



# DER Impacts on Bulk System and T&D Interaction

## ESIG Spring Workshop Tutorial

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March 19, 2019



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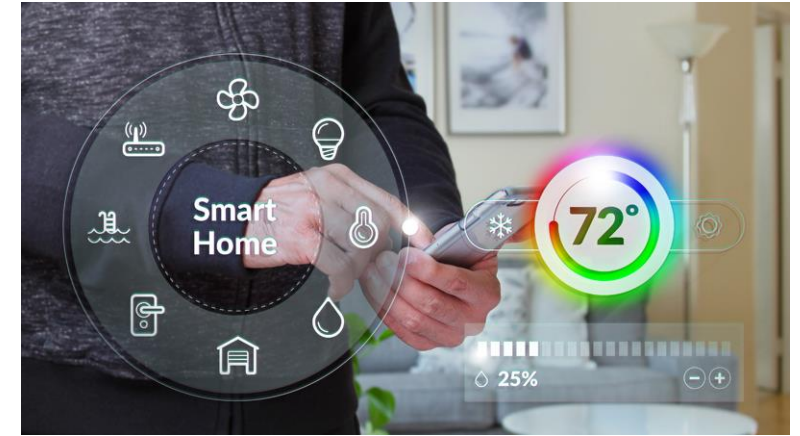
# Why Must Grid Operations and Planning Evolve?



