

BURNS  MCDONNELL



BEST PRACTICES

FORUM

Asheville, N.C. | 2019



Future of Transmission

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Duke Energy

Topics

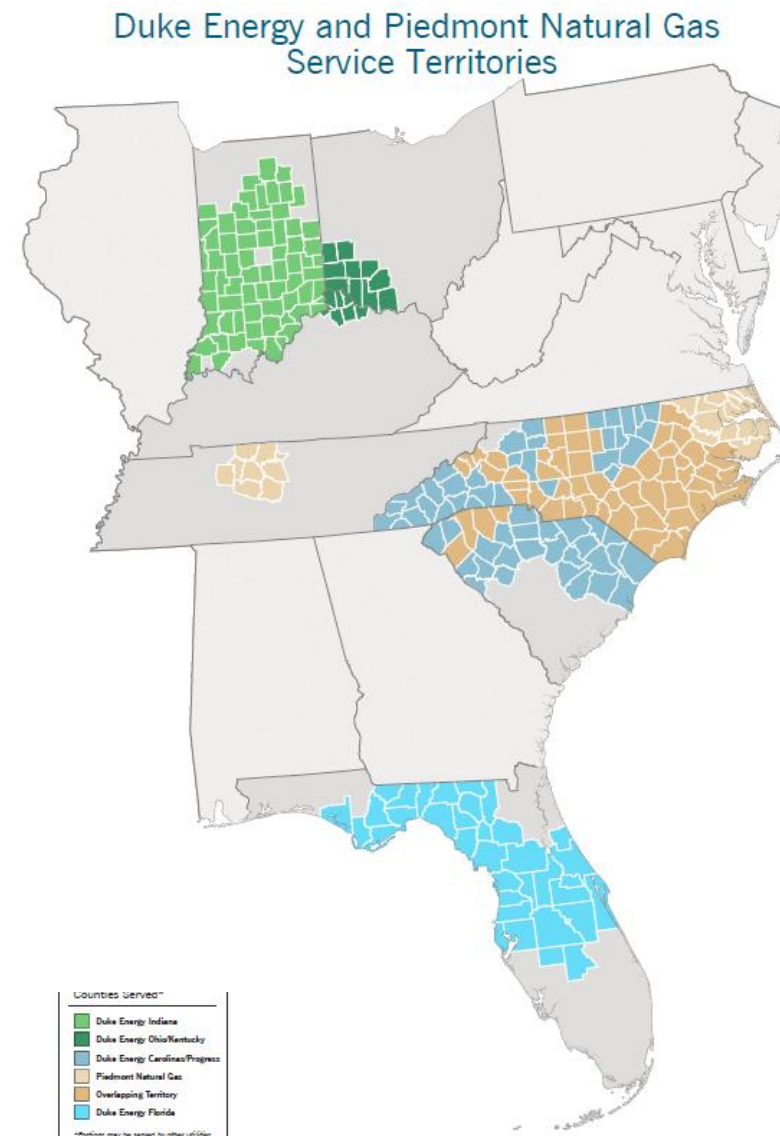
- Background
 - Duke Energy and Transmission
 - Capital Investment
 - Distributed Generation
- Issues / Challenges
 - Industry Issues
 - Operational Changes
- Business Transformation



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Facts About Duke Energy

- 150+ years of service
- Fortune 150 company headquartered in Charlotte, N.C.
- 7.7 million electric retail customers (~24 million people) in six states
- 1.6 million natural gas customers in five states
- 51,000 MW of owned generation capacity
- Renewable and energy efficiency programs
- Wind and solar projects operating in 14 states
- Electric vehicle charging station initiatives
- Duke Energy Renewables – 3,000 MW electric generating capacity
 - Power sold to: electric utilities, municipalities, commercial and industrial customers



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Duke Energy Transmission Overview

Construction, Maint. and Vegetation	System Planning and Operations	Engineering and Asset Management	Resource and Project Management	Operations Services
<ul style="list-style-type: none">• 1,558 employees• 138 contingent workers• Construction and Maintenance• Vegetation Management	<ul style="list-style-type: none">• 384 employees• 16 contingent workers• Control Centers• System Planning• NERC Compliance	<ul style="list-style-type: none">• 610 employees• 169 contingent workers• Engineering• Asset Management	<ul style="list-style-type: none">• 300 employees• 136 contingent workers• Resource and Project Management	<ul style="list-style-type: none">• 83 employees• 18 contingent workers• Training & Workforce• Org. Effectiveness• Health & Safety

Employee and contingent workers as of November 2018

Work Function

- ~3,400 employees, staff augmentation team members
- Approximately 2,500 service contractors
- 2019 Budgets: Capital \$1.5 billion/O&M \$251 million
- Wholesale Revenue: ~\$300 million

Infrastructure

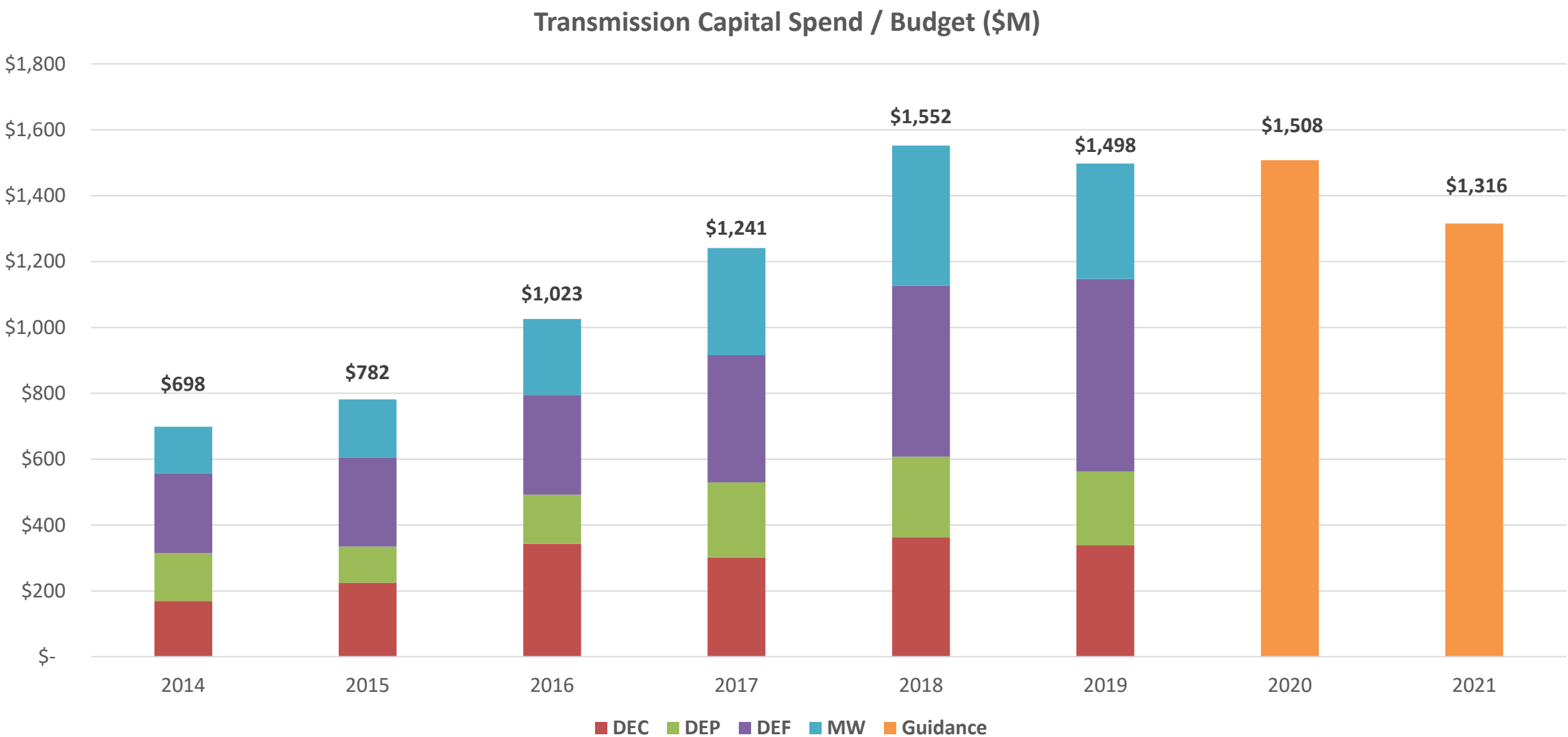
- Miles of transmission lines: 32,200
- Number of transmission substations: 3,300
- Transmission control centers: Five

Industry Standing

- Operating cost – Top decile
- Safety performance – Number one (1st) for large utilities (2018 – Southeastern Electric Exchange)

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Duke Energy Transmission Capital Investments



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Duke Energy – Modernizing the Power Grid



Modernize

Hardening & Resiliency of Substations

Animal **mitigation** and **barriers**

Oil-filled breaker elimination

Replace poor health **Transformers**

Replace vulnerable and outdated equipment

Hardening & Resiliency of Lines

Modified designs for extreme flooding, wind and ice

Wood structures elimination and line **strengthening**



Protect

Physical & Cyber Security

Physical **security** improvements at subs

Eliminating **security** vulnerabilities of field equipment

Threat identification and analysis **tools**



Optimize

System Intelligence Platforms

Conditioned-based **monitoring**

Advanced **fault location & isolation**

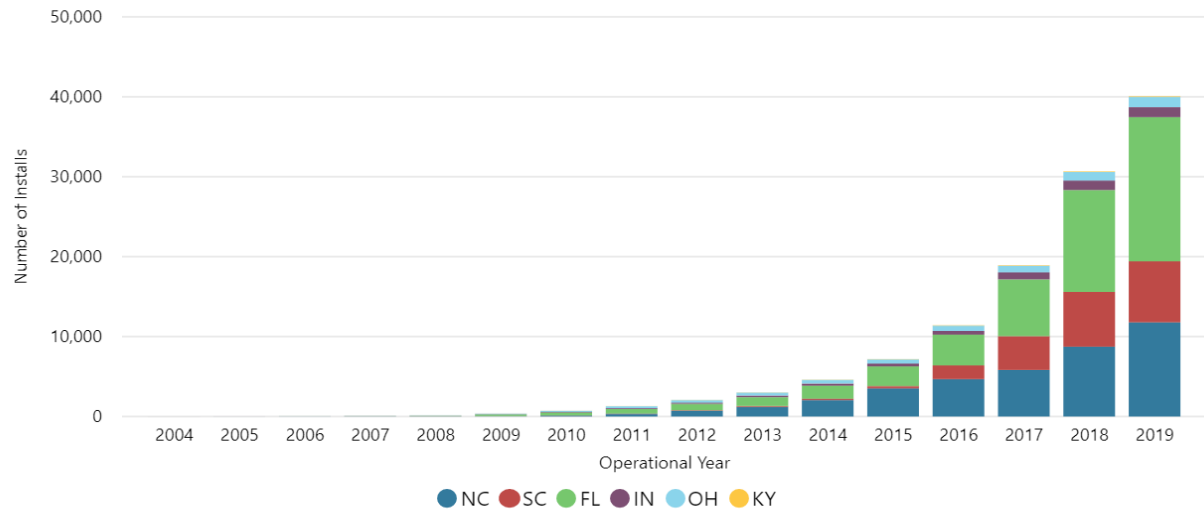
Improved **communication & system intelligence**

Remote switching capability improvements

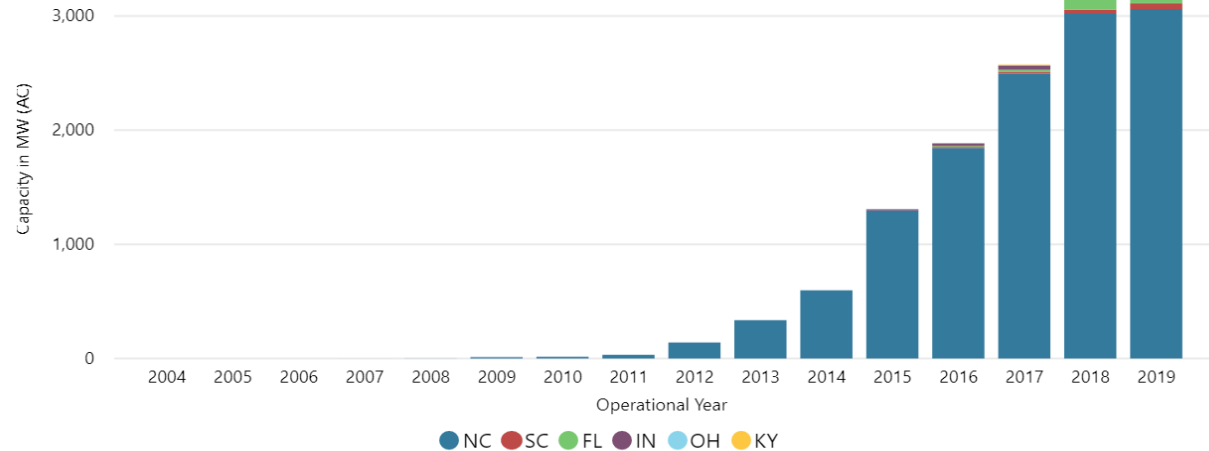
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Duke Energy Solar Generation – Connections by State

