
BURNS McDONNELL
EMERGING
LEADERS
FORUM

Welcome

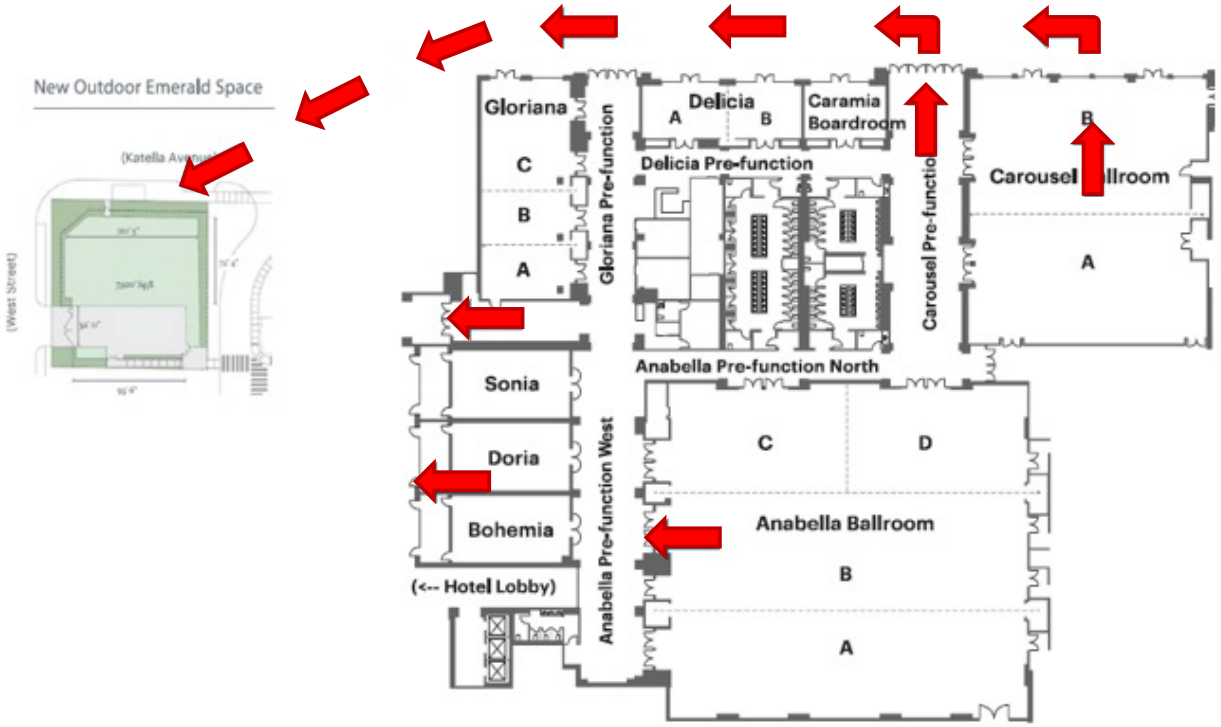
Megan Weismantel
Sales Operations Manager
Burns & McDonnell

AGENDA

Monday, May 6 | 8 a.m.-4 p.m.

8 a.m.	**Breakfast in the Carousel Ballroom**
9 a.m.	**Welcome and Opening Remarks**
9:30 a.m.	**Offshore Wind: The Opportunities and the Truths**
10 a.m.	**Break**
10:30 a.m.	**PNM and Burns & McDonnell Grid Modernization Update: Building a Grid for the Future**
11 a.m.	**The Case for a Digital Twin: Can It Assist in Solving Complex Utility Questions?**
11:30 a.m.	**Lunch**
1 p.m.	**Project Billing Structures: Why Lump Sum?**
1:30 p.m.	**Energy in Transition: Embracing DEI**
2:15 p.m.	**Break**
2:45 p.m.	**DERMS: A Customer-Centric Approach to Project Design**
3:15 p.m.	**Connecting the Dots: Unraveling the Impact of Regulation on Transmission Networks**
4 p.m.	**Closing Remarks**
6-10 p.m.	**Finale Reception and Dinner** Enjoy award-winning tacos, cocktails and signature cerveza at **Puesto**, the resort's Mexican restaurant.

EMERGENCY EXITS



Submit Questions for Q&A

To submit a question, visit

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101-842-550

Or, using your smartphone camera app, scan the QR code on the left and tap on the notification to open the link.

Opening Remarks

Rashmi Menon
Vice President
Burns & McDonnell

- Sunday, 1/26/20, a Sikorsky S-76B helicopter crashed in Calabasas
- En-route from John Wayne Airport to Camarillo Airport
- 9 died in crash including Kobe

NTSB REVIEW

- Weather played a major role
- Unclear if pilot received a briefing
- Risk assessment form- Low risk
- Airport operator indicates pride in safety culture

KEY TAKEAWAYS

- “Get there-itis”
- Complacency from repeated experience performing a task
- Turn around when the path ahead is unsafe

ABOUT OUR
CALIFORNIA OFFICES

- **STRENGTH** — MORE THAN **340+** PROFESSIONALS
- **DEPTH** — **6** OFFICES STATEWIDE
- **EXCELLENCE** — ENR CA **#8** TOP A&E DESIGN FIRMS
- **EXCELLENCE** — ENR CA **#27** TOP CONTRACTORS
- **TECHNICAL** — **104+** PROFESSIONAL ENGINEERS

MAMBA MINDSET

The belief that your vision can be a reality, failure is not an option and the intention to devote time and energy towards making the vision a reality

The mindset isn't about seeking the result, its more about the process to get to the result

- **Be Fearless**
  What are you going to allows yourself to do? Fear is temporary, regret is forever
- **Give it Your Heart**
  No matter what you do in business, give it your everything
- **Build a Good Team**
  In business you cannot do it alone- find the right people to achieve your company's goal
- **Make Your Own Luck**
  If you work hard and hustled, when the opportunities arise, you can seize them
- **Handle Pressure**
  Everything negative, is an opportunity to rise

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Offshore Wind

The Opportunities and the Truths

Tony Appleton
Offshore Wind Director
Burns & McDonnell

Tyler Studds
Golden State Wind

Agenda

- Welcome and Introductions
- Burns & McDonnell and Offshore Wind
- The US Offshore Wind Market
- Ocean Winds
- Q&A


INTRODUCTIONS

Tony Appleton

Burns & McDonnell
Offshore Wind Director

25+ years
of experience

Chartered Mechanical Engineer with over 25 years of experience in the Global Power Sector – more than 15 years in the Offshore Wind sector

British but now live in Connecticut, USA

Worked in the Far East, Middle East, Canada, France, Spain, Belgium, Denmark

Worked on over 40 offshore wind initiatives; Currently working on multiple projects in the USA

Tyle Studds
PLACEHOLDER


BURNS & McDONNELL
AND OFFSHORE WIND

BMcD Global Offshore Wind Experience

Involved in over 75% of all offshore wind projects in the USA

Working with developers that:

- Have existing PPAs
- Have existing Lease Areas
- Are prospecting potential lease areas
- Are located on the East Coast, West Coast, Gulf of Mexico and the Great Lakes

Worked in wide range of activities including:

Power system studies
(10 projects)

Permitting, siting, stakeholder engagement
(12 projects)

Onshore cable system, landing and trenchless design
(18 projects)

Offshore cable system design and routing
(18 projects)

Onshore substation design
(13 projects)

Offshore substation design
(4 projects)

HVDC system and converter design
(8 projects)

Project Management Services
(17 projects)

Offshore Wind Experience

Project Summary Matrix

Client	Project	Location(s)	Interconnection Study	Onshore Cable Feasibility	Onshore Cable Routing Study	Onshore Cable Preliminary Design/FEED	Onshore Cable Detailed Design	Offshore to Onshore HDD	AC Substation Design	Onshore EPC	Offshore Substation Design	Offshore Cable Design	Offshore Cable Routing	HVDC	Cost Estimating	Schedule Management	Risk Identification and Mitigation Management	Constructability Reviews	Technology Review	Environmental Site Assessments	Site/Civil Survey	Geotechnical/Field Explorations	Siting and Permitting Technical Support	Construction Management
US Offshore Wind Project Experience																								
Shell / Ocean Winds	Mayflower Wind	MA	●	●	●	●	●							●	●	●	●	●						
Avangrid Renewables	Kitty Hawk Wind	VA		●	●	●	●		●						●	●	●	●					●	
Ørsted / PSEG	Ocean Wind 01	NJ		●	●	●	●		●	●					●	●	●	●					●	●
Dominion Energy	Coastal Virginia Offshore Wind	VA		●	●	●																		
EDF Renewables / Shell	Atlantic Shores	NJ		●	●	●			●		●	●	●		●	●	●	●						
Eversource / Ørsted	Sunrise Wind	NY		●	●	●								●	●	●	●	●					●	●
Eversource / Ørsted	South Fork Wind	NY		●	●	●									●	●	●	●					●	●
Eversource / Ørsted	Revolution Wind	RI		●	●	●	●		●						●	●	●	●					●	●
Confidential Client 1	US offshore wind project 1-1	MA		●	●	●			●						●	●	●	●						
Confidential Client 2	US offshore wind project 2-1	MD		●	●	●			●						●	●	●	●					●	
Confidential Client 3	US offshore wind project 3-1	Multiple	●																					
Confidential Client 4	US offshore wind project 4-1	TBD	●																					
Confidential Client 5	US offshore wind project 5-1	NY										●	●		●									
Confidential Client 6	US offshore wind project 6-1	NY		●	●	●									●		●	●		●	●	●	●	
Confidential Client 7	US offshore wind project 7-1	NY		●	●	●						●	●											
Confidential Client 7	US offshore wind project 7-2	CA	●	●	●										●		●							
Confidential Client 7	US offshore wind project 7-3	CA	●								●	●		●	●				●					
Confidential Client 8	US offshore wind project 8-1	NY		●	●	●					●			●	●		●	●		●	●			
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Confidential Client 12	US offshore wind project 12-1	Multiple	●	●	●									●	●									

Offshore Wind Experience

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Confidential Client 12	US offshore wind project 12-1	Multiple	●	●	●									●	●									

OCEANTIC NETWORK

1. **Maine Aqua Ventus I** (Diamond Offshore Wind) [12 MW]
2. **Revolution Wind** (Orsted / GIP) [704 MW]
3. **Block Island Wind Farm** (Orsted) [30 MW]
4. **South Fork Wind Farm** (Orsted / GIP) [132 MW]
5. **Sunrise Wind** (Orsted) [924 MW]
6. **Bay State Wind** (Orsted)
7. **Vineyard Wind 1** (CIP / Avangrid) [800 MW]
8. **New England Wind** (Avangrid)
9. **Beacon Wind** (bp)
10. **Southcoast Wind** (Shell / Ocean Winds)
11. **Liberty Wind** (Vineyard Offshore)
12. **Empire Wind 1 & 2** (Equinor) [816 MW]
13. **Excelsior Wind** (Vineyard Offshore) [1,314 MW]
14. **Bluepoint Wind** (Ocean Winds / GIP)
15. **Attentive Energy One & Two** (TotalEnergies Renewables / Rise Light & Power / Corio Generation) [AE1 - 1,404 MW / AE2 - 1,342 MW]
16. **Community Offshore Wind** (RWE / National Grid) [1,314 MW]
17. **OCS-A 0541** (Atlantic Shores)
18. **Leading Light Wind** (Invenergy / energyRe) [2,400 MW]
19. **Atlantic Shores Offshore Wind** (EDF / Shell) [1,510 MW]
20. **Ocean Wind 1 & 2** (Orsted)
21. **Skipjack Wind Farm** (Orsted)
22. **MarWin / Momentum Wind** (US Wind) [270/808.5 MW]
23. **Central Atlantic WEAs**
24. **Coastal Virginia OSW - Commercial** (Dominion Energy / Stonepeak) [2,587 MW]
25. **Coastal Virginia OSW - Pilot** (Dominion Energy) [12 MW]
26. **Kitty Hawk Offshore Wind** (Avangrid)
27. **TotalEnergies Carolina Long Bay** (TotalEnergies Renewables)
28. **OCS-A 0546** (Duke Energy Renewables Wind)
29. **Oregon WEAs**
30. **Canopy Offshore Wind Farm** (RWE)
31. **OCS-P 0562** (Vineyard Offshore)
32. **Atlas Wind** (Equinor)
33. **Golden State Wind** (Ocean Winds / CPPIB)
34. **Even Keel Wind** (Invenergy)
35. **OCS-G 37334** (RWE)
36. **Gulf of Mexico WEAs**
37. **Cajun Winds** (Steelhead Americas [Vestas])
38. **DOW LA** (Diamond Offshore Wind)
39. **Gulf of Maine WEAs**
40. **Maine Floating Offshore Wind Research Array** (Diamond Offshore Wind)
41. **CADEMO** (Floventis)

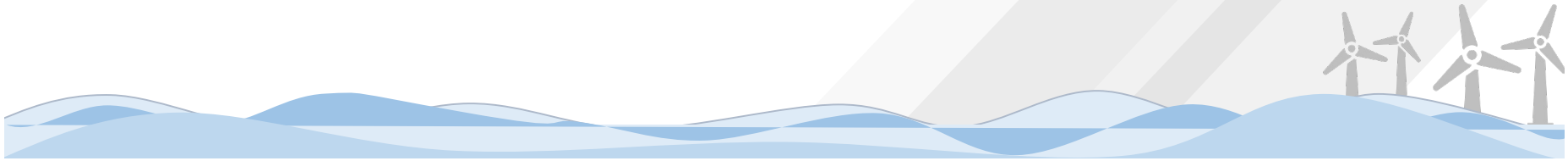
OCEANTIC NETWORK

U.S. OFFSHORE WIND MARKET

Understanding the US Market

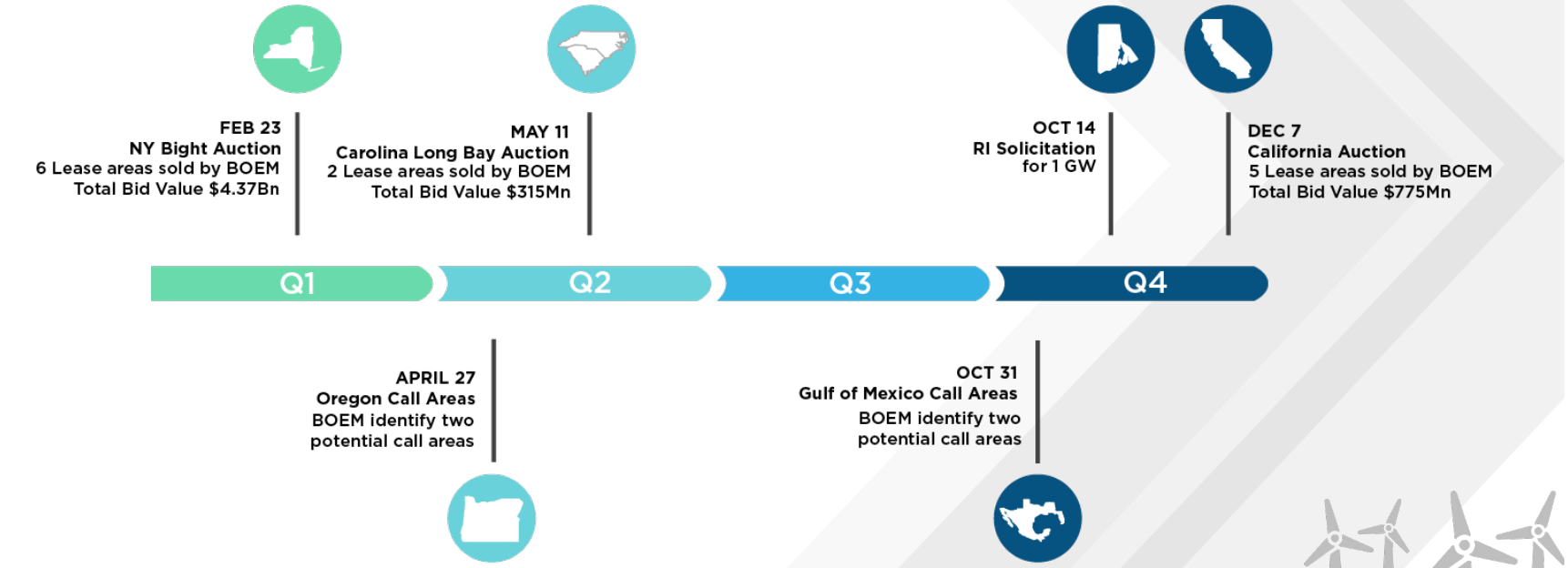
THE PROCESS

1. The Federal Government (BOEM – Bureau of Ocean Energy Management) identifies potential lease areas
2. The lease areas are then sold to Developers
3. The States then undertake a Solicitation Process (RFP)
4. The competitively selected projects then enter into contracts to sell Offshore Wind Renewable Energy Certificates (ORECs) to the state on behalf of the state's electricity ratepayers.
5. The Developer enters into a PPA (Power Purchase Agreement) with the State Public Utility

