Staff Subcommittee on Electricity and Electric Reliability

NARUC Summer Policy Summit

Staff Subcommittee on Electricity & Electric Reliability and Staff Subcommittee on Energy Resources and the Environment

Do Your Utilities Need Grid Modernization to Integrate Distributed Generation?

NARUC Summer Policy Summit

Grid Modernization to Integrate Distributed Generation?

<u>Moderator:</u> Kim Jones, North Carolina

<u>Speakers:</u>

Anda Ray and Barbara Tyran, EPRI

Joe Paladino, DOE

Paul DeMartini, Newport Consulting Group

Our Energy Future:

Integrated Energy Network

Anda Ray, Barbara Tyran

EPRI | ELECTRIC POWER RESEARCH INSTITUTE

SVP, External Relations and Technical Resources
Executive Director, Government & External Relations

NARUC Summer Policy Summit
San Diego, CA
July 16, 2017

Our Members…

- 450+ participants in more than 30 countries
- EPRI members generate approximately 90% of the electricity in the United States
- International funding of nearly 30% of EPRI's electric utility research, development, and demonstration funding

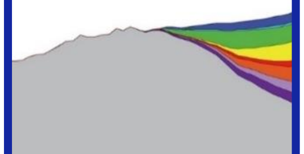
Our Advisors…

- Public Utilities Commissioners
- Wall Street and Academia
- Consumer Advocate
- Academia
- Business and Government Leaders

EPRI ELECTRIC POWER RESEARCH INSTITUTE

The Integrated Energy Network Builds upon Decades of EPRI Thought Leadership

PRISM: Portfolio for Clean Generation



Energy Efficiency

Flexible, Resilient, and Connected Power System

Connected Customers

Integrated Grid

2016-2017

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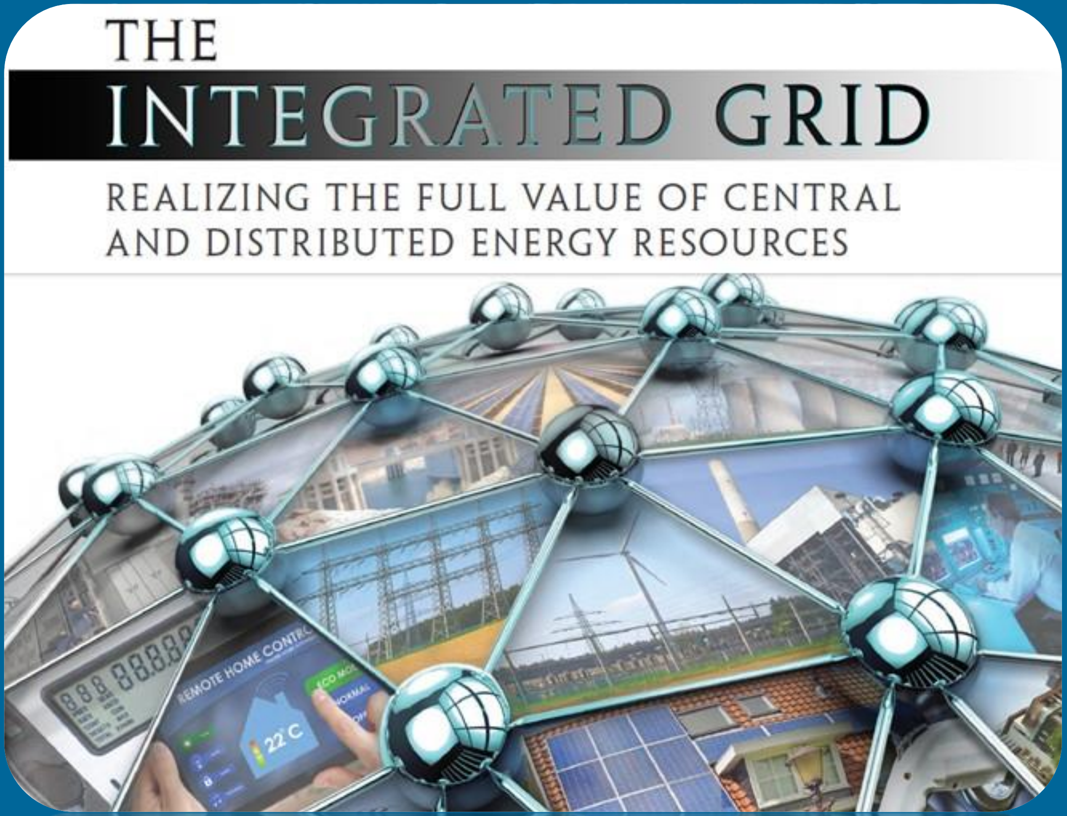
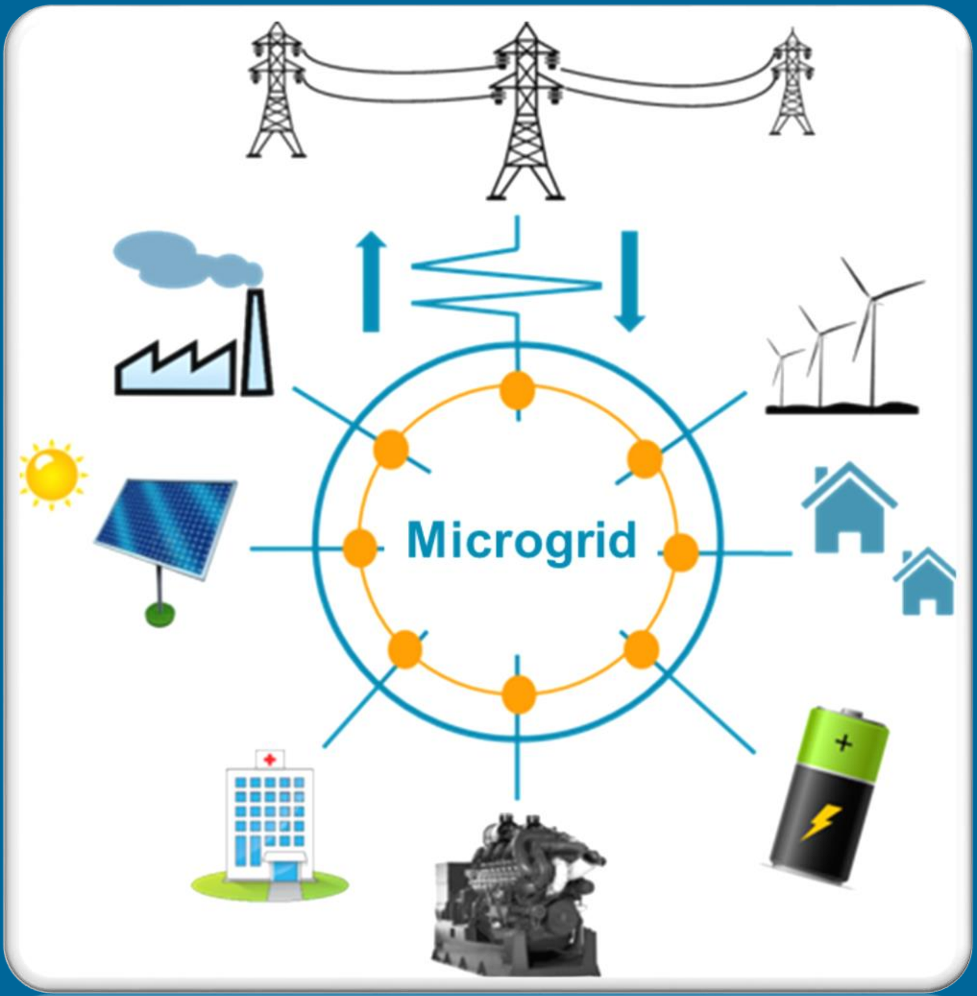
The Integrated Grid Platform