3rd Party Private Solar - Cumulative Number of Installs



Universal Solar – Cumulative Installed Capacity in MW (AC)



3rd Party Private Solar - Average Facility Size in kW (AC)

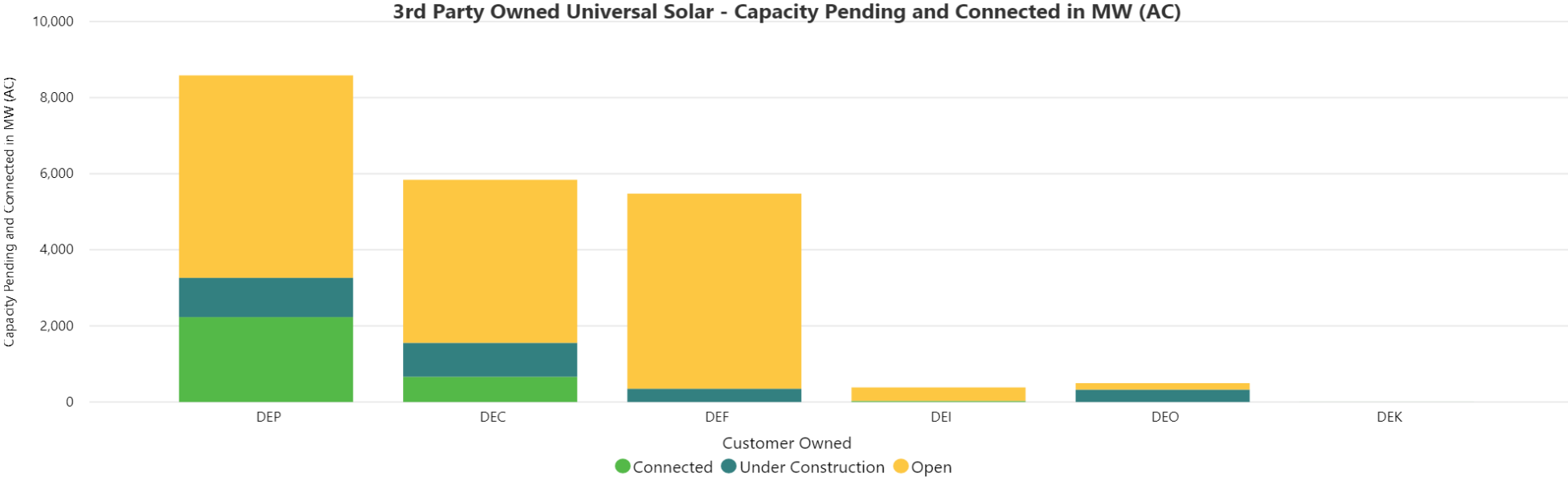
State	Number Of Installs	kW (AC)	Average Size kW (AC)
NC	11,784	111,791	9.49
SC	7,635	92,441	12.11
FL	18,038	147,372	8.17
IN	1,251	29,334	23.45
OH	1,280	22,549	17.62
KY	77	1,365	17.73
Total	40,065	404,851	10.10

Universal Solar - Average Facility Size in MW (AC)