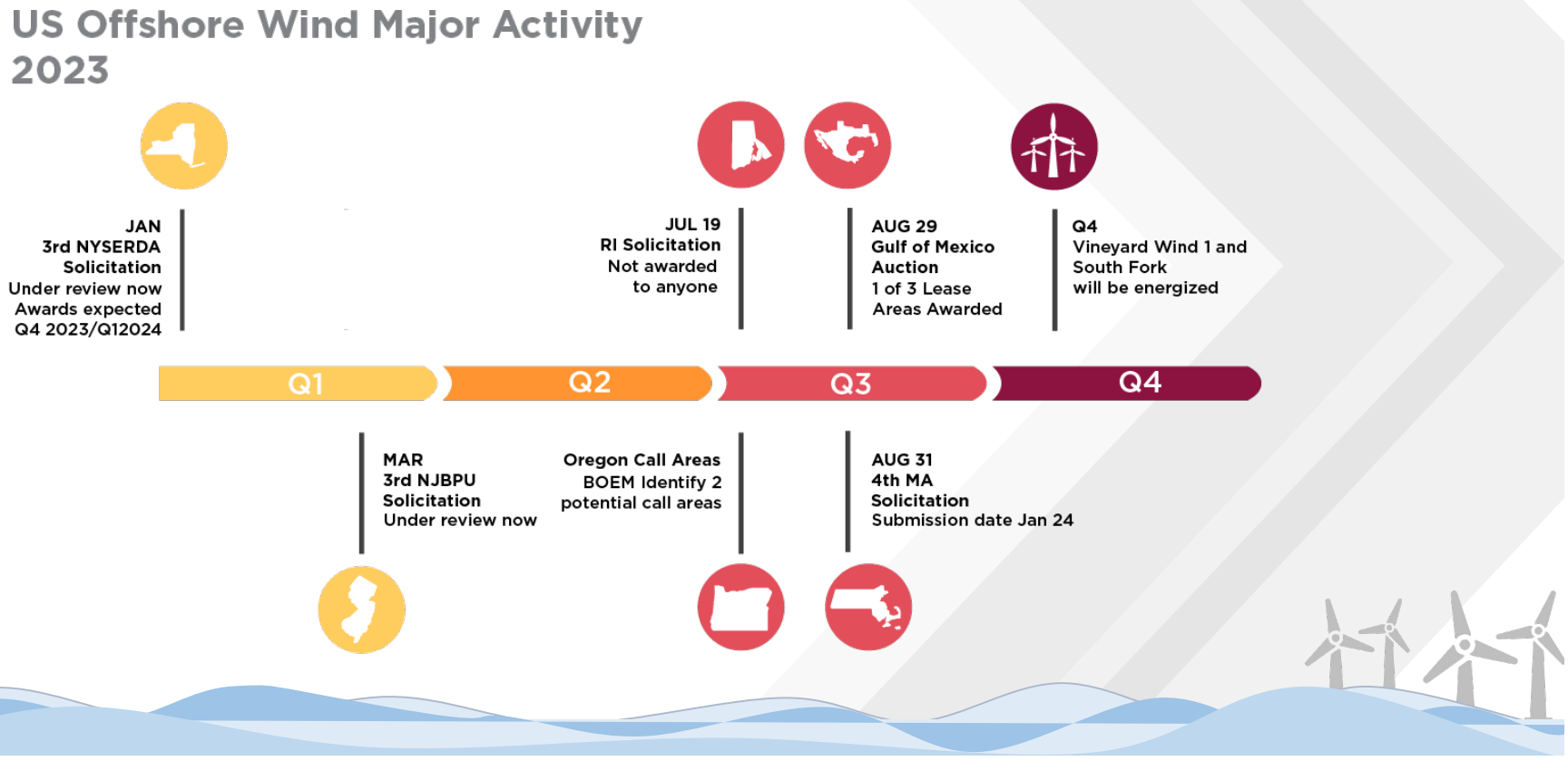


US Offshore Wind Major Activity 2022-3

US Offshore Wind Major Activity 2022



US Offshore Wind Major Activity 2022-3



Market/Industry Update

- **New York RD4**
  - Sunrise Wind (900 MW) - Ørsted
  - Empire Wind 1 (XX MW) - Equinor
- **CVOW (2,600 MW) sells 50% to XX**
- **Project cancellations**
  - Empire Wind 2 – Equinor/BP (1,260 MW)
  - Ocean Wind 1 and 2 - Ørsted (2,248 MW)
  - SJW - Ørsted (966 MW)
- **Orsted/BP Re-focus**
- **Blackrock Acquisitions**
  - Purchased GIP (Global Infrastructure Partners). GIP will retain is 'namesake'
  - Purchased (through GIP), Eversource's stake in SFW (132MW) and Revolution Wind (704 MW) for $1.1B
  - Portfolio now includes 50% ownership of SFW, REV and BPW.
- **Upcoming NY Award (BW1, EW1, SRW1, COSW2)**
- **Upcoming CT, RI, MA solicitation: due end March**
- **Upcoming Federal Auctions**

South Fork Wind First Power Dec-2023
(Turbine A-07)

Offshore Wind in the USA

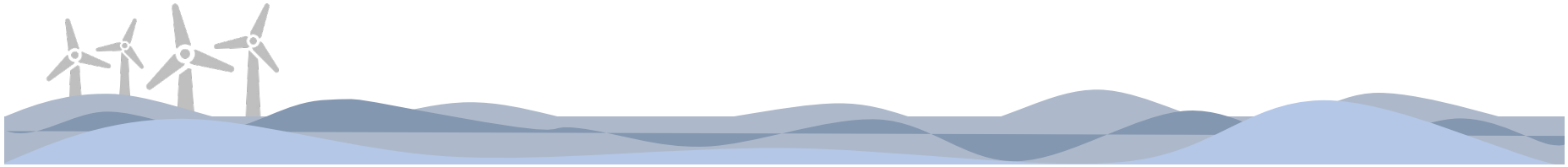
There are some issues in the offshore wind sector in the US!

However, the sort of issues are not unusual in this sector and have been seen before elsewhere.

There is a natural reset taking place at the moment.

BUT these issues need to be addressed

However, once addressed the **opportunities are enormous!**

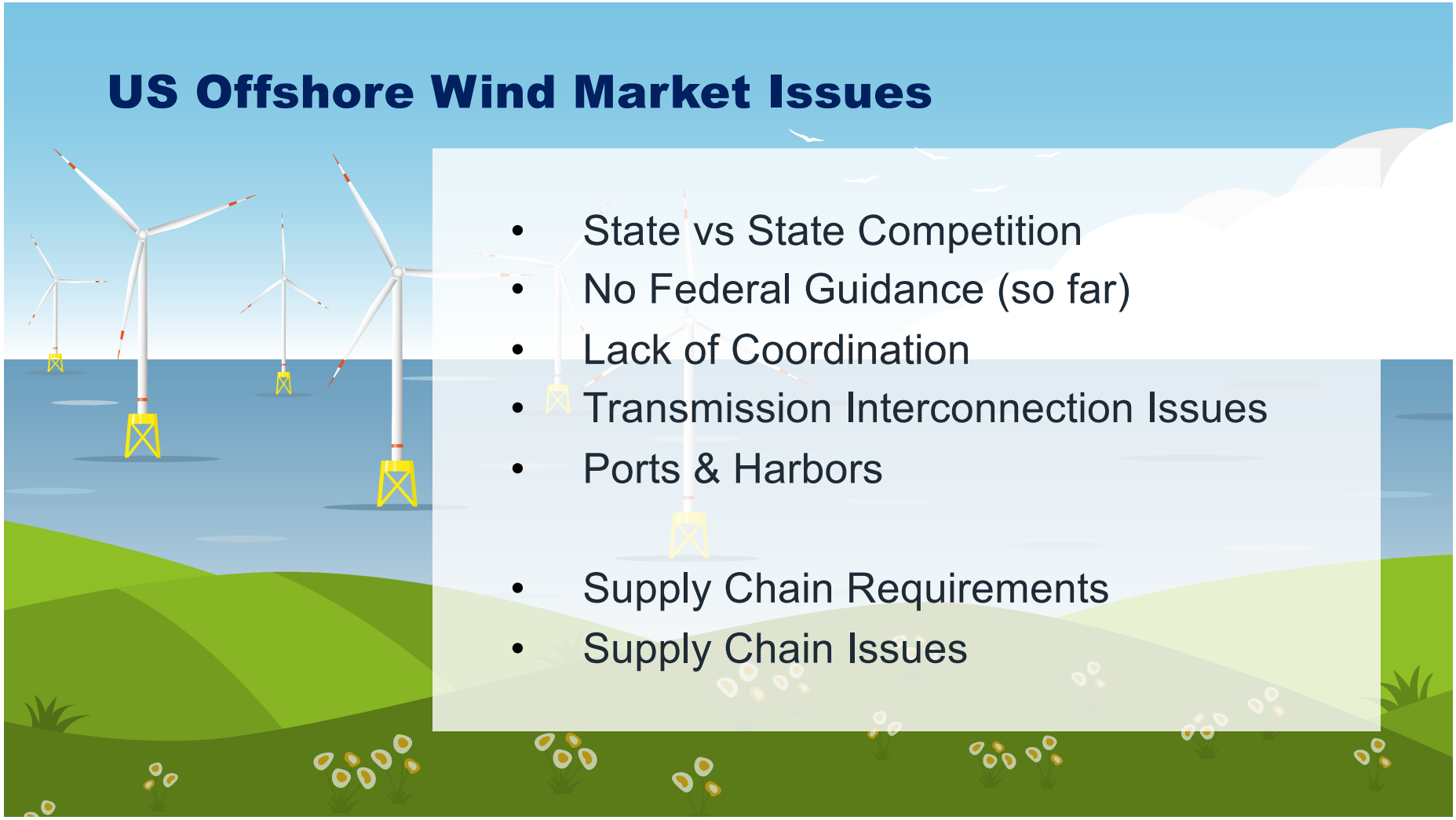


Offshore Wind in the USA – (Some of) The Issues

Offshore Wind in the USA – The Possible Solutions


OCEAN WINDS

US Offshore Wind Market Issues



- State vs State Competition
- No Federal Guidance (so far)
- Lack of Coordination
- Transmission Interconnection Issues
- Ports & Harbors

- Supply Chain Requirements
- Supply Chain Issues


Q
A
&

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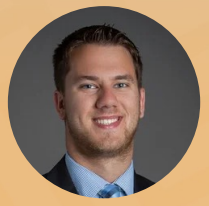
Building a Grid for the Future

PNM and Burns & McDonnell Grid Modernization Update

Michael Moyer
Manager, Distribution Engineering
and Grid Modernization
Public Service Co. of New Mexico

Jeremy Tabet
Distribution Engineer
Public Service Co. of New Mexico



Colton Russell
Distribution Engineering Manager
Burns & McDonnell

Agenda

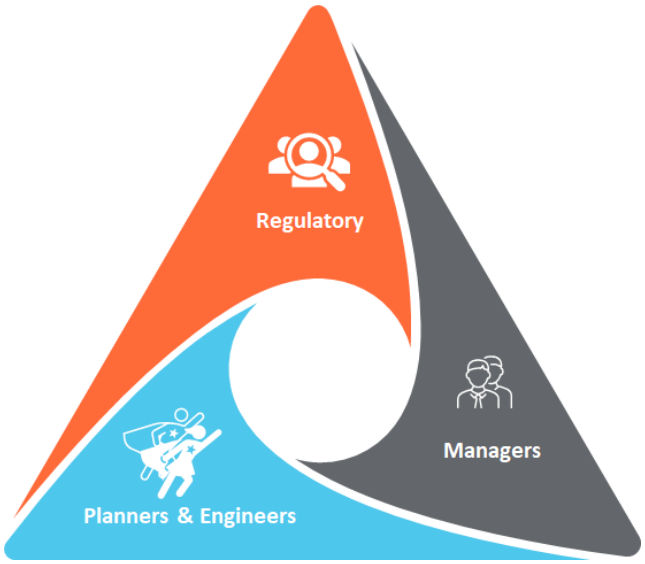
- Introduction to PNM
- PNM and BMCD Partnership
- A look back at 2022
- 2024 and Beyond
- A Continued Collaboration
- What's Next?
- PNM Fiber Network

Public Service Company of New Mexico (PNM)

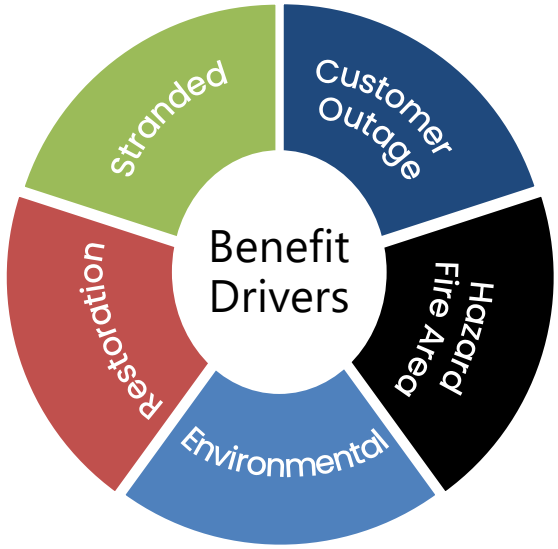
- 198 Substations and Switching Stations
- 345kV to 2.4kV
- 2,982 MW Generation Capacity
- 15,428 Miles of Transmission & Distribution
- Serving approximately 574,000 meters

Public Service Company of New Mexico (PNM)

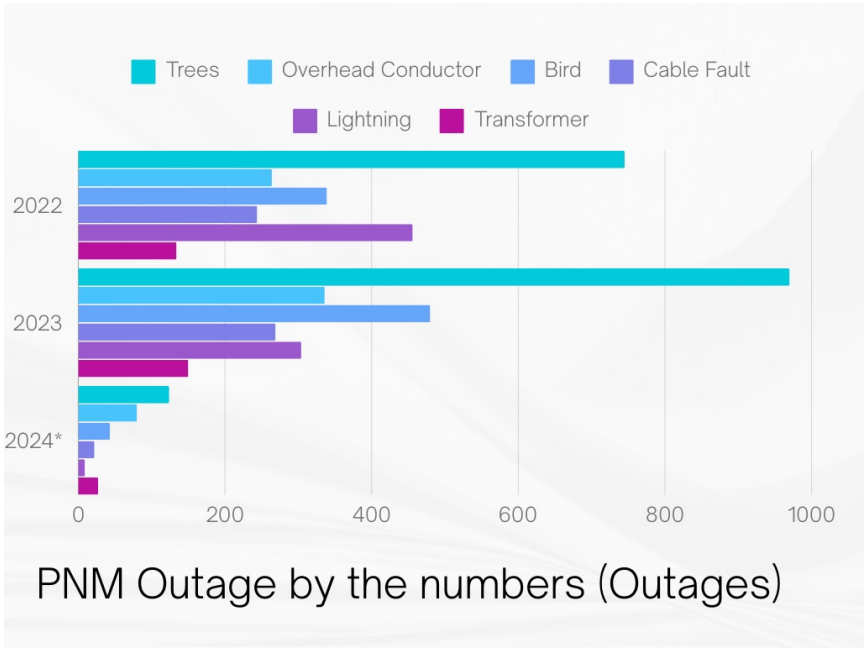
- Investment Portfolio Stakeholders



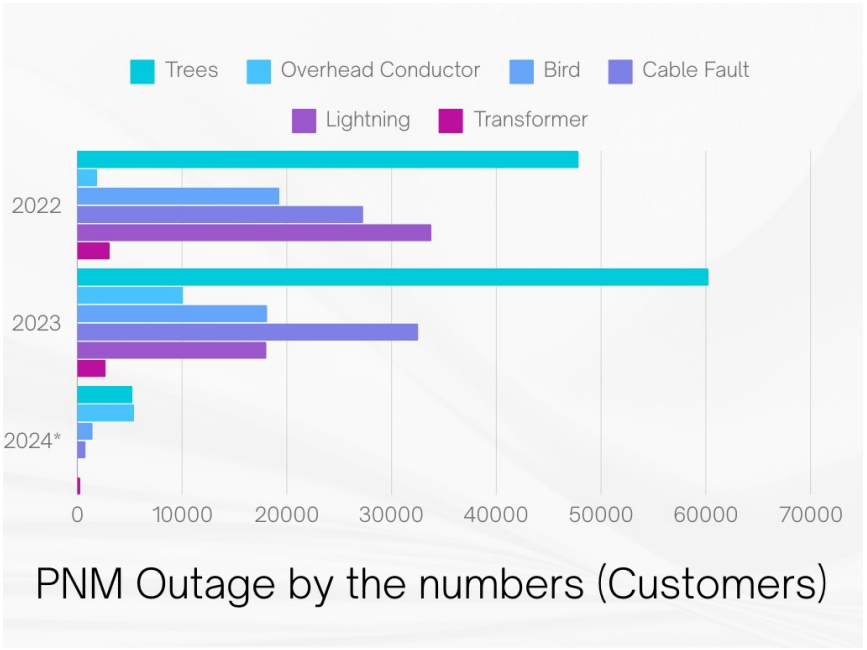
- Investment Drivers:



Reliability Drivers by the numbers



PNM Outage by the numbers (Outages)



PNM Outage by the numbers (Customers)

PNM Grid Modernization

- “Grid Modernization” Rider filed in 2023
- Testimonies ongoing throughout 2023 and into 2024
- Infrastructure investment to support future growth in PNM’s service territory while continuing investment into system reliability

PNM and BMCD Partnership

Creating a collaborative and successful future

PNM & BMCD

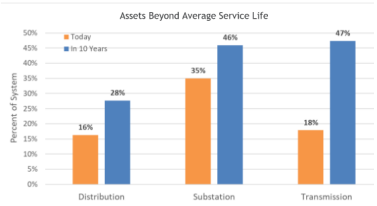
- PNM Infrastructure Investment Program (PIIP) beginning in 2021
- Targeted replacement and upgrade of assets with an enhanced focus on assets nearing end of life
- Partnership between PNM and BMCD in establishing holistic approach to the program
- Supporting:
  - Distribution
  - Substation
  - Transmission
  - Telecom
  - Dist. Planning
  - ENS

PNM & BMCD

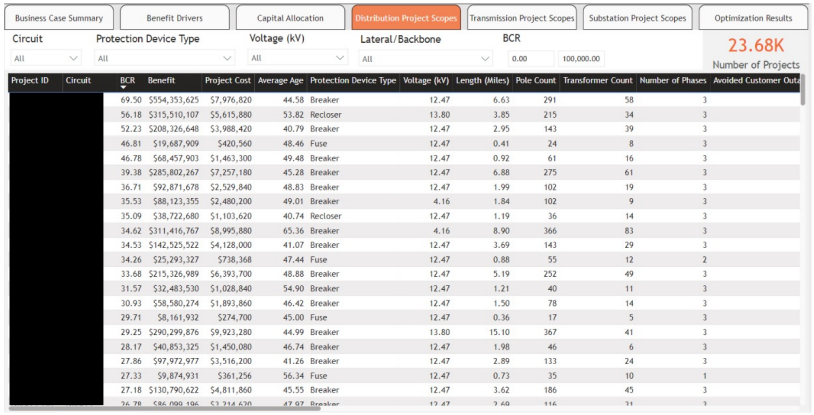
- Portfolio Investment Strategy Study
- Overall assessment of PNM assets to build a focused strategy on investment
- Completed in 2021 with a refresh in 2024
- Overall results leveraged to determine investment strategies moving forward