Reliability, Connectivity and Flexibility – realizing the full value of the Integrated Grid.

EPRI 2015 Report

Distributed Energy Resources and Microgrids/Nanogrids



DSOs – an emerging role evolving towards *information hubs* to facilitate retail markets that allow customers to choose their supplier and allow suppliers to offer options and services best tailored to customer needs

Growth of Smart Cities

A Smart City...

…Uses communication networks, wireless sensor, technology and intelligent data management to make decisions in real time about infrastructure needs and services delivery.

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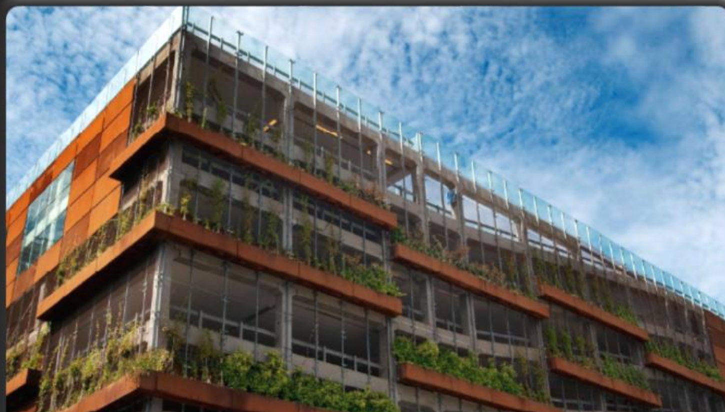
Today Smart Cities Becoming a Reality



Malmö, Sweden

Songdo, South Korea

Columbus, Ohio

LIVEABILITY

WORKABILITY

SUSTAINABILITY

The Role of the Digital Utility in Smart Cities

June 2017

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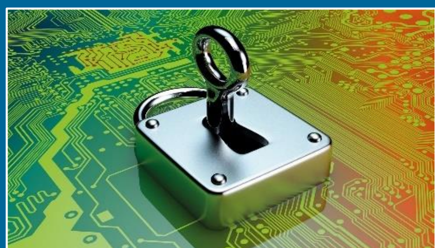
The Digital Utility

