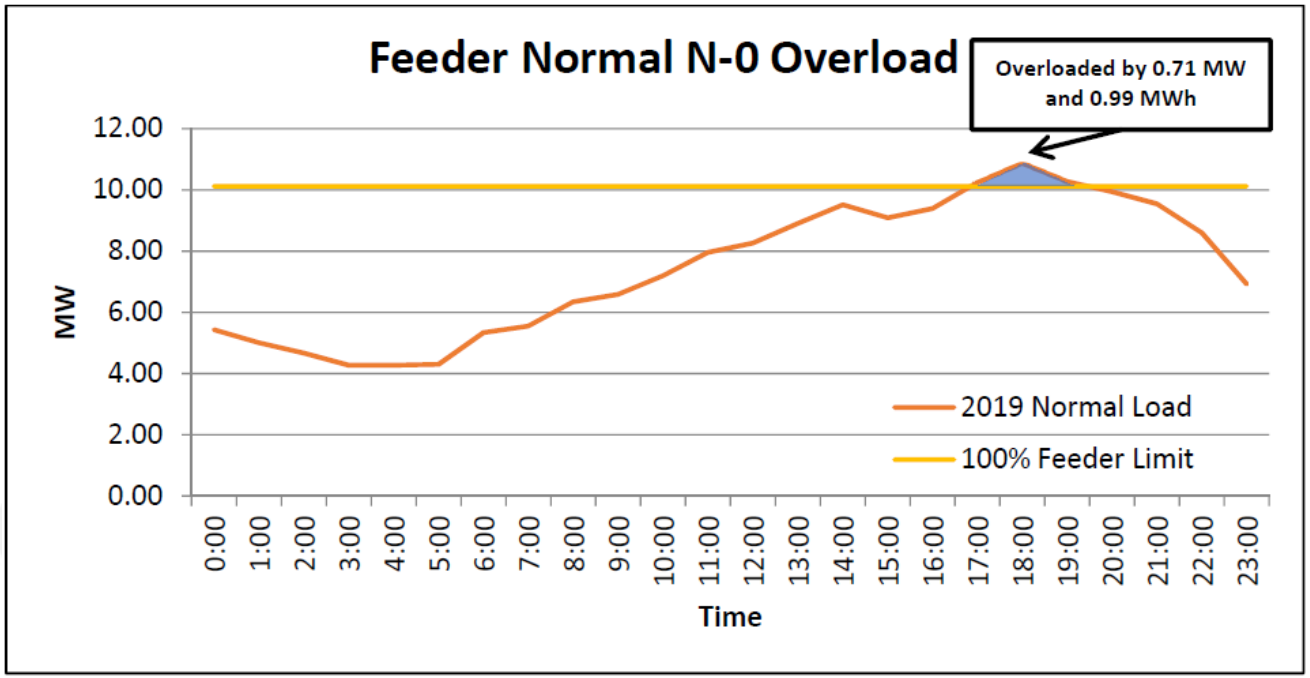
- **Mandated Projects:**
  - Relocating infrastructure in public rights-of-way in order to accommodate public projects such as road widenings or realignments.
  - ✗ Replacing with NWA "…*would leave a segment of customers electrically unserved due to having no physical connection to the Xcel system.*"
  - "*Removing interconnectedness takes away .. flexibility and redundancy … and makes [operation] more difficult and less reliable*"
- **Asset Health Projects:**
  - Replacing equipment which is reaching the end of life or has failed (pole replacements, storms, underground cables, etc.)
  - ✗ "*Because asset health affects every part of the distribution system and is essential to maintaining reliability, an NWA is not workable*"
- **Capacity Projects (preferred application for Xcel):**
  - Better suited for NWA as they are driven by a capacity deficiency that can be offset or deferred by strategically-sited DER
  - ✓ *"… without some external driving need, NWA must be cost-competitive with a traditional solution to be viable in the budget create process*"

NWA for Capacity Projects: N-0 overload example

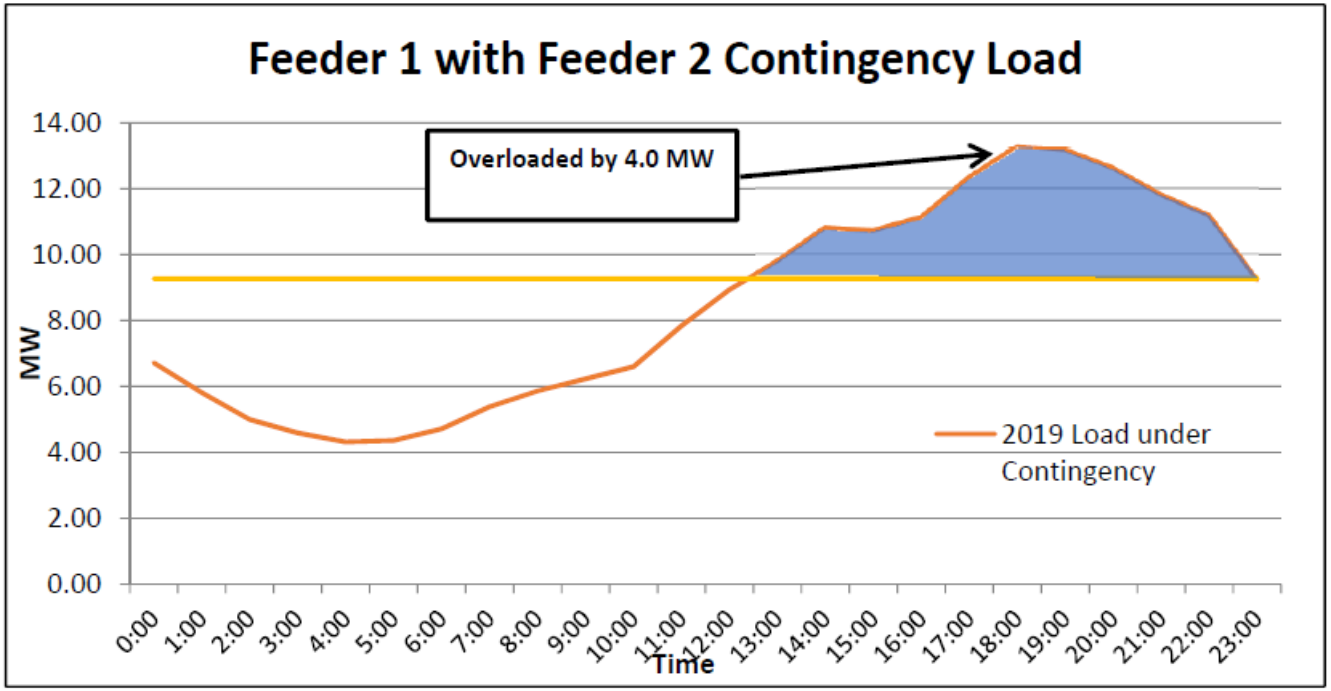


- Small overload with a peak magnitude of 0.71 MW
- Total overload duration is brief, ~1 MWh overloaded

Assuming a $400,000/MWh cost for battery storage, overload could be mitigated with DER for $400,000.