System Age

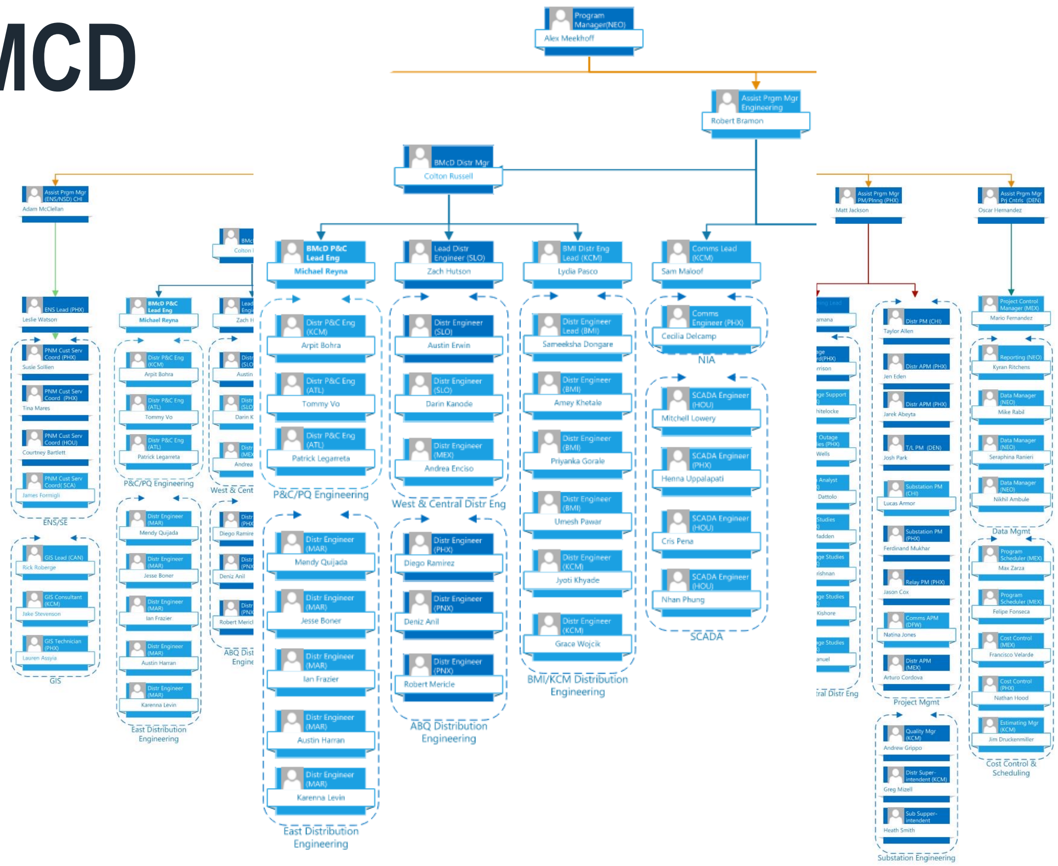
- Percentage of the System to be at or past average service life is expected to increase dramatically in the next 10 years.
- Almost half of the transmission assets will age past their expected service life in the next 10 years
- 35% of substation assets today are past their expected service life



Asset Class	Average Service Life (years)
Wood Distribution Pole	45-75
OH Primary Conductor	45-65
UG Primary Cable	40-65
Line Transformer	40-50
Transmission Pole	60-85
Transmission Conductor	65-75
Power Transformer	50
Breaker	40-50
Relay	20-40
Circuit Switcher	45



PNM & BMCD

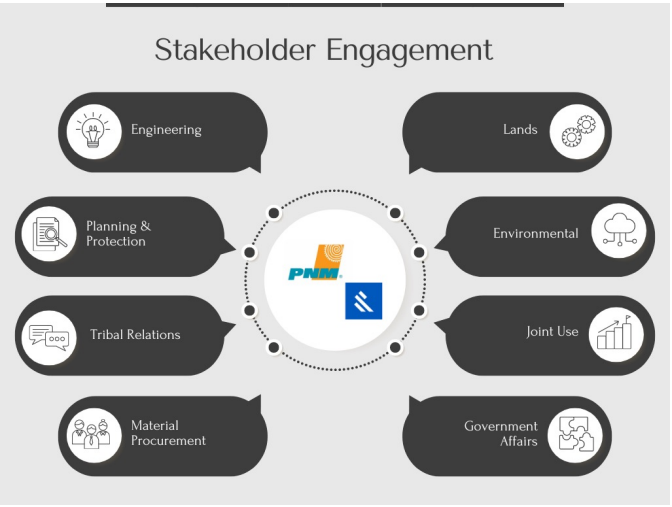


Program Manager(NEO)
Alex Meekhoff
Assist Prgm Mgr Engineering
Robert Bramon
BMcD Distr Mgr
Colton Russell
BMcD P&C Lead Eng
Michael Reyna
Lead Distr Engineer (SLO)
Zach Hutson
BMI Distr Eng Lead (KCM)
Lydia Pasco
Comms Lead (KCM)
Sam Maloof
Distr P&C Eng (KCM)
Arpit Bohra
Distr P&C Eng (ATL)
Tommy Vo
Distr P&C Eng (ATL)
Patrick Legarreta
P&C/PQ Engineering
Distr Engineer (SLO)
Austin Erwin
Distr Engineer (SLO)
Darin Kanode
Distr Engineer (MEX)
Andrea Enciso
West & Central Distr Eng
Distr Engineer Lead (BMI)
Sameeksha Dongare
Distr Engineer (BMI)
Amey Khetale
Distr Engineer (BMI)
Priyanka Gorale
Distr Engineer (BMI)
Umesh Pawar
Distr Engineer (KCM)
Jyoti Khyade
Distr Engineer (KCM)
Grace Wojcik
BMI/KCM Distribution Engineering
Comms Engineer (PHX)
Cecilia Delcamp
NIA
SCADA Engineer (HOU)
Mitchell Lowery
SCADA Engineer (PHX)
Henna Uppalapati
SCADA Engineer (HOU)
Cris Pena
SCADA Engineer (HOU)
Nhan Phung
SCADA
Distr Engineer (MAR)
Mandy Quijada
Distr Engineer (MAR)
Jesse Boner
Distr Engineer (MAR)
Ian Frazier
Distr Engineer (MAR)
Austin Harran
Distr Engineer (MAR)
Karenna Levin
East Distribution Engineering
Distr Engineer (PHX)
Diego Ramirez
Distr Engineer (PNX)
Deniz Anil
Distr Engineer (PNX)
Robert Mericle
ABQ Distribution Engineering
ENS/SE
GIS
Project Mgmt
Data Mgmt
Cost Control & Scheduling
Substation Engineering

A look back at 2022

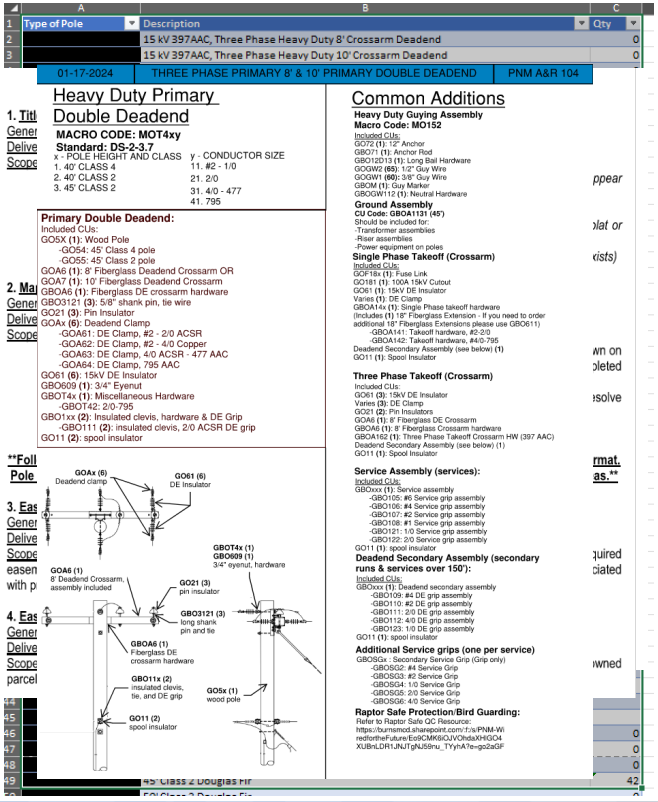
- Full scope of rebuilds being developed
- Stakeholder timelines unclear
- Full integration into PNM process lifecycles ongoing
- Construction, schedule & budget timeline constraints encountered

A look back at 2022



- Identification of ***all*** stakeholder timelines
  - Government Affairs & Community Engagement
  - Lands & Environmental departments
- Process documentation, internal reference creation
- "Lessons learned" sessions
  - Open & honest conversations with PNM regarding shortcomings
- Conversations with teams **outside** of project execution (finance, regulatory, sourcing)
  - Ex: Conversation with Finance team regarding timelines for preliminary tasks
- Engineering timeline
  - Identification of deliverables directly affecting engineering design to identify sequencing
- Creation of tools & processes to **compliment** existing PNM processes
  - Tools that can easily integrate into PNM existing processes & programs

A look back at 2022



Type of Pole	Description	Qty
	15 kV 397AAC, Three Phase Heavy Duty 8' Crossarm Deadend	0
	15 kV 397AAC, Three Phase Heavy Duty 10' Crossarm Deadend	0

01-17-2024 | THREE PHASE PRIMARY 8' & 10' PRIMARY DOUBLE DEADEND | PNM A&R 104

Heavy Duty Primary Double Deadend

MACRO CODE: MOT4xy
Standard: DS-2-3.7
x - POLE HEIGHT AND CLASS
1. 40' CLASS 4
2. 40' CLASS 2
3. 45' CLASS 2

y - CONDUCTOR SIZE
11. #2 - 1/0
21. 2/0
31. 4/0 - 477
41. 795

Primary Double Deadend:
Included CUs:
GO5X **(1)**: Wood Pole
-GO54: 45' Class 4 pole
-GO55: 45' Class 2 pole
GOA6 **(1)**: 8' Fiberglass Deadend Crossarm OR
GOA7 **(1)**: 10' Fiberglass Deadend Crossarm
GBOA6 **(1)**: Fiberglass DE crossarm hardware
GBO3121 **(3)**: 5/8" shank pin, tie wire
GO21 **(3)**: Pin Insulator
GOAx **(6)**: Deadend Clamp
-GOA61: DE Clamp, #2 - 2/0 ACSR
-GOA62: DE Clamp, #2 - 4/0 Copper
-GOA63: DE Clamp, 4/0 ACSR - 477 AAC
-GOA64: DE Clamp, 795 AAC
GO61 **(6)**: 15kV DE Insulator
GBO609 **(1)**: 3/4" Eyenut
GBOT4x **(1)**: Miscellaneous Hardware
-GBOT42: 2/0-795
GBO1xx **(2)**: Insulated clevis, hardware & DE Grip
-GBO111 **(2)**: insulated clevis, 2/0 ACSR DE grip
GO11 **(2)**: spool insulator

Common Additions

Heavy Duty Guying Assembly
Macro Code: MO152
Included CUs:
GO72 **(1)**: 12" Anchor
GBO71 **(1)**: Anchor Rod
GBO12D13 **(1)**: Long Ball Hardware
GOGW2 **(65)**: 1/2" Guy Wire
GOGW1 **(60)**: 3/8" Guy Wire
GBOM **(1)**: Guy Marker
GBOGW112 **(1)**: Neutral Hardware

Ground Assembly
CU Code: GBOA1131 (45')
Should be included for:
-Transformer assemblies
-Riser assemblies
-Power equipment on poles

Single Phase Takeoff (Crossarm)
Included CUs:
GOF18x **(1)**: Fuse Link
GO181 **(1)**: 100A 15kV Cutout
GO61 **(1)**: 15kV DE Insulator
Varies **(1)**: DE Clamp
GBOA14x **(1)**: Single Phase takeoff hardware
(Includes **(1)** 18" Fiberglass Extension - If you need to order additional 18" Fiberglass Extensions please use GBO611)
-GBOA141: Takeoff hardware, #2-2/0
-GBOA142: Takeoff hardware, #4/0-795
Deadend Secondary Assembly (see below) **(1)**
GO11 **(1)**: Spool Insulator

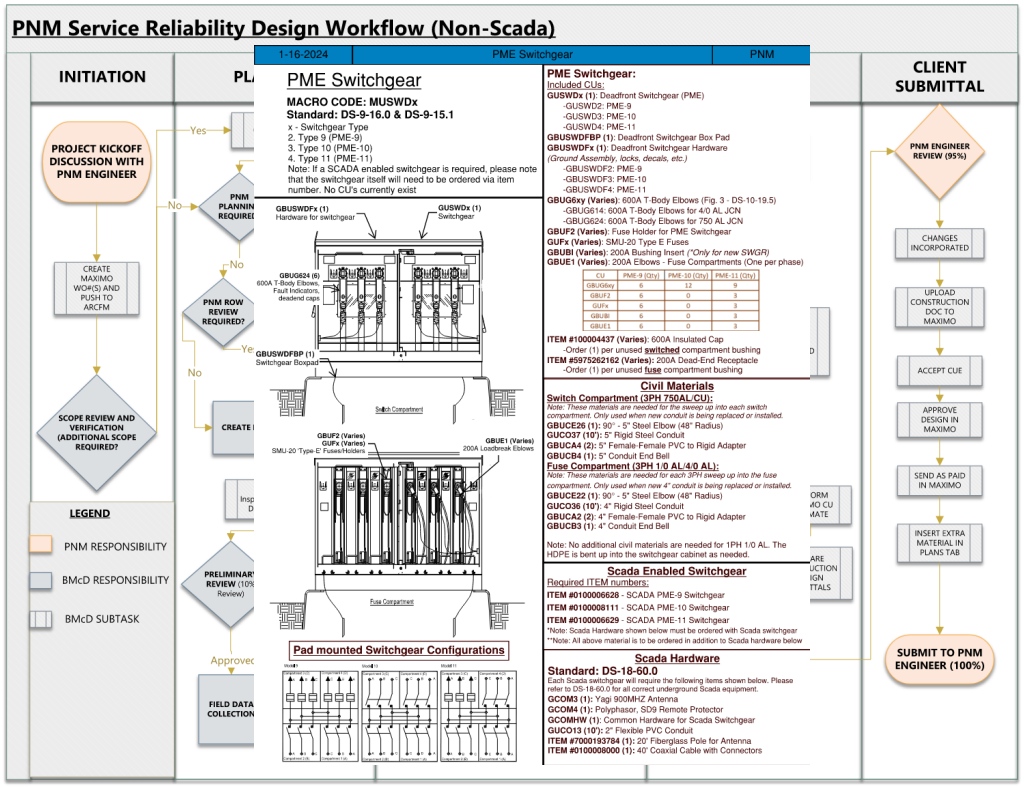
Three Phase Takeoff (Crossarm)
Included CUs:
GO61 **(3)**: 15kV DE Insulator
Varies **(3)**: DE Clamp
GO21 **(2)**: Pin Insulators
GOA6 **(1)**: 8' Fiberglass DE Crossarm
GBOA6 **(1)**: 8' Fiberglass Crossarm hardware
GBOA162 **(1)**: Three Phase Takeoff Crossarm HW (397 AAC)
Deadend Secondary Assembly (see below) (1)
GO11 **(1)**: Spool Insulator

Service Assembly (services):
Included CUs:
GBOxxx **(1)**: Service assembly
-GBO105: #6 Service grip assembly
-GBO106: #4 Service grip assembly
-GBO107: #2 Service grip assembly
-GBO108: #1 Service grip assembly
-GBO121: 1/0 Service grip assembly
-GBO122: 2/0 Service grip assembly
GO11 **(1)**: spool insulator

Deadend Secondary Assembly (secondary runs & services over 150'):
Included CUs:
GBOxxx **(1)**: Deadend secondary assembly
-GBO109: #4 DE grip assembly
-GBO110: #2 DE grip assembly
-GBO111: 2/0 DE grip assembly
-GBO112: 4/0 DE grip assembly
-GBO123: 1/0 DE grip assembly
GO11 **(1)**: spool insulator

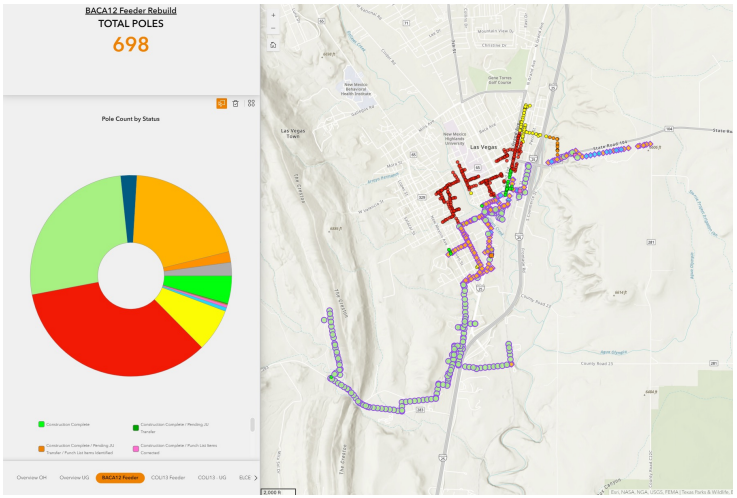
Additional Service grips (one per service)
GBOSGx - Secondary Service Grip (Grip only)
-GBOSG2: #4 Service Grip
-GBOSG3: #2 Service Grip
-GBOSG4: 1/0 Service Grip
-GBOSG5: 2/0 Service Grip
-GBOSG6: 4/0 Service Grip

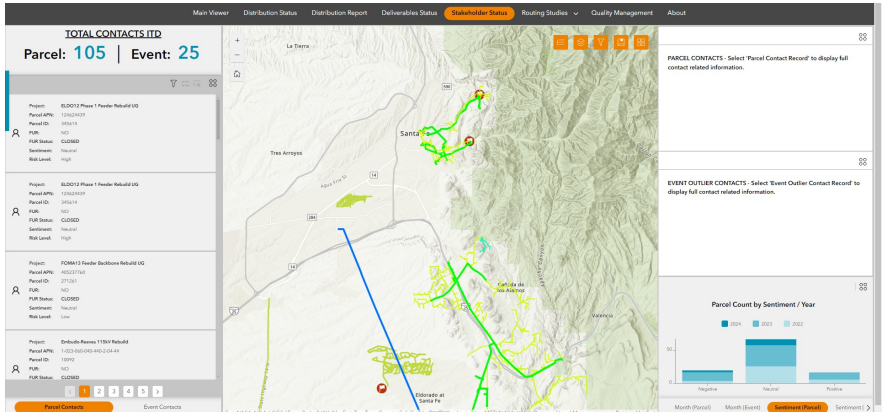
Raptor Safe Protection/Bird Guarding:
Refer to Raptor Safe QC Resource:
https://burnsmcd.sharepoint.com/:f:/s/PNM-WeRiotheFuture/Eo9CMK6OJVOhdaXHGiO4XUBnLDR1JNJTgNJ59nu_TYyhA?e=go2aGF

