INTEGRATED PLANNING CONSIDERATIONS

Emerging requirements on the electric grid are becoming more complex and requiring new system designs, additional grid functions, and improved coordination across the transmission, distribution, and behind-the-meter (e.g., customer and merchant) domains. Integrated planning provides an approach for enabling the formulation of coherent strategies for deploying advanced grid capabilities needed to address the operational realities of controlling myriad and highly variable assets, including distributed energy resources[1] and electric vehicles. In addition, such planning is necessary to address multiple objectives, e.g., those associated with meeting reliability, resilience, efficiency, decarbonization, equity, and cost-effectiveness goals, and to ensure that they are adequately supported in decisions to deploy technology. As shown in Figure 1, integrated planning involves a holistic treatment of several factors that shape grid investment strategies.

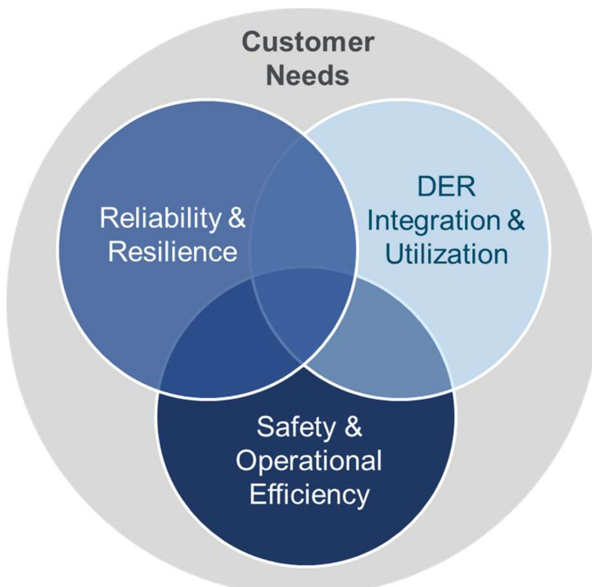

Figure 1 – Overlapping Areas Associated with Integrated Planning

An integrated planning process, as shown below in Figure 2, involves multiple steps which should result in both annual plans (e.g., with 3-year time horizons) and long-term plans (e.g., with 10- to 15-year time horizons). Long-term planning is needed to address possible future scenarios that may require foundational investments in the near-term. For example, staged strategies for deploying sensing, communication, and control technologies may need to be

[1] DERs are resources sited close to customers that can provide all or some of their electric power needs or can be used by the system to either reduce demand (such as improve energy efficiency) or provide supply to satisfy the energy, capacity, or ancillary service needs of the grid. The resources are small in scale, connected to the distribution system, and physically close to the load. Examples of DER types are solar photovoltaic (PV), wind, combined heat and power (CHP), energy storage, demand response (DR), electric vehicles (EVs), microgrids, and energy efficiency (EE).

undertaken in the near term to enable the downstream integration and utilization of DERs, electric vehicles, and/or microgrids. In addition, plans for developing, testing, and demonstrating immature technologies needed to support future anticipated capabilities should also be considered in the near-term as the timespans for placing new technology into practice are may take several years. The integrated planning process begins with setting objectives, forecasting future trends, and undertaking a systems analysis to identify gaps and determine infrastructure investment strategies. It involves the active participation of several entities including regulators, utilities, consumers, and merchants providing both technologies and services.