State	Number Of Installs	MW (AC)	Average Size MW (AC)
NC	908	3,061	3.37
SC	38	50	1.31
FL	4	93	23.13
IN	12	42	3.48
OH	2	0	0.00
KY	4	8	1.96
Total	968	3,252	3.36

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Solar Generation – Growth in the Queue



3rd Party Owned Universal Solar - Capacity Pending by Queue Year in MW (AC)							
Queue Issued Year	DEP	DEC	DEF	DEI	DEO	DEK	Total
2013	31	18	0	0	0	0	49
2014	77	2	0	0	0	0	79
2015	551	85	0	0	125	0	761
2016	1,411	415	886	4	0	0	2,716
2017	1,618	1,335	1,616	353	350	0	5,272
2018	2,300	2,686	1,703	0	0	0	6,689
2019	364	637	1,272	0	20	0	2,293
Total	6,353	5,177	5,476	357	495	0	17,859

3rd Party Owned Universal Solar - Number of Installs Pending by Queue Year							
Queue Issued Year	DEP	DEC	DEF	DEI	DEO	DEK	Total
2013	3	2	0	0	0	0	5
2014	14	1	0	0	0	0	15
2015	90	24	0	0	1	0	115
2016	111	45	14	1	0	0	171
2017	61	58	26	4	3	0	152
2018	69	117	23	0	0	0	209
2019	9	13	19	1	2	0	44
Total	357	260	82	6	6	0	711

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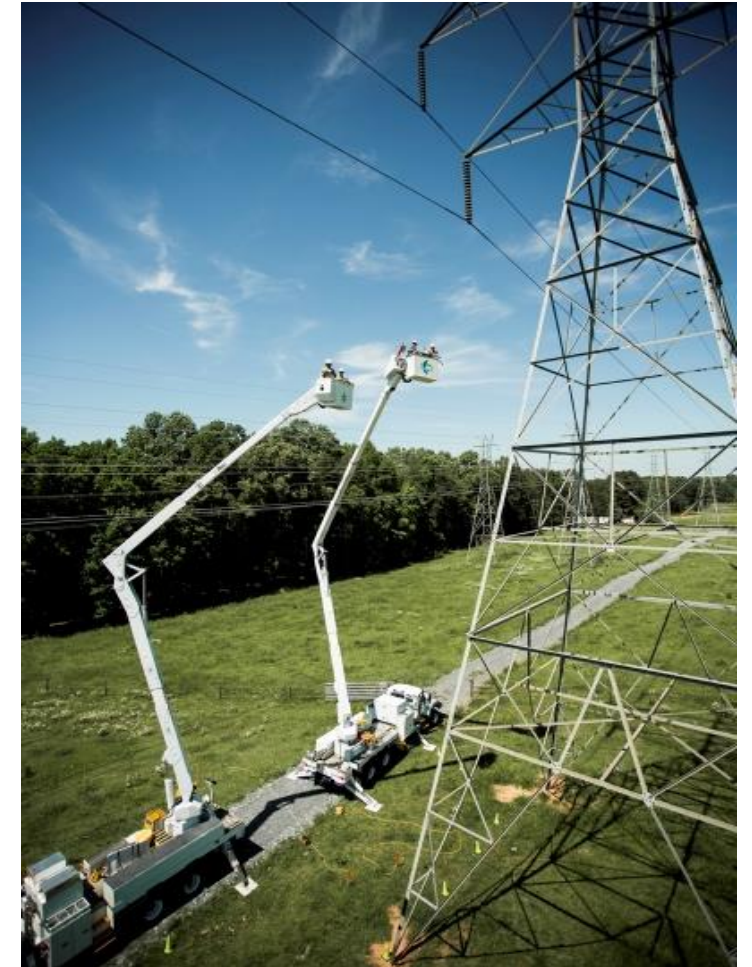
Landscape – NERC-Identified Industry Risks

- Changing Resource Mix
- Bulk Power System Planning
- Resource Adequacy and Performance
- Protection System Complexity
- Human Performance and Skilled Workforce
- Loss of Situational Awareness
- Extreme Natural Events (e.g., hurricane, polar vortex)
- Physical Security Vulnerabilities
- Cyber Security Vulnerabilities
- Critical Infrastructure Interdependencies

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Landscape – Operational Changes