**Changing  
Generation Mix**



**Active Distribution  
Systems**

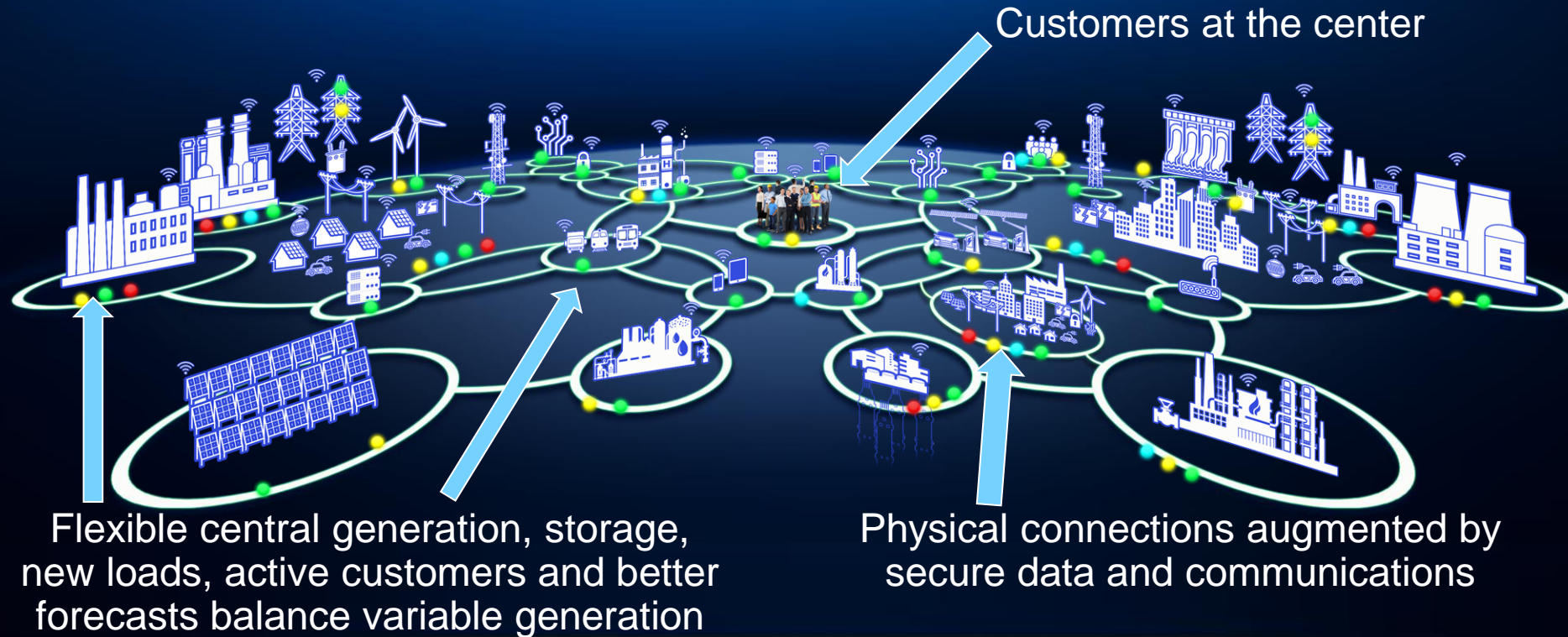


**Consumer Control  
and Electrification**



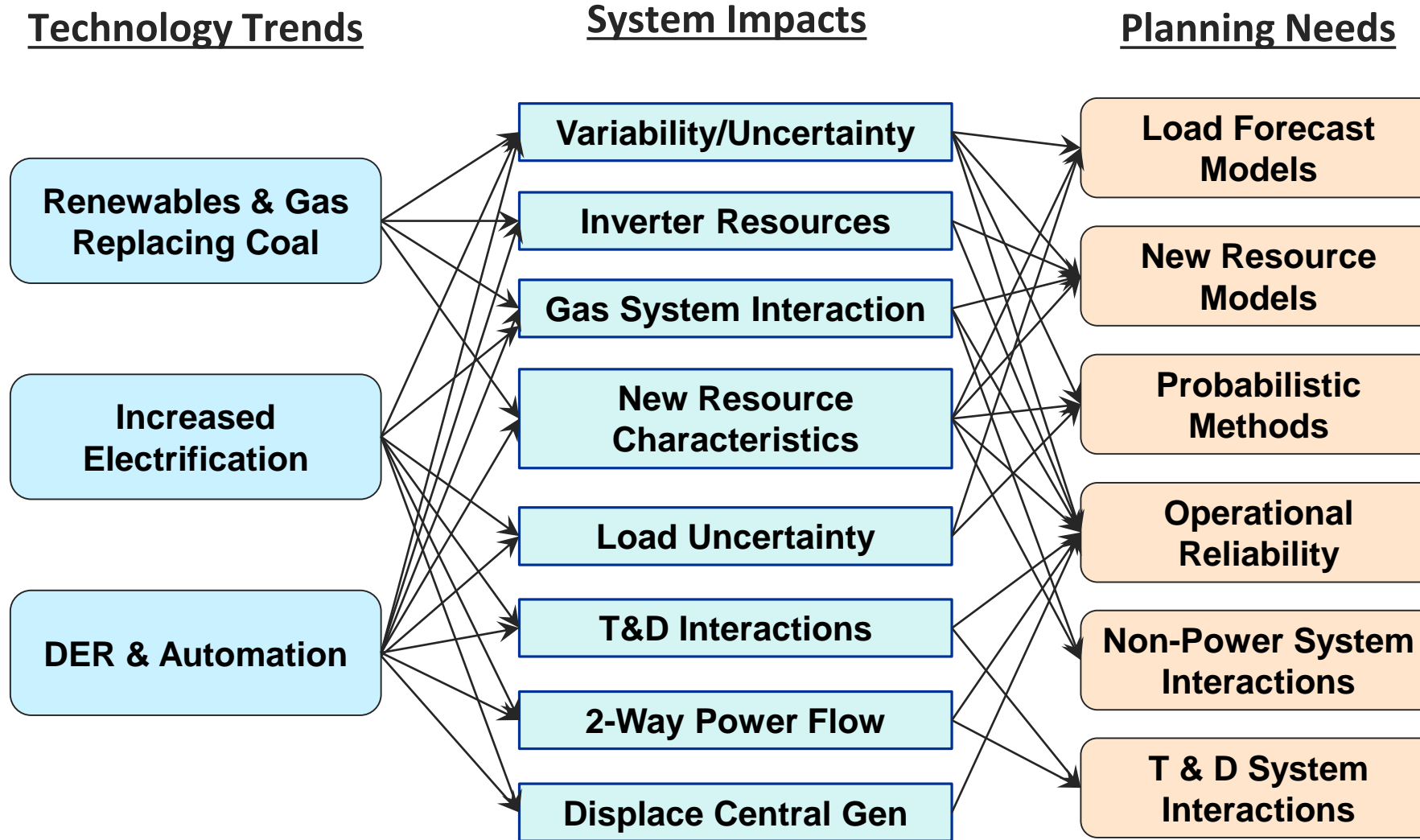


# *Integrated Energy Network*

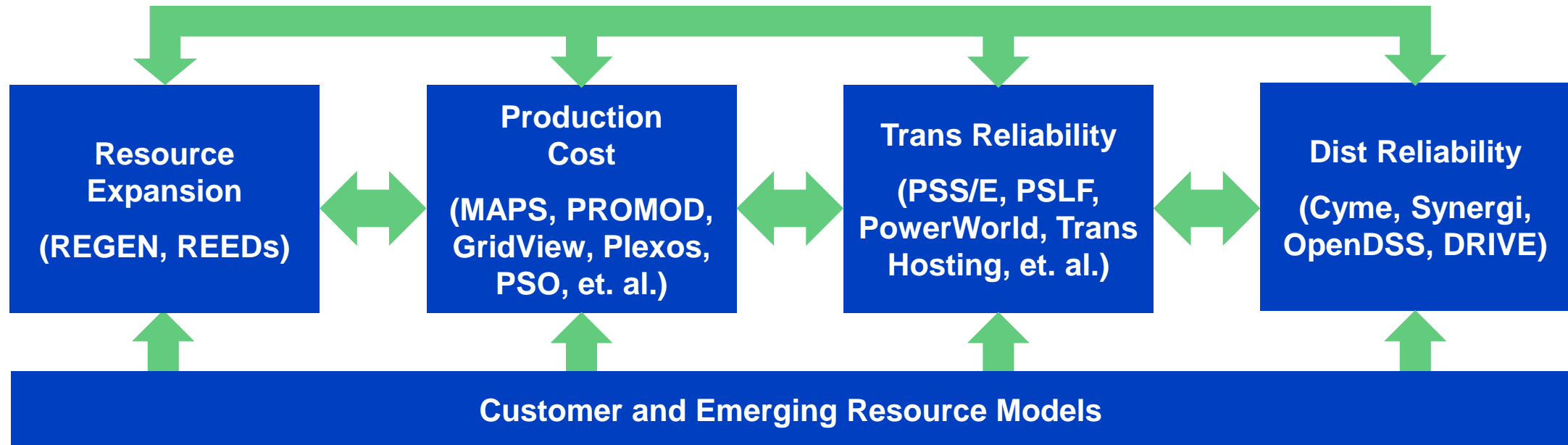


**Energy and Natural Resource Systems are Integrated to Provide Reliable, Safe, Affordable, Cleaner Energy and Expanded Customer Choice**

# Emerging System Characteristics & Planning Impacts



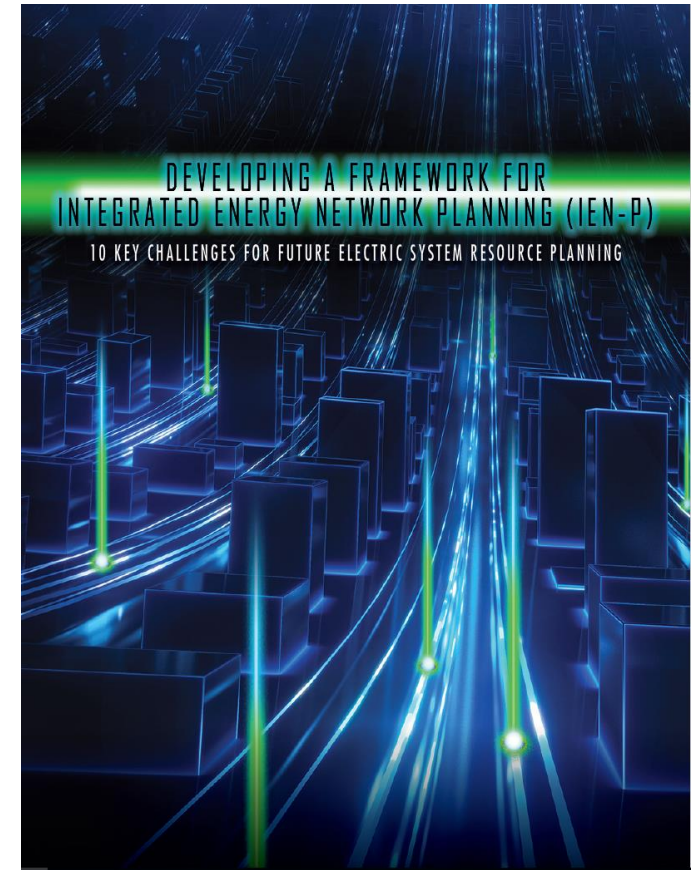
# New Planning Paradigm Needed



**Operational realities of emerging resource mix and potential benefits of DER necessitates new and more integrated planning analytics.**

# IEN Resource Planning Challenges

Category	Key IEN Planning Challenge
Modeling the Changing Power System	<ol style="list-style-type: none"><li>1. Incorporating operational detail</li><li>2. Increasing modeling granularity</li><li>3. Integrating generation, transmission &amp; distribution planning</li><li>4. Expanding analysis boundaries and interfaces</li><li>5. Addressing uncertainty and managing risk</li></ol>
Integrating Forecasts	<ol style="list-style-type: none"><li>6. Improving forecasting</li><li>7. Improving modeling of customer behavior and interaction</li></ol>
Expanding Planning Boundaries	<ol style="list-style-type: none"><li>8. Incorporating new planning objectives and constraints</li><li>9. Integrating wholesale power markets</li><li>10. Supporting expanded stakeholder engagement</li></ol>

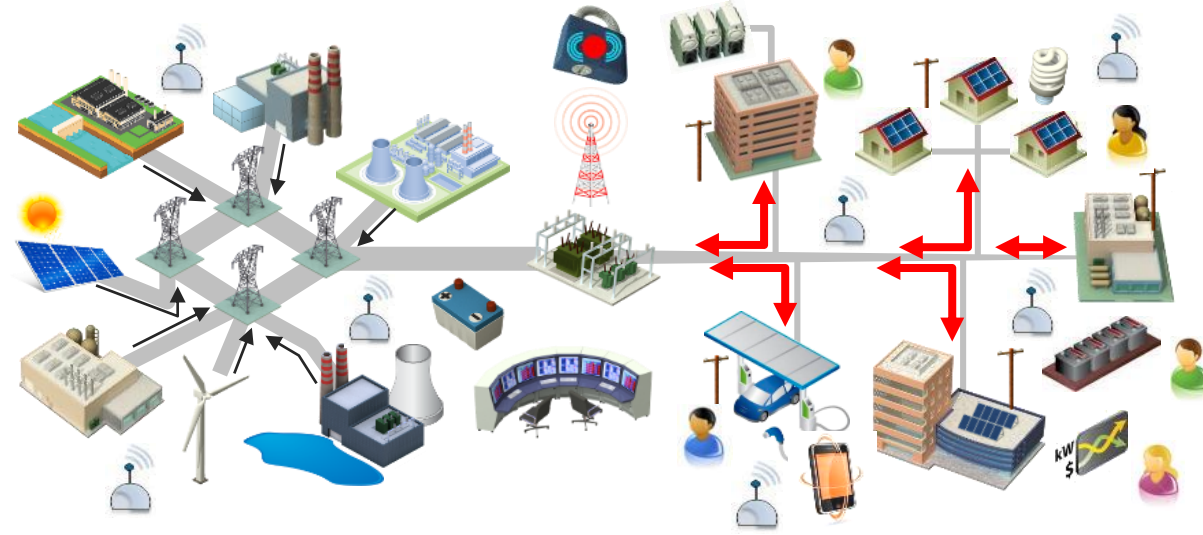


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