Cost-competitive with a typical traditional mitigation project (upgrading feeder cables or conductors, extending a feeder and transferring load, or installing a new feeder)

NWA for Capacity Projects: N-1 overload example

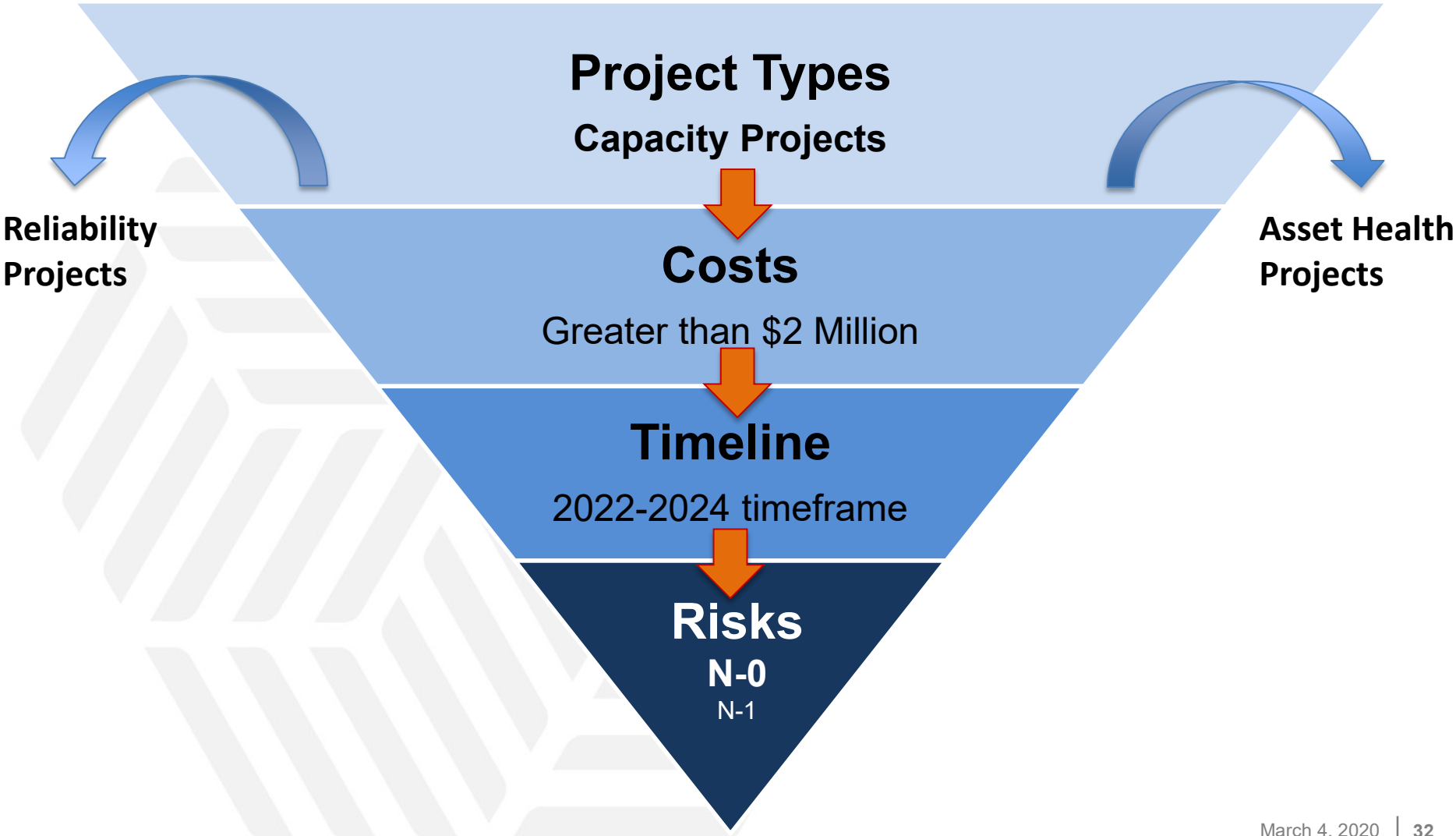


- 4 MW overload (standard for N-1 risks)
- Duration of the overload extends to 10 hours, ~24 MWh overloaded

Assuming a $400,000/MWh cost for battery storage, overload could be mitigated with DER for $9,632,000.

Orders of magnitude higher than a typical traditional mitigation project (upgrading feeder cables or conductors, extending a feeder and transferring load, or installing a new feeder)

NWA Screening Process



Asset Health and Reliability Management

Electric Distribution Standards

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- Develop and maintain a broadly-accepted set of material and construction standards that meet the needs of operating companies and stakeholders

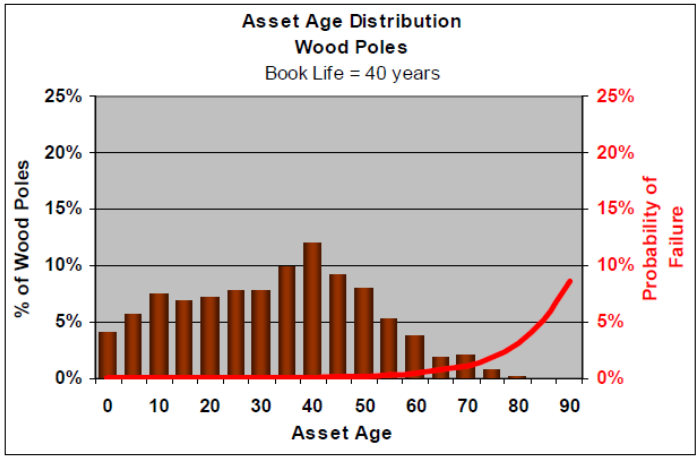
Some Common Industry Standards Applied in Distribution Engineering

Condition	Standard
Safety	National Electric Safety Code (NESC)
	Xcel Energy Safety Manual
Voltage Limits	ANSI C84.1 – minimum and maximum voltage limits, voltage imbalance limits
	Xcel Energy Standard for Installation and Use – voltage limits and imbalance (same as ANSI C84.1)
Thermal limits	Xcel Energy Design Manuals (Distribution Standards Engineering)
	Substation Field Engineering (SFE) transformer loading database – based off of IEEE standards
	IEEE 738 – Overhead conductor ampacity rating IEC 287 and IEC 853 – Cable ampacity rating methodology in CYMCAP program
	IEEE C57.91 – transformer and regulator loading guide IEEE C57.92– power transformer loading guide
Distribution Interconnection	IEEE 1547 – Interconnection of Distributed Resources
Harmonics	IEEE 519 – total harmonic distortion and individual harmonic limits
Voltage Fluctuation	IEEE 1453 – rapid voltage change and flicker limits

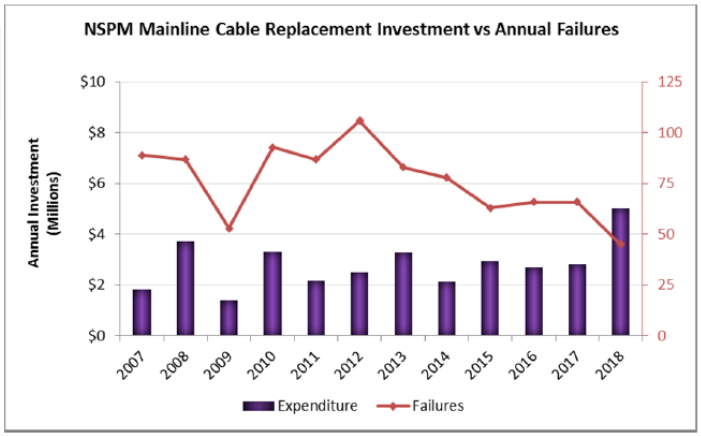
Asset Health

Monitor and address the health of distribution assets using a variety of programs and metrics

- Overhead (OH) distribution reliability performance dependent on many factors including vegetation, weather, and health of OH assets
  - E.g. Pole rot at the base of the pole can cause failure, especially in stormy weather
  - Track the fleet age of wood poles, and use age as a proxy for asset health



- Underground distribution reliability performance is heavily influenced by the performance of mainline and tap cable
  - Analyze cable failure rates for both types of cable, and budgets to manage the reliability
  - Era of the cable correlated with its failure rate
  - Tracking allows focused efforts on the cable most likely to fail