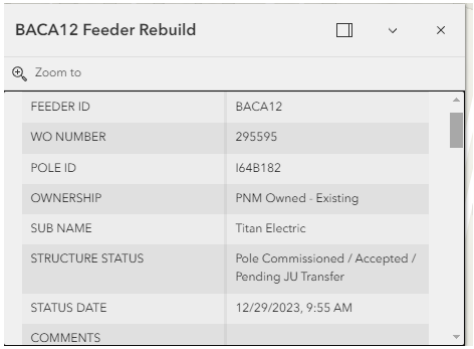


A look back at 2022

- GIS Application Buildout
  - Construction, permit tracking & stakeholder engagement tracking
  - Daily Field Reports, asset commissioning, and quality tracking
  - Engineering Support: population of PNM GIS data into a centralized location

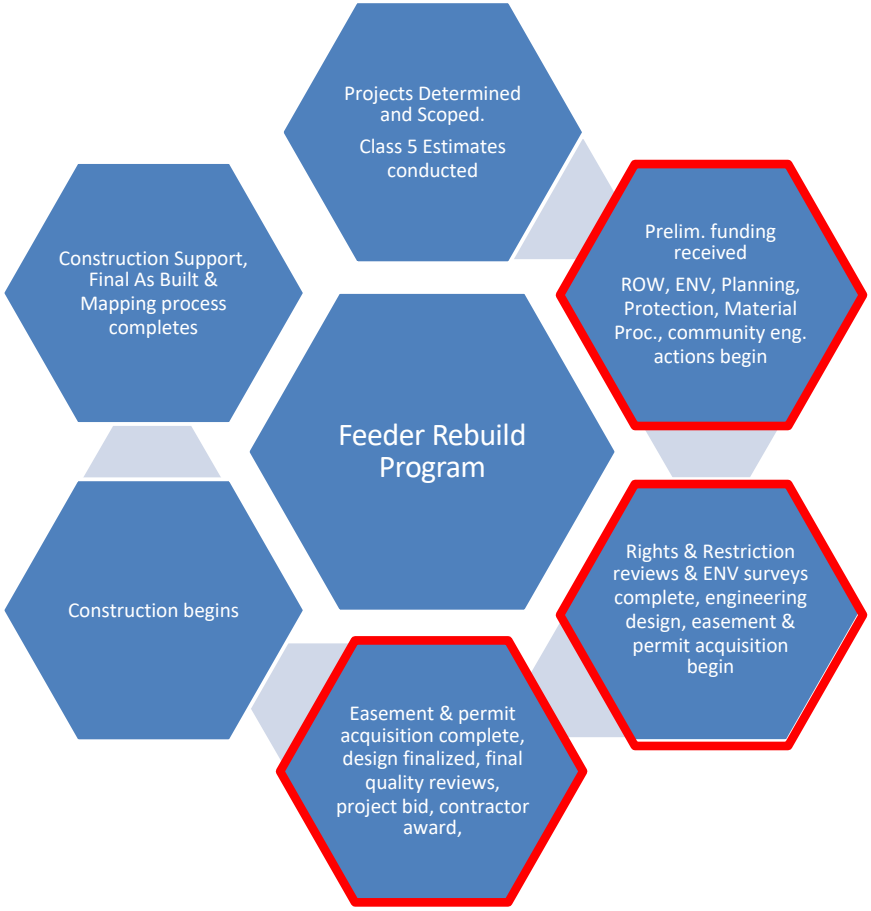






2024 and Beyond

- New funding approval process
  - Preliminary project funds allocated to the project allowing for surveys to begin 8-12 months before engineering start
- Stakeholder timelines identified & built into timelines
- Custom tools created to aid existing PNM processes
  - Ex: Material Calculators built to plug into Maximo before project engineering begins



Results

- 8 Construction Projects completed/in progress
  - 100+ miles of infrastructure rebuild
- 160 miles of line currently being worked
  - Surveys begin 12+ months before construction begins
  - Conversations with municipalities regarding new ordinances
  - Strategic approach to undergrounding
  - Discussions with planning & protection departments regarding future load growth in high density areas
- 1000+ miles identified for replacement over next 5+ years

A successful collaboration

- Fort Marcy Underground Installation
  - 7+ miles of non-looped direct buried conductor in an Army Corp of Engineers maintained Arroyo
  - Topography & permitting required relocation to two-lane mountain road in highly affluent area

PNM

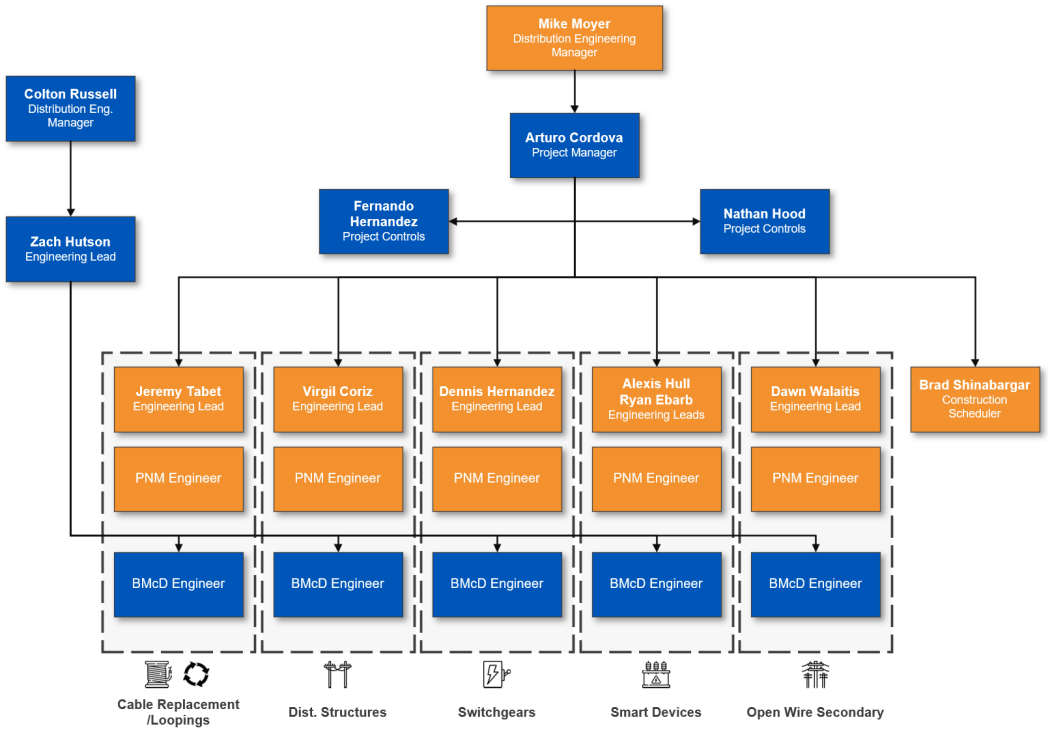
- Knowledge of system performance and win themes in the local community
- Understanding of consumer concerns
  - traffic delays, disruption to “status quo”, reliability of power service
- Relationship with **key** stakeholders
  - Government affairs, DOT representatives, local engineers & maintenance crews

Burns and McDonnell

- Engineering approach and design
- Project lifecycle ownership
  - Engineering design, permitting support, protection analysis, planning approach, etc
- Boots on the ground
  - Field supervisors & community engagement representatives
- Relationship with contractors
  - Surveyors, construction, traffic control

A continued collaboration

- PMO Support:
  - Partnered collaboration between PNM and BMCD PMs and Engineers supporting (6) six Capital Portfolios
  - Supporting construction scheduling & financial health to meet spend and clearing goals



A continued collaboration

- Capital Investment Engineering Support
  - 8-10 FTEs supporting the following:
    - Facility Relocations
    - Cable Replacements
    - Distribution Looping Efforts
    - MISC Eng. support
- New Service Delivery
  - Application processing & execution
  - Engineering Design
    - 338 engineering projects to construction
      - 45% of PNM's executed engineering projects
  - Field Surveying
  - GIS Mapping Services
  - Project Management

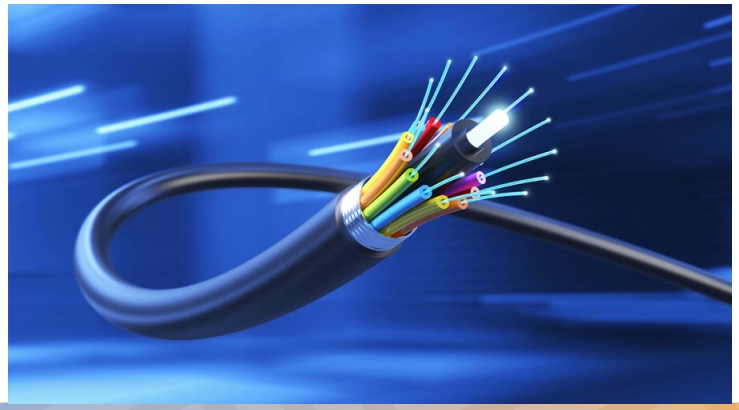
What's next?

- Fire Mitigation
- Material Procurement Timelines
- Regulatory Regulations
  - Undergrounding Ordinance & procedures
  - Overhead Variance Requests
- Continued Stakeholder Engagement
- Implementing the concept of "Rapid Change"

PNM Fiber Network

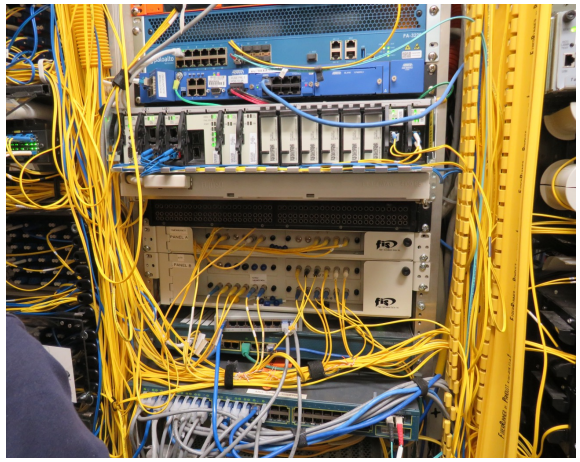
2022 PNM Fiber

- Hurdles
  - Connections primarily documented in drawings
  - KMZ files of individual paths
  - Tribal knowledge of Communications Technicians
  - Indefeasible right of use (IRUs)
- Goals for 2024
  - Documentation of fiber
  - Create an Online Map
  - Implement strand management software
  - Review of indefeasible right of use (IRUs)
  - Grid Modernization

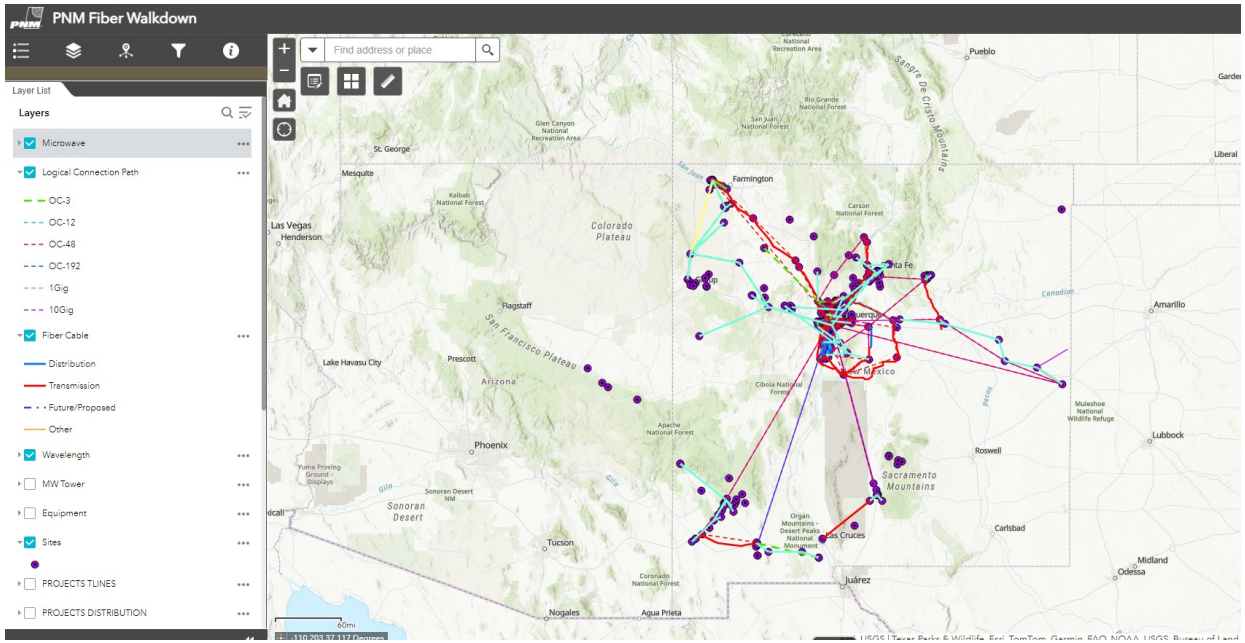


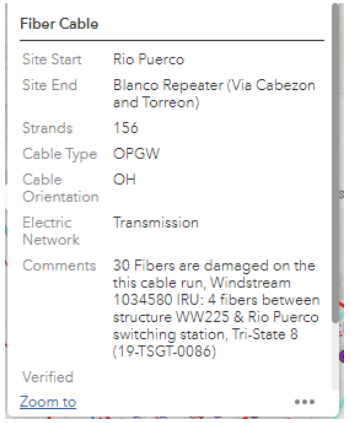
Documentation of Fiber

- Audited over 250 sites
  - Substations, Service Centers, Generation Facilities etc.
- Documented single mode and bulk fiber
- Translated into network block diagrams



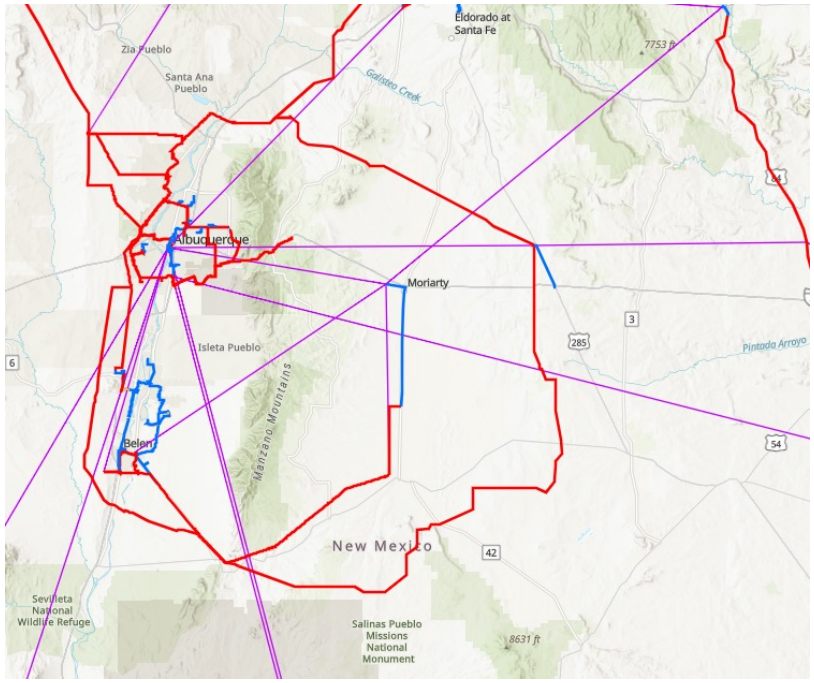
Online Fiber Map





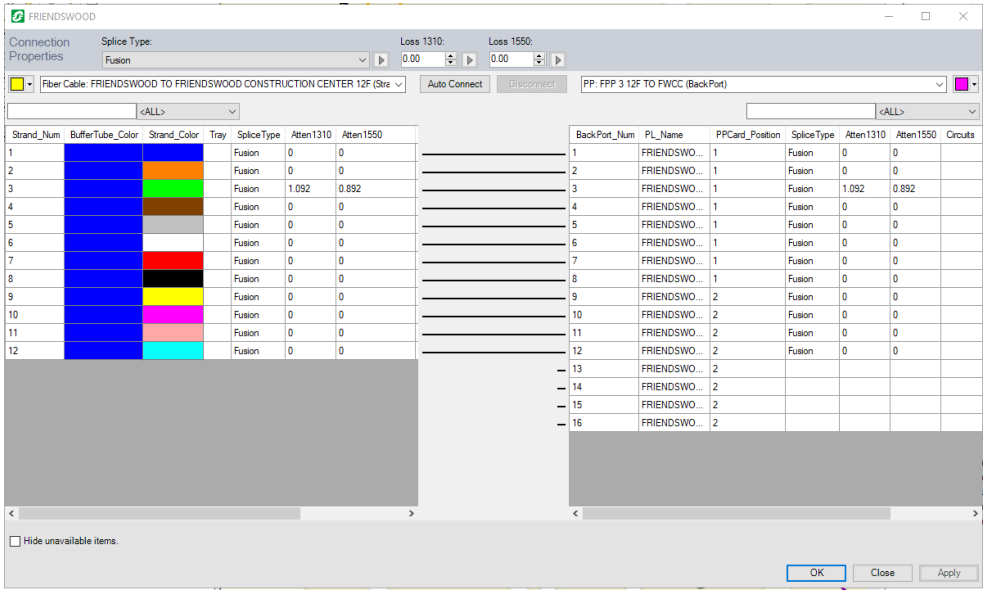
Online Fiber Map (Cont'd)

- Created an ArcGIS Online map for Fiber
- Better planning and preparation
- Where we are vs where we are going
- First visible fiber map for PNM



Strand Management

- Deeper detail of connection paths
- Allows for specific circuit designation and better tracking
- Optical Time Domain Reflectometer (OTDR) information
- Splice location information