Enabling Responsiveness and Commercial Operation



Enabling Protection of Privacy and Data

Enabling Efficient Asset Performance

Integrating Advances in Information Communications Technologies

Enabling and Protecting the Workforce

Enabling Customer and Delivery Services

Potential Effects of the Sharing Economy

Digital Technology Growth Out Paces Other Technologies

600 Million

Smart Meters already connected

20,000,000,000

By 2025

Every 10 Seconds

Data collected

Terabytes per day

Modern Power Plants produce

$1.3 trillion Worldwide value 2025

2%

Less than 2% analyzed today

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The Integrated Energy Network:

Connecting Customers to Reliable, Safe, Affordable and Cleaner Energy

+ Cross-cutting Issues

- **Improves Reliability**
  - Integration enables quick assessment, containment, and rapid response
- **Promotes Economic Efficiency, Energy Efficiency, and Cleaner energy**
  - Integration makes possible a wide array of efficient, affordable, cleaner energy options
- **Expands Customer Choice and Enhances Value**
  - Digitalization of energy provides both near-term and unforeseeable opportunities

The "Internet of Things" Connectivity

26 billion devices will be connected to the internet of things by 2020 – including home automation, integrated grid, smart cities, transportation, space conditioning and lighting.

The Integrated Energy Network:

Connecting Customers to Reliable, Safe, Affordable and Cleaner Energy

- Improves Reliability

- Promotes Cleaner Energy and Efficient Electrification

- Provides Economic Efficiencies

- Expands Customer Choice and Enhances Value

Big Shifts to the Digital Utility: “Eyes Wide Open”

Key Insights

- The Integrated Energy Network requires rethinking "energy"
- Electric, gas, transport, and water systems are increasingly interdependent
- Advances in wireless connected technologies will be instrumental in integrating energy systems.
- Efficient electrification play essential roles in the future energy system
- Integrated (electric) Grid essential to enable to the Integrated Energy Network by enabling customers to use, produce and store electricity the way they desire.
- Innovation is needed in technology, policy, regulation, business models and market designs to effect an efficient transformation
- Global collaboration in innovation necessary

Together…Shaping the Future of Electricity

U.S. DEPARTMENT OF ENERGY
Office of Electricity Delivery & Energy Reliability

Considerations for a Modern Distribution Grid

A Collaboration with State Commissions & Industry to Frame Grid Modernization

NARUC Summer Meetings

July 16, 2017

Overview

Origin:

Initiated by CA and NY, plus DC, HI & MN commissions to examine what is needed to develop a next generation distribution system platform (DSPx)

Objective:

Provide guidance to facilitate grid modernization conversations around 2 important questions:

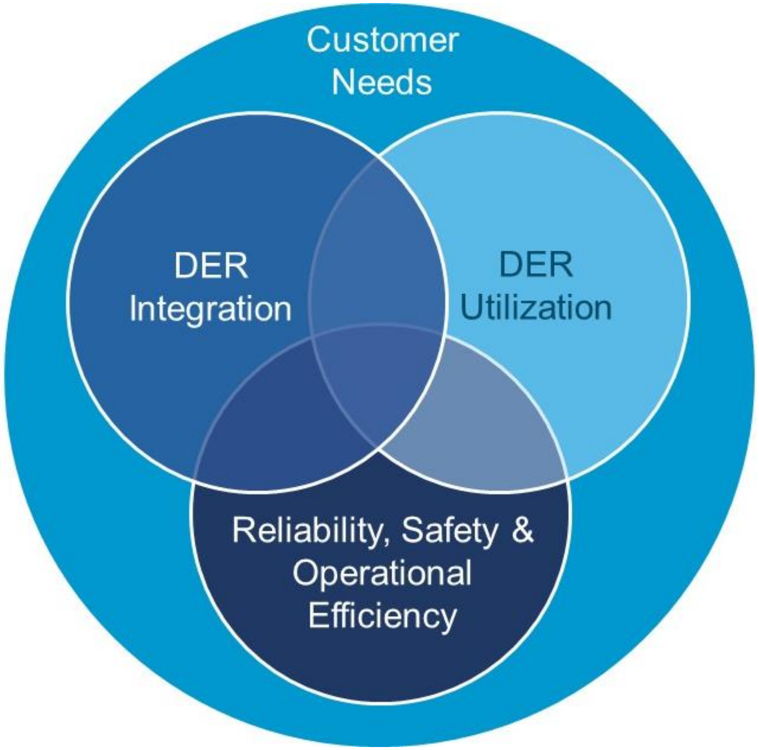
1) ***What considerations are of particular importance within a grid modernization decision process?***

2) ***What considerations should be given to timing and pace for states beginning to consider grid modernization?***

Grid Modernization Strategies

3 strategic concepts are generally considered:

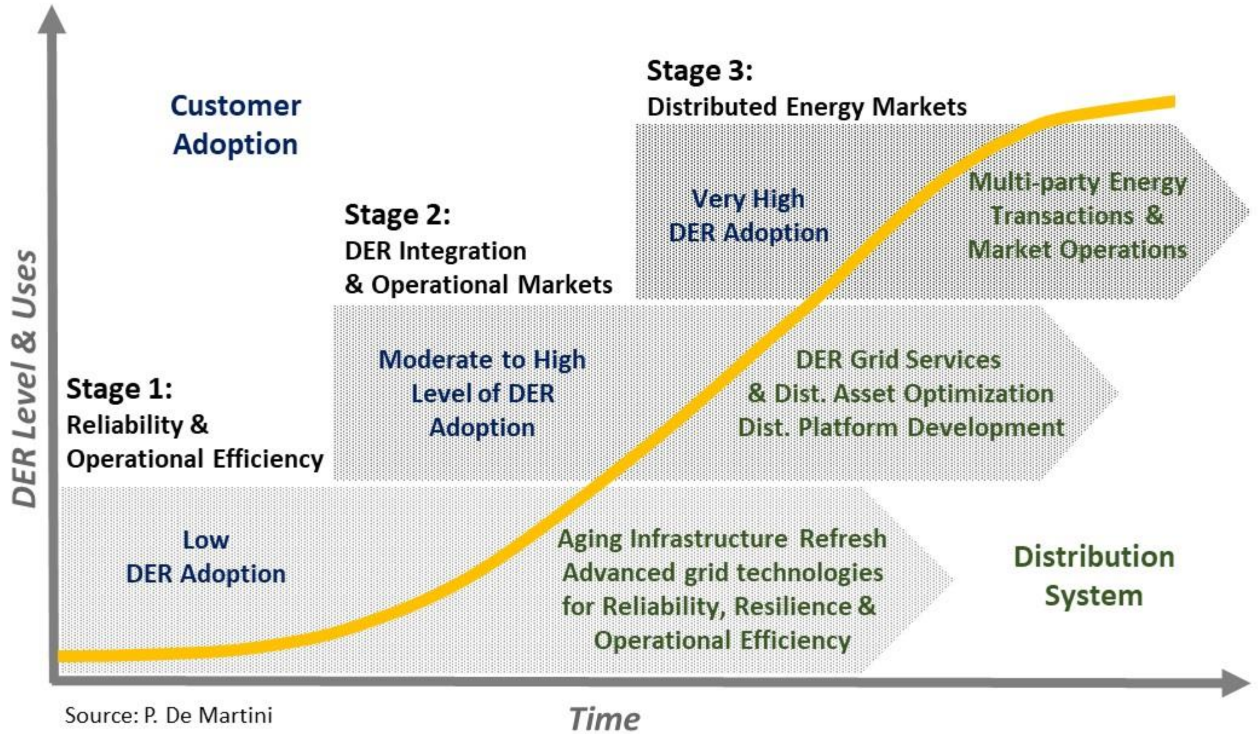
- **Adopt technology innovations to increase customer value, system reliability, resilience & security**
- **Enable customer choice & DER integration**
- **Enable opportunities for DER to provide grid services which in turn will create customer value through system efficiencies**



Note: It is important to not confuse business model questions with those related to the cyber-physical distribution system and the modernization that is required irrespective of who may develop and aggregate DERs, or who may operate the grid.

Distribution Grid Evolution

US distribution systems currently have Stage 1 functionality - a key issue is whether and how fast to transition into Stage 2 functionality



DSPx explored rational approaches for moving from Stage 1 to 2 over the next 5 years. These include maintaining traditional grid functions (reliability, security, efficiency), plus enabling DER integration at scale and operational value realization.

Modern Distribution Grid Report

A rigorous architectural approach to support development of grid modernization strategies and implementation plans based on best practices

Volume I: Maps Grid Modernization Functionality to Objectives

- Grid architectural approach that maps grid modernization functionality to state objectives within a planning, grid operations & market operations framework

➢ **Enables evaluation of functionality required to meet a specific objective**

Volume II: Assessment of Grid Technology Maturity

- Assessment of the readiness of advanced grid technology for implementation to enable functionality and objectives identified in Volume I.

➢ **Enables evaluation of technology readiness for implementation**

Volume III: Implementation Decision Guide

- Decision criteria and considerations related to developing a grid modernization strategy and implementation roadmap with examples to illustrate application

➢ **Enables development & evaluation of grid modernization strategies and roadmaps for implementation**

State Objectives are Fairly Consistent

Leading to grid properties enabling DER utilization – though timing, scale and scope are different

Objectives	CA	DC	FL	HI	IL	MA	MN	NC	NY	OR	TX
Affordability	•	•	•	•	•	•	•	•	•	•	•
Reliability	•	•	•	•	•	•	•	•	•	•	•
Customer Enablement	•	•	•	•	•	•	•	•	•	•	•
System Efficiency	•	•	•	•	•	•	•	•	•	•	•
Enable DER Integration	•	•	•	•	•	•	•		•	•	•
Adopt Clean Technologies	•	•	•	•	•	•		•	•	•	•
Reduce Carbon Emissions	•	•	•	•				•	•	•	•
Operational Market Animation	•	•		•			•		•		