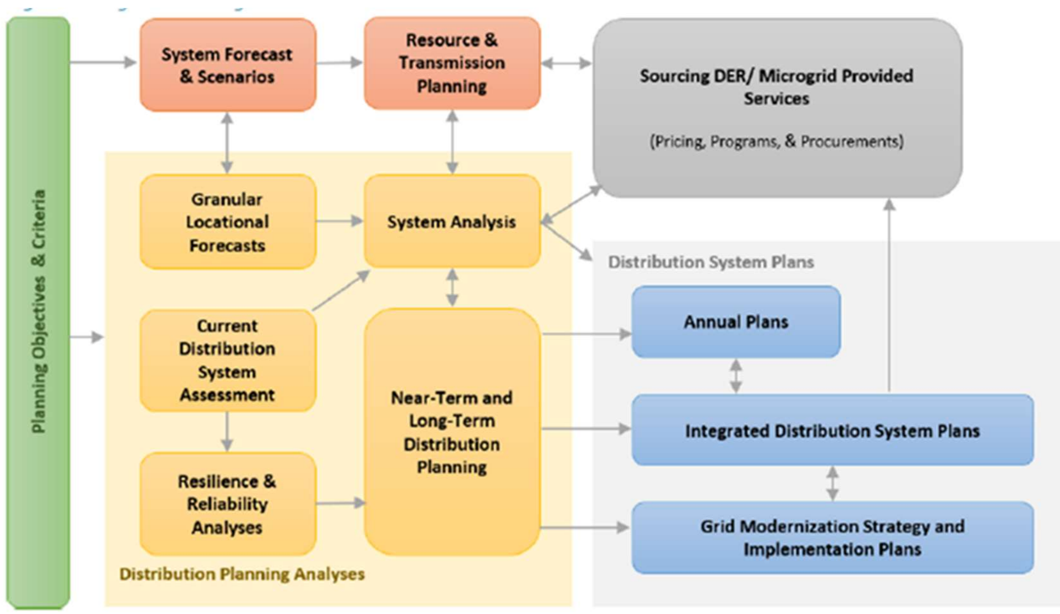

Figure 2 – A Distribution-Centric Integrated Planning Process

Key elements of an integrated planning process include:

1. The formulation of objectives and associated metrics for guiding the development of a technology investment strategy and for measuring its performance once implemented. The determination of objectives and metrics is usually undertaken through a stakeholder process that considers community and state policy goals and consumer preferences.
2. The forecasting of customer demand for electricity (i.e., customer load), the adoption rate of DERs (including electric vehicles), and various weather and climate-related parameters that may pose threats to the electric grid and supporting infrastructures.
3. An engineering analysis that determines technological investments needed over time, an implementation roadmap, for addressing stated objectives. These investments may include grid modernization upgrades, i.e., sensing, communication, control,

data/information management, and computing systems tied to the physical infrastructure, that are necessary to support envisioned structural and functional improvements to the electric grid.

4. The articulation of coordination requirements with other states and regional planning authorities to identify and address cross-jurisdictional planning, grid operations, and market design/operation requirements. This may include determining and utilizing a resource mix capable of providing needed reliability, resilience, and flexibility based on both transmission- and distribution-based assets.

Deploying advanced grid capabilities can be accomplished in a proportional manner (spatially and temporally) according to need, which is often shaped by the rate of DER adoption and aligned with timelines for meeting objectives associated with reliability, resilience, and decarbonization. In addition, it is important to note that foundational investments are usually necessary to enable more sophisticated capabilities, as shown in Figure 3. For example, establishing a robust asset management program is essential for improving reliability and resilience. Also, building an operational platform that provides sensing, communication, control, and computing capabilities may be needed to support more advanced functionality associated, for example, with the application of microgrids, flexible operations that include energy storage and responsive loads, and sophisticated protection schemes that can anticipate and respond to events to prevent or mitigate outages.

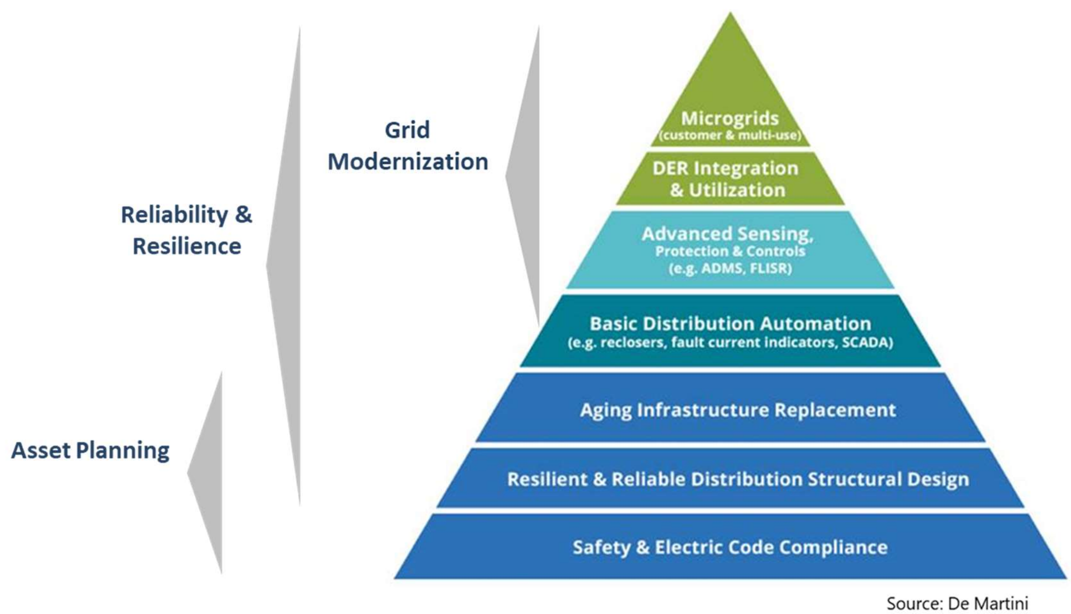

Figure 3 – Foundational Investments are Necessary to Support More Complex Grid Operations

As discussed above, near-term infrastructure improvements should ultimately support a longer-term strategy commensurate with the specific needs of a jurisdiction. In addition, investments related to meeting reliability, resilience, and decarbonization objectives may range considerably depending upon where utilities are positioned within the pyramid shown in Figure 3, above.