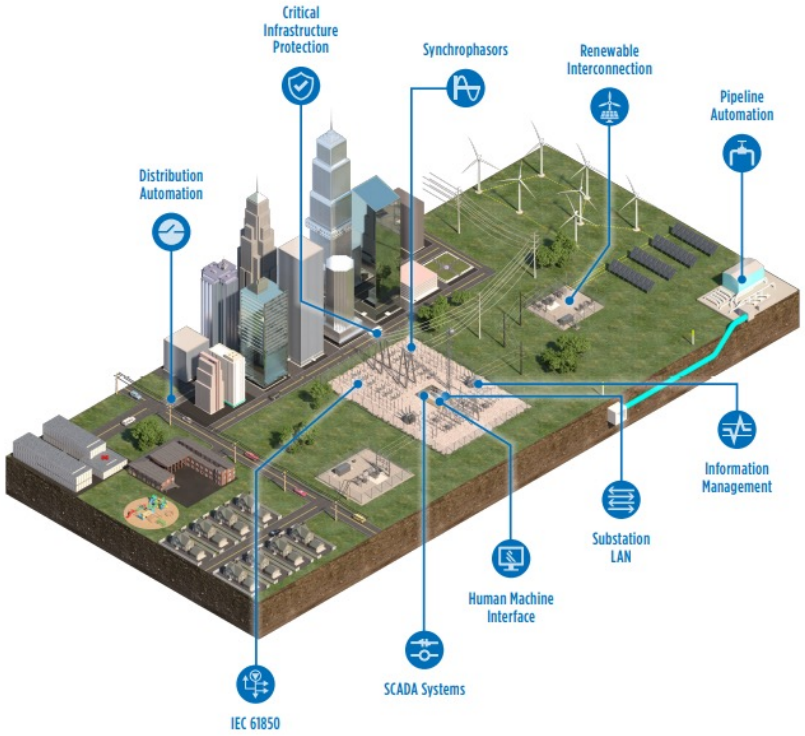
IRU Documentation

- Leased circuit tracking
- Over 3300 documents reviewed
- Determined over 2500 fibers leased to/from PNM
- Figuring out which connections can be terminated

Contract # 6414				
Term Start: 01/04/1993				
Term End: 03/31/1993				
Contract # 6491				
Term Start: 01/20/1994				
Term End: 01/20/2014	Terminated			
Contract # 1035963				
Term Start: 09/08/2013				
Term End: 09/08/2033	Renewals: 4 x 5 years			
Active	No		Active	(All)
Capacity to [redacted]	**Count**		**Leased Fibers**	
fiber cable	2		Sum of Fibers from [redacted]	78
duplex wavelengths	2		Sum of Fibers to [redacted]	2190
Grand Total	**4**			
Active	All			
Capacity from [redacted]	**Count**			
1 Gb Ethernet	1			
100 Mbps Ethernet	1			
2 x Bell Core CIC	1			
2.5 Gb	12			
28 x DS1	1			
5 x DS3	1			
DS1	11			
OC3	1			
OC48 SONET	10			
T1 services	2			
Grand Total	**41**			

Grid Modernization

- All distribution & transmission rebuilds incorporating fiber
- New smart devices being utilized to improve reliability & efficiency
- Planning for the future
  - Upgraded transport system
- Three distribution projects in progress
- 80,000 feet of fiber installed
- ~155,000 feet planned for 2024



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The Case for a Digital Twin

Can It Assist in Solving Complex Utility Questions?

Abder Elandaloussi
T&D Innovation Manager
Southern California Edison

Gary Huffman
Senior Client Relations Manager
Burns & McDonnell

AGENDA

- Background
- Drivers
- Definition
- Core Components
- Use Cases
- Existing Initiatives
- Opportunities for Innovation
- SCE DT Initiative
- Conclusion

BACKGROUND

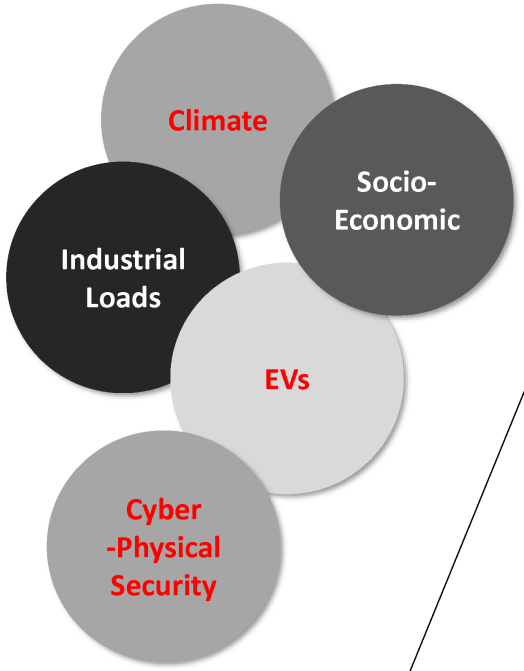
IEEE PES Sponsoring Committee: Industry Technical Support Leadership Committee(ITS LC)

- Objective: White Paper covering the over-arching definition and vision for Digital Twins specifically for the electric utility industry that will drive the industry to innovate new products, services, standards, processes, and even regulation
- (Too)Many definitions exist today
- Often mistaken with functionalities of ADMS, DMS, OMS, DERMS
- Diverse collaboration across industry partners
  - Utilities
  - Vendors
  - Research Labs
  - Regulatory

DRIVERS

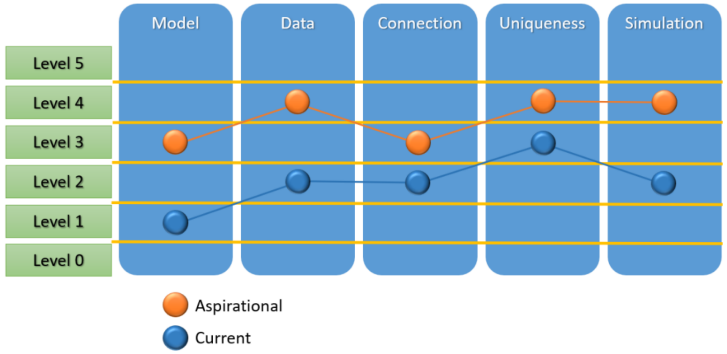
The grid DNA is changing as we speak and expected to drastically be different by 2045, but our approaches to plan, design, engineer, operate, and maintain it are not changing at the same speed

- The grid is becoming unpredictable- load, generation, customers, assets
- Existing models used are often outdated due to large backlogs
- It is difficult to integrate context into engineering functions- could be the difference maker for more informed decisions
- Existing simulation tools that leverage physics-based simulation maybe not adequate for the complexities the grid will face
- Big data holds tremendous value, but is under-utilized in existing decision making across engineering, planning, and operations



Dt (Electric utility specific) Definition

- High Fidelity, virtual and visual representation of systems of systems representing electric grid, its surroundings, and any relevant context
- System: Capacitor Bank→ Feeder →Substation →Entire Grid
- Multi-Modal representation of grid-use case driven
- Real Time and/or Offline
- Analyze the complete current state of the grid and predict future state using combination of AI/ML and physics-based modeling



Core Components

Model Maintenance

- Foundational aspect to create high fidelity representation of any system

- Automation, processes with human in the loop

Simulation Engine

-Multi-Domain

-Integration AI/ML to augment traditional simulation

Interactive Visualization

- Flexible/Customizable interface

- Advanced Multi-modal dataset+ analysis

- Responsive

Model Acceptance

- Managing models for accuracy, usability, fitness for purpose, limitations

-Model refinement for intended application (ie. Timestep)

Model Validation/Data Quality

-Cross Validation operational, non-operational, external datasets

- Garbage in/garbage out

USE CASES

- Design
- Planning
- Grid Operations
- Asset Management
- Generation
- Electrification
- AI/ML
- Protection, Control & Automation
- Risk & Compliance
- Cybersecurity

Existing Initiatives	Description
Utility DT Consortium	A team of individuals representing utilities and organizations from North America, objectives/focus to create an initial definition of the digital twin to begin conversation and refine in a larger task force(ITS LC)
Utility CIM	The Common Information Model (CIM) is maintained and updated by the CIM user's group, under the auspices of the UCA-IUG
Electric Power Research Institute (EPRI)	Numerous efforts addressing protection relay models and simulations, nuclear reactors, information and communications technology (ICT), various generator models, geospatial data and augmented reality, monitoring, and advanced analysis.
SLAC National Accelerator Laboratory	• Data driven analytics to manage extreme weather events • Dynamic and flexible power flow simulation tool to support resilience analysis, tariff design, renewable energy integration, etc. • Methodologies for forecasting electrical load on the grid
OMG DT Consortium	Object Management Group (OMG) Digital Twin Consortium: • Has working groups for various industries (notably, utility industry missing) • The consortium has published four white papers on decarbonization
ENTSO-E, EU DSO DT	European effort to support energy transition through "digitalizing the energy system," focused on DT for the EU power system.
G-PST Consortium	Global Power System Transformation Consortium (G-PST), a consortium of power systems operators and partners aiming to accelerate clean energy transitions at scale
CIGRE WG C4.64	CIGRE Working Group C4.64: "Application of Real-Time Digital Simulation in Power Systems"
IEEE PES T&D Committee	White paper discussing digital twins for power system equipment: "Digital Twin for Power Equipment"
IEEE TF on DTs of Large-Scale Power Systems	Community of researchers and practitioners from electric utilities, academia, industrial R&D, and software vendors to share activities on the concept of DT in the power system space.

OPPORTUNITIES FOR INNOVATION

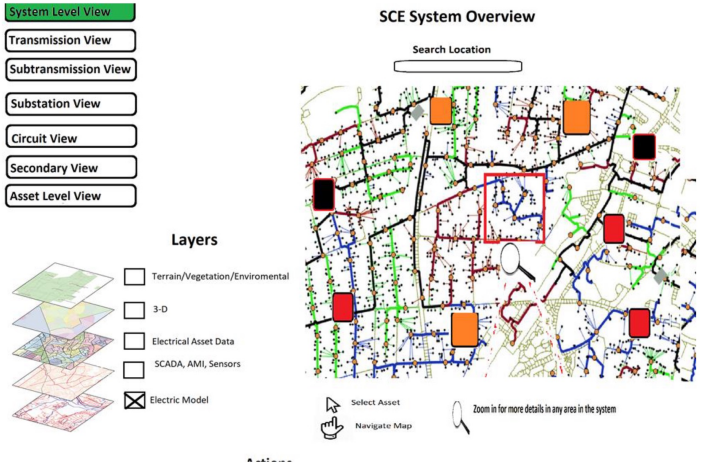
- Network Model Management
- Common DT Framework
- Existing Solutions Integration
- Computation
- Model Interoperability
- Use Case development
- Application development

ML-Augmented Digital Simulation (MAD-S)

Project Overview

Context

The future electric grid will face greater load and generation variability than ever before. The impact on the grid and our customers must be constantly tracked and seamlessly integrated into processes such as planning to optimize decision making. This is a big data + engineering effort that requires innovation & collaboration



Estimated Budget: $9M

Problem	Project Objectives	Potential Outcomes

• Existing power flow engines generally assume static grid configuration, capacity, asset ratings, and performance.
• This can result in sub-optimal load flow analyses that lead to sub-optimal decision making.
	• Improve power flow engine results by augmenting results with a digital twin platform to analyze grid data and integrate predictive analytics to improve LF engine assumptions.
	• Demo a situational, context-based power flow engine use case with:
	  • Data and model Ingestion/Clean-Up/integration layer
	  • ML powered power flow engine
	  • Visualization of predictive analytics results
		• Integration of operational and non-operational datasets to reflect real-world operating conditions.
		• ML Augmented planning decisions that improve reliability and resiliency and result in more efficient capital investment decisions—including DER opportunities.

CONCLUSION

Big data will become a liability if we don't collect, store, and leverage it efficiently, effectively, and in a timely manner

Grid is rapidly increasing in complexity while our tools are not changing and adapting at the same speed

Combining insights from data with traditional simulation could optimize our existing decision-making processes. Are our existing assumptions for simulation accurately reflecting reality?

The DT is a scalable, open, modular, system of systems platform that maintains a high-fidelity replica of the physical grid and the context in which its assets exist. It brings together the necessary processes, technologies, and applications that maintain and leverage that digital replica to effectively operate, maintain, plan, design, engineer, and monitor the electric grid.

We need innovation in standards, technology, processes to make the DT framework a success

Special Thanks to…

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Gerald Gray, PG&E
Mayank Malik, SLAC
Maziar Isapour, SCE

Brad Johnson, Bentley Systems
Farnoosh Rahmatian, Nugrid Power
Elizabeth Cook, DLC
Tim Chang, Quanta Technology
Damir Novosel, ITSLC Past Chair & Quanta Technology
Mark Lauby, NERC
Aung Thant, NERC
Alex Shattuck, NERC
Dan Sabin, Schneider Electric

THANK YOU

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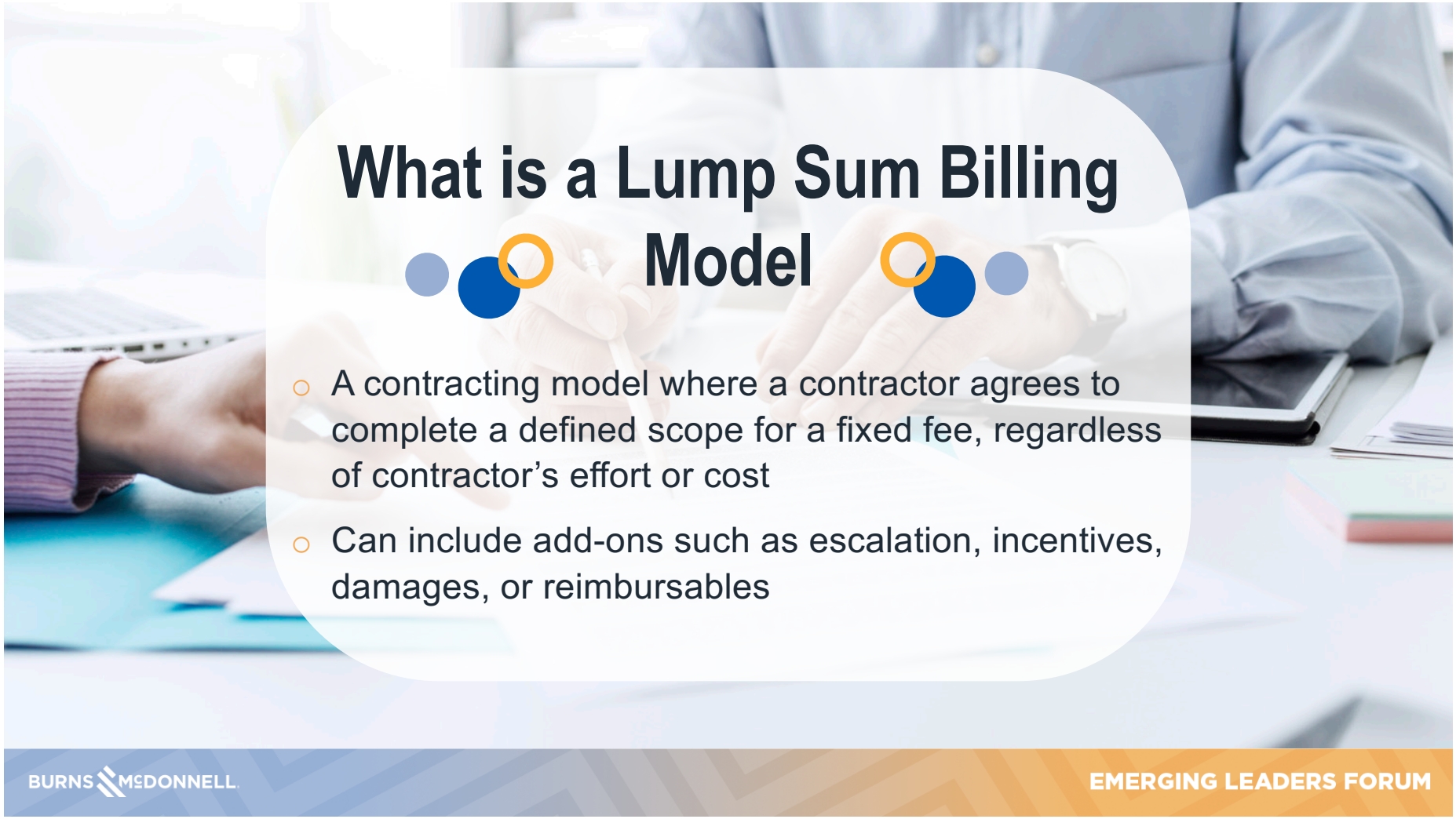
Project Billing Structures

Why Lump Sum?

