Business Case Summary Template: Overview

This Template contains the following tabs:

1. **Instructions**
   This reference tab contains instructions on how to fill in Tabs 3 to 6 in the Template.
2. **Key Terms**
   This reference tab contains definitions of key terms that are used throughout the Template.
3. **Benefits**
   In this input tab, the company will identify, list, characterize, and value all projected benefits (monetized, quantified, and unquantified) associated with its portfolio of grid modernization investments.
   Note: The Benefits tab is pre-filled with an illustrative example.
4. **Costs**
   In this input tab, the company will identify, list, characterize, and value all projected costs associated with its portfolio of grid modernization investments.
5. **Summary - Benefits and Costs**
   In this input tab, the company will sum the value of monetized costs and benefits associated with grid modernization investments, as well as list the quantified, but non-monetized benefits and the unquantified benefits.
6. **Stranded Costs**
   In this input tab, the company will identify, list, and characterize, and value stranded assets resulting from new grid modernization investments.
7. **Glossary**
   This reference tab contains a glossary of grid modernization functions and technologies, which are listed in the dropdown menus in the Benefits and Costs tabs.
   These definitions are primarily sourced from the U.S. Energy Information Agency, Electric Power Research Institute, and SmartGrid.gov.
8. **List of Technologies and Functions**
   This reference tab contains a list of technologies and a list of functions, which are listed in the dropdown menus of the Benefits and Costs tabs.
9. **List of Benefits**
   This reference tab contains a list of benefit categories and a list of benefit sub-categories, which are listed in the dropdown menus of the Benefits tab.
10. **List of Costs**
    This reference tab contains lists of cost categories and cost sub-categories, which are listed in the dropdown menus of the Costs tab.

Business Case Summary Template: Instructions

<u>Instructions:</u>	This Template (<u>i.e.</u>, Tabs 3 to 6) is to be filled in by each company to capture the costs and benefits of its grid modernization investments and to quantify them to the extent possible. *Note: Refer to the Key Terms and Glossary tabs for definitions of terms as needed.* *Note: Technologies, functions, costs, and benefits can be added to the Template as needed, but they cannot be deleted from it. When adding a technology, function, cost, or benefit that is not already included in the drop down menus, a company will need to add a new row below Row 30 in the Costs and Benefits tabs and enter the information manually.* *Note: A company is only required to fill in information regarding its proposed portfolio of grid modernization investments.*

<u>Benefits:</u>	<u>Steps:</u>
Columns A, B, C, D, E	1. Select a technology proposed by the company to achieve measureable progress on grid modernization objectives. Enter an "X" in the column of each objective associated with the proposed technology. *Note: A company may propose multiple technologies.*
Columns E, F	2. For each technology, select the associated functions. *Note: A technology may be linked to more than one function. Create a separate row for each function.* *Note: For examples of how to map technologies to functions, refer to Electric Power Research Institute, Methodological Approach for Estimating the Benefits and Costs of Smart Grid Demonstration Projects at Figure 4-4 (January 2010), available at* *https://www.smartgrid.gov/sites/default/files/doc/files/Methodological_Approach_for_Estimating_Benefits_Costs_Smart_201007.pdf*
Columns F, G, H	3. For each function, select the associated benefit categories and benefit sub-categories. *Note: Each function may have more than one benefit category with multiple benefit sub-categories. Add a separate row for each benefit category and benefit sub-category.* *Note: The benefit category and benefit sub-category menus are linked. First select the category and then the appropriate sub-category.* *Note: For examples of how to map functions to benefits, refer to Electric Power Research Institute, Methodological Approach for Estimating the Benefits and Costs of Smart Grid Demonstration Projects at Figure 4-8 (January 2010), available at* *https://www.smartgrid.gov/sites/default/files/doc/files/Methodological_Approach_for_Estimating_Benefits_Costs_Smart_201007.pdf*
Column I	4. Select the appropriate beneficiary.
Column J	5. Determine whether the benefit can be monetized. Select "Yes" or "No."
Column K	6. For each monetized benefit, enter a single dollar value equal to the present value accrued over a 15-year period. *Note: If the benefit is enabled by a network systems enabler ("NSE"), a system or application that is necessary to enable grid modernization capabilities, but provides no direct benefit of its own, then enter the term "NSE" in place of a monetary value. For a list of examples, <u>see</u> D.P.U. 12-76, Grid Modernization Stakeholder Working Group Report, Section 3.3, at 19-21.*
Column L	7. Determine whether the benefit can be quantified. Select "Yes" or "No."
Column M	8. If the benefit can be quantified, then state the value of its quantified impact (through a proxy, alternative benchmark, etc.). For example, "Reduction in SAIDI by X %."
Columns N, O	9. For unquantified benefits, weigh each benefit on two criteria: (1) relevance to state policy; and (2) impact on grid modernization objectives. Select "Low," "Med," or "High."
Column P	10. Provide a detailed description of each unquantified benefit identified by the company.