Planning for Reliability, Resilience, and Equity

Planning for reliability, resilience, and equity should be considered within the context of an integrated process that involves active participation from a variety of stakeholders, including for the setting of objectives and metrics that will shape the strategy for infrastructure investments. Involving stakeholders, including the public, in the planning process is becoming important as we begin to shift our approaches for determining and evaluating investment decisions from those based purely on economics to a new paradigm that considers both economic and social concerns. Ensuring that underserved and disadvantaged communities are provided the benefits derived from investments that address reliability, resilience, and decarbonization, is an essential consideration, as is reflected within President Biden's Executive Order 14008.[2] In addition, all communities should have equitable access to and participation in decision-making processes shaping the design objectives and outcomes of energy systems. Identifying and organizing stakeholders, including underserved and disadvantaged communities, in an iterative feedback process for creation of policies and formulation of planning objectives and metrics is essential for addressing the procedural, distributive, and restorative equity principles shown in Figure 4, below.

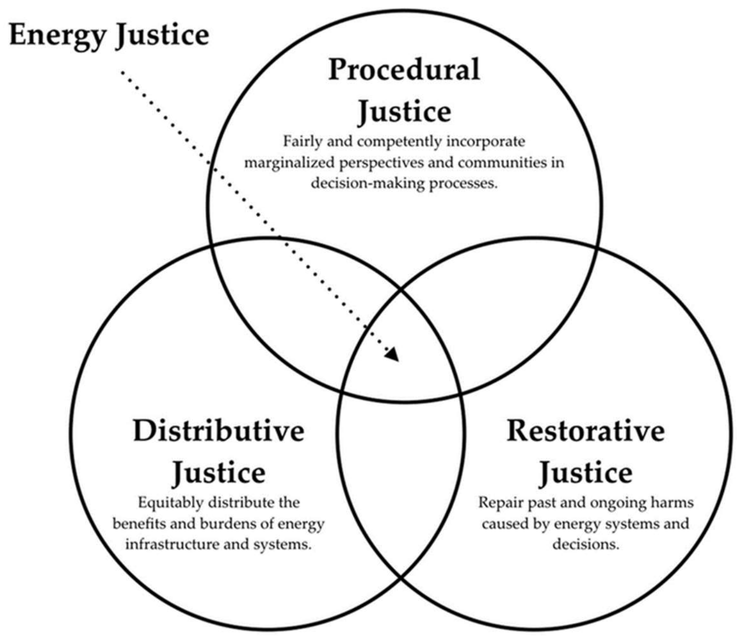

Figure 4 – Key Principles Associated with Energy Equity

[2] The Executive Order on Tackling the Climate Crisis at Home and Abroad, E.O. 14008, was signed on January 27, 2021; https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/.

An integrated planning process that addresses reliability, resilience, and equity,[3] among other parameters, should consider how to incorporate the following key components into the scheme provided in Figure 2:

1) Determining reliability, resilience, and equity objectives and associated metrics through a stakeholder process. Applicable metrics might include:
    a. SAIDI, SAIFI, and CAIDI, as defined in the IEEE 1366 -2012 standard on electric power distribution reliability indices,
    b. A resilience index that tracks restoration times with stated targets for critical, priority, and remaining customers (see descriptions below), and
    c. Equity indices that track such factors as energy burden, accessibility to energy savings programs, and community acceptance of reliability and resilience investments.
2) Undertaking a threat-based risk assessment that applies forecasts of future weather and climate-related threats (including cyber-based threats) to:
    a. Identify and prioritize relevant threats, and
    b. Determine the impacts of those threats on vulnerable infrastructure and populations.
3) Identifying and prioritizing key customers and infrastructure sectors with a focus on system recovery and public safety and well-being, including:
    a. Developing and applying criteria for identifying/prioritizing key customers and infrastructure based on priority and urgency (e.g., through allocation into tiers), and
    b. Aligning the tiering and prioritization of the infrastructure sectors and populations with existing emergency management, homeland security, and hazard mitigation/resiliency frameworks.
4) Determining gaps in utility capabilities and self/back-up supply capabilities and requirements, and developing solutions. Solutions may range, but should include partnering with local businesses and institutions to, for example:
    a. Develop and implement load management/load curtailment capabilities,
    b. Maintain ample onsite fuel supplies and temporary emergency power,
    c. Determine suitable locations for microgrids, and
    d. Utilize grid-forming inverters so that renewables and DERS can provide a black-start capability.

[3] These parameters and others, e.g., decarbonization, operational and energy efficiency, and cost-effectiveness among others, will factor into the normalization and prioritization of grid investment projects.