

Assessment of Market Reform Options to Enhance Reliability of the ERCOT System

Prepared for the Public Utility Commission of Texas

November 2022



Energy+Environmental Economics

This report is prepared by:

Energy and Environmental Economics, Inc. (E3)

Zach Ming

David Delgado

Nick Schlag

Arne Olson

Astrapé Consulting

Nick Wintermantel

Alex Dombrowsky

Rajaz Amitava

This report is prepared for:

The Public Utility Commission of Texas (PUCT)

Table of Contents

Acronyms	v
Glossary	vi
1 Executive Summary	1
1.1 Methods and Assumptions	2
1.2 Analytical Results	5
1.3 Sensitivity Analysis	6
1.4 Key Findings	7
1.5 E3 Recommendation	9
2 Introduction	11
3 Description of Market Design Alternatives	13
3.1 Load-Serving Entity Reliability Obligation (LSERO)	16
3.2 Forward Reliability Market (FRM)	18
3.3 Performance Credit Mechanism (PCM)	21
3.4 Backstop Reliability Service (BRS)	25
3.5 Dispatchable Energy Credits (DECs)	27
3.6 Dispatchable Energy Credit and Backstop Reliability Service Hybrid (DEC/BRS Hybrid)	29
4 Methodology and Assumptions	30
4.1 Analytical Approach	30
4.1.1 SERVVM Loss of Load Probability Model	30
4.1.2 Analysis Under Market Equilibrium Conditions	31
4.1.3 Future Scenarios Tested	32
4.2 Key Assumptions	33
4.2.1 Load Forecast	33
4.2.2 Ancillary Services	35
4.2.3 Energy-Only Market Design and Phase I Enhancements	36
4.2.4 Resource Portfolios	37
4.2.5 Renewable Profiles	39
4.2.6 Fuel Prices	40
4.2.7 Planned and Unplanned Outages	41
4.3 Model Outputs	42
4.3.1 Reliability Metrics	42
4.3.2 Cost Metrics	43

5	Results	45
5.1	Energy-Only Design	45
5.2	Alternative Market Designs	48
5.2.1	Resource Portfolio	50
5.2.2	Reliability	52
5.2.3	Cost Metrics	54
6	Sensitivity Analysis	66
6.1	High Renewables	66
6.1.1	Energy-Only Design	67
6.1.2	Alternative Market Designs	68
6.2	High Gas Price	68
6.2.1	Energy-Only Design	68
6.2.2	Alternative Market Designs	69
6.3	No ORDC	70
6.3.1	Energy-Only Design	70
6.3.2	Alternative Market Designs	71
6.4	Low Cost of Retention Equilibrium	72
6.4.1	Energy-Only Design	72
6.4.2	Alternative Market Designs	73
6.5	LSERO, FRM, and PCM Technology Eligibility	74
7	Qualitative Review	76
7.1	Market Power Risk	77
7.2	Market Competition & Efficiency	79
7.3	Implementation Timeline	81
7.4	Administrative Complexity	83
7.5	Real-Time Performance Incentives and Penalties	84
7.6	Ability to Address Extreme Weather Events	86
7.7	Cost and Revenue Stability	88
7.8	Load Migration	89
7.9	Demand Response	90
7.10	Prior Precedent	91
8	Additional Considerations and Implementation Options	92
8.1	Load-Serving Entity Reliability Obligation (LSERO) and Forward Reliability Market (FRM)	92
8.1.1	Resource Accreditation	92
8.1.2	Allocation of System Need to LSEs	94

8.1.3	Generator Performance Penalties _____	96
8.1.4	LSE Compliance Penalties in LSERO Framework _____	98
8.1.5	Zonal/Geographic Construct _____	98
8.1.6	Seasonality _____	101
8.1.7	Forward Procurement Timing _____	102
8.1.8	Market Power Mitigation _____	104
8.2	Performance Credit Mechanism (PCM) _____	105
8.2.1	Demand Curve Determination _____	105
8.2.2	LSE Performance Credit Obligation Determination _____	106
8.2.3	Generator Performance Credit Production Structure _____	106
8.2.4	Zonal/Geographic Structure _____	107
8.2.5	Seasonality _____	107
8.2.6	Procurement Timing _____	107
8.2.7	Market Power Mitigation _____	108
8.3	Backstop Reliability Service (BRS) _____	108
8.3.1	Procurement Mechanism _____	108
8.3.2	Cost Allocation _____	109
8.3.3	Generator Performance Penalties _____	110
8.3.4	Forward Procurement Timing and Contracting _____	111
8.3.5	Contract Duration _____	111
8.3.6	Seasonality _____	112
8.3.7	Retention of Energy Margins _____	112
8.4	Dispatchable Energy Credits (DEC) _____	112
8.4.1	Procurement Mechanism _____	113
8.4.2	LSE Showing Timing _____	113
8.4.3	DEC Eligibility Criteria and Generation Requirements _____	113
8.4.4	DEC Time Window Qualification _____	114
8.4.5	DEC Generation Requirements _____	115
8.4.6	System DEC Requirements _____	115
8.4.7	LSE Compliance Penalties _____	116
8.4.8	Distortionary Effect on Energy Markets _____	116
9	Conclusion _____	118
10	E3 Recommendation _____	120

Acronyms

Acronym	Definition
4CP	4 Coincident Peak
AS	Ancillary Services
BRS	Backstop Reliability Service
CDR	Capacity, Demand and Reserves (ERCOT Report)
CONE	Cost of New Entry
CT	Combustion Turbine
DEC	Dispatchable Energy Credit
ECRS	ERCOT Contingency Reserve Service
ERS	Emergency Response Service
EFOR	Equivalent Forced Outage Rate
EFORd	Equivalent Forced Outage Rate on Demand
ELCC	Effective Load Carrying Capability
ERCOT	Electric Reliability Council of Texas
EUE	Expected Unserved Energy
E3	Energy and Environmental Economics, Inc.
FFRS	Fast Frequency Response Service
FRM	Forward Reliability Market
IMM	Independent Market Monitor
ISO	Independent System Operator
LOLE	Loss of Load Expectation
LOLH	Loss of Load Hours
LOLP	Loss of Load Probability
LR	Load Resource
LSE	Load Serving Entity
LSERO	Load Serving Entity Reliability Obligation
ORDC	Operating Reserve Demand Curve
PBPC	Power Balance Penalty Curve
PCM	Performance Credit Mechanism
PRD	Price Responsive Demand
PUCT	Public Utility Commission of Texas
PUNS	Private Use Networks
REC	Renewable Energy Credit
RPS	Renewable Portfolio Standard
RRS	Responsive Reserve Service
SERVM	Strategic Energy & Risk Valuation Model
TDSP	T&D Service Providers

Glossary

- + **1-Day-in-10-Years:** Shorthand for a common electricity industry reliability standard that specifies that an electricity system must have sufficient generating resources to serve load all but one day every ten years. This standard is equivalent to 0.1 days per year loss of load expectation.
- + **Accreditation:** The process by which a generating unit is assigned a value that quantifies its contribution to system reