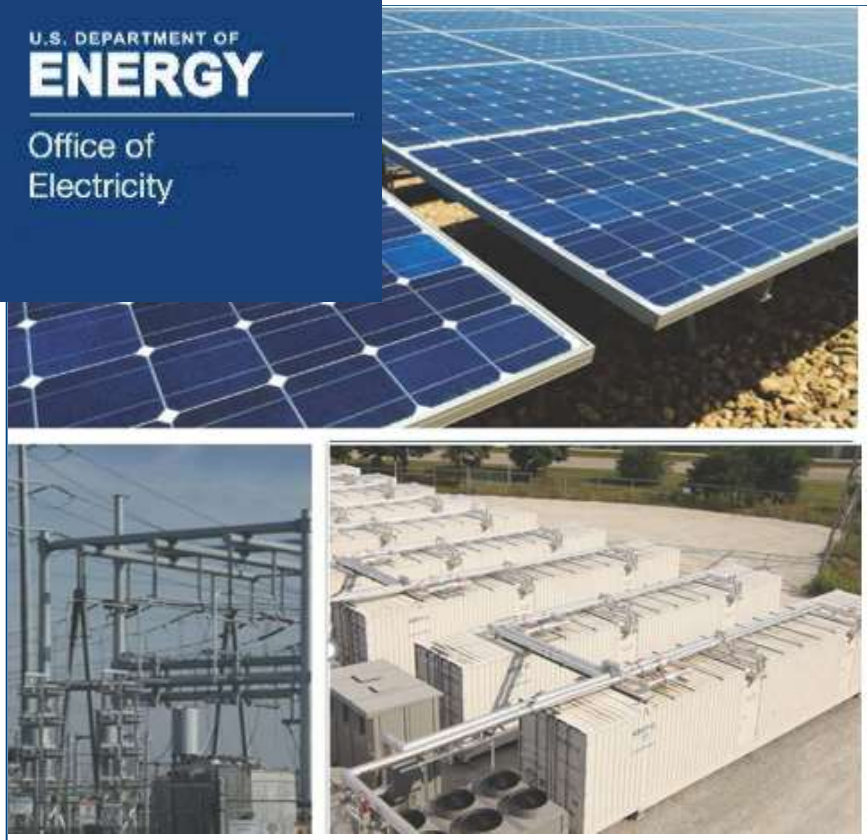
U.S. DEPARTMENT OF ENERGY
Office of Electricity



System Integration Considerations

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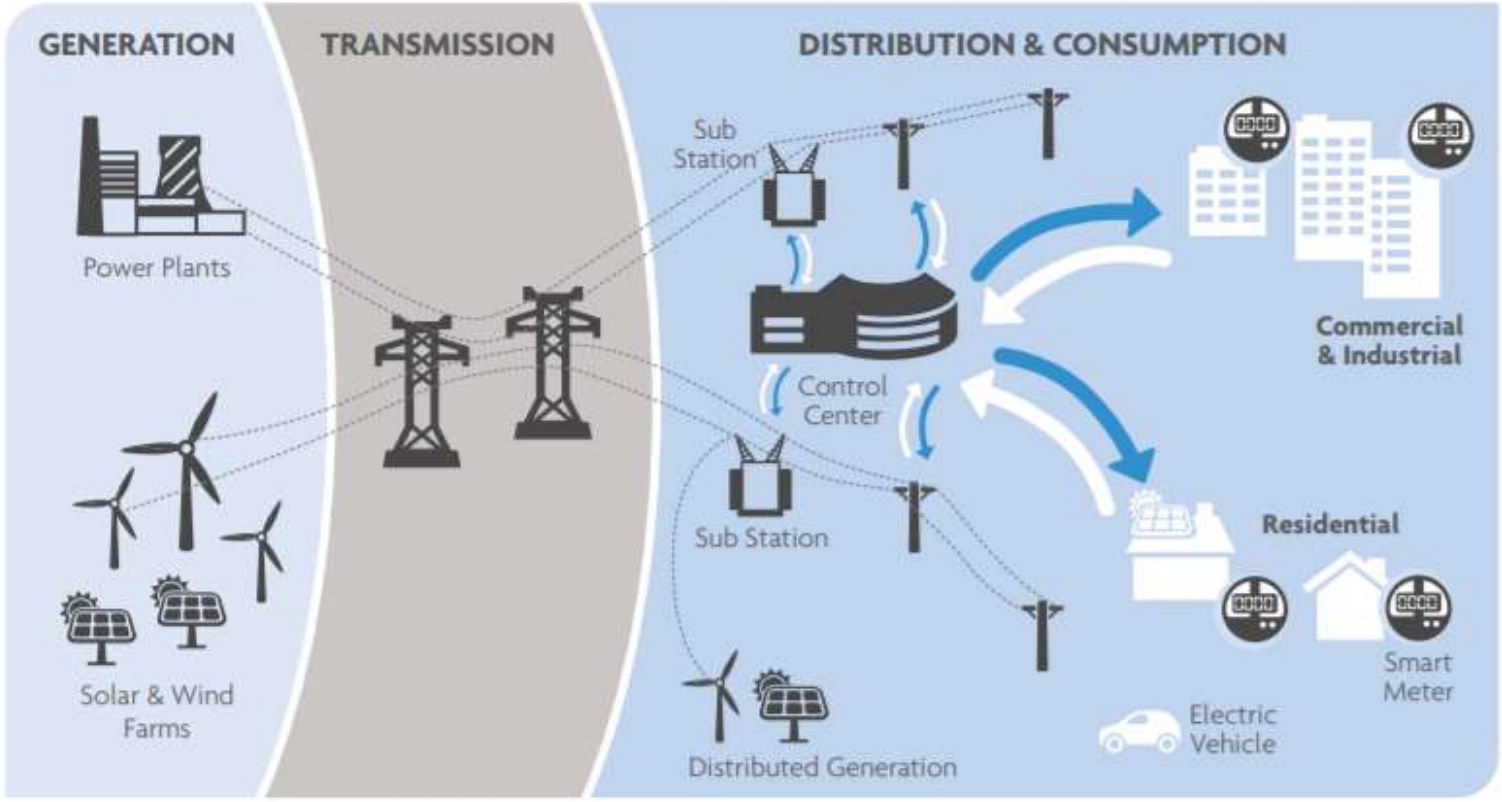
Office of Electricity, U.S. DOE

2019 NASEO Annual Meeting

September 17, 2019

Increasing Complexity

We are evolving from a one-directional to multi-directional network with regard to the flow of energy, information, and financial transactions, yet need to maintain or improve reliability, resilience, and affordability



Traditional Planning Processes

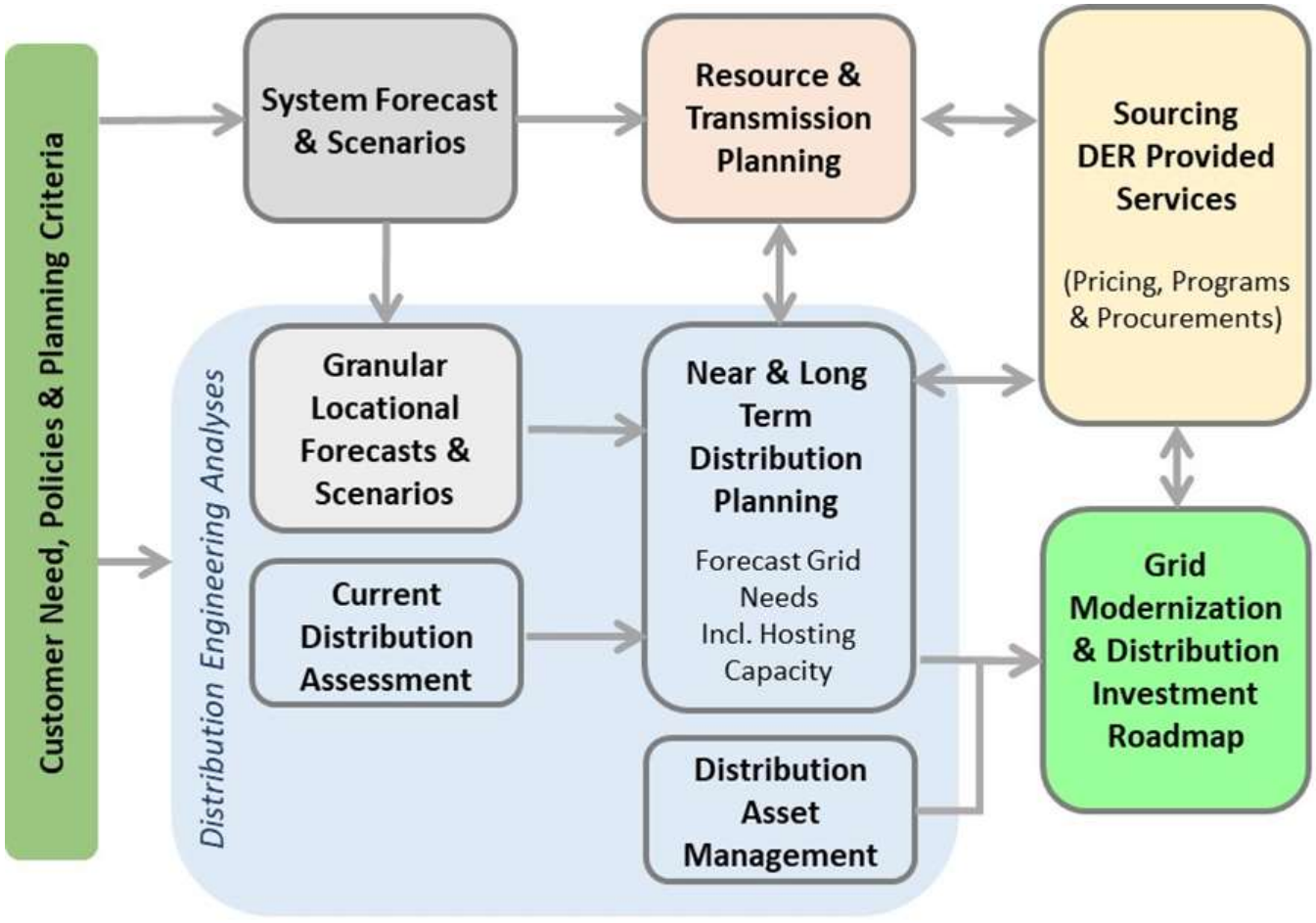
Distribution Asset Management	Evaluate asset condition to identify **asset replacement** schedules and **manage risk** around the likelihood and consequence of outages stemming from various failure modes
Distribution Planning	Identify the distribution system upgrades needed to maintain **load serving capacity** and **distribution system reliability**
Resource Planning	Assess system **supply/demand balance** and the need for additional resources needed to maintain **resource adequacy**
Transmission Planning	Address bulk system infrastructure needs to ensure generator **deliverability** and address **bulk system congestion**