- Evolution of Generation Portfolio
 - Adjustments in Integrated Resource Plans
 - Less baseload
 - Renewables penetration
 - Increase in distributed generation
- Changes in Transmission System Characteristics
- System Planning Challenges



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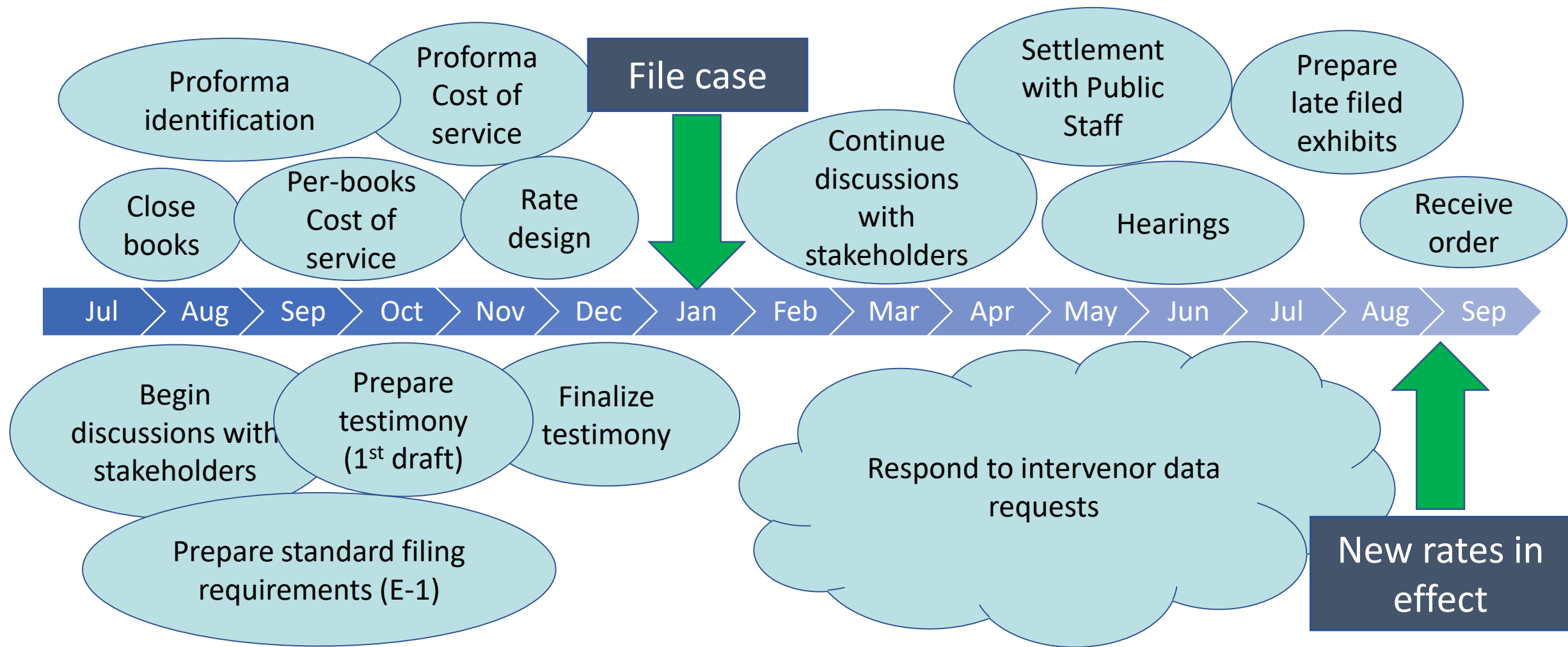
Path Forward

- Balance Competing Fiscal Objectives
- Invest in Analytics, Data Acquisition
 - Leverage technology in vegetation management
 - Integrate digital equipment monitoring for Grid with HRM
- Operating Efficiency
- Respond Quickly to Business Changes
 - Resource mix (Distributed Renewables, Gas)
 - Increased customer demands
 - Innovative technology deployment



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Ratemaking Process – Recognizing Regulatory Lag



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Transmission Business Transformation