<u>Costs:</u>	<u>Steps:</u>
Columns A, B, C, D, E	1. Select the technology proposed by the company to achieve measureable progress on grid modernization objectives. Enter an "X" in the column of each objective associated with the proposed technology. *Note: A technology may further multiple objectives.*
Column E, F, G	2. For each technology, select the associated cost categories and cost sub-categories. *Note: Each technology may have more than one cost category with multiple cost sub-categories. Add a separate row for each cost category and cost sub-category.* *Note: The cost category and cost sub-category menus are linked. First select the category and then the appropriate sub-category.* *If a cost category (<u>e.g.</u> , customer education marketing) is not associated with a particular technology, then leave the technology column blank.*
Column H	3. Enter Uniform System of Accounts ("USOA") account number.
Column I	4. Enter a single dollar value equal to the present value of each monetized cost accrued over a 15-year period.
Column J	5. Determine the type of cost. Select "Direct capital cost," "Capitalized overhead cost," or "Non-capitalized O&M cost."
Column K	6. Determine whether the company proposes to include all of the cost, some of the cost, or none of the cost in the capital expenditure tracker. Select "Yes," "Partially," or "No."

<u>Summary - Benefits and Costs</u>	<u>Steps:</u>
Column C	1. Sum the present values of all monetized benefits by function (in the Benefits tab) and enter each summed value for each function in Column C. Total up the values for each function and enter it in C22 ("Total Monetized Benefits"). *Note: Include functions added to the Benefits tab.*
Column C	2. Sum the present values of all costs by cost category (in the Costs tab) and enter each summed value for each cost category in Column C. Total up the values for each cost category and enter it in C34 ("Total Costs"). *Note: Include cost categories added to the Costs tab.*
Column C	3. Sum "Total Monetized Benefits" and "Total Costs" and enter the value in C36 ("Total Monetized Net Benefits").
Column E, F, G	4. List all quantified benefits that cannot be monetized. Include the function, benefit, and quantified value for each.
Column I, J	5. List all unquantified benefits. Include the function and benefit for each.

<u>Stranded Costs:</u>	<u>Steps:</u>
Column A	1. Enter the technology category.
Column B, C, D	2. Enter the book value for each category of stranded assets.
Column E	3. To calculate unrecovered asset value, subtract Column C from Column B and add Column D.
Column F	4. Source the remaining depreciable life (in years) from the company's most recent depreciation study.
Column G	5. Enter the carrying charge rate applied (%).

Business Case Summary Template: Key Terms

Benefits and Costs Tabs:	
Function:	A specific capability, often linked to a technology, which delivers the desired action(s) or impact(s) necessary to achieve a particular grid modernization objective.
Technology:	An application, device, or system that performs specific functions, which are necessary to achieve a particular grid modernization objective.
Network Systems Enablers ("NSE"):	Systems and software applications that underpin distribution company operations and support implementation of various grid modernization capabilities. For example, supervisory control and data acquisition ("SCADA") and distribution management systems ("DMS") are NSEs that may be necessary to implement automated feeder reconfiguration. For other examples, see D.P.U. 12-76, Grid Modernization Stakeholder Working Group Report, Section 3.3, at 19-21.
Direct Capital Costs:	Direct capital costs are fixed, one-time costs, having an expectation of life in service of more than one year from date of installation, for a new plant or project. Examples of these costs include the price of purchased assets, such as land, buildings, equipment, and supplies, which are needed to bring a project to fully operable status. Account 103 (Experimental electric plant unclassified) Account 107 (Construction work in progress - Electric) Sum of Accounts 301 - 399 (Electric Plant Accounts) Uniform System of Accounts, 220 C.M.R. §51.00 et seq., 18 C.F.R. Ch. 1, Pt. 101.
Capitalized Overhead Costs:	Capitalized overhead costs are direct and indirect costs that are incurred as part of the planning, development, and installation of a new capital project. Examples of these costs include professional services, salaries, permits, equipment installation, and other expenses, which are needed to bring a project to a fully operable status. Follow Electric Plant Instructions, No. 3 (Components of construction cost) and No. 4 (Overhead construction costs) for allocation into FERC Account 101 Refer to Accounts 301 - 399 (Electric Plant Accounts) Uniform System of Accounts, 220 C.M.R. §51.00 et seq., 18 C.F.R. Ch. 1, Pt. 101.
Non-capitalized Operations and Maintenance (“O&M”) Costs:	This type of cost represents the increase in O&M costs resulting from the implementation of the company's grid modernization short-term investment plan ("STIP") that are integral to the achievement of its benefits. Expenses for marketing, education, and outreach to implement time-varying rate programs may be an example of these non-capitalized O&M expenses. Expenses for non-recurring employee training necessary for the operation and maintenance of a new STIP-eligible project may be an additional example. Reductions in O&M costs resulting from the implementation of the company's STIP should be captured as benefits in the Benefits Tab.