Modern Grid Evolution

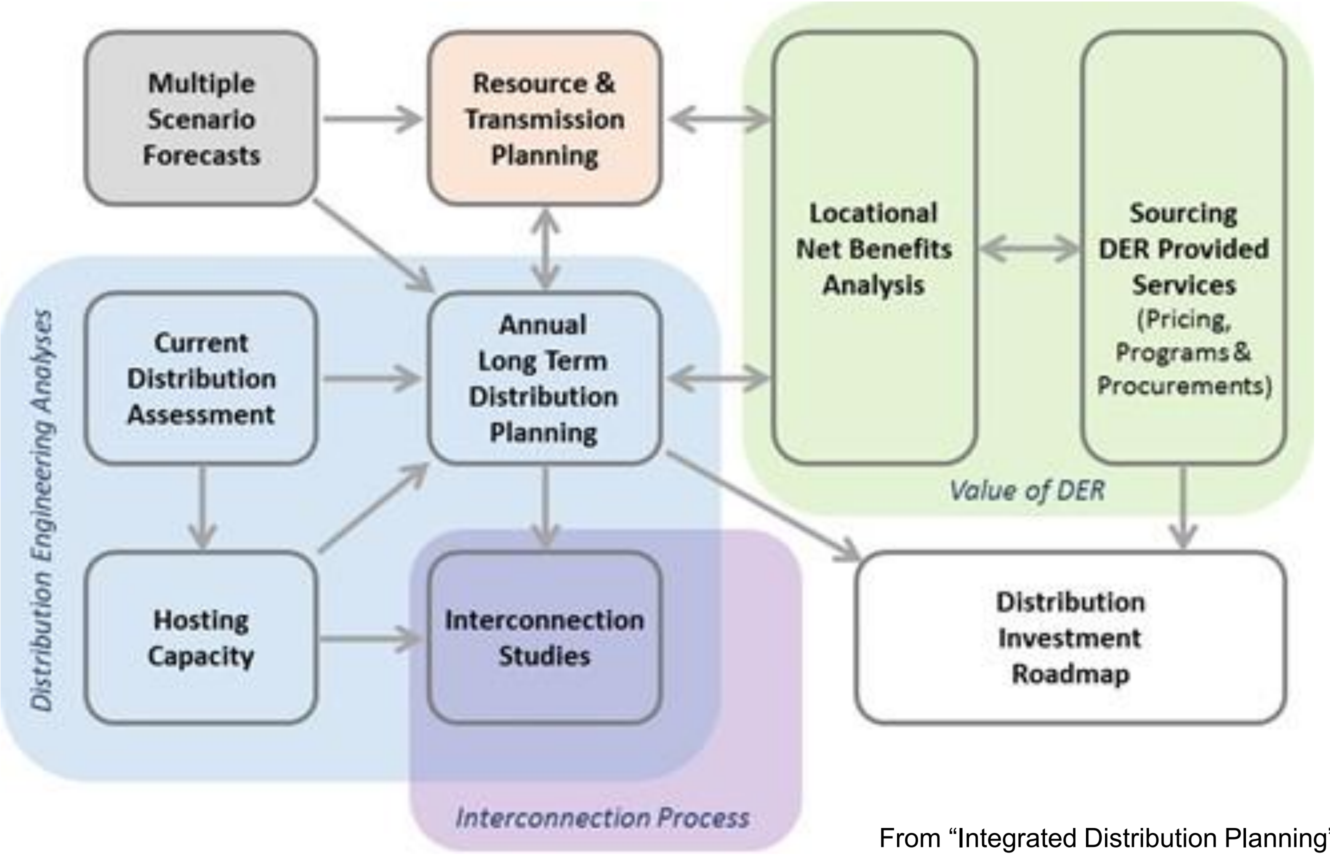
Needs & objectives drive grid capabilities and corresponding enabling business functionality and technology

● New
● Existing

Functions	Grid Capabilities: Reliability, Safety & Operational Efficiency	Grid Capabilities: DER Integration	Grid Capabilities: DER Utilization
Market Operations	New	New	New
Grid Operations	Existing	New	New
Planning	Existing	New	New

Integrated Planning Considerations

Integrated planning and analysis needed within and across the transmission, distribution and customer/3rd party domains



From "Integrated Distribution Planning", August 2016, prepared for the MN PUC, ICF International