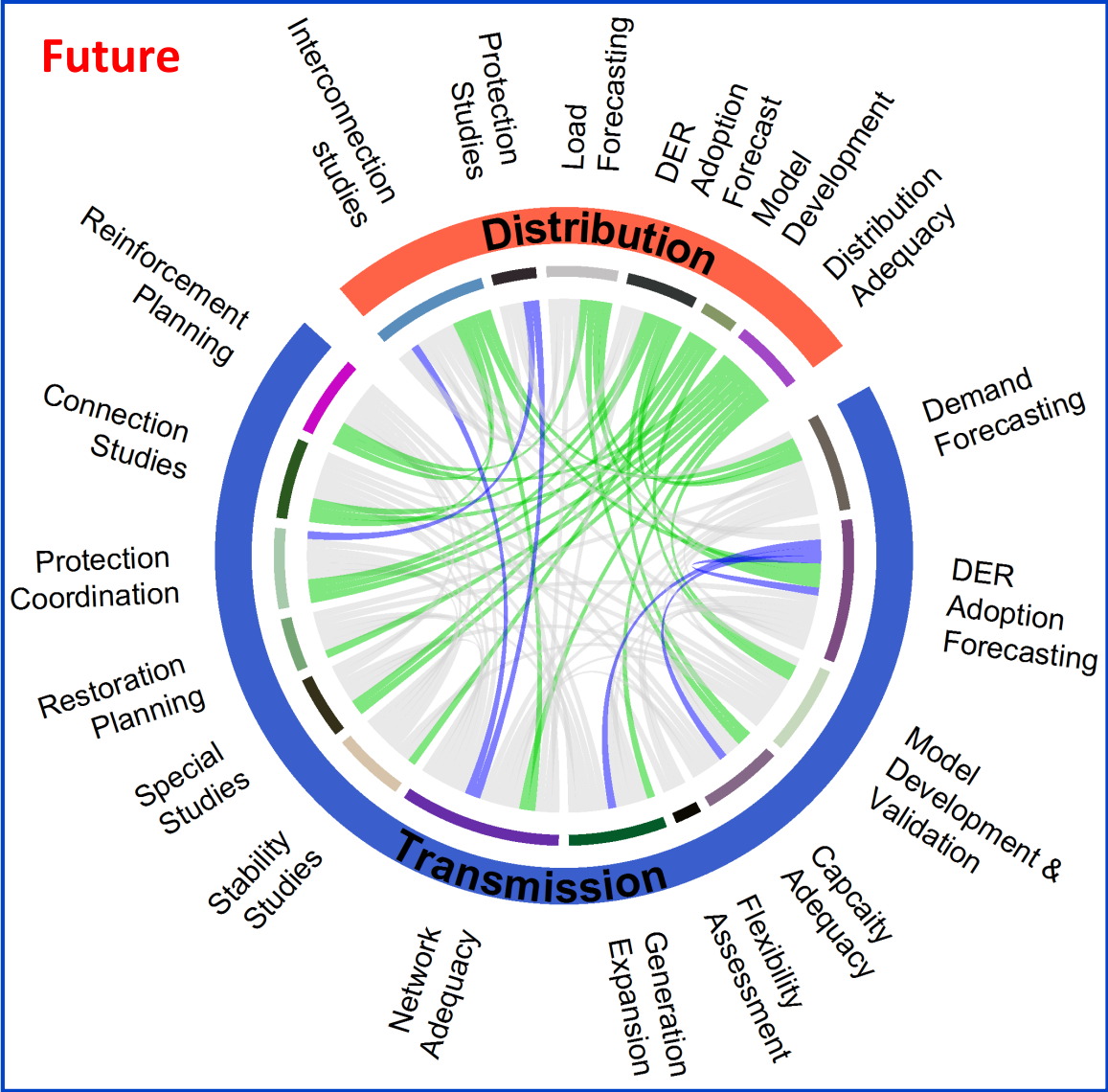
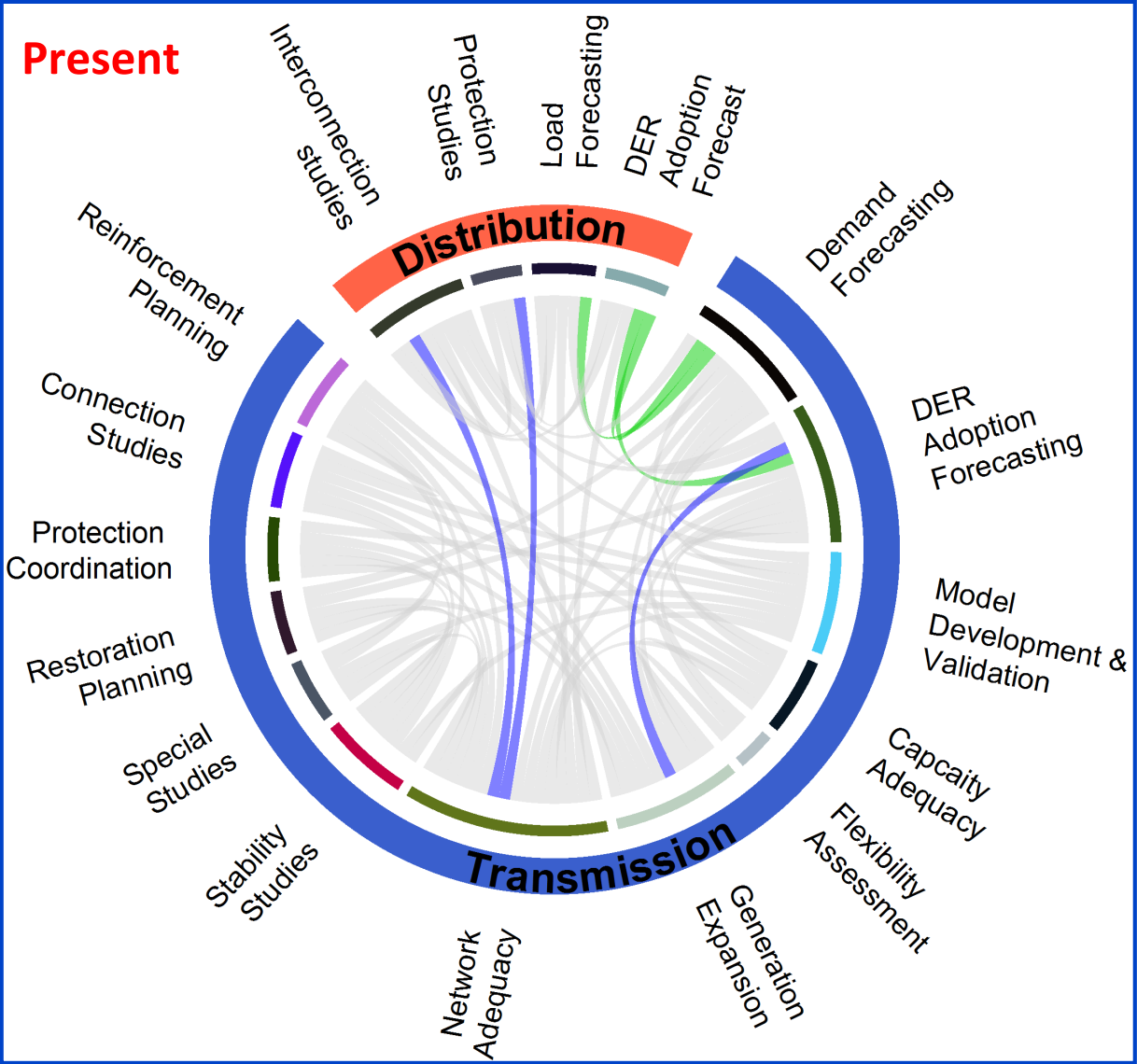
# Integrating G, T, and D Planning