Stranded Costs Tab:	
Stranded Asset:	Undepreciated existing capital equipment that the company proposes to replace as a result of its proposed capital investments for grid modernization.
Plant Investment:	Sum of Accounts 301 - 399 (Electric Plant Accounts) Uniform System of Accounts, 220 C.M.R. §51.00 et seq., 18 C.F.R. Ch. 1, Pt. 101.
Accumulated Depreciation:	Account 108 (Accumulated provision for depreciation of electric utility plant) associated with specific stranded assets. Account 111 (Accumulated provision for amortization of electric utility plant) associated with specific stranded assets. Uniform System of Accounts, 220 C.M.R. §51.00 et seq., 18 C.F.R. Ch. 1, Pt. 101.
Retirement Cost (Cost of Removal):	The estimated cost of retiring and disposing of plant to be retired as a result of grid modernization. Cost of removal means the cost of demolishing, dismantling, tearing down or otherwise removing electric plant, including the cost of transportation and handling incidental thereto. It does not include the cost of removal activities associated with asset retirement obligations that are capitalized as part of the tangible long-lived assets that give rise to the obligation.
Unrecovered Asset Value:	Uncovered Asset Value = Plant Investment - Accumulated Depreciation + Retirement Cost

Business Case Summary Template: Benefits

Color Key:
White = Enter info directly into cell
Light Blue = Select item from dropdown menu choices
Dark Blue = Select from linked dropdown menu choices

Grid Mod Objectives: #1 Reduce Effects of Outages	#2 Optimize Demand	#3 Integrate DR	#4 Workforce & Asset Mgmt	Technology	Function	Benefit Category	Benefit Sub-Category	Beneficiary	Can Be Monetized? (y/n)	Present Value ($ Mil)	Can Be Quantified? (y/n)	If So, Quantified Impact	Unquantified Benefit: Relevance to State Policy	Impact on GM Objectives	Description of Unquantified Benefit
	X		X	Customer EMS/ Display/ Portal	Customer Electricity Use & Optimization	T&D Capital Savings	Deferred transmission capacity investments	Customer/ Utility	Yes	$10	Yes				
	X		X	Customer EMS/ Display/ Portal	Customer Electricity Use & Optimization	T&D Capital Savings	Deferred distribution capacity investments	Customer/ Utility	Yes	$8	Yes				
	X			Customer EMS/ Display/ Portal	Customer Electricity Use & Optimization	System Optimization	Reduced electricity losses	Customer/ Utility	Yes	$2	Yes				
	X			Customer EMS/ Display/ Portal	Customer Electricity Use & Optimization	Electricity Cost Savings	Reduced electricity cost	Customer/ Utility	Yes	$6	Yes				
	X			Customer EMS/ Display/ Portal	Customer Electricity Use & Optimization	Air Emissions	Avoided GHG emissions compliance cost	Customer/ Utility	Yes	$4	Yes				
	X			Customer EMS/ Display/ Portal	Customer Electricity Use & Optimization	Air Emissions	Avoided SOx, NOx, and PM-10 emissions compliance cost	Customer/ Utility	Yes	$3	Yes				
				Enter additional function, technology, benefit category, or benefit sub-category, as needed (below this row)											

Business Case Summary Template: Costs

Color Key:
White = Enter info directly into cell
Light Blue = Select item from dropdown menu choices
Dark Blue = Select from linked dropdown menu choices

Grid Mod Objectives: #1 Reduce Effects of Outages	#2 Optimize Demand	#3 Integrate DR	#4 Workforce & Asset Mgmt	Technology	Cost Category	Cost Sub-Category	Uniform System of Accounts, Account #	Present Value ($ Mil)	Type of Cost	Costs Proposed for CapEx Tracker?
				Enter additional technology, cost category, or cost sub-category as needed (below this row)						

Business Case Summary Template: Summary - Benefits and Costs

Monetized Benefits	
Function	**Present Value ($ mil)**
Adaptive Protection	
Advanced Meter Reading & Billing	
Automated Feeder Switching	
Automated Islanding & Reconnection	
Automated Voltage & VAR Control	
Current Voltage & Power Factor	
Customer Electricity Use & Optimization	
Demand Response	
Diagnosis & Notification of Equipment Condition	
Distributed Energy Resource Monitoring & Control	
Distributed Generation Integration	
Distribution-Sited Grid Storage Integration & Control	
Dynamic Capability Rating	
End-Use Energy Efficiency	
Enhanced Fault Protection	
Fault Current Limiting	
Fault Location, Isolation & Service Restoration	
Power Flow Control	
Real-time Load Measurement & Management	
Real-time Load Transfer	
Revenue Assurance	
Service Outage Management	
Wide Area Monitoring, Visualization & Control	
Total Monetized Benefits	**0**