Asset Health Programs - Incremental System Investment

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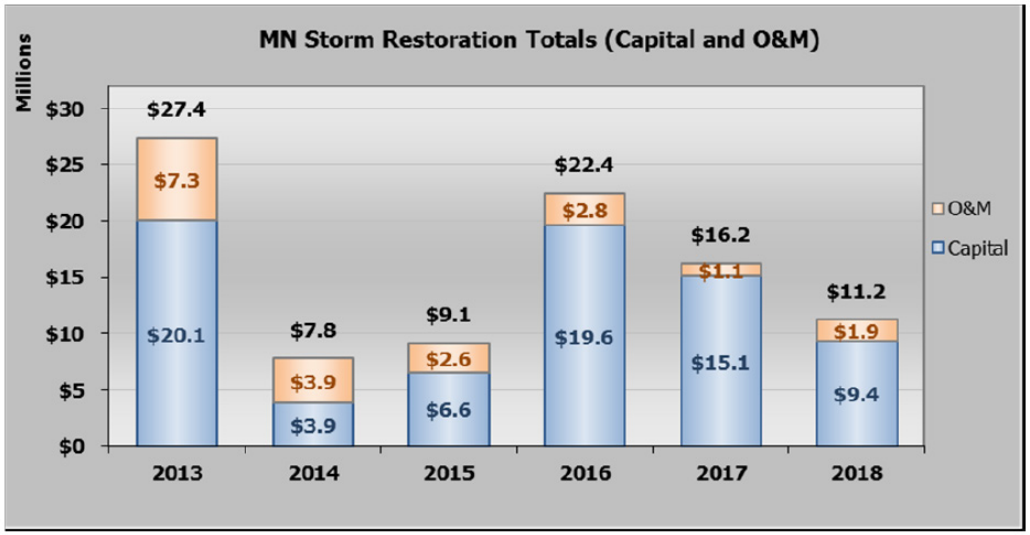
Driven by the need to **improve reliability** on elements of the system closest to customers and to **support DER integration**

- Overhead (OH) Tap Programs
  - Target Undergrounding, Low Cost Reclosers, Pole Top Reinforcements
  - Transformer and Secondary Replacements
  - High Customer Count Taps, Community Resiliency
- Underground (UG) Programs
  - Mainline Cable Replacement, URD Cable Replacement
  - Cable Assessment, Network Monitoring, St. Paul Tunnel Rehabilitation
  - Feeder Exit Capacity, Purchases / Tooling
- Substation Programs
  - Substation Asset Renewal
  - Transformer Replacement
- Overhead Mainline Programs
  - Lightning Protection Replacement
  - Pole Fire Mitigation

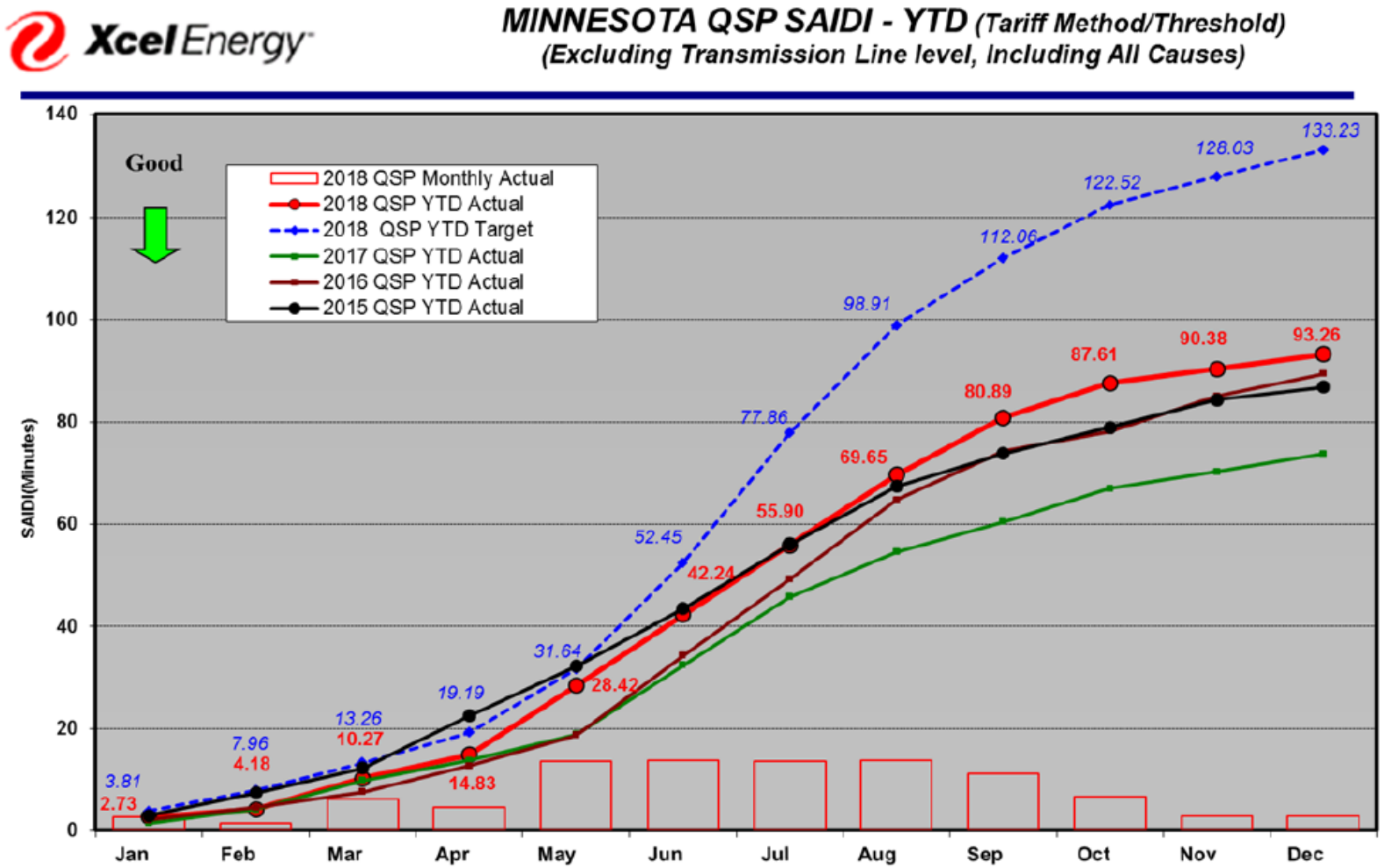
Capital budget: Over $80 million/year
O&M Budget: $1.5 million/year

Distribution Operations Programs

- Vegetation management program – reduce preventable tree-related outages
- Damage prevention program – help public identify/avoid UG infrastructure
- Fleet, tools, and equipment – support the distribution function
- Escalated operations – storm pre-planning and outage restoration
  - Ensure sufficient workforce:
    - Agreements with contractors to supplement field forces when needed
    - Mutual aid agreements with other utilities
  - Prepare for supporting outage restoration crews:
    - Maintain list of hotel accommodations and conference facilities across the service area
    - Maintain lists of available transportation options
    - Ensure ready access to catering to feed crews, restroom availability, etc.
  - Ensure a sufficient **storm restoration budget** is available



Reliability Management - Indices (SAIDI)