Alexis Nieto
Senior Manager of Capacity Planning
Exelon

Luke Ezell
Project Execution Manager
Burns & McDonnell



What is a Lump Sum Billing Model

- A contracting model where a contractor agrees to complete a defined scope for a fixed fee, regardless of contractor's effort or cost
- Can include add-ons such as escalation, incentives, damages, or reimbursables

Goals of Stakeholders

- Hitting Planned Spend
- Quality Installation of Assets
- Customer Reliability
- Prudency of Investment
- Timeline/Adherence to Execution

UTILITY

- Profitability
- Providing Quality Deliverables for Repeat Business
- Customer Reliability
- Maintaining Workload

CONSULTANT/CONTRACTOR

Alignment of Goals

- Having a firm price to deliver a well-defined scope of work.
- Flexibility in staffing to provide quality deliverables.
- Incentives to reduce price through efficiencies/automation
- Milestones that promote engagement, progress measurement, and billing flexibility

Lump Sum

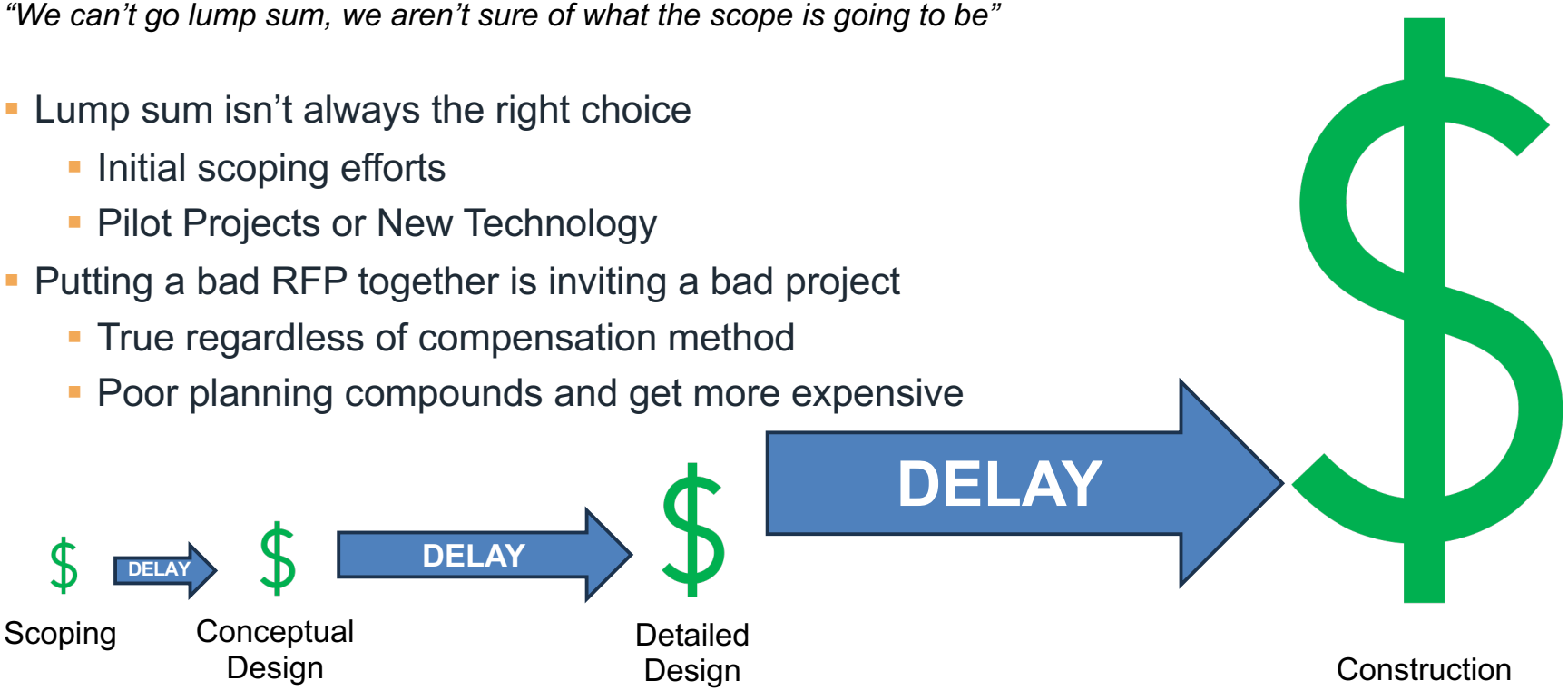
COMMON GOALS

Challenges of Lump Sum

Uncertainty of Scope

"We can't go lump sum, we aren't sure of what the scope is going to be"

- Lump sum isn't always the right choice
  - Initial scoping efforts
  - Pilot Projects or New Technology
- Putting a bad RFP together is inviting a bad project
  - True regardless of compensation method
  - Poor planning compounds and get more expensive



Perception of Change Orders

“If we go lump sum, you’re just going to change order us to death”

Once contract is awarded, any changes to scope can result in change orders

Contractor takes the risk on level of effort on a lump sum project

Incentivizes front end planning, which reduces overall project costs in any model

Risk Transfer Additional Fee

"If we go lump sum, you're just going to price in the risk"

- Contractors could increase cost to account for risk transfer
- Bids will still be evaluated
  - Contractors must still price competitively
- Efficiencies could cancel these out
- Automation
  - Resource loading and invoicing flexibility benefits both parties
- Other options to address
  - Shared Savings
  - Incentives

Cutting Corners

"If we go lump sum, you're going to cut corners just to increase profit"

- Contractors could try to cut corners to save cost
  - Evaluation of the quality and a solid scope will avoid this
  - Review cycles will still be there
- Most contractors depend on repeat work, so not incentivized to lose future work based on a single loss case
- Many utilities have "of Choice" contracts that are re-evaluated periodically

Disputes

"If we go lump sum, we're going to be fighting over scope continuously"

- There can be disagreements on what is covered in scope
- This gives an opportunity for improvement on clarity of scope writing and will allow for open conversation on performance
- Brings transparency to how execution is being done
  - Allows for immediate lessons learned
  - Feeds into continual improvement process
- This is not unique to Lump Sum
  - Change orders on T&E work are common
  - Has the additional advantage of prioritizing efficiencies

ADVANTAGES

Cost Certainty

Known total cost per scope upfront

Less administrative burden

Aids in financial planning and cash flow

Allows for better schedule compliance and planning

Risk Transfer

Puts onus of level of effort on contractor

- Mis-estimation of a defined scope item is not open to change orders
- Delays or schedule overruns resulting in additional cost that were defined in the scope do not get transferred
- Knowledge retention

Input to change

- Opportunity to review any potential change of scope and associated fee
- Provide visibility and decision-making opportunity to better manage scope
- Resource loading and invoicing flexibility

Emerging Technology Adoption

- Provides the opportunity to help manage the typically ballooning costs of early technology
- Helps with planning and helps bridge some of the non-familiarity with these technologies

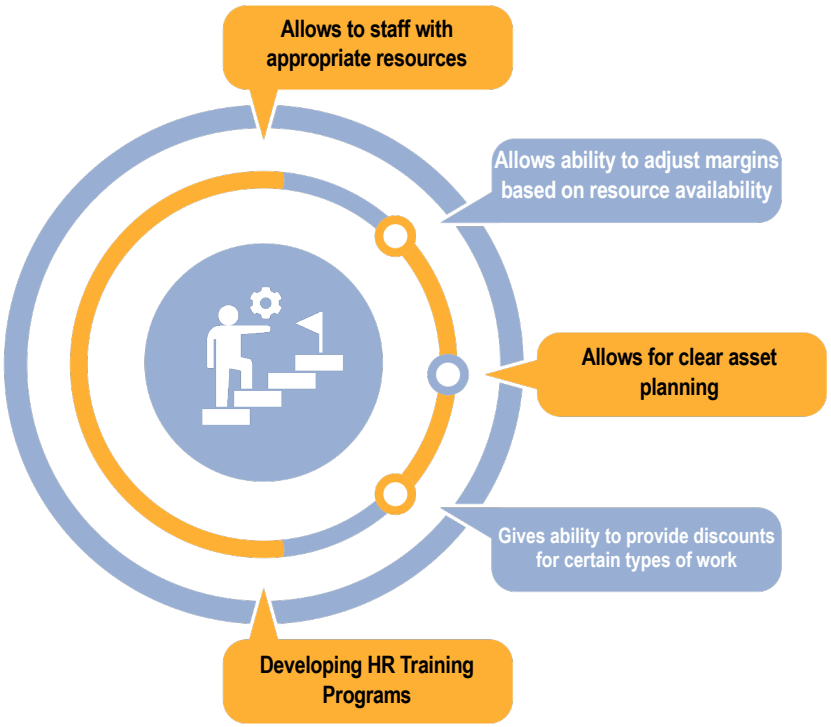
Incentive for Efficiency

- Contractor can make more profit if project is done ahead of schedule
- Contractor will have greater quality, as rework will significantly impact profitability without recourse to recoup
- No incentive on an hours-based approach
- Helps drive innovation and advancements towards efficiency – BIM, Advanced design platforms, etc.
  - Not just on engineering, but also on construction
  - Construction approaches/added value

Scope Clarity

- Proposals will come in with more detail to better clarify scope being executed by contractor
- Allows better evaluation of what each contractor will be providing
- Could allow for optional pricing breakout to determine all in cost based upon available funding
- Will show your good partners are (show what they're missing and provide options and clarifications)

Pricing Flexibility



Bringing It All Together

- Having a firm price to deliver a well-defined scope of work.
- Flexibility in staffing to provide quality deliverables.
- Incentives to reduce price through efficiencies/automation
- Milestones that promote engagement, progress

Lump Sum

Improves the Partnership

- We have common goals
- We have improved communication
- We have clear expectations

Drives Innovation

- Exploits the profit motive to create novel approaches to improve the grid
- This will increase competition and drive better quality and efficiency

Increases Focus

- Greatly simplifies billing and administrative tasks, while providing flexibility to hit spend
- Places an emphasis on front end planning, resulting in less rework, less installed cost, and an overall better project experience

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Energy in Transition

Embracing DEI

Suzana Arbana
Manager, P&C Engineering
Hydro One

Joanna Osawe
Senior Client Relations Manager
Burns & McDonnell

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DERMS

A Customer-Centric Approach to Project Design

Tommy Bertken
Distribution Engineering
Burns & McDonnell

Tammie Rhea
Senior Product Manager
Evergy

Agenda

01 **Introduction**
- Intro to Evergy
- Intro to DERMS
- Marketing and Outreach

02 **Two Silos**
- Energy Solutions
- Operations Technology
- A Discussion on ownership

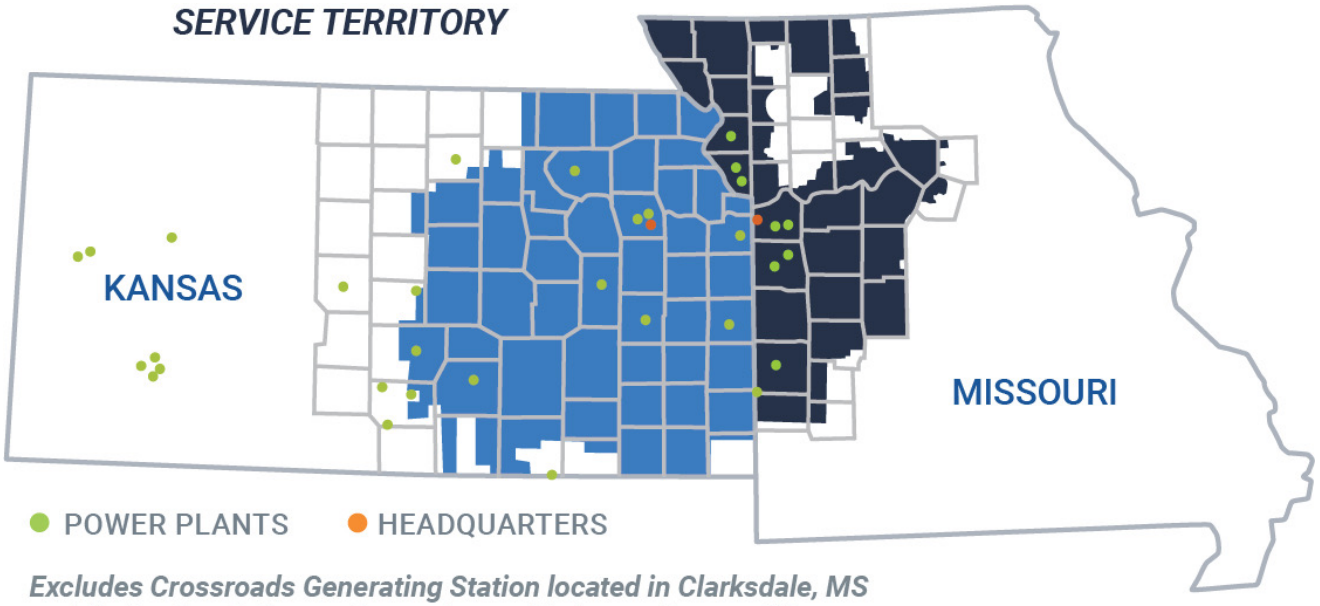
03 **Case Studies**
- DSO Operations
- Residential Battery Pilot

04 **Takeaways**

Who is Evergy?

A **YOU**tility company

SERVICE TERRITORY

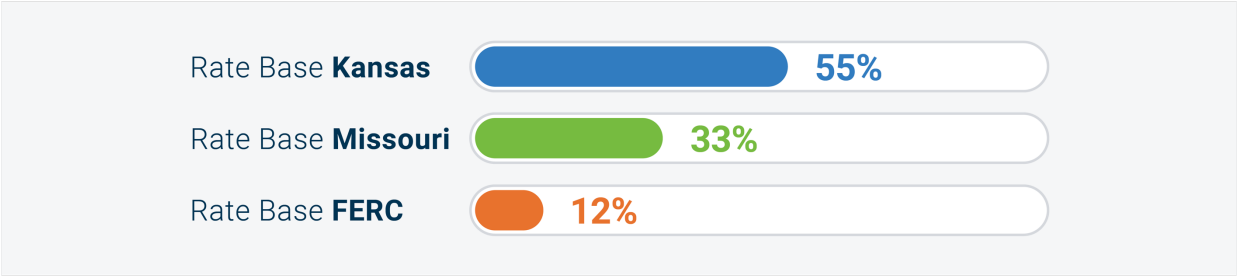


Excludes Crossroads Generating Station located in Clarksdale, MS and Spring Creek Energy Center located in Logan County, OK

~1,422,000
RESIDENTIAL CUSTOMERS

~192,000
COMMERCIAL CUSTOMERS

~7,000
INDUSTRIAL CUSTOMERS



13,903 Self-Generating Residential Customers

DERMS Deployment

History of the Burns & McDonnell - Evergy Partnership

What is **D E R M S ?**

istributed
nergy
esource
anagement
ystem

- Platform that helps utilities manage their distributed energy resources (DERs) and demand response programs
- Platform for customer enablement that links the utility to the customer for enrollment, control, and measurement

DERMS Deployment

KCP&L Smartgrid

2010

- Integrate an ORACLE MDM and OMS, OATI DERMS, Siemens DMS
- 1 MW battery
- 1000 ChargePoint stations

DERMS Deployment

OATI DERMS Deployment

2018

- Initial Business Process and Stakeholder buy-in
- Mapped Business Requirements to technical processes
- Hands-on System Configuration

DERMS Deployment

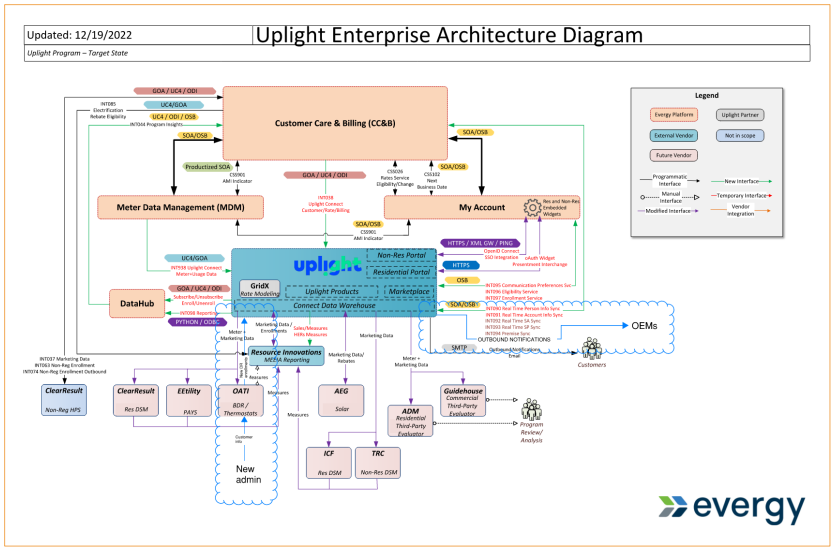
DERMS Owner's Engineer

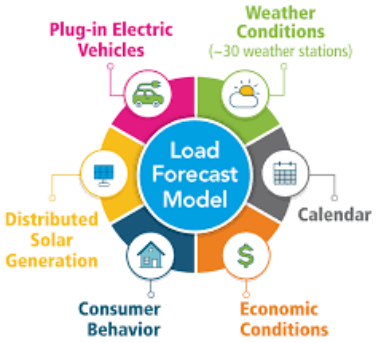
2019- Present

- DERMS Product Owner
- Data Architecture
- Roadmapping and Requirements

The Future of DERMS

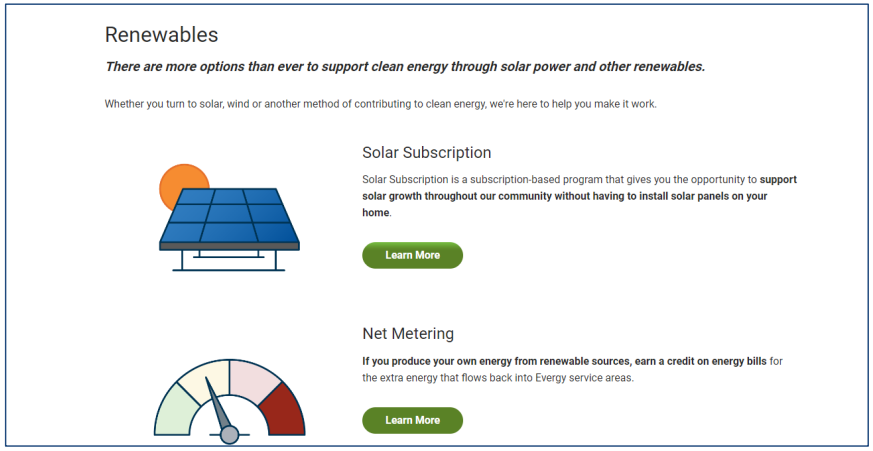
- **From DRMS to DERMS**
  - **Short Term (2024)**
    - GIS Inclusion
    - Integration of Uplight
    - Third Party Aggregator Registration (FERC 2222)
    - Residential Batteries
    - Emergency Winter Programs
  - **Medium Term (2025)**
    - Load/Generation Forecasting
    - Market Participation