Costs	
Cost Category	**Present Value ($ mil)**
Advanced Metering System	
Communications Systems	
Electric Distribution System	
Integrated Crosscutting Systems	
Customer Education Marketing	
Project Management Administration	
Operational O & M	
Other Costs	
Total Costs	**0**

Total Monetized Net Benefits	**0**

List of Quantified Benefits (Non-Monetized)		
Function	**Benefit**	**Quantified Value**

List of Unquantified Benefits	
Function	**Benefit**

Business Case Summary Template: Stranded Costs

Stranded Asset (Technology Category)	Plant Investment ($ mil)	Accumulated Depreciation ($ mil)	Retirement Cost (Cost of Removal Net of Salvage) ($ mil)	Unrecovered Asset Value ($ mil)	Remaining Depreciable Life (years)	Carrying Charge Rate Applied (%)
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
				$0		
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				$0		
				$0		

Business Case Summary Template: Glossary

Smart Grid Technologies

Smart Grid Functions

Technology	Definition		Function	Definition
Advanced Metering Infrastructure	Electricity meters that use two-way communication to collect electricity usage and related information from customers and to deliver information to customers.		Adaptive Protection	Adaptive protection uses adjustable protective relay settings (e.g., current, voltage, frequency) in real time based on signals from local sensors or a central control system. This is particularly useful for feeder transfers and two-way power flow issues associated with high distributed energy resource ("DER") penetration.
Advanced Interrupting Switch	A distribution switch with built-in technology that can detect and interrupt faults more quickly and precisely. Such a device may rely on advanced fault detection techniques, and may not require full-line reclosing and sectionalizing to isolate faults.		Automated Feeder Switching	Automated feeder switching is realized through automatic isolation and reconfiguration of faulted segments of distribution feeders via sensors, controls, switches, and communications systems. These devices can operate autonomously in response to local events or in response to signals from a central control system.
Automated Capacitors	Automated capacitors can increase the voltage on a distribution circuit by providing reactive power (often referred to as volt-amperes-reactive or "VAR"). Capacitor banks are switched in discrete steps, either manually, or in response to the voltage at the location where they are connected. Typically, distribution capacitor banks are switched in a single step.		Automated Islanding and Reconnection	Automated islanding and reconnection is achieved by automated separation and subsequent reconnection (autonomous synchronization) of an independently operated portion of the transmission and distribution system (e.g., microgrid) from the interconnected electric grid. A microgrid is an integrated energy system consisting of interconnected loads and distributed energy resources which, as an integrated system, can operate in parallel with the grid or as an island.
Automated Voltage Regulators	Voltage regulators are transformers that can increase or decrease the voltage on a distribution circuit to help keep the voltage within a pre-determined band. Unlike capacitor banks, voltage regulators cannot adjust power factor. They typically monitor the voltage at the location where they are connected, comparing it to a programmed set point. If the voltage deviates too far from the set point, the voltage regulator can adjust its output voltage by moving the tap on the secondary side up or down.		Automated Voltage and VAR Control	Automated voltage and VAR control requires coordinated operation of reactive power resources such as capacitor banks, voltage regulators, transformer load-tap changers, and distributed generation ("DG") with sensors, controls, and communications systems. These devices could operate autonomously in response to local events or in response to signals from a central control system.
Backhaul Communications Systems	The infrastructure used to connect the AMI head-end system to the AMI data collectors or access points, and/or used to communicate with other grid modernization technologies. Backhaul communications typically utilize fiber-optic cables, high speed wireless connections, or other networks that can handle large amounts of data. Backhaul communications can utilize utility-owned infrastructure or third party communications providers.		Customer Electricity Use Optimization	Customer electricity use optimization is possible if customers are provided with information to make educated decisions about their electricity use. Customers should be able to optimize toward multiple goals such as cost, reliability, convenience, and environmental impact.
Controllable/ Regulating Inverter	Alternating current ("AC") to direct current ("DC") converters that properly regulate voltage and can be controlled remotely. These devices can significantly increase the integration of renewable or intermittent sources of electricity.		Demand Response	Changes in electric usage by demand-side resources from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized.
Customer Energy Management System ("EMS")/ Display/ Portal	Devices or portals through which energy and related information can be communicated to and from utilities or third-party energy service providers. These devices can also help customers control electricity usage automatically by responding to signals from the utility or owner-set parameters.		Diagnosis and Notification of Equipment Condition	Diagnosis and notification of equipment condition is defined as on-line monitoring and analysis of equipment, its performance and operating environment to detect abnormal conditions (e.g., high number of equipment operations, temperature, vibration). Automatically notifies asset managers and operations to respond to conditions that increase the probability of equipment failure.