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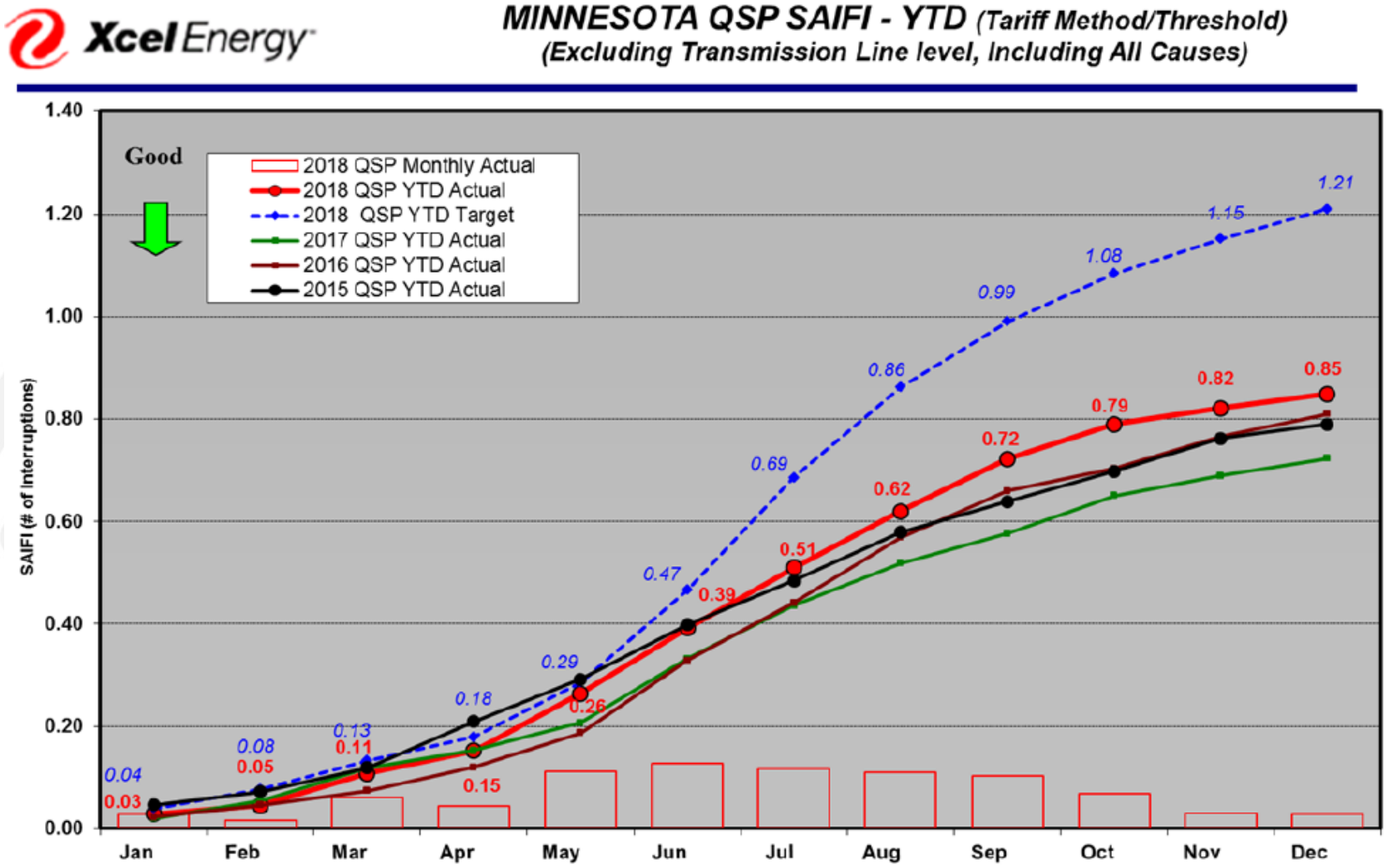
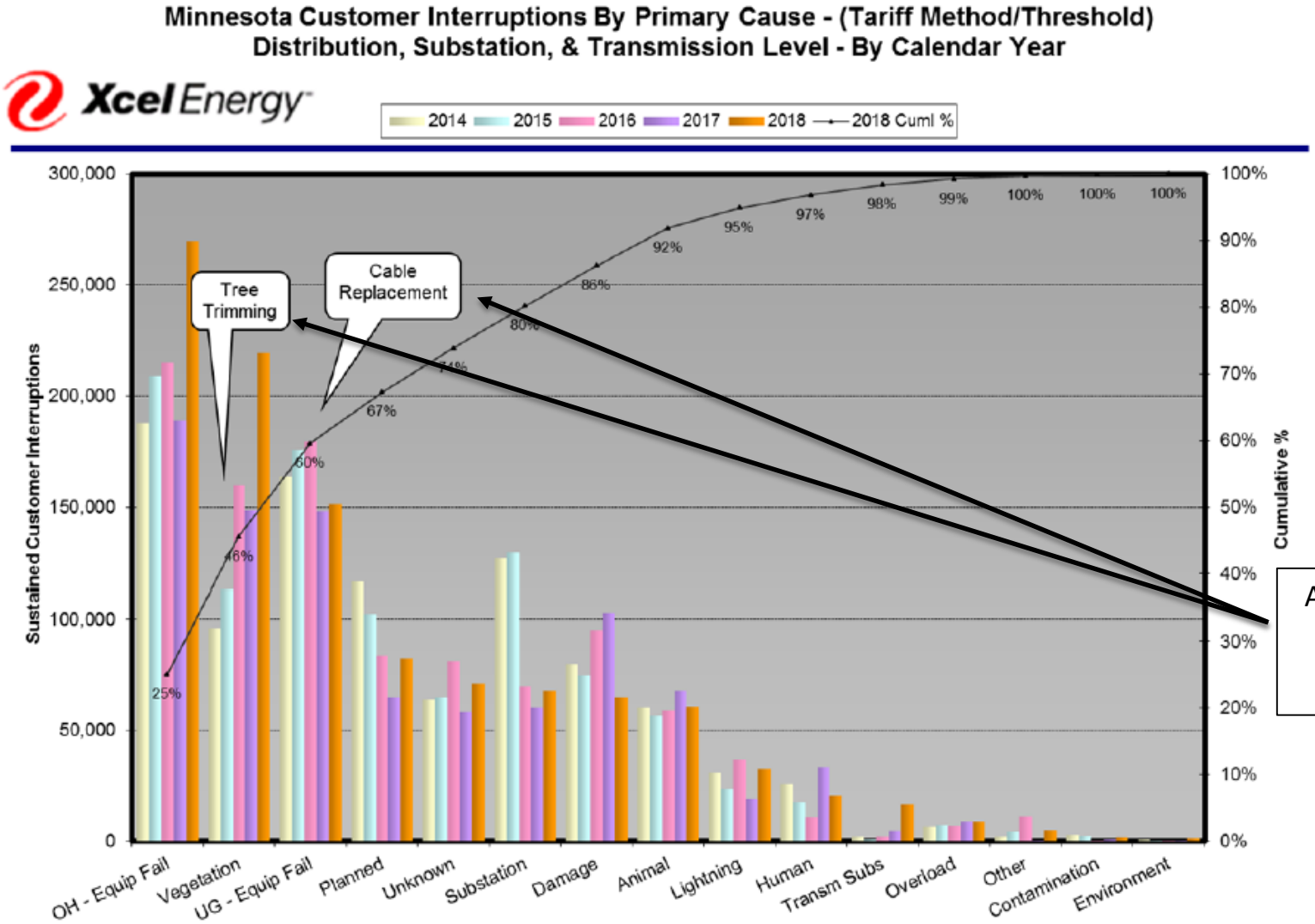


Reliability Management - Cause Analysis



Areas Xcel's plans are currently focusing on

Tariff Method: IEEE 1366 Normalized by Region after excluding Transmission Line level, Meter-based customer counts.