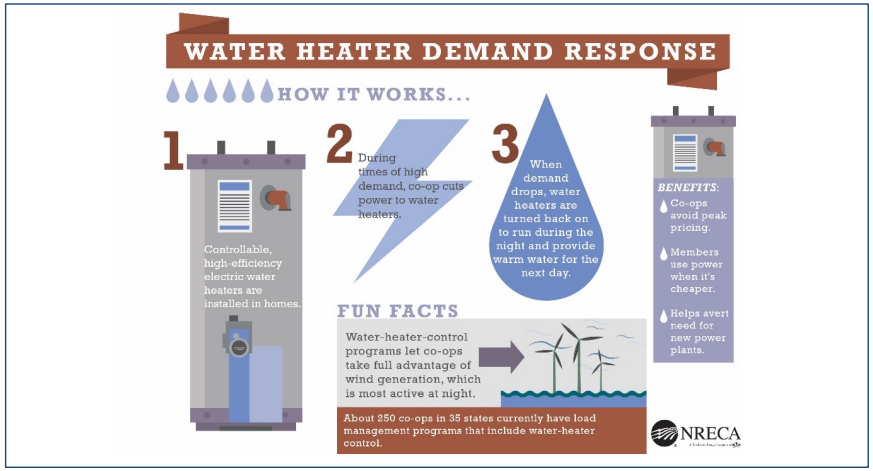




The Future of DERMS

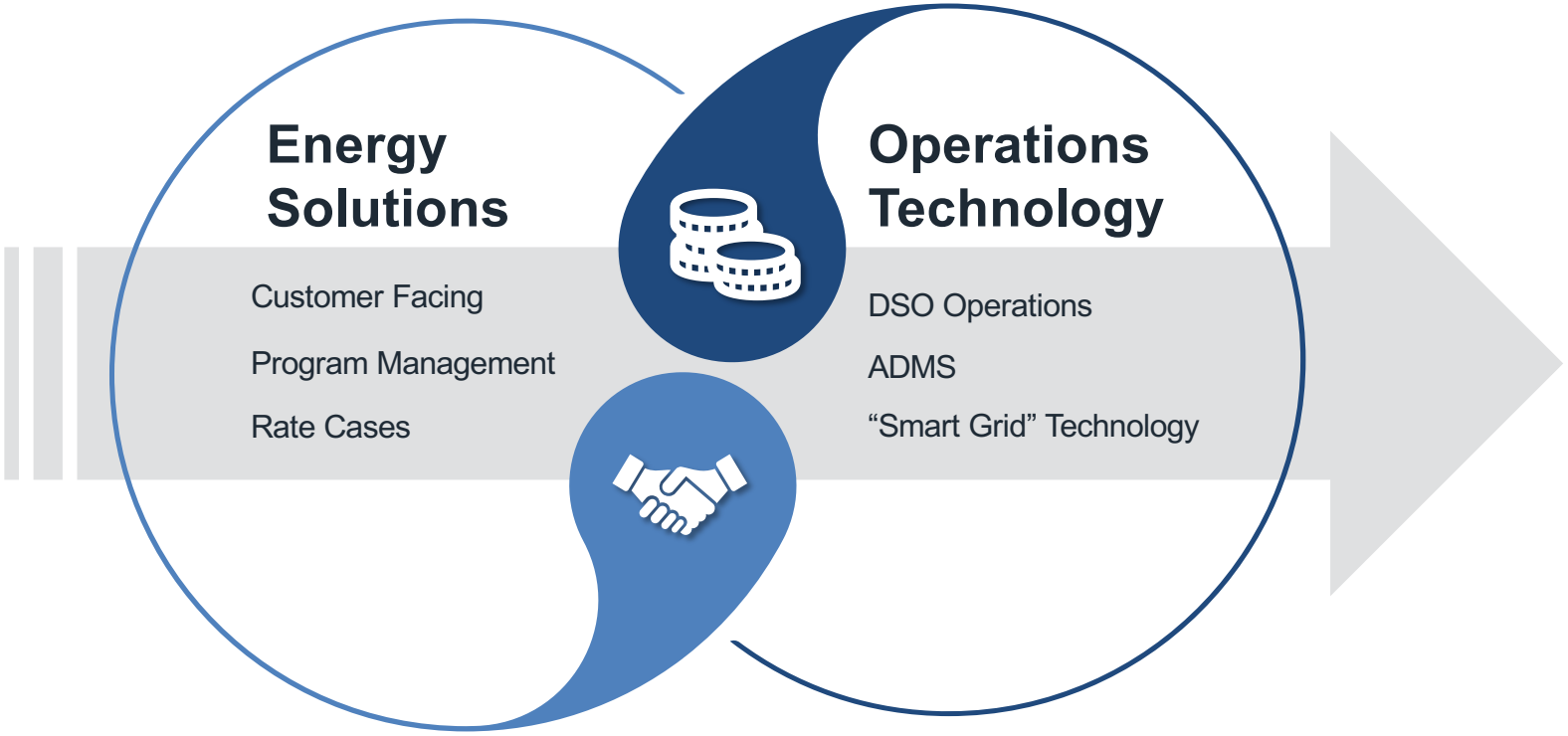
- **From DRMS to DERMS**
  - Long Term (2026)
  - Solar Rebates and Community Solar
  - Net Metering Customers
- **Future Goals (2027-2028)**
  - Distribution Grid Congestion Management
  - Winter Program Expansion
  - Connected Homes and Appliances
  - Water Heater Control





A Tale of Two Silos

The Two Halves



Ecosystem Summary

Evergy's Programs

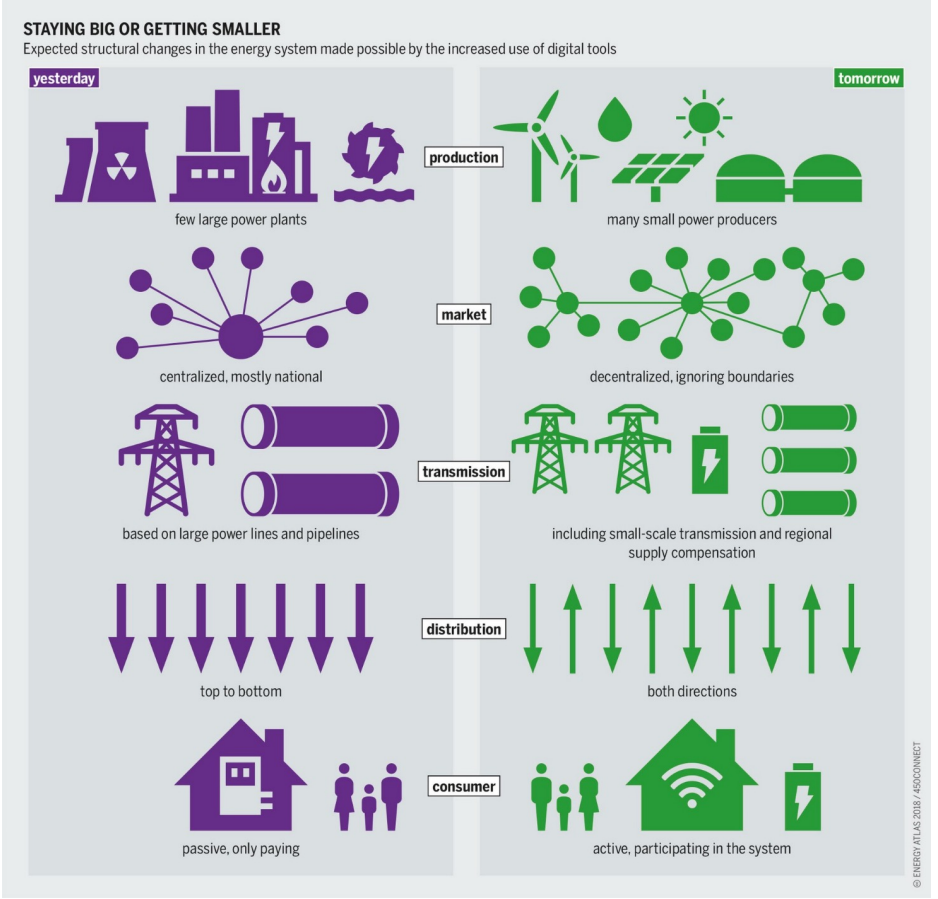
- **Residential Thermostats**
  - Nest
  - Ecobee
  - Yukon
- **Business Demand Response**
  - C&I Customers
  - School Districts
  - Etc.
- ***Soon:*** Residential Batteries, EV Charging, Water Heater Control, Smart Buildings, Solar, Net Metering

Evergy's Systems

- **Customer Information System (CIS)**
  - Information about participating customers
- **Meter Data Management (MDM)**
  - AMI data, meter usage
- **GIS**
  - Geographic and network connectivity information for assets

Why?

- **Event = 170 MW**
  - 120,000 “average” homes
  - 6-8 Acres of Solar
- **OR 534 MWh**
  - 2,136,000 miles in a Tesla
  - 587,400 pounds of coal



Energy Solutions

Customer Facing Organization

Who is Energy Solutions

- **PROGRAMS**
  - **Energy Efficiency Programs**
    - Commercial and Residential
  - **Demand Response**
  - **Renewable Tariffs**
    - Subscription Based Programs
  - **Electric Vehicle Programs**
    - Fleet
    - Residential
  - **Behind the Meter Programs**
    - Cust Gen
    - Net Metering
    - Parallel Generation

The Energy Solutions use-case

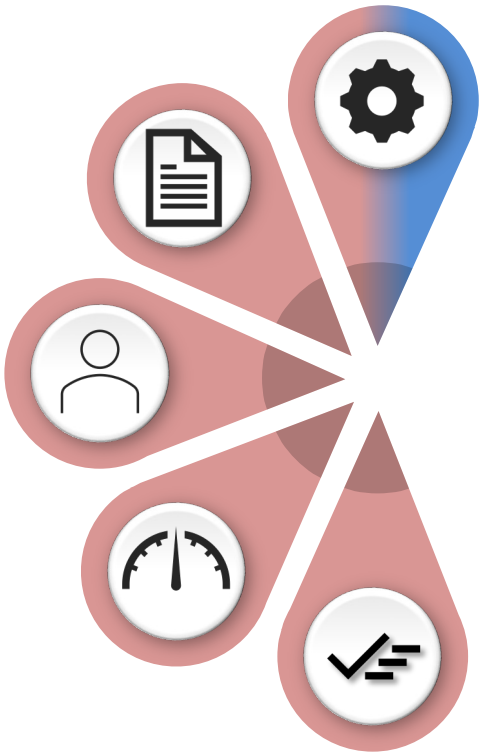
Device Control

DER Registration/ Warehouse

Customer Outreach

Reporting/ Results

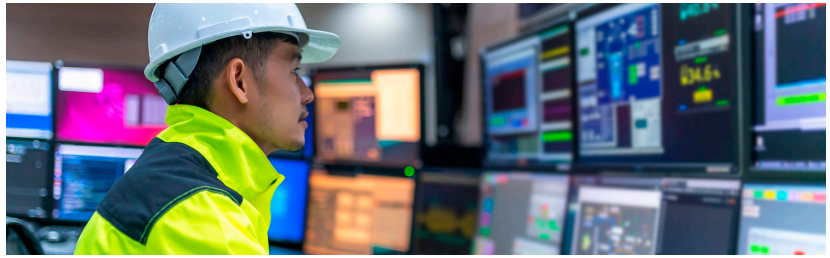
Product Enrollment



Operations Technology

Leader of Technology

Who is Operations Technology



- **Software/Control**
- DSCADA -> ADMS 2026
  - OMS
  - FLA
  - FLISR
  - DSCADA
  - VVO
  - DERMS
- Oracle NMS

- **Field Devices**
- Reclosers
- CFCI
- Cap Banks
- LTC
- RTAC

The Operations Technology Use-case

Device Control

Device Telemetry

System Opertation

ADMS Integration

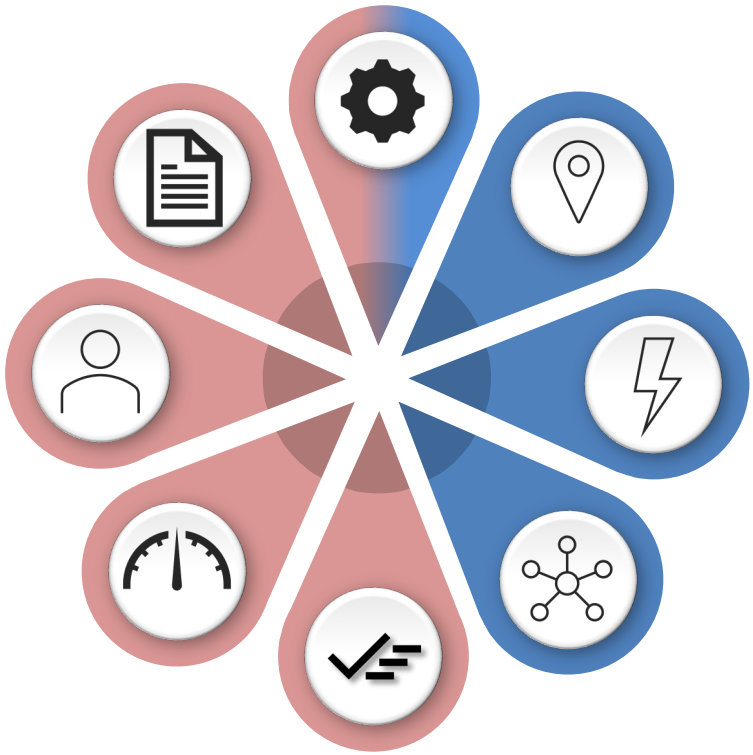
Device Control

DER Registration/ Warehouse

Customer Outreach

Reporting/ Results

Product Enrollment



Device Telemetry

System Opertation

ADMS Integration

Unexpected Benefits

Tales from the DSO – Case Study

Observable Results From the DSO

Approaching Limits Timeline

- Lower limit 576
- Middle limit 612
- Upper limit 648

Observable Results From the DSO

Hook Road 26423

- 7/28/23
- 99 Degree High
- DR 4PM – 6PM

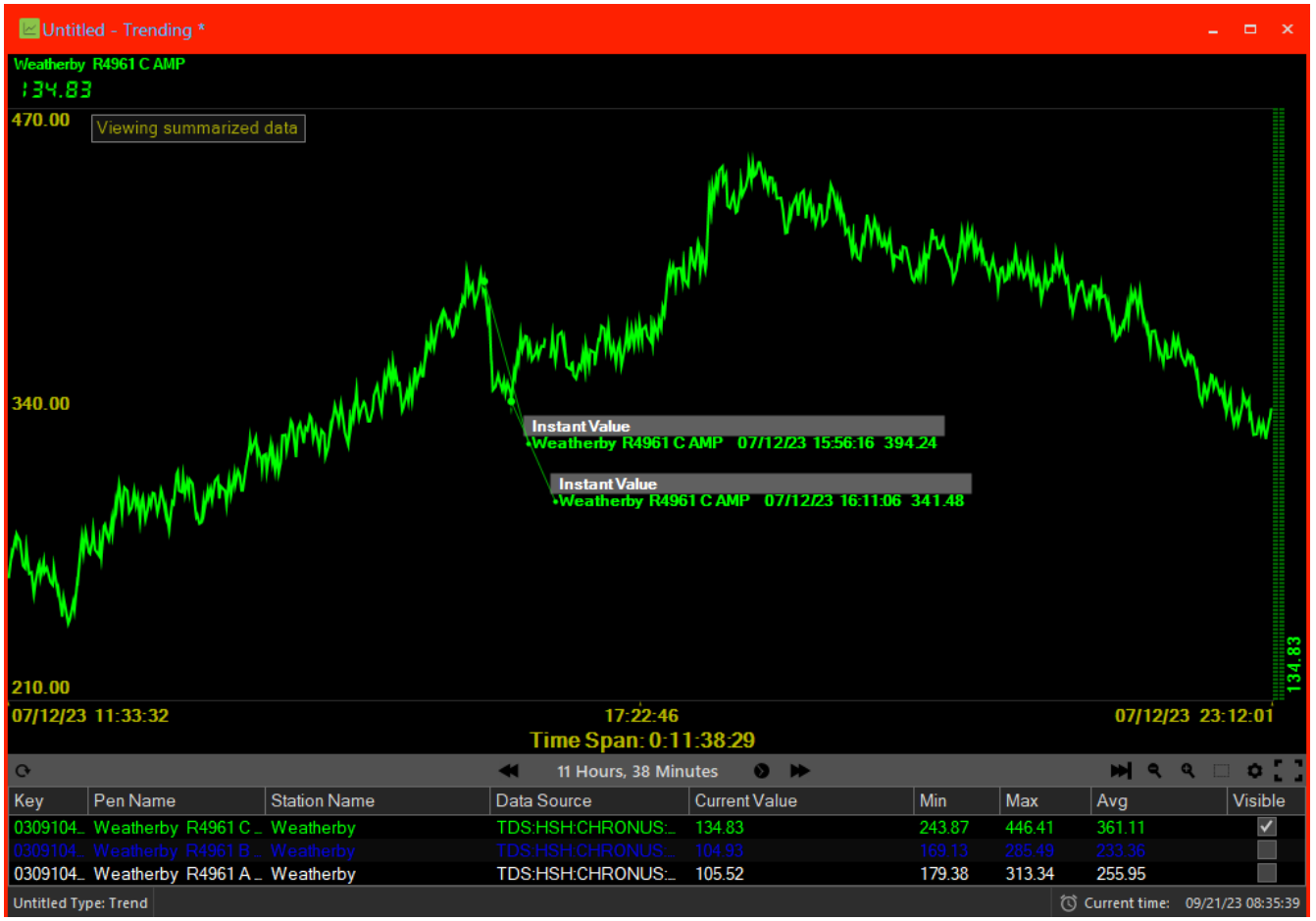
Observable Results From the DSO

Without DR/ Switching Event

- 8/19/23
- 98 degree high
- Lower limit 576
- Middle limit 612
- Upper limit 648

Post Switching Event

- 8/22/23
- 94 degree high
- DR 4PM – 6PM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470.00
Viewing summarized data
340.00
210.00
Instant Value
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Instant Value
Weatherby R4961 C AMP 07/12/23 16:11:06 341.48
134.83
07/12/23 11:33:32
17:22:46
07/12/23 23:12:01
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11 Hours, 38 Minutes
Key | Pen Name | Station Name | Data Source | Current Value | Min | Max | Avg | Visible
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0309104... | Weatherby R4961 B ... | Weatherby | TDS:HSH:CHRONUS:... | 104.93 | 169.13 | 285.49 | 233.36
0309104... | Weatherby R4961 A ... | Weatherby | TDS:HSH:CHRONUS:... | 105.52 | 179.38 | 313.34 | 255.95
Untitled Type: Trend
Current time: 09/21/23 08:35:39

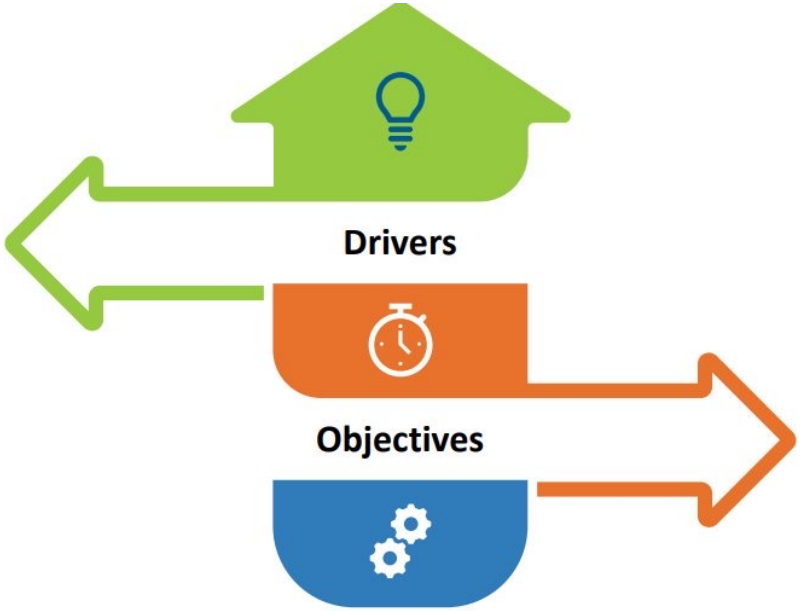
Evergy Battery Pilot

An example of successful co-ownership – Case Study

Battery Pilot: Drivers and Objectives

Drivers

- Battery storage awareness and adoption has increased
- Customers want choice and ways to manage and reduce costs
- Battery storage systems can support multiple use cases that will support the grid