Direct Load Control Device	A remotely controllable switch that can turn power to a load or appliance on or off. Such a device could also be used to regulate the amount of power that a load can consume. Direct load control devices can be operated by a utility or third party energy provider to reduce a customer's energy demand at certain times.		Distributed Energy Resource ("DER") Monitoring and Control	Monitoring, analysis, and control the output and performance of the DER, and coordination of the DER's operation with other smart grid systems.
Distributed Energy Resource ("DER")	A DER is a device or measure that produces electricity or reduces electricity consumption, and is connected to the electrical system, either "behind the meter" in the customer's premise, or on the utility's primary distribution system. A DER can include, but is not limited to, energy efficiency, distributed generation, demand response, microgrids, energy storage, energy management systems, and electric vehicles.		Distribution-Sited Grid Storage Integration and Control	Distribution-sited grid storage integration and control encompasses smart grid capabilities that provide the ability to store electrical energy in battery systems, including battery systems sited at end-use facilities (i.e., residential, small commercial and industrial ("C&I"), large C&I, and institutional facilities) on the distribution system.
Distributed Energy Resource ("DER") Interface/ Control Systems	A device through which a DER is connected to the electrical system. The interface may include power conversion, communications and control systems that can manage the output and performance of the DER, and coordinate the DER's operation with other smart grid systems.		Dynamic Capability Rating	Dynamic capability rating can be achieved through real-time determination of an element's (e.g., line, transformer) ability to carry load based on electrical and environmental conditions.
Distributed Generation ("DG")	Generation that is located close to the particular load that it is intended to serve. General, but non-exclusive, characteristics of these generators include: an operating strategy that supports the served load; and interconnection to a distribution or sub-transmission system (138 kV or less).		End-Use Energy Efficiency ("EE")	Smart end-use energy efficiency encompasses smart grid capabilities that reduce energy consumed by customers through enhanced information feedback, identification of poorly performing equipment as candidates for replacement or maintenance, and other enhancements to EE that require smart grid functionality. Capabilities encompass consumer behavior change, automated energy management, geo-targeting, efficiency equipment upgrades, and improved maintenance.
Distribution Automation ("DA")	DA is a family of technologies including sensors, processors, communication networks and switches that can perform a number of distribution system functions depending on how they are implemented. Over the last 20 years, utilities have been applying DA to improve reliability, service quality and operational efficiency. More recently, DA is being applied to perform automatic switching, reactive power compensation coordination and other feeder operations/control.		Enhanced Fault Protection	Enhanced fault protection requires higher precision and greater discrimination of fault location and type with coordinated measurement among multiple devices. For distribution applications, these systems will detect and isolate faults without full-power reclosing, reducing the frequency of through-fault currents. Using high resolution sensors and fault signatures, these systems can better detect high impedance faults. For transmission applications, these systems will employ high speed communications between multiple elements (e.g., stations) to protect entire regions, rather than just single elements. They will also use the latest digital techniques to advance beyond conventional impedance relaying of transmission lines.
Distribution Management System ("DMS")	DMS is a utility information technology system capable of collecting, organizing, displaying and analyzing real-time distribution system information. A DMS can help plan and execute distribution system operations to increase system efficiency, optimize power flows, and prevent overloads. A DMS can interface with other applications such as geographic information systems ("GIS"), outage management system ("OMS"), and customer information systems ("CIS") for a full view of distribution operations.		Fault Current Limiting	Fault current limiting can be achieved through sensors, communications, information processing, and actuators that allow the utility to use a higher degree of network coordination to reconfigure the system to prevent fault currents from exceeding damaging levels.
Dynamic Rating Systems	Dynamic capability rating adjusts the thermal rating of power equipment based on factors such as air temperature, wind speed, and solar radiation to reflect actual operating conditions. These systems are primarily used on high capacity or critical power system elements such as transmission lines and large power transformers.		Fault Location, Isolation, and Service Restoration ("FLISR")	A distribution automation application utilizing sensors, information processors, communications and switches, designed to locate faults and minimize affects by switching portions of the affected circuit to other circuits. FLISR reduces the number of customers that experience a sustained power outage by quickly reconfiguring distribution circuits. FLISR can be initiated and managed from central control systems, or by distributed, local control systems.

Business Case Summary Template: Glossary

Smart Grid Technologies

Technology	Definition
Electricity Storage Technologies	Technologies that can store electricity to be used at a later time. These devices require a mechanism to convert AC electricity into another form for storage, and then back to AC electricity. Common forms of electricity storage include batteries, flywheels, and pumped hydro. Electricity storage can provide backup power, peaking power, and ancillary services, and can store excess electricity produced by renewable energy resources when available.
Enhanced Fault Detection Technology	Enhanced fault detection technology enables higher precision and greater discrimination of fault location and type with coordinated measurement among multiple devices. For distribution applications, this technology can detect and isolate faults without full-power re-closing, reducing the frequency of through-fault currents. For transmission applications, this technology will employ high speed communications between multiple elements (e.g., stations) to protect entire regions.
Equipment Health Sensor	Monitoring devices that automatically measure and communicate equipment characteristics that are related to the 'health' and maintenance of the equipment. These characteristics can include, but are not limited to temperature, dissolved gas, and loading. These devices can also automatically generate alarm signals if the equipment characteristics reach critical or dangerous levels.
Fault Current Limiter	A fault current limiter prevents current in an electrical circuit from exceeding a predetermined level by increasing the electrical impedance of that circuit before the current through the circuit exceeds that level. Fault current limiters are designed so as to minimize the impedance of the circuit under normal conditions to reduce losses, but increase the impedance of the circuit under fault conditions to limit fault current.
Flexible Alternating Current Transmission System ("FACTS") Device	An electronic system and other static equipment that provide control of one or more AC transmission system parameters to enhance controllability and increase power transfer capability.
Head-End System	A head-end system is hardware and software that receives the stream of meter data brought back to the utility through the AMI system. Head-end systems may perform a limited amount of data validation before either making the data available for other systems to request or pushing the data out to other systems.
Line Monitoring Equipment	Automated equipment that will locate power line outages as they occur that can speed recovery since repair crews will not have to search for the source of an outage and can begin repairs much sooner.
Loading Monitor	Technology that can measure and communicate line, feeder, and/or device-loading data via a communication network in real- or near real-time.
Meter Data Management System ("MDMS")	A MDMS collects and stores meter data from a head-end system and processes that meter data into information that can be used by other utility applications including billing, customer information systems, and outage management systems. The MDMS is a key resource for managing large quantities of meter data.
Microgrid Controller	A device that enables the establishment of a microgrid by controlling DERs and loads in a predetermined electrical system to maintain acceptable frequency and voltage.
Outage Management System ("OMS")	A software application that can process outage reports from a variety of utility operational systems including SCADA, AMI, and customer phone calls, and display outage information to utility operators. The OMS can help a utility interpret outage information and determine where the likely cause of an outage may be. It can also help the utility optimize its service restoration resources.
Phase Angle Regulating Transformer	Transformers that enable phase angle control between the primary (source) and the secondary (load) side to create a phase shift between the primary side voltage and the secondary side voltage. The purpose of this phase shift is to control the real power flow through interconnected power systems.
Phasor Measurement Technology	The phasor measurement units, phasor data concentrators, communications technology, and advanced software applications that enables system operators to collect and analyze synchrophasor data from the bulk transmission system.
Smart Appliances and Equipment	Home appliances and devices (e.g., thermostats, pool pumps, clothes washers/dryers, water heaters) that use wireless technology (e.g., ZigBee) to receive real-time data from the AMI system to control or modulate their operation.
Software - Advanced Analysis/ Visualization	Systems installed to analyze grid information or help human operators.
Supervisory Control and Data Acquisition ("SCADA") Communications Network	SCADA is a system of remote control and telemetry used to monitor and control the transmission system. A SCADA Communications Network is a highly distributed system used to control geographically dispersed assets, often over thousands of square miles, where centralized data acquisition and control are critical to system operation.
Very Low Impedance ("VLI") Cables	Cables that use conducting materials that are very low impedance, which can enable better power flow control. Cables that use high temperature superconducting ("HTS") conductor would be characterized as a VLI cable. HTS cables may enable additional benefits such as lower losses, increased power density, and self-fault limiting.

Smart Grid Functions

Function	Definition
Power Flow Control	Power flow control requires techniques that are applied at transmission and distribution levels to influence the path that power (real and reactive) travels. This uses such tools as flexible AC transmission systems ("FACTS"), phase angle regulating transformers ("PARs"), series capacitors, and very low impedance superconductors.
Real-time Load Measurement and Management	This function provides real-time measurement of customer consumption and management of load through AMI systems (smart meters, two-way communications) and embedded appliance controllers that help customers make informed energy use decisions via real-time price signals, time of use ("TOU") rates, and service options.
Real-time Load Transfer	Real-time load transfer is achieved through real-time feeder reconfiguration and optimization to relieve load on equipment, improve asset utilization, improve distribution system efficiency, and enhance system performance.
Wide Area Monitoring and Visualization	Wide area monitoring and visualization requires time synchronized sensors, communications, and information processing that allow the condition of the bulk power system to be observed and understood in real-time so that action can be taken.