Reliability Management - Programs

- Work plans, or programs, target investments after considering common failures and their causes, as well as at-risk equipment
- Programs on "Star Chart" represent proactive investments to
  - improve reliability and asset health
  - meet contingency planning requirements
- Investments are made in addition to other capital investments for capacity

	Funded Programs	Description	2016 Actuals (k$)	2017 Actuals (k$)	2018 Actuals (k$)	IMPACTS			
						SAIFI	CAIDI	CEMI	Complaints
Reliability	Feeder Perf. Improvement Program (OH & UG)	FPIP evaluates and implements improvements for feeders experiencing an increased number of outages based on prior year information.	381	870	1,451	★		★	★
Reliability	Outage Exception Reporting Tool (OH & UG)	OERT process provides automatic notification to area engineers when repeating outage criteria have been met and engineering solutions are implemented to eliminate recurring problems.	637	455	490			★	★
Reliability	Mainline Cable Replacement, (UG)	Deteriorating non-jacketed cable is failing and causing repeat outages. Proactive and reactive replacement of this cable reduces the outages.	2,184	3,056	1,930	★			★
Reliability	Tap (URD) Cable, (UG)		16,980	18,329	19,593	★	★		★
Reliability	Install Automated Switches	These automation solutions reduce restoration times for long lines with long drive times to bring CAIDI in-line with other distribution lines.	103	0	0	★		★	★
Reliability	Feeder Infrared Evaluation (OH)	Many pieces of equipment show excess heating prior to failure. The FIRE program provides infrared scans of overhead mainline which reveal specific equipment that is likely to fail so it can repaired prior to causing an outage.	20	20	58	★			
Reliability	Vegetation Management (Transmission & Distribution)	Cost benefit prioritized circuit trimming in NSPM. Continued reactive "Hot Spot" trimming.	26,247	29,024	29,352	★		★	★
Reliability	Program Replacements (Transmission)	Replaces end-of-life equipment (i.e. - switches, laminated arms, specific insulators, poles) in order to reduce maintenance costs and improve reliability.	656	11	229	★			★
Integrity	Pole Inspection & Replacement (Distribution)	Pole Inspections include an above groundline visual inspection. Groundline inspections are based on age and environment and may include visual, sound and bore and excavation. Treatment of poles may be included. Based on results poles may be tagged for replacement.	7,197	7,707	11,035	★	★		
Integrity	Transmission Substation	Replaces end-of-life equipment in order to reduce maintenance costs and improve reliability.	1,472	6,984	9,228	★			
Integrity	Line ELR Work (Transmission)	Identifies lines that have components that have reached their end of life or where significant refurbishment work is needed to enhance system performance and reliability. Project focus may be to extend life of existing asset 20 + years or to replace and address future capacity upgrade concerns.	2,166	4,824	2,834	★			★

Grid Modernization Technologies to Enable Advanced Distribution Planning

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Utility-Facing and Customer-Facing Grid Modernization Technologies

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Grid Modernization

Utility-Facing

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

Customer-Facing

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

Source: Tim Woolf, Synapse Energy Economics, for Berkeley Lab: "Benefit-Cost Analysis for Utility-Facing Grid Modernization Investments," March 2019

Modernizing the grid to make it "smarter" and more resilient through the use of cutting-edge technologies, equipment, and controls that communicate and work together

Advanced Distribution Management Systems (ADMS) Integrate Several Components

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Detailed network topology

GIS

Outage-Related Restoration Activities

OMS

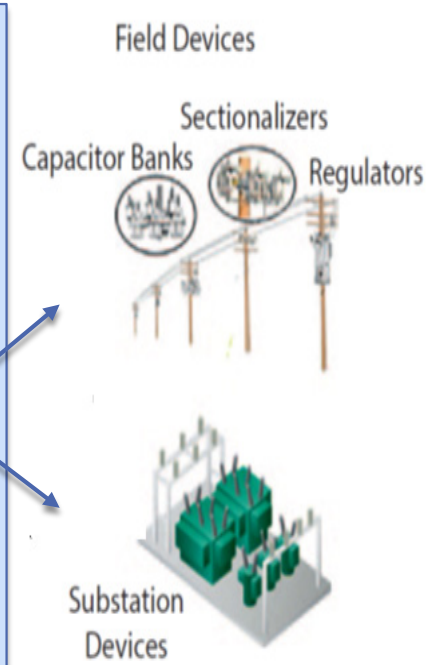
Monitor, control, optimize and predict operations

Core DMS Applications + Optional Applications e.g., FLISR VVO

Monitor and Operate the Distribution Network

DSCADA

FAN



Manage a variety of interconnected DER Assets

DERMS/Microgrid Controllers

AMI

Two-way communication between customer and utilities

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

Xcel Energy's Grid Modernization Goals

GRID MODERNIZATION LABORATORY CONSORTIUM
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Grid mod goals encapsulated in Advanced Grid Intelligence and Security (AGIS) Initiative

- Transformed customer experience
  - Provide greater visibility and insight into customer consumption and behavior
- Improved core operations and capabilities
  - Smarter networks forming the backbone of operations
- Facilitation of future capabilities
  - Support new developments in smart products and services

*"The **AGIS initiative** is our long-term strategic plan to transform our electric distribution system to **update system technology and capabilities, meet changing customer demands, enhance transparency** into the distribution and to system data, to **promote efficiency**, and **reliability**, and to safely **integrate more distributed resources**."*