- TSO/DSO interaction increasingly is important, particularly as the distribution system provides more services
- Allows for evaluation of “non-wires alternatives” (NWA) to new G, T and/or D investments
- DER valuation and targeting, including locational attributes
- Improve communications and “hand shakes” between planning functions
- Connections to other critical infrastructure (e.g., natural gas, H<sub>2</sub>O, EVs)



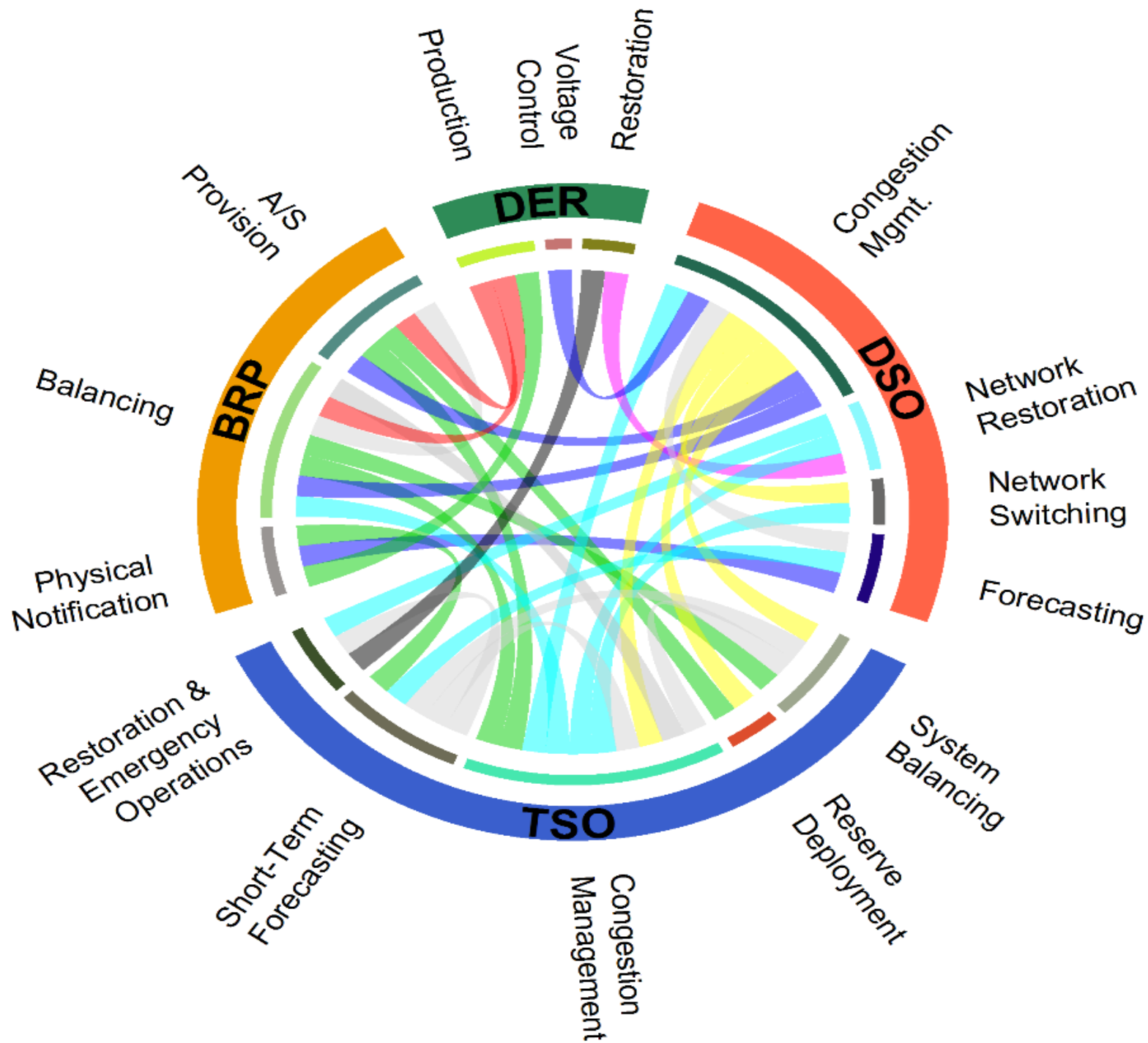


# Coordination in Long Term Planning





# Real Time Operations



# Ongoing Initiatives

## U.S.



## Europe



- CIGRE
- IEEE

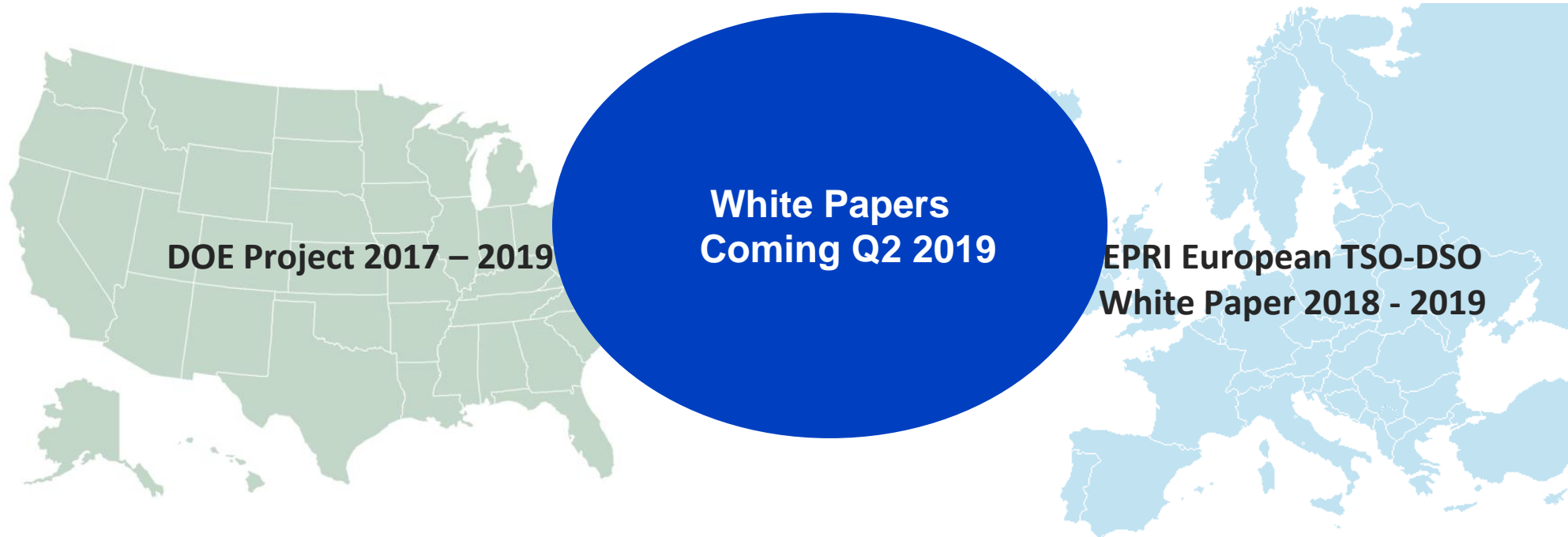
- FERC orders and proposals
- New York NYISO roadmap
- California DR, DER, market integration
- Texas ERCOT DER integration
- Hawaii HECO programs

- European Network Codes
- ENTSO-e + DSO Group Initiatives
- Germany National Processes
- Netherlands ETPA
- SmartNet H2020 multiple partners

# Two Parallel EPRI Efforts to Investigate the Issue

U.S.

Europe



Two Stakeholder Workshops in 2018 attended by  
> 25 EPRI member companies from transmission  
and distribution



# Today's Panel

# Aims of Session

- Discuss changes coming based on increased DER penetration
- Provide opportunity to hear on latest modeling and analysis
- Dive into a few of the most important aspects of T&D interaction
- Audience discussion to identify key challenges for future work

**Knowledge transfer and discussion of key issues**

# Overview of Remainder of Session

1. Charlie Vartanian, PNNL - IEEE 1547 and Bulk Power System Considerations
2. Bryan Palmintier, NREL - Transmission/Distribution Co-simulation Approaches
3. Ning Kang, ANL - T&D Co-simulation Considerations  
(Short break)
4. Ratan Das, GE - Protection Implications of DER
5. Paritosh Das, NREL - Load forecasting for planning
6. Group discussion



# Participate in Interactive Polls

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**How many previous EPRI GO&P Advisory meetings have you attended?**