Sources:

Electric Power Research Institute, Methodological Approach for Estimating the Benefits and Costs of Smart Grid Demonstration Projects at 4-6 – 4-7 (January 2010), available at https://www.smartgrid.gov/sites/default/files/doc/files/Methodological_Approach_for_Estimating_Benefits_Costs_Smart_201007.pdf

Navigant Consulting, Inc., Smart Grid Regional Business Case for the Pacific Northwest at 59 (December 17, 2013), available at http://www.bpa.gov/Projects/Initiatives/SmartGrid/DocumentsSmartGrid/Navigant-BPA-PNW-Smart-Grid-Regional-Business-Case-2013-White-Paper.pdf

www.eia.gov

www.smartgrid.gov

Business Case Summary Template: List of Technologies and Functions

Technology	Function
Advanced Interrupting Switch	Adaptive Protection
Advanced Meters	Advanced Meter Reading & Billing
Automated Capacitors	Automated Feeder Switching
Automated Distribution Circuit Switches	Automated Islanding & Reconnection
Automated Voltage Regulator	Automated Voltage & VAR Control
Backhaul Communications System	Current Voltage & Power Factor
Controllable/ Regulating Inverter	Customer Electricity Use & Optimization
Customer EMS/ Display/ Portal	Demand Response
Distributed Generation	Diagnosis & Notification of Equipment Condition
Distributed Energy Resource Interface/ Control Systems	Distributed Energy Resource Monitoring & Control
Direct Load Control Device	Distributed Generation Integration
Distribution Automation	Distribution-Sited Grid Storage Integration & Control
Distribution Management System	Dynamic Capability Rating
Dynamic Rating Systems	End-Use Energy Efficiency
Energy Storage Technologies	Enhanced Fault Protection
Enhanced Fault Detection Technology	Fault Current Limiting
Equipment Health Sensor	Fault Location, Isolation & Service Restoration
Flexible Alternating Current Transmission System Device	Power Flow Control
Fault Current Limiter	Real-time Load Measurement & Management
Head-End System	Real-time Load Transfer
Line Monitoring Equipment	Revenue Assurance
Loading Monitor	Service Outage Management
Meter Data Management System	Wide Area Monitoring, Visualization & Control
Microgrid Controller	
Outage Management System	
Phase Angle Regulating Transformer	
Phasor Measurement Technology	
Plug-In Electric Vehicles	
SCADA Communications Network	
Smart Appliances and Equipment	
Software - Advanced Analysis/ Visualization	
Vehicle-to-Grid Two-Way Power Converter	
Very Low Impedance Cables	

Business Case Summary Template: List of Benefits

Benefit Category	Benefit Lookup	T & D Capital Savings Category	Distribution O & M Savings Category	Theft Reduction Category	System Optimization Category	Electricity Cost Savings Category	Power Interruptions Category	Power Quality Category
T & D Capital Savings	T & D Capital Savings	Deferred transmission capacity investments	Deferred asset management planning	Reduced electricity theft	Reduced electricity losses	Reduced electricity cost	Reduced sustained outages	Reduced momentary outages
Distrbution O & M Savings	Distrbution O & M Savings	Transmission rate impacts	Improved distribution planning	Increased theft and tamper detection	Reduced energy use from additional energy efficiency programs	Demand savings	Reduced major outages	Reduced sags and swells
Theft Reduction	Theft Reduction	Deferred distribution capacity investments	Reduced distribution equipment maintenance cost		Reduced energy use due to optimized system voltages	Reduced electricity consumption	Reduced restoration costs	Limit total harmonic distortion ("THD") levels
System Optimization	System Optimization	Deferred capital replacement	Reduced distribution operations cost		Improved load balancing	Savings from TVR, shifting peak demand	Reduced outage frequency	Delivery of acceptable voltage, vurrent, and frequency
Electricity Cost Savings	Electricity Cost Savings	Avoided purchases of existing meters	Reduced meter reading cost			Reduced costs due to optimized system voltages	Avoided cost to restart industrial/ commercial business operations	Reduce voltage violations
Power Interruptions	Power Interruptions	Avoided purchase of existing meter reading systems	Reduced meter reading employee expenses			Reduced energy use from demand response	Avoided cost of spoiled inventory	
Power Quality	Power Quality	Avoided purchase of other distribution devices	Reduced meter reading vehicle expenses			Avoided capacity costs	Faster outage detection and notification	
Distributed Energy Resources	Distributed Energy Resources	Reduced equipment failures	Reduced meter reading system associated expenses			Market price suppression	Improved outage duration info and reporting	
Other Customer Benefits	Other Customer Benefits		Reduced meter testing costs (sample savings)				More reliable restoration notification	
Air Emissions	Air Emissions		Reduced disconnection and reconnection costs				Reduced truck rolls at the end of outages by better understanding nested outages	
Other Benefits	Other Benefits		Reduced off-cycle/ special meter reading expenses				Improved response time to restoration	
			Reduced on-cycle manual meter reading expenses				Extended outage restart assistance	
			Reduced trip expense for "ok on arrival" meters				Avoided lost sales due to outages	
			Reduced trip expense for "low voltage" calls				SAIDI improvement	
			Reduced costs from malfunctioning meters				SAIFI improvement	
			Reduced energy use from inactive meters				CKAIDI improvement	
			Improved issue detection, including dead meters				CKAIFI improvement	
			More accurate meter readings				MAIFI improvement	
			Reduced on-site visits					
			Reduced truck rolls					
			Reduced accidents/ physical injury					
			Reduced vehicle expenses for field services					
			Reduced communication expenses					
			Reduced back office costs					
			Reduced IT expenses					
			Reduced call center volume					
			Reduced or eliminate estimated bills					
			Improved billing window					
			More streamlined procedures for customers moving in/ out of system					
			Lower marginal cost to obtain interval data on customer usage					
			Improved load research					