15-Year Advanced Grid Initiatives Roadmap

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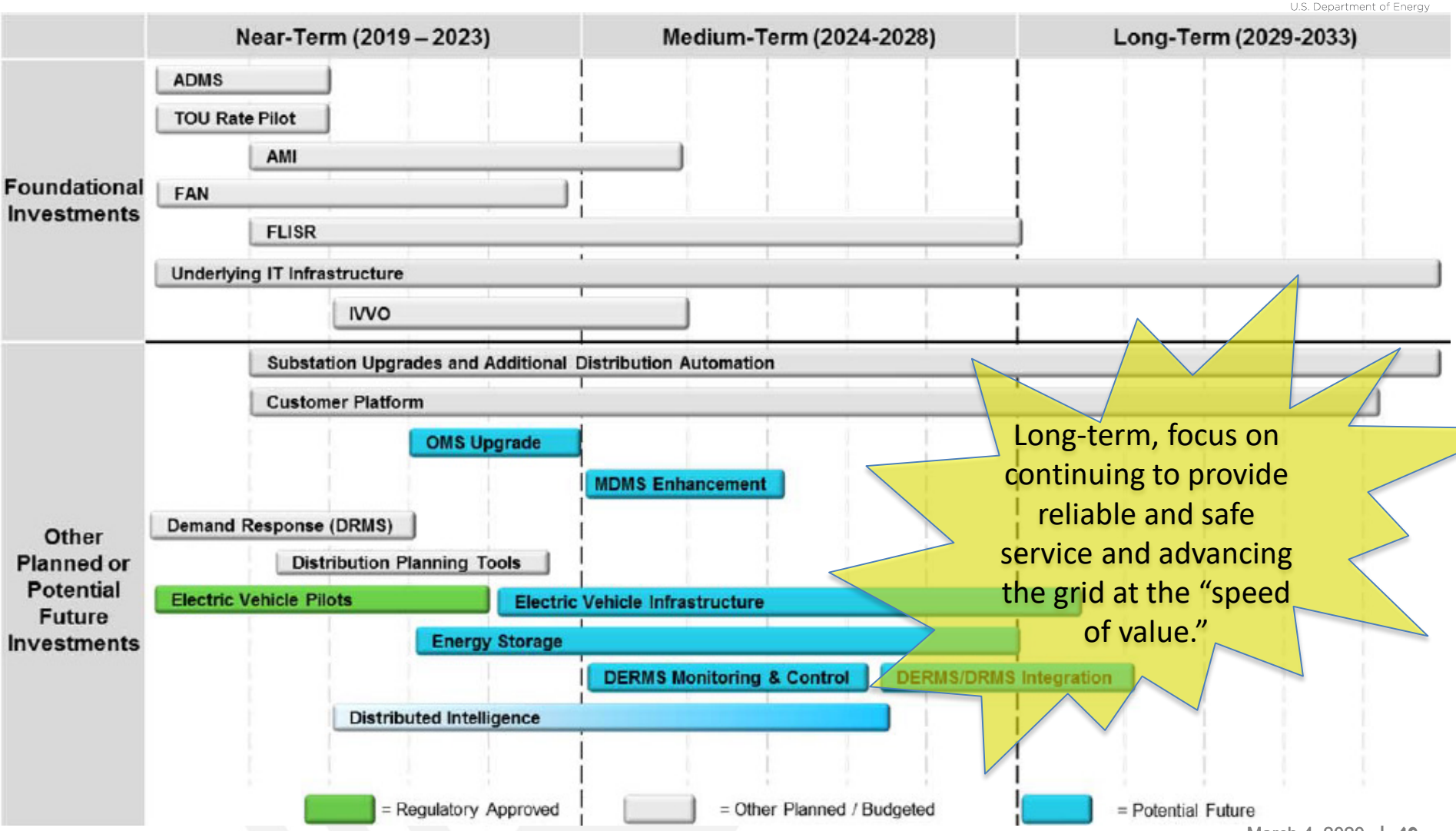
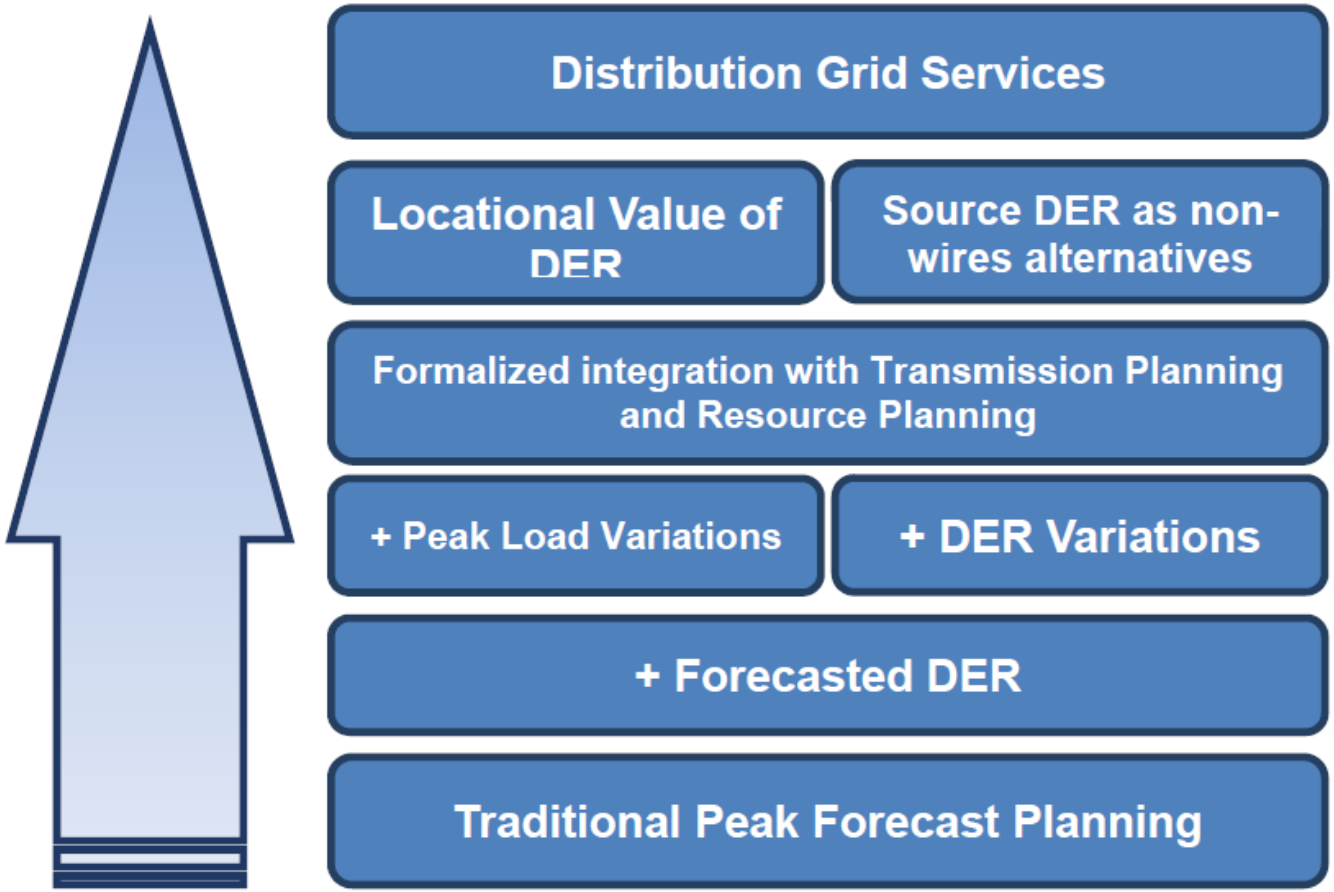


Long-term, focus on continuing to provide reliable and safe service and advancing the grid at the "speed of value."

Evolution in Planning Practices



Key Take-Aways

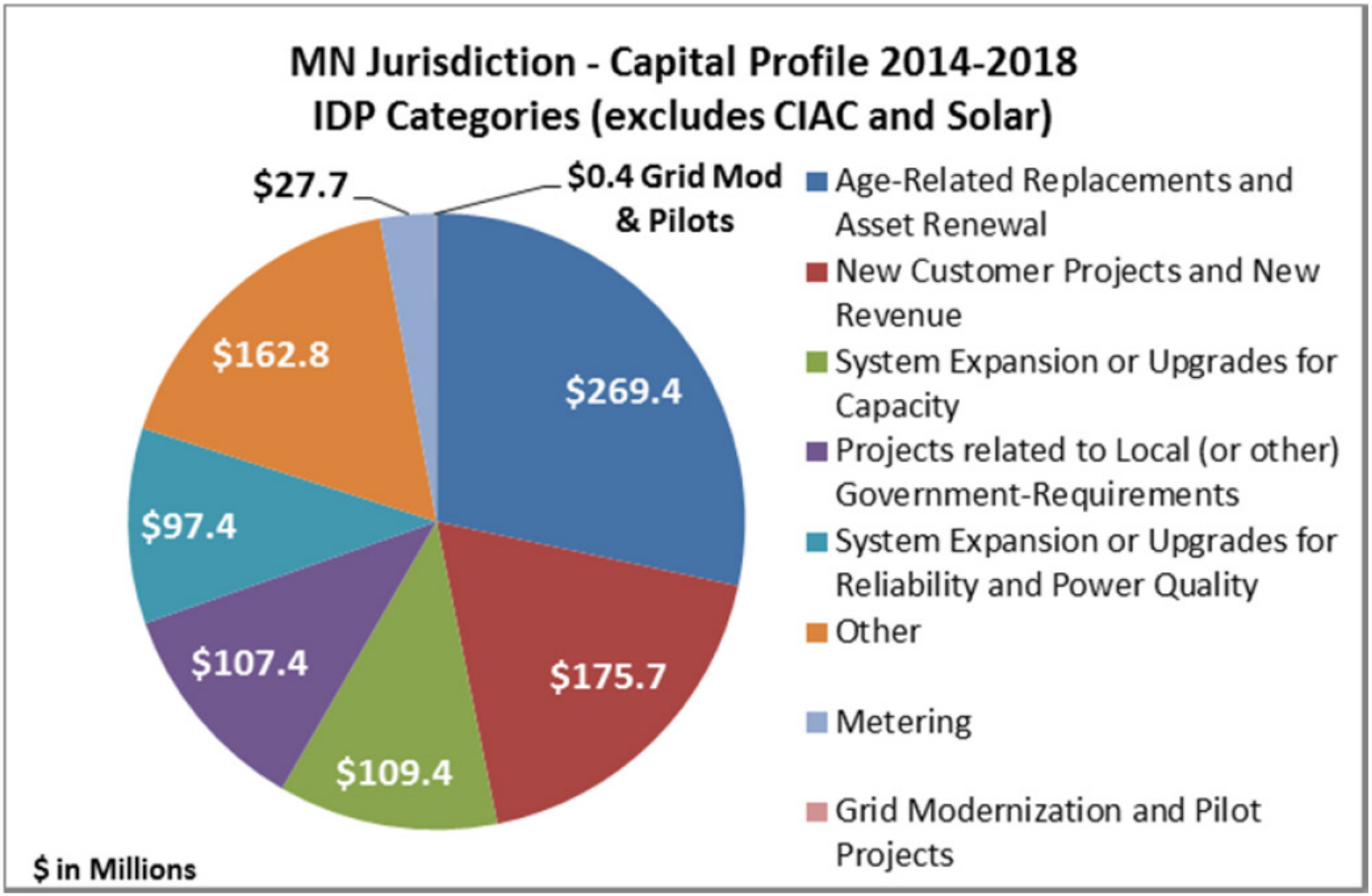
- $2.7 billion in capital and O&M spending projected over 6 years, ~ 25% in grid modernization (AGIS)
- Investments in physical grid infrastructure (poles, wires, relays, transformers, etc.) provide the necessary foundation for upgrading grid capabilities
- Grid modernization goals cannot be fully met if new technology is deployed on existing aging infrastructure
- Must coordinate advanced capabilities with physical grid infrastructure upgrades
- This will allow advanced communications and intelligent applications to manage the grid as a fully integrated bi-directional system