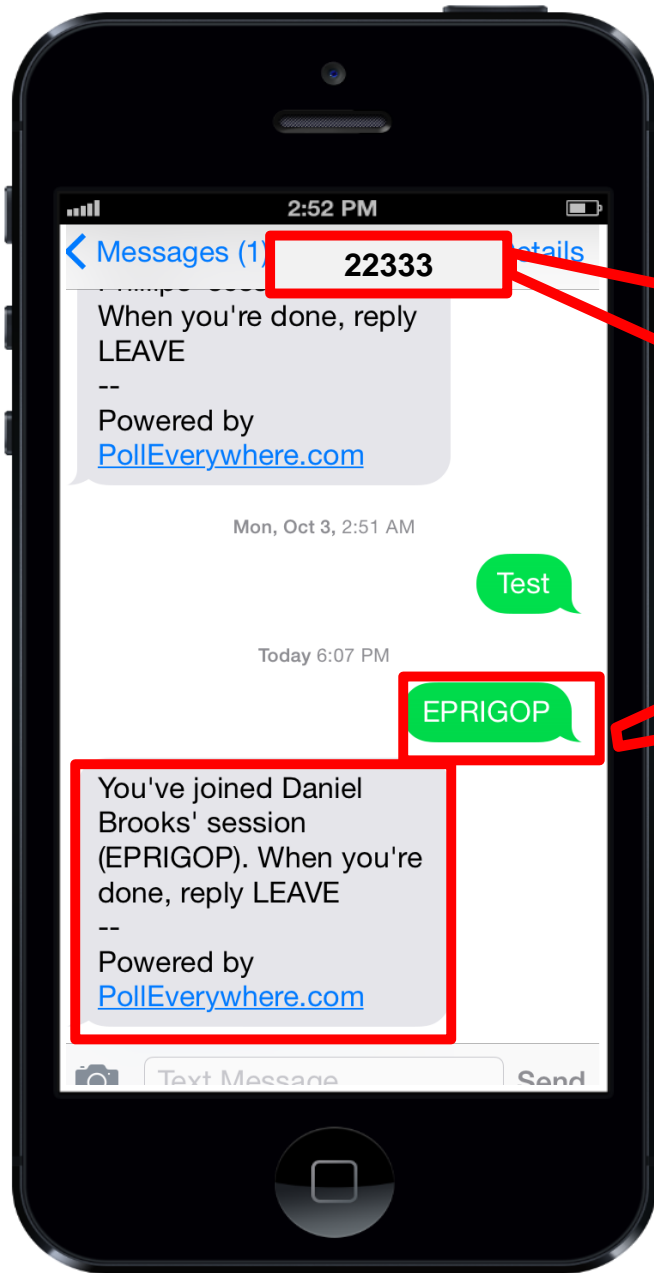
You can respond once

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0	1-2
0	3-4
0	>4

Clear last response

**Page auto updates with current poll. Respond by clicking or typing text.**

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Brooks' session  
(EPRIGOP). When you're  
done, reply LEAVE

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# Which of the following best describes your organization?

Utility

ISO

Consultancy

Software vendor

Hardware vendor

Renewable developer

R&D organization

University

Other

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## In which area do you work or carry out research? (Select closest one)

Resource/System Planning

Transmission Planning

Distribution Planning

Corporate Strategy

Transmission Operations (Real Time, Ops Planning)

Distribution Operations

Market Operations and Design

System Protection

T&D Interaction

Forecasting

Trading

Other

# What type of DER are you experiencing in your region, or do you analyze in your job?

Rooftop/Small Scale PV

Community Scale/Commercial Distributed PV

CHP

Diesel Generators

Other Synchronous DER

Electric Vehicles

Demand Response

Other

## What level of T&D interaction do you currently experience in your day-to-day role?

Frequent interactions between T&D  
that are significant to my role

Frequent interactions, but minor to  
my role

Infrequent but important to my role

Infrequent and not important to my  
role

None

Not sure



# What challenges are you currently seeing or actively working on related to DER and T&D coordination? (All that apply)

Visibility of DER

Controllability of DER

Protection settings and considerations

DER modeling in transmission planning studies

DER modeling in distribution planning

Data sharing across T&D Operations

Data sharing across T&D Planning

Impacts of Reverse Power Flow on System Protection

Standards development and applications

Forecasting adoption of DER

Operational forecasting

Scheduling/Dispatch with DER

Market design

Resource planning

Other (please speak up)

# What is one thing that is most pressing related to DER and T&D interactions you would like to hear about?

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# Panel Discussion

# What level of T&D interaction do you expect to experience in your role in coming years?

More frequent interactions between  
T&D and more significant to my role

More frequent interactions, but doesn't  
change my role much

About the same, though more important

About the same, and same or less  
importance

Less frequent interactions

No interactions

Not sure

**What are the key challenges related to DER integration and T&D coordination? (short answers please, and use a dash between words, e.g. "DER-modeling")**



**What new information or challenges did you learn about today? (Short answers, separated by a dash, e.g. 'Long-term-forecasting')**

# What other information would you like to learn about in this area?

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