



U.S. Department of Energy

Office of Electricity Delivery and Energy Reliability

# Smart Grid Metrics and Benefits

Transmission Metrics

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# BUILD METRICS

## Electric Transmission System Assets

BUILD METRICS: Electric Transmission System Assets		
Metric	Value	Remarks
Portion of transmission system covered by Phasor Measurement systems	%	Including lines, transmission substations, and key equipment
Phasor Measurement Systems		
PMUs	# and Description	Make and model, security measures, consistency with NASPI and synchrophasor standards, substation name, location, nominal voltage level, settings, CEII designation, PT/VT and CT transducer make and model
Phasor Data Concentrators	# and Description	Make and model, security measures, consistency NASPI and synchrophasor standards, number of PMUs networked
Communications Network	Description	Type and characteristics
Advanced Transmission Applications		Applications utilizing phasor data or other Smart Grid information for transmission operations and planning
Angle/Frequency Monitoring	Yes/No	Indicate if Phasor Measurement Systems will be used for these purposes
Post-mortem Analysis (including compliance monitoring)	Yes/No	
Voltage Stability Monitoring	Yes/No	
Thermal Overload Monitoring	Yes/No	
Improved State Estimation	Yes/No	
Steady-State Model Benchmarking	Yes/No	
DG/IPP Applications	Yes/No	
Power System Restoration	Yes/No	
Dynamic Capability Rating Systems		Systems designed to determine real-time ratings
Transmission lines	#	Based on line loading, temperature, sag or other operating parameters
Station Transformers	#	Based on equipment loading, temperature, oil condition, or other operating parameters
Other Transmission equipment	#	Other equipment that could benefit from a real-time rating
Other Transmission devices	#	Characteristics of transmission devices



# IMPACT METRICS

## Electric Transmission Systems

IMPACT METRICS: Electric Transmission Systems		
Metric	Value	Remarks
Metrics Related Primarily to Economic Benefits		
Peak Generation and Mix	MW Mix	Specify intermittent generation by type and amount
Peak Load and Mix	MW Mix	Specify controllable load by type
Annual Generation Cost	\$	Total cost of generation to serve load
Hourly Generation Cost	\$/MWh	Aggregate or market price of energy in each hour
Annual Generation Dispatch	MWh	Total electricity produced by central generation
Ancillary Services Cost	\$	Total cost of ancillary services
Congestion (MW)	MW	Total transmission congestion during the reporting period
Congestion Cost	\$	Total transmission congestion cost during the reporting period
Transmission line or equipment overload incidents	#	The total time during the reporting period that line loads exceeded design ratings
Transmission line load	MW MVAR	Real and reactive power readings for those lines involved in the project. Information should be based on hourly loads.
Deferred Transmission Capacity Investments	\$	The value of the capital project(s) deferred, and the time of the deferral.
Equipment failure incidents	#	Incidents of equipment failure within the project scope, including reason for failure
Transmission Equipment Maintenance Cost	\$	Activity based cost for transmission equipment maintenance during the reporting period
Transmission Operations Cost	\$	Activity based cost for transmission operations during the reporting period
Transmission Restoration Cost	\$	Total cost for transmission restoration during the reporting period
Transmission losses	%	Losses for the portion of the transmission system involved in the project. Could be modeled or calculated.
Transmission power factor	pf	Power factor for the portion of the transmission system involved in the project. Could be modeled or calculated.



# IMPACT METRICS

## Electric Transmission Systems (Continued)

IMPACT METRICS: Electric Transmission Systems (continued)		
Metric	Value	Remarks
Metrics Related Primarily to Transmission Reliability		
BPS Transmission Related Events Resulting in Loss of Load (NERC ALR 1-4)	#	
Energy Emergency Alert 3 (NERC ALR 6-2)	#	
Metrics Related Primarily to Environmental Benefits		
Transmission Operations Vehicle Miles	Miles	Total mileage for transmission operations and maintenance during the reporting period
CO2 Emissions	tons	Could be modeled or estimated
Pollutant Emissions (SOx, NOx, PM-10)	tons	Could be modeled or estimated
Metrics Related Primarily to Energy Security Benefits		
Event Capture and Tracking		Major Events or Blackouts
Number, Type ,and Size	Events Cause Load lost	Causes could include line trips, generator trips, or other large disturbances
Duration	Minutes/Hours	
PMU dynamic data	PMU Data	From related PMUs
Detection	Application	Application that detected the event
Events Prevented	#	Include reason for prevention
Metrics Related Primarily to PMU/PDC System Performance		
PMU Data Completeness	%	Portion of PMUs that are operational and successfully providing data
Network Completeness	%	Portion of PMUs networked into regional PDCs
PMU/PDC Performance	Reliability Quality	
Communications Performance	Availability	
Application Performance	Description	Usefulness of applications, including reliability improvements, markets and congestion management, operational efficiency