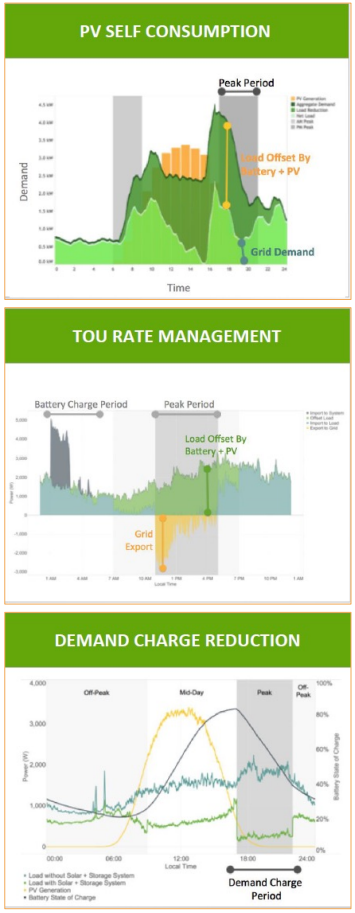


Objectives

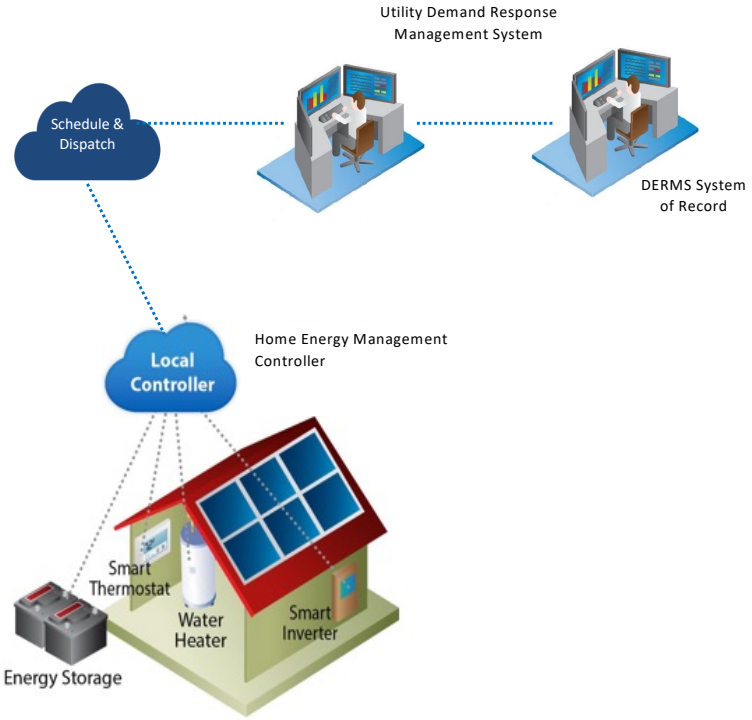
- Gain operational knowledge on customer interactions with battery and grid impacts
- Evaluate use case impacts by DER type
- Analyze charge-discharge strategies deployed
- Increase customer satisfaction

Battery Pilot: Use Cases

CONSUMER	UTILITIES
Maximize PV Investment	Peak Load and Load Reduction & Shifting /Demand Response
Bill Management and reduction	Meet Renewable targets Feeder resiliency Better customer engagement and CAIDI
Backup Power	Frequency Regulation Voltage Management Wholesale market participation
Participate in TOU	Distribution & Transmission Asset Upgrade Deferral Grid modernization



Battery Pilot: Use Cases



Component	Function/Purpose
Size/Duration LG Home 8	5-7 kW, up to 14.4 kWh of storage
Local Controller	Home Energy Management local controller perform real-time control of storage and loads at customer's site
Cloud Platform	System cloud platform provides individual DER management, forecasting and optimization algorithms.
DRMS Sunverge	Sets charge and discharge schedules and optimization of battery over pilot period
DERMS OATI	Will provide full visibility across all commissioned approved Evergy DR programs and determine scheduling for peak or operational events

DRMS-Demand Response Management System
DERMS-Distributed Energy Resource Management System

How to use customer programs to drive technology

Takeaways

Lessons

- If you have a project that can benefit from a customer program, be ready to reach “across the aisle”
- Some projects necessitate a start in the “customer solutions” space, this can be the driver for technological innovation
- By understanding how other segments of a utility define, fund, and execute projects, you can unlock new opportunities

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Connecting the Dots

Unraveling the Impact of Regulation on Transmission Network

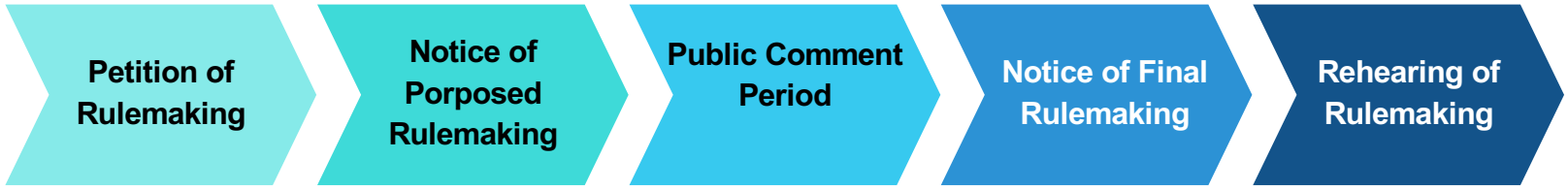
Chuck Marshall
Vice President of Transmission Planning
ITC Holdings

Stephanie Villarreal
Project Execution Manager
Burns & McDonnell

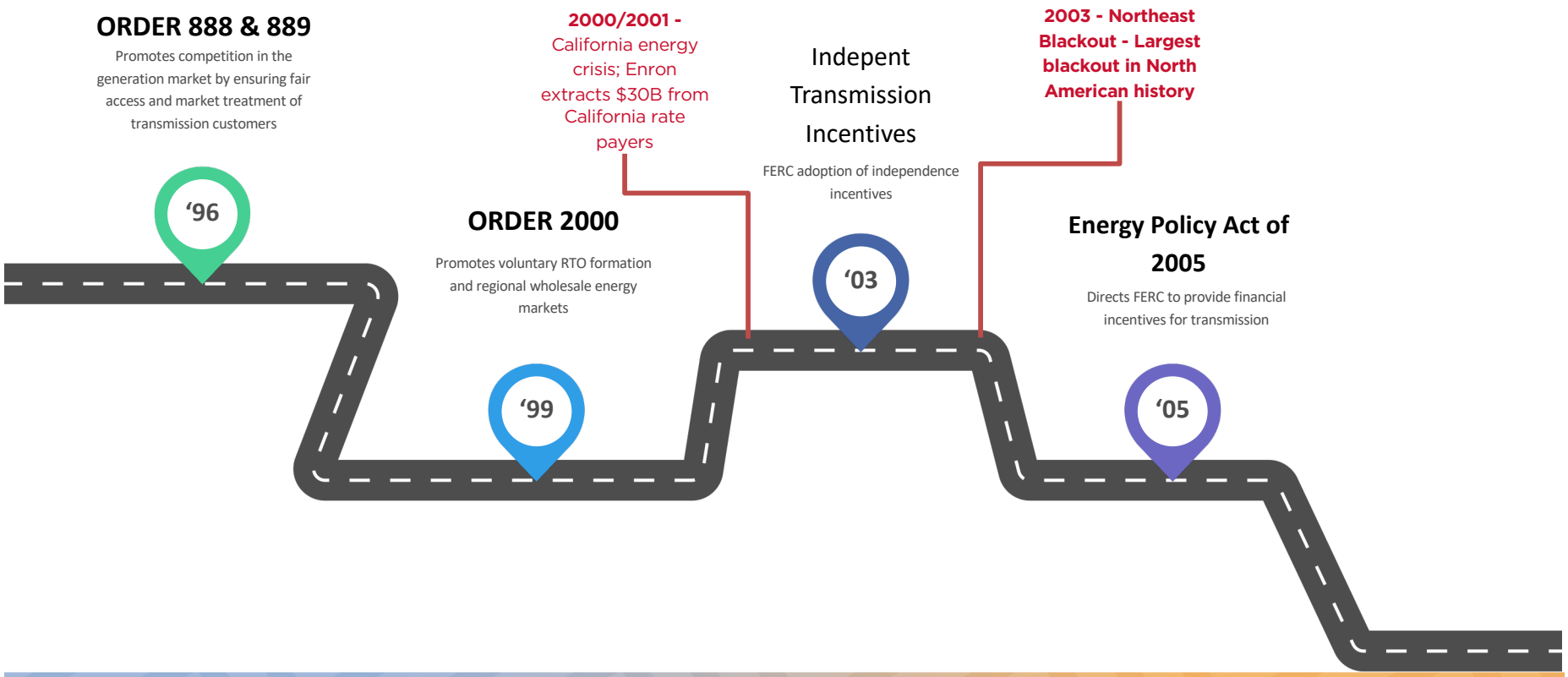
FERC

- Independent Federal Agency formed in 1977
- Core function is to manage wholesale electricity and natural gas in interstate commerce
- 5 commissioners appointed by the President / confirmed by the Senate
- No more than 3 commissioners can be from a single party
- 5-year term
- Administrative agency that penalizes violators through fines

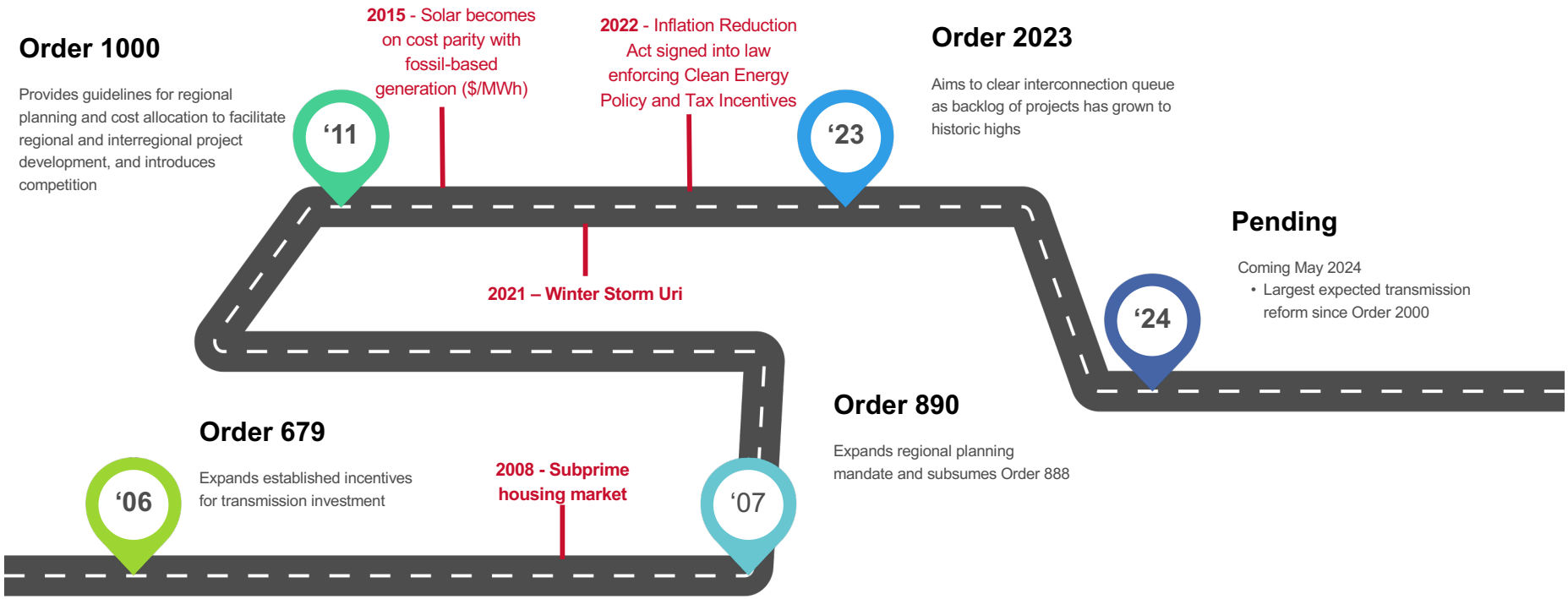
Rulemaking Process



EVOLUTION OF TODAY'S POWER MARKET



EVOLUTION OF TODAY'S POWER MARKET



GROWING CHALLENGES

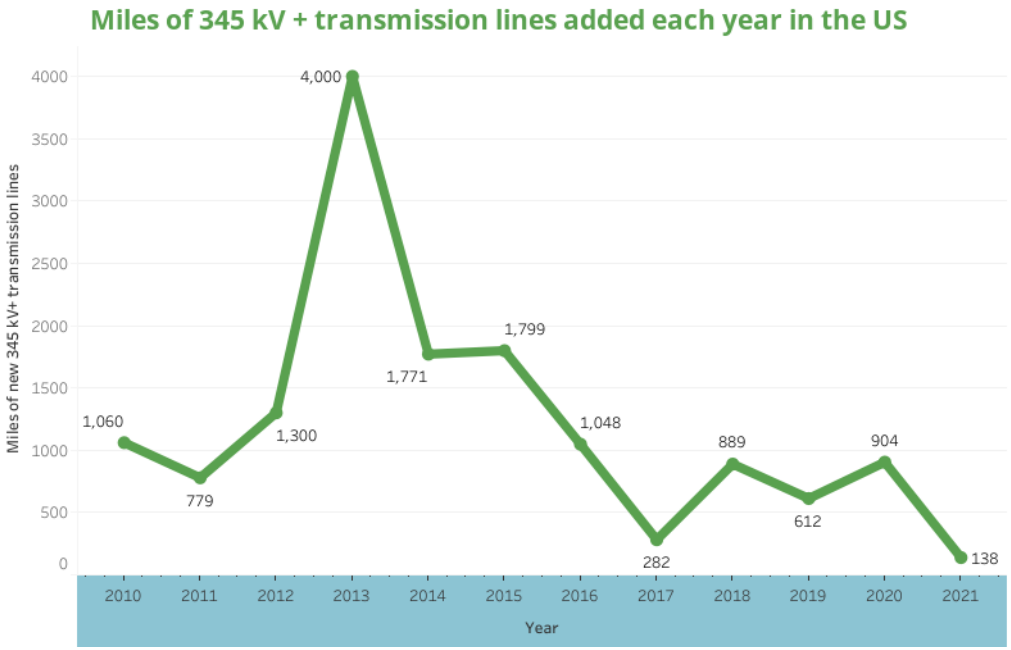
*"We need to expand electricity transmission systems by **60% by 2030**, and may need to **triple it by 2050** to meet the country's increase in renewable generation and expanding needs"*

DOE May 2022

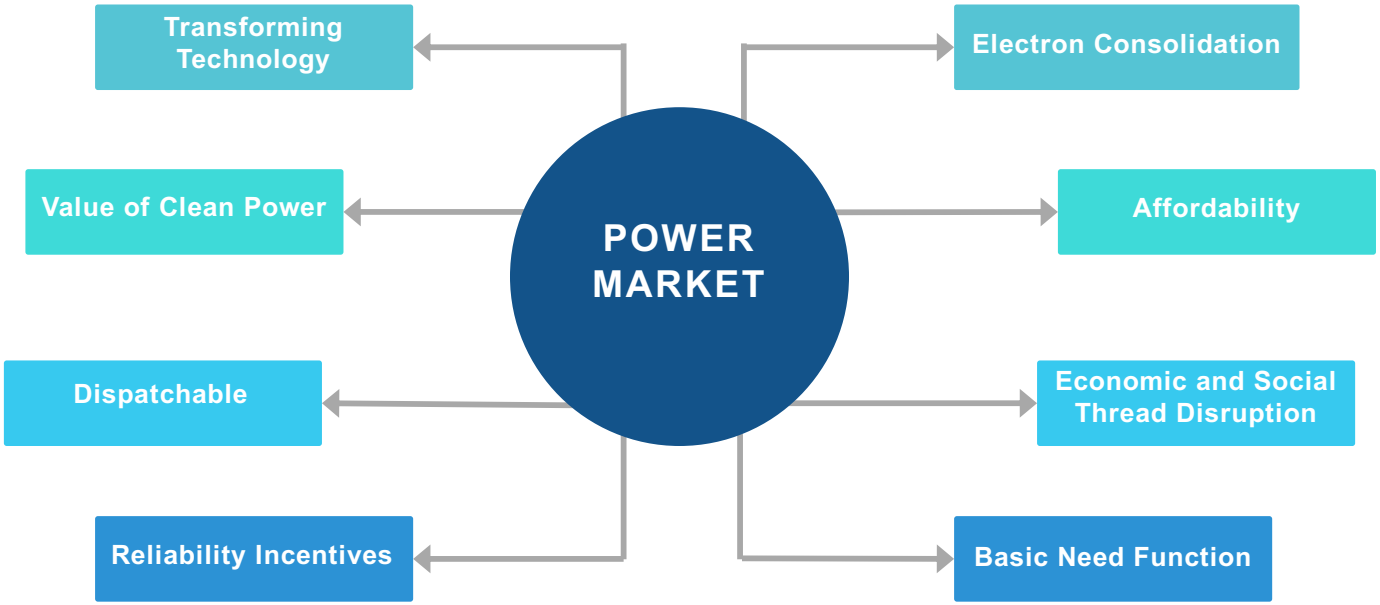
Current Network

>500,000 miles of HV Transmission Lines

>5,000,000 miles of Distribution



HOW SHOULD REGULATORS THINK ABOUT ELECTRICITY IN THE FUTURE?



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CHICAGO
2026

IEEE
May 5-7, 2026

Emerging Leaders Forum
May 3-4, 2026

DINNER

6:00 PM

Puesto


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LEADERS
FORUM
THANK YOU FOR ATTENDING