Any Questions?

Contact Lavelle Freeman at
518-385-3335
Lavelle.freeman@ge.com

Extra Slides: Distribution Budgets

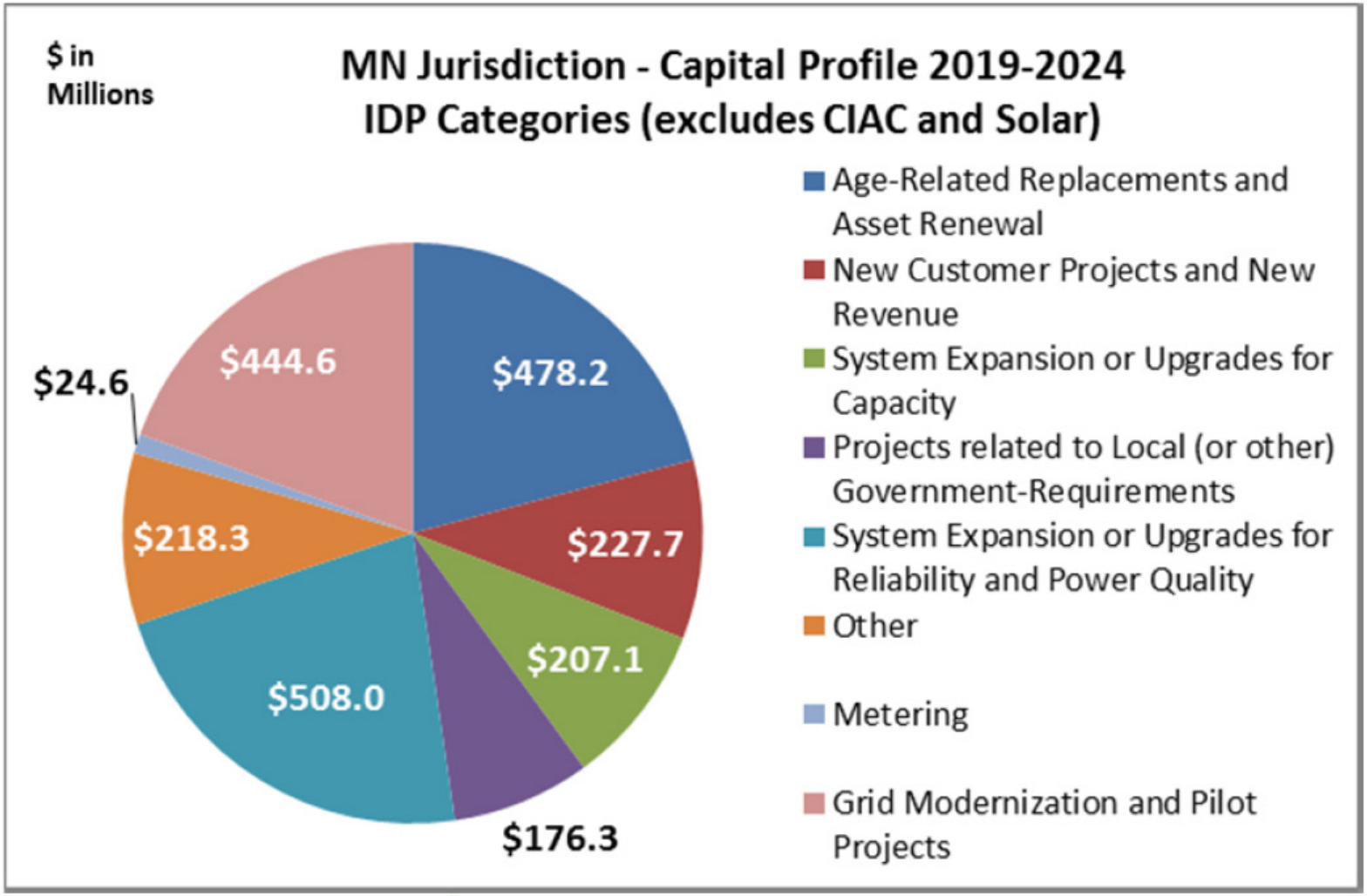
NSPM* Actual Historical Distribution Capital Investments by IDP Category (2014-2018)



Note: excludes non-investment amounts.

*Northern States Power Company-Minnesota (Xcel Energy subsidiary)

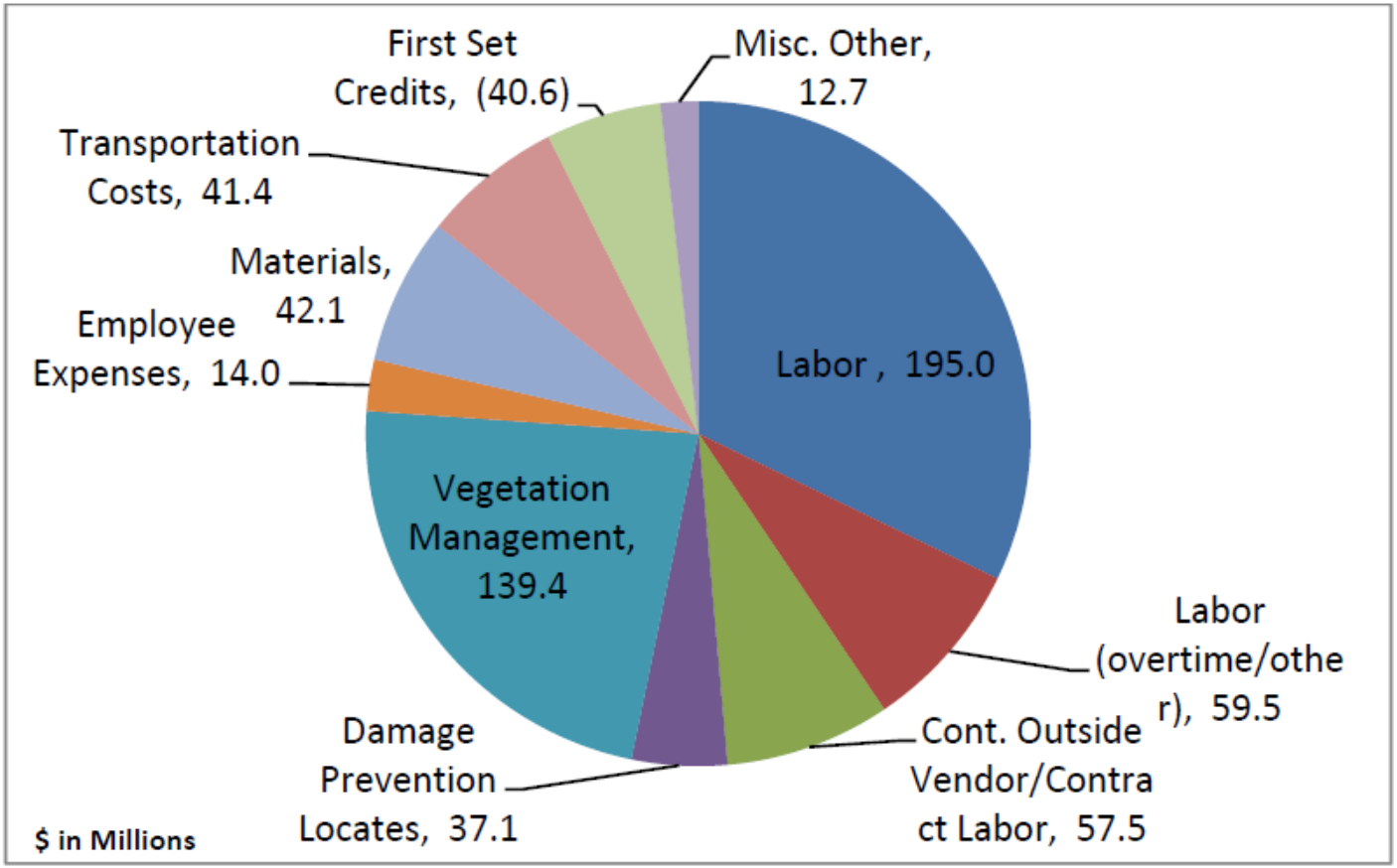
NSPM Budgeted Distribution Capital Investments by IDP Category (2019-2024)