Evolution of Planning

Distribution Asset Management	Evaluate asset condition to identify **asset replacement** schedules and **manage risk** around the likelihood and consequence of outages stemming from various failure modes		
Distribution Planning	Identify the distribution system upgrades needed to maintain **load serving capacity** and **distribution system reliability**	+	Support **DER integration** and **DER utilization** to meet grid needs (e.g. through non-wires alternatives)
Resource Planning	Assess system **supply/demand balance** and the need for additional resources needed to maintain **resource adequacy**	+	**Reflect the impact of distributed energy resources** on system resource adequacy
Transmission Planning	Address bulk system infrastructure needs to ensure generator **deliverability** and address **bulk system congestion**		

EIA reports solar generation as a percentage of total generation (2014 - 2017): CA (7-16%), VT (1-11%), NV (3-11%), HI (5-11%), & MA (3-8%)

Integrated Grid Planning Processes



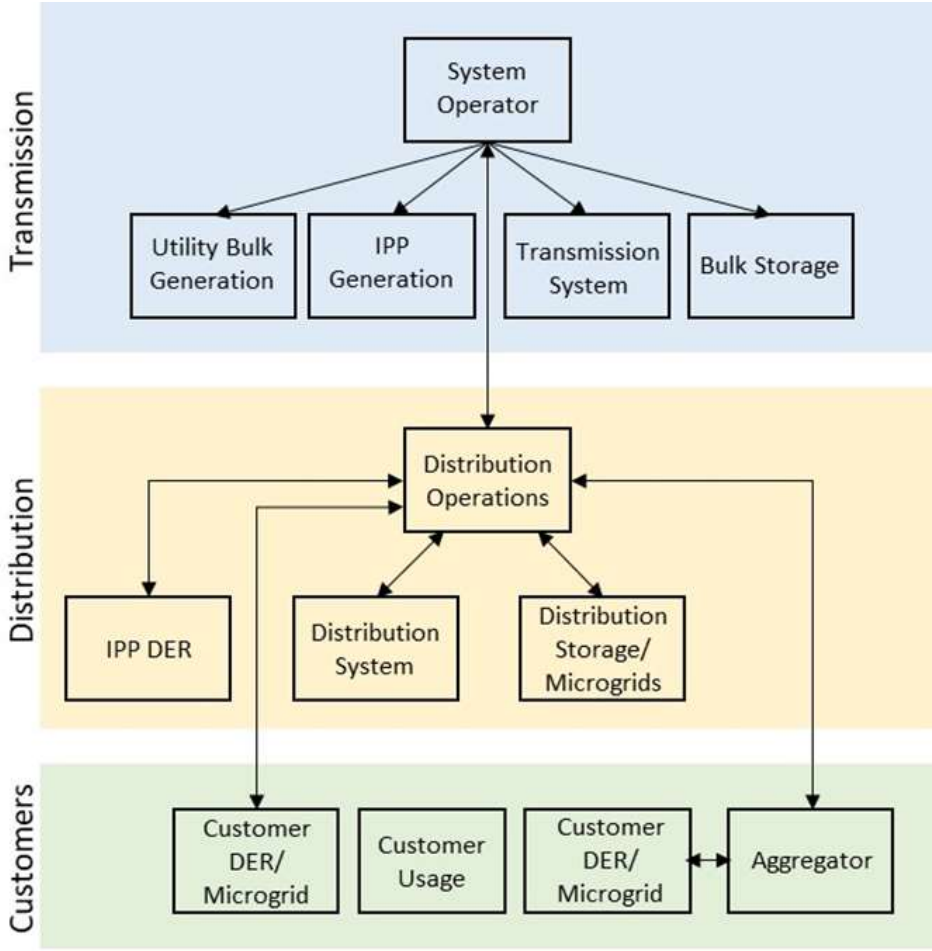
Adapted from P. De Martini, *Integrated Distribution Planning*, ICF