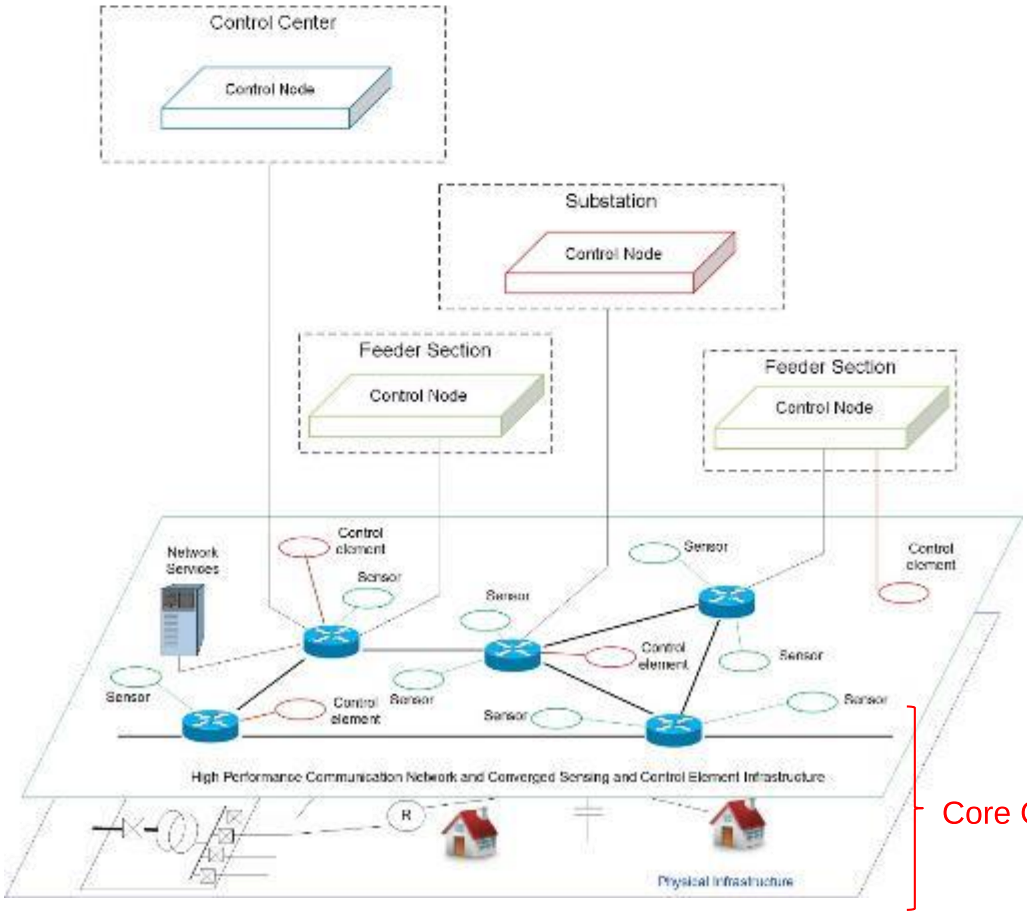
Architecture Manages Complexity

The engineering issues associated with the scale and scope of dynamic resources envisioned in policy objectives for grid modernization requires a holistic architectural approach

So, pick-up a pencil

Before trying to hang windows

Architectural Considerations



Core Cyber-Physical Operational Platform

- **Separate core infrastructure layers from modular applications:**
- **Communications in particular should be treated as a foundational infrastructure layer;**
- **Grid sensing and automation should be included**

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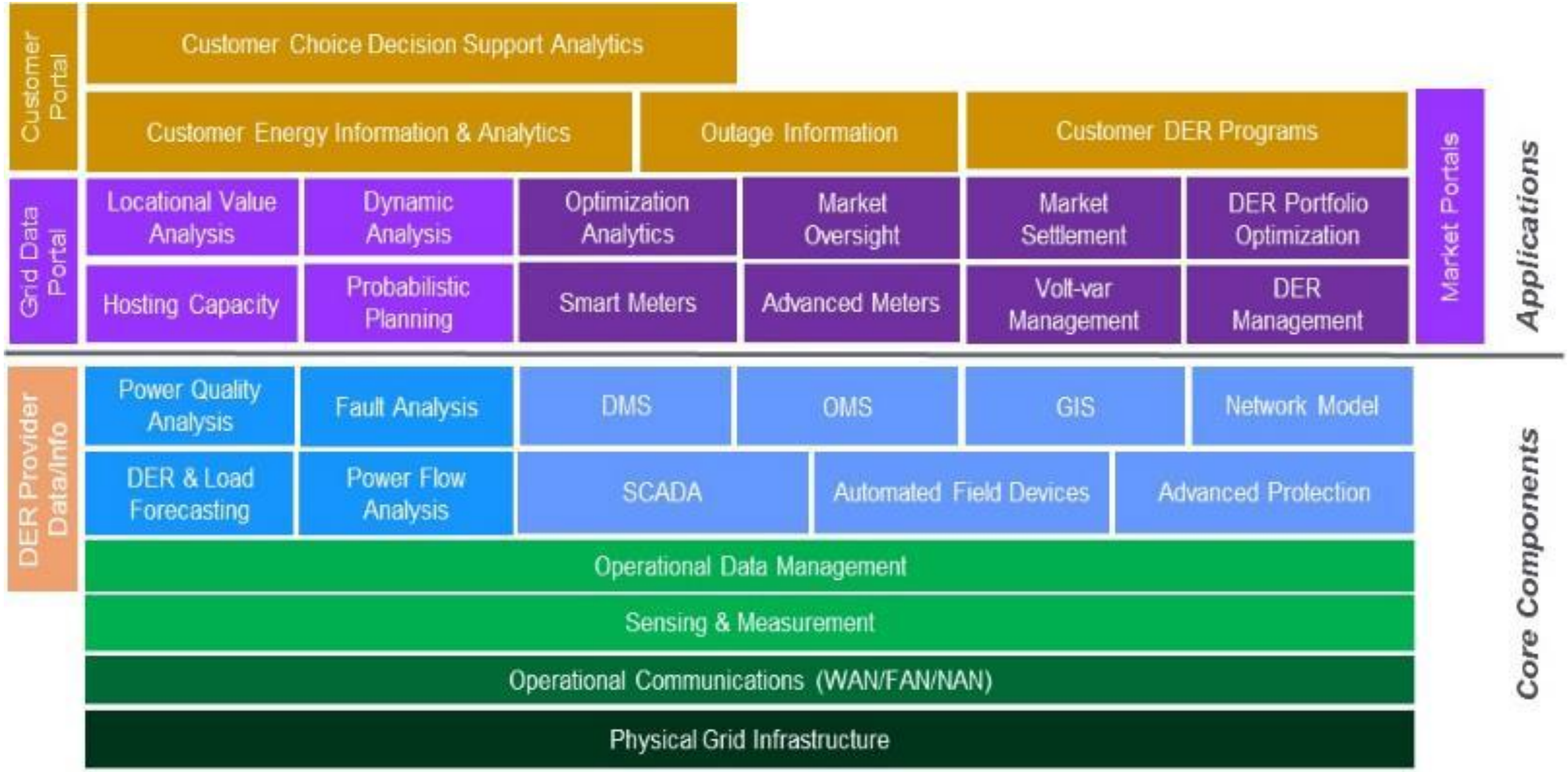
Platform Considerations