Note: excludes non-investment/CIAC amounts.

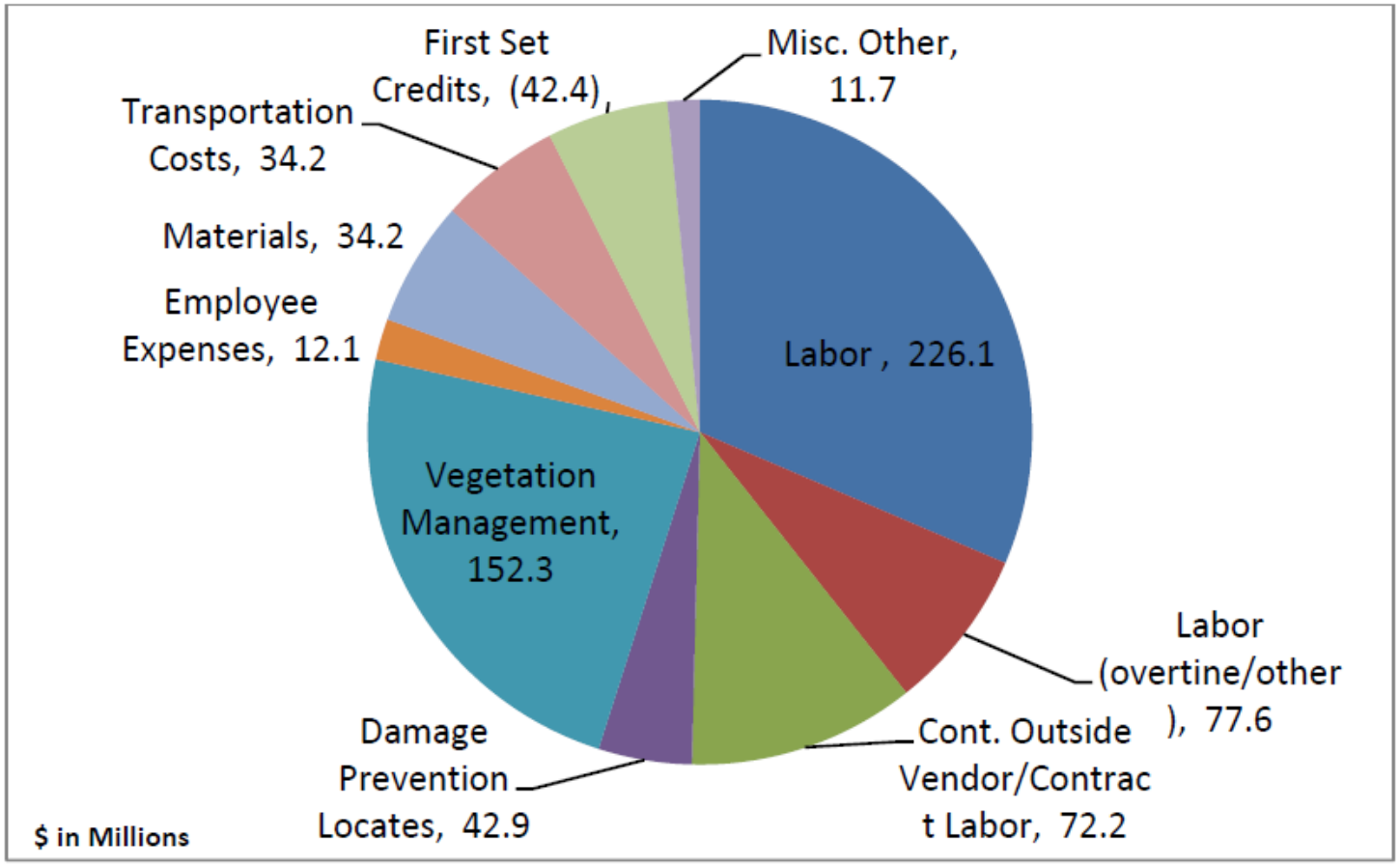
~$2B over six years (2019-2024)

NSPM Actual Historical Distribution O&M Costs by Cost Element (2014-2018)



Capital and O&M expenditures associated with the advanced grid initiative are presented separately as a holistic initiative; The average Contract Outside Vendor annual expense related to Vegetation Management and Damage Prevention are $27.9M and $7.4M, respectively; Misc. Other: Includes bad debt, use costs, office supplies, janitorial, dues, donations, permits, etc.

NSPM Budgeted Distribution O&M Costs by Cost Element (2019-2024)



Capital and O&M expenditures associated with the advanced grid initiative are presented separately as a holistic initiative; The average Contract Outside Vendor annual expense related to Vegetation Management and Damage Prevention are $30.5M and $8.6M, respectively; Misc. Other: Includes bad debt, use costs, office supplies, janitorial, dues, donations, permits, etc.

~$0.7B over six years (2019-2024)

Grid Modernization (AGIS) Investments

GRID MODERNIZATION LABORATORY CONSORTIUM
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Capital Expenditures

	MYRP Case Period			5-Year Period	10-Year Period
Component	2020	2021	2022	2023-2024	2025-2029[2]
ADMS[3]	$6.5	$1.0	$3.0	$7.5	-
AMI[4]	$14.0	$28.9	$144.0	$185.2	$15.0
FAN[5]	$14.7	$37.3	$36.8	$3.8	-
FLISR	$3.5	$8.6	$6.6	$18.8	$29.7
IVVO	$0.1	$6.5	$9.8	$18.6	-
Total	**$38.8**	**$82.3**	**$200.2**	**$233.9**	**$44.7**

$600M over 10 years

O&M Expenditures

	Rate Case Period			5-Year Period	10-Year Period
Component	2020	2021	2022	2023-2024	2025-2029[7]
ADMS[8]	$1.9	$2.5	$2.5	$6.9	$5.2
AMI[9]	$6.6	$16.4	$14.1	$25.2	$67.2
FAN[10]	$0.1	$2.3	$1.5	$0.5	$8.6
FLISR	$0.2	$0.4	$0.3	$3.3	$2.5
IVVO	$0.0	$0.4	$0.8	$0.6	$0.8
Total	**$8.8**	**$22.0**	**$19.2**	**$36.5**	**$84.3**

$170M over 10 years