Operational Coordination

A coordination framework should identify roles, responsibilities and information sharing requirements

Application of grid architecture principles to examine and shape coordination frameworks:

- Observability
- Scalability
- Cyber security vulnerability
- Layered decomposition
- Tier bypassing
- Hidden coupling
- Latency cascading



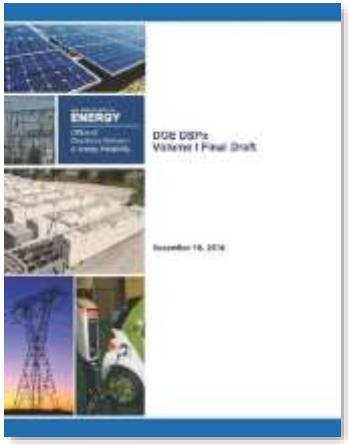
Thank You

Contact:

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

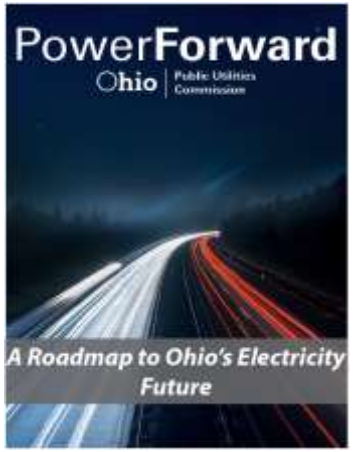
References:

Modern Distribution Grid Report



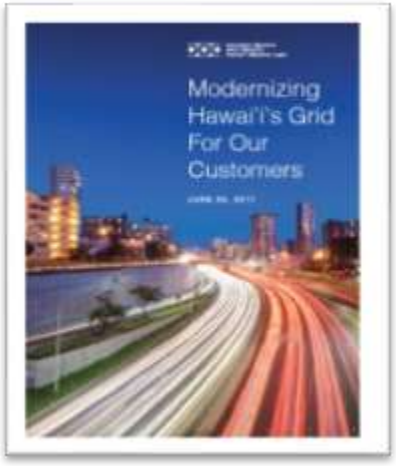
https://gridarchitecture.pnnl.gov/modern-grid-distribution-project.aspx

PUCO Grid Mod Roadmap



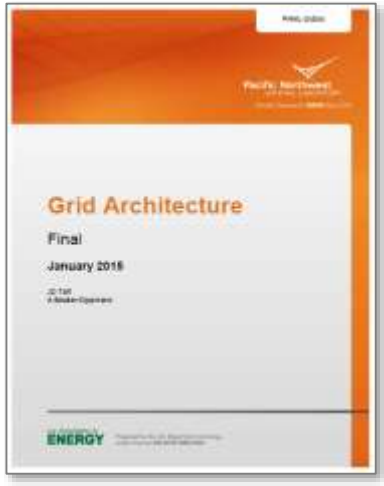
https://puco.maps.arcgis.com/apps/Cascade/index.html?appid=59a9cd1f405547c89e1066e9f195b0b1

Grid Modernization Strategy Using DSPx



www.hawaiianelectric.com/gridmod

Grid Architecture



http//gridarchitecture.pnnl.gov