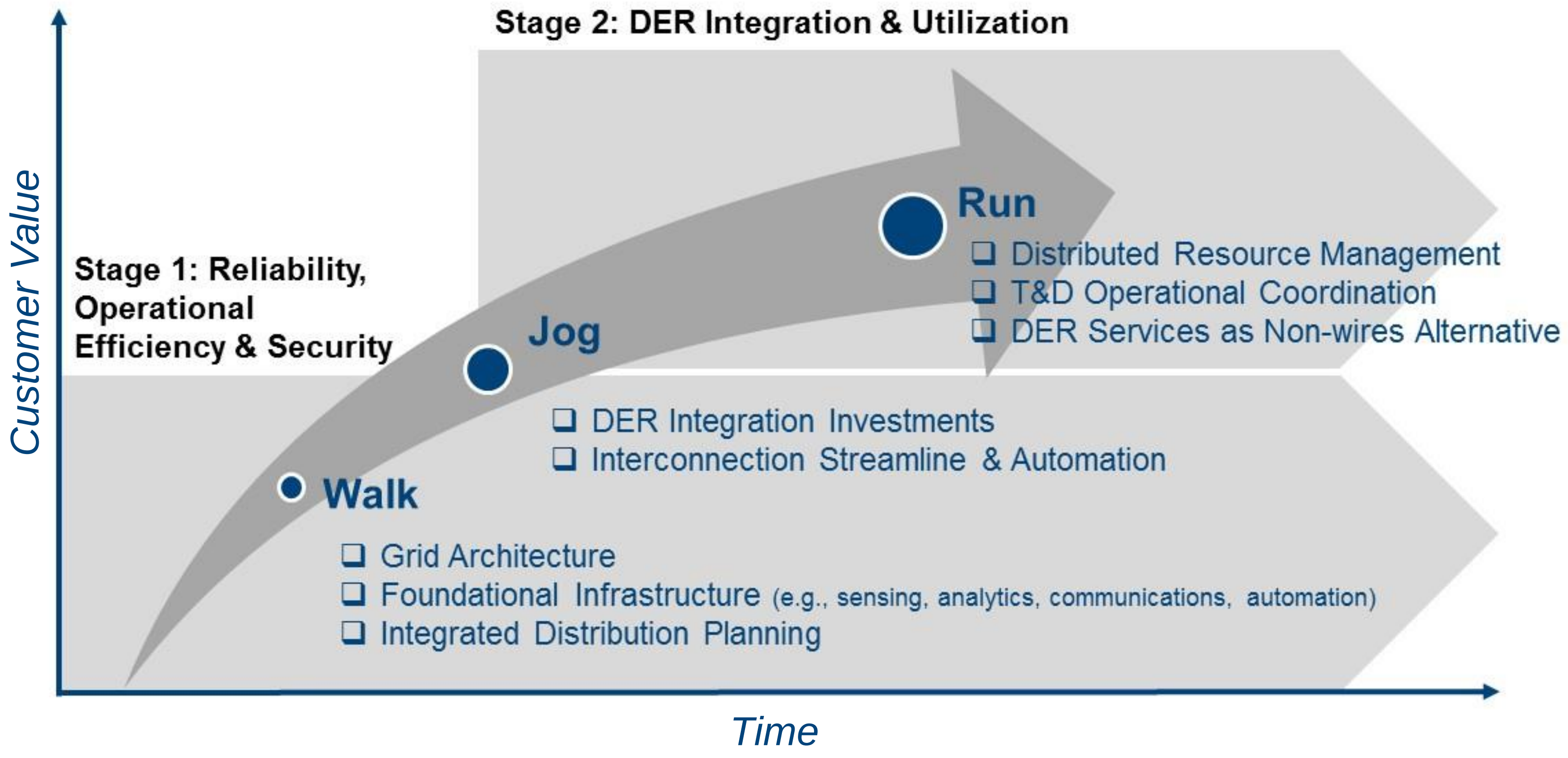
Core components are foundational; applications layer on this foundation as additional functionality is needed



From DSPx, Volume 3 – Decision Guide, under review

Timing & Pace Considerations

Pace & scope of investments are **driven by customer needs** & policy objectives. **Proportional deployment to align with customer value**



