Appendix F. Modernized grid capability descriptions

The description of each capability identified in the DOE's DSPx framework along with the needs they address, and examples of the associated technologies and functions are included in the table below.

Capability	Description of capability and needs statement
Customer DER Portal	**Description:** Provide customer access to relevant and timely usage, performance, and system data. Data-driven personalization of product and program recommendations to aid customers in meeting their energy goals. **Needs statement:** Enable customer choice, customer awareness and decision making. **Example technologies:** Customer analytic tools (e.g., calculators), green button (automated data transfer), smart meters/meter data management system, customer energy management tools. **Example functions:** Remote meter data collection and verification, energy management and DER purchase/program performance analysis, advanced interactive voice response (IVR) systems, IT based customer interfaces, mobile-enabled digital dashboards, mobile alerts.
Virtual power plant (VPP)	**Description:** Aggregated flexible loads and DERs, that in coordination supply grid services visible to and dispatchable by PGE power operations, characteristic of a traditional power generation facility. **Needs statement:** Distribution investment deferral, support for customer needs such as resilience and resource adequacy. **Example technologies:** DERs, DER programs, dynamic tariffs, DERMS. **Example functions:** Delivery of peak load electricity or load-following power generation on short notice, ancillary services including frequency regulation and providing operating reserve.
Planning and engineering	**Description:** Integrated tools to support distribution system planning and engineering functions. **Needs statement:** Improved planning enables more efficient grid investments, incorporating DER integration, stakeholder information exchange, and non-wires solutions. **Example technologies:** CYME (power flow analysis), cost-effectiveness tools, AdopDER (DER forecasting). **Example functions:** Grid needs analysis, locational net benefit analysis, non-wires solutions analysis, hosting capacity analysis, DER forecasting and Interconnection studies.

Capability	Description of capability and needs statement
Grid management systems	**Description:** Operational technology-based tools used by operators of electric utility grids to monitor, control and manage the performance of the distribution system. **Needs statement:** Shifting from management of one-way power flows to two-way power flows requiring coordination of large numbers of DERs presents engineering and operational challenges. As DER adoption grows, so grows the need for technology to enable efficient operation of the system to handle proliferation of possible control actions, reduction in time to implement control actions, and increases in frequency and magnitude of potential safety and reliability issues. **Example technologies:** Advanced distribution management system (ADMS), DER management system (DERMS), outage management system (OMS), demand response management system (DRMS). **Example functions:** Monitor grid operations, analyze the data collected, predict events and grid behavior through algorithms, schedule operations and switching, issue commands to grid devices based on the analyzed information (fault location, isolation, and service restoration/FLISR scheme and volt VAR optimization/conservation voltage reduction), Optimal Power Flow, Constraint management, and DER operational functions.
Sensing, measurement and automation	**Description:** Operating the distribution system requires continuous monitoring of the infrastructure that comprises the grid. Sensing, measurement and automation is accomplished through devices installed at various points on the distribution system — such as along feeders, at breakers, switching devices and distribution power transformers. The deployment of those devices determines the degree to which the grid can be controlled by the grid management system. **Needs statement:** More granular sensing and measurement is needed to operate the distribution grid in a high DER scenario. Power flows along the feeder could vary from point to point based on the location of various DERs and how they are called to operate for various gird services. **Example technologies:** Reclosers, Smart Communicating Faulted Circuit Indicators, real time metering of solar qualifying facilities, Bell-weather meters etc. **Example functions:** Grid management system can use measurement from these devices to optimize the grid for voltage and power flow and enable reliability and safety for all DER use scenarios for DERs on the feeder.
Telecommunications	**Description:** The infrastructure that connects grid assets and the distribution system operators. **Needs statement:** A reliable telecommunications network allows grid operators to monitor and control with grid assets and enable more grid services. **Example technologies:** Communication spectrum licensed from the Federal Communications Commission (FCC), owned and leased fiber, cellular communication equipment, AMI mesh network. **Example functions:** Communication networks at different levels of granularity — field area networks (FAN) to enable communication between field devices and the Integrated Operations Center, neighborhood area networks (NAN) to enable communication between devices in a microgrid.

Capability	Description of capability and needs statement
Physical grid infrastructure	**Description:** The poles, wires, transformers, substations, operations control center and other distribution system equipment (e.g., reclosers, capacitors, regulators) and intelligent monitors/controllers that comprise the distribution system. **Needs statement:** Enable the safe, reliable, bi-directional flow of power. **Example technologies:** Poles, wires, transformers, switchgear, line capacitor banks, microprocessor-based capacitor controls, line regulators, line regulator controls. **Example functions:** Voltage transformation, reactive power compensation, voltage control, and switching.
Cybersecurity	**Description:** The protection of computer systems, operational technology equipment and networks from information disclosure, theft of or damage to their hardware, software or electronic data and the disruption or misdirection of the services they provide. **Needs statement:** The power grid is a highly connected system as described by the capabilities above. The ongoing modernization of the grid will create more connections and introduce more vulnerability to cyberattacks, efforts by rogue actors to threaten the operation of the grid. **Example technologies:** Cyber-physical barriers to restrict access to critical assets, advanced physical security systems (e.g., intelligent badging), firewalls, data encryption, spyware/malware detection. **Example functions:** Ensuring access is restricted to authorized personnel, insulating critical infrastructure networks from external threats, obscuring critical communication between devices and operators.