Business Transformation Areas

Health & Risk Management Drives Nominal Maintenance

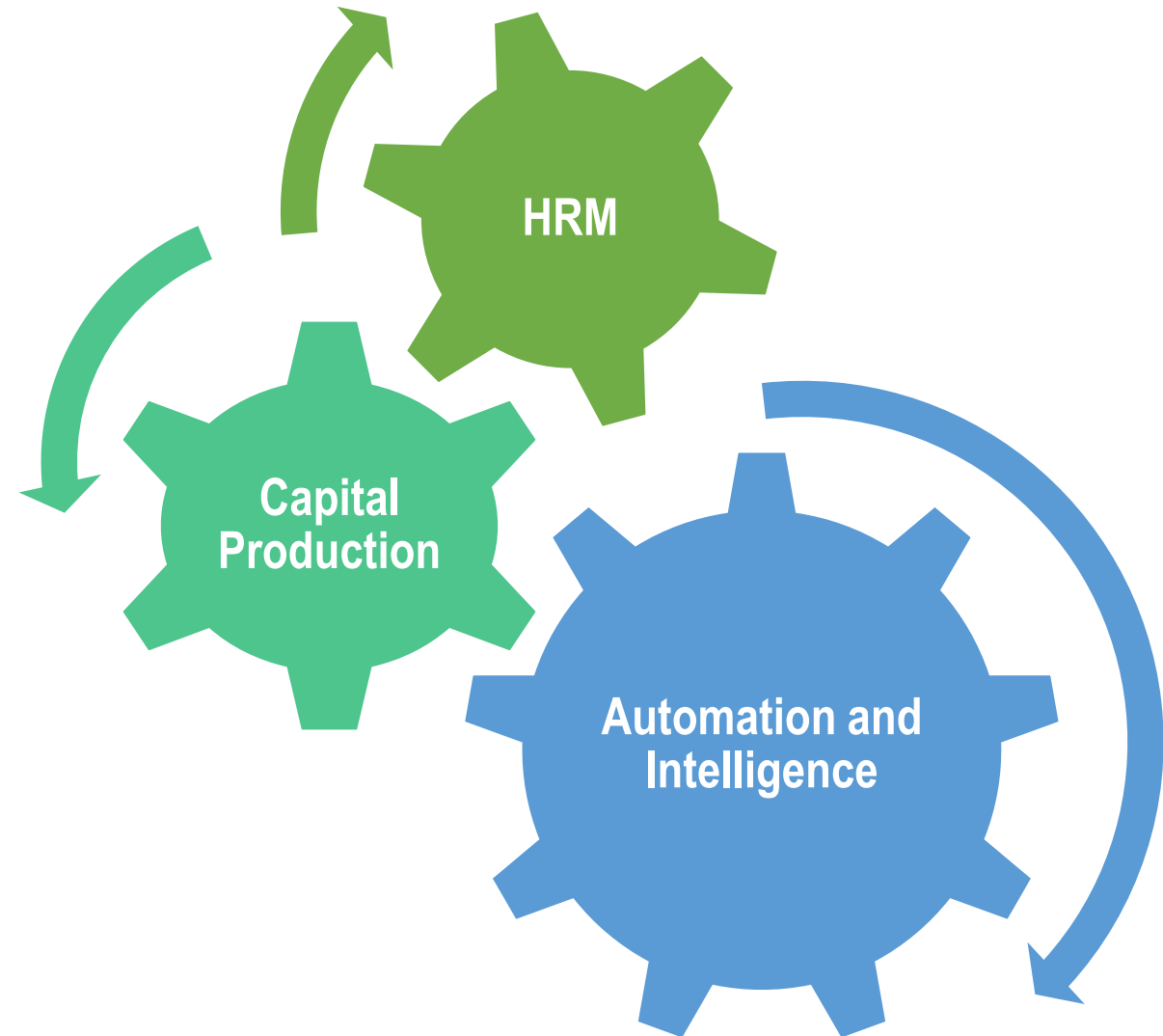
- Eliminate substation inspections
- Maintenance only on condition
- Retrofit high preventative maintenance equipment

Automation and Intelligence

- Robotic Design (sub/line)
- Automated compliance inventory
- Automated switching plans
- Drone info to automated repair work orders
- CU Asset Automation (operational)

Capital Production Effectiveness

- Regional project cost baselines
- Real-time work completion and invoicing
- Amazon-like material tracking



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