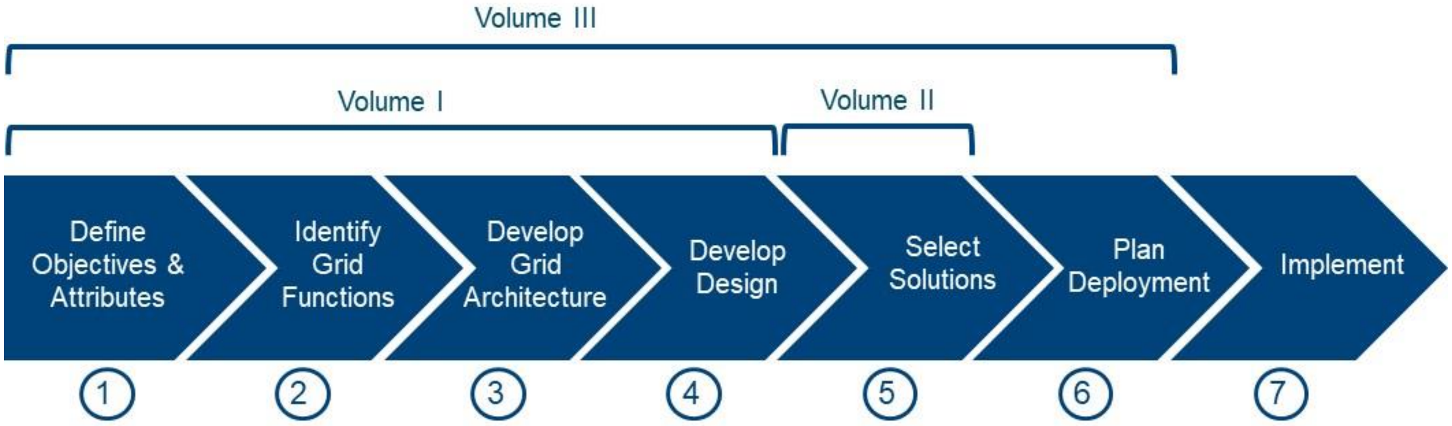
Cost Effectiveness Considerations

Grid modernization investments fall into several categories that may be evaluated under different methods for equitable attribution

No.	Expenditure Purpose	Methodology
1	Grid expenditures to replace aging infrastructure, new customer service connections, relocation of infrastructures for roadwork or the like, and storm damage repairs.	Least cost, best-fit or other traditional method recognizing the opportunity to avoid replacing like-for-like and instead incorporate new technology
2	Grid expenditures that will be paid for directly by customers participating in DER programs via a self-supporting margin neutral opt-in DER tariff, or as part of project specific incremental interconnection costs, for example.	These are “opt-in” or self-supporting costs, or costs that only benefit a customer’s project and do not require regulatory benefit-cost justification.
3	Grid expenditures required to maintain reliable operations in a grid with much higher levels of distributed resources connected behind and in front of the customer meter that may be socialized across all customers.	Least cost, best-fit for core platform, or Traditional Utility Cost-Customer Benefit for “applications”
4	Grid expenditures not paid for by customers adopting DERs or merchant DER developers (e.g., community solar or DERs for bulk power services) and not required for safety or reliability but are proposed to enable public policy and/or incremental system and societal benefits for all customers.	Integrated Power System & Societal Benefit-Cost (e.g., EPRI and NY REV BCA)

From Modern Distribution Grid Volume III – Decision Guide, under review

Summary



1. Identify Customer Needs & Societal Objectives
2. Identify Capabilities & Functionality Needed
3. Develop a Grid Architecture
4. Develop Related Designs
5. Select Appropriate Grid Technologies
6. Develop a Roadmap aligned to Pace & Scope of Needs
7. Implement Proportionally to Customer Value

Thank You

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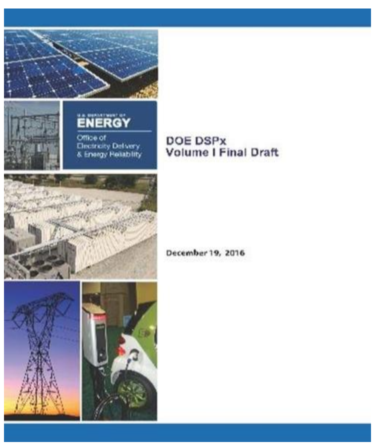
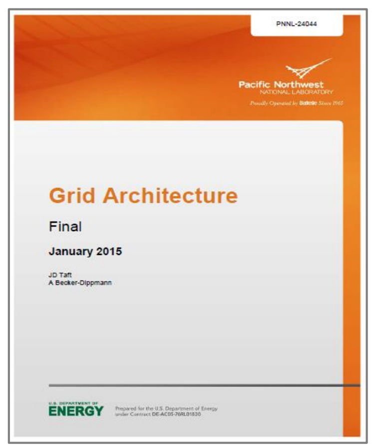
References:





www.doe-dspx.org

http//gridarchitecture.pnnl.gov

https://emp.lbl.gov/projects/feur

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