Business Case Summary Template: List of Benefits

Distributed Energy Resources Category	Other Customer Benefits Category	Air Emissions Category	Other Benefits Category	Beneficiary	Monitized? Quantified?	Weight
Increased integration of DERs in the service territory	Daily usage data with price signals for managing energy usage	Avoided GHG emissions compliance cost	Reduced bad debt expenses	Customer	Yes	Low
Increased integration of renewable fuel sources	Day ahead pricing signals allowing customers to plan usage	Avoided SOx, NOx, and PM-10 emissions compliance cost	Increased program revenue	Utility	No	Med
Increased DER nameplate capacity in the service territory (in MW)	Increased customer control of appliances and lighting		Forward Capacity Market payments	Customer/ Utility		High
Avoided electricity costs by energy produced by DERs (kWh)	Increased customer access to the energy management portals		Tax credits			
Enable microgrids	Improved customer satisfaction					
Increased number of EVs in the service territory	Increased customer choice and control					
Reduced fuel transportation expense from EVs	In-home feedback tools					
Reduced costs from energy storage	Customer consumption info on dedicated website					
Reduced costs from DER	Customer selected due dates					
Reduced interconnection costs	Better informed customer reps					
	Convenience - no longer require meter access to meter readers					

Business Case Summary Template: List of Costs

Cost Category	Cost Lookup	Advanced Metering System Category	Communications Systems Category	Electric Distribution System Category	Integrated Crosscutting Systems Category	Customer Education Marketing Category	Project Management Administration Category	Operational O & M Category	Type of Cost	CapEx Tracker
Advanced Metering System	Advanced Metering System	Advanced meters	Communications infrastructure (e.g., cell towers, collectors, head-end systems)	Substation equipment (e.g., transformers, cap banks, regulators, LTCs, circuit breakers)	Develop new or modify existing metering systems	Develop marketing and education plan	Develop overall implementation strategy and associated plan	Customer inquiry, through all channels (e.g., call center, web)	Direct capital cost	Yes
Communications Systems	Communications Systems	Meter installation	Communications infrastructure installation costs	Line switches/reclosers	Develop new or modify existing CIS & billing systems	Develop marketing and education collateral	Standard program management	Customer enrollment processing (opt in or opt out)	Capitalized overhead cost	Partially
Electric Distribution System	Electric Distribution System	Meter acceptance testing	Communications hardware acceptance testing (lab)	Line capacitor banks	Develop new or modify existing MDMs, data warehousing, and reporting systems	Execute marketing and education plan	Standard change management	Executive complaint resolution	Non-capitalized O&M cost	No
Integrated Crosscutting Systems	Integrated Crosscutting Systems	Home Area Network ("HAN") chip	Legal fees for communications infrastructure siting	Line voltage regulators	Develop new or modify existing orders systems	IT solution for marketing and education plan	Develop and execute RFIs and RFPs	Billing data exception processing		
Customer Education Marketing	Customer Education Marketing	Remote connect/disconnect chip		Line transformers	Develop new or modify customer notification systems	Incentives to customers	New policies and controls	Revenue protection equipment, vehicles, data analysts, and investigators		
Project Management Administration	Project Management Administration			Line sensors/fault indicators	Develop new or modify web/mobile portals		Governance and oversight	Meter testing and new meter testing equipment		
Operational O & M	Operational O & M			Energy storage systems	Develop new or modify systems to support TVR		Quality management	Meter test equipment maintenance		
					Develop new or modify load flow analysis tools		Change control process	Meter, HAN, and remote disconnect maintenance		
					Size and procure capacity for IT infrastructure components (e.g., storage, processing)		Regulatory process management	Meter exchange processing		
					Develop new or modify outage management systems		Vendor/contract management	Meter data exception processing		
					Develop new or modify SCADA systems		Severance and recruiting	Communications technology energy usage costs		
					Develop new or modify distribution management systems		Financing costs	Communications testing equipment		
					Develop new or modify GIS systems			Communications equipment maintenance		
					Develop new or modify existing network management and security systems			Ongoing communications costs (e.g., cell service)		
					Develop new or modify existing interfaces			Additional field equipment		
								Additional field services		
								Operational data analysts (meter, billing, work management)		
								Operations costs to support new distribution system technologies and systems		
								Maintenance costs to support new distribution system technologies and systems		
								IT data analysts and developers for all affected product areas		
								IT infrastructure components maintenance		
								Equipment costs to support additional FTEs in IT and Business		
								Facilities costs		
								Dispatch costs		
								Training		
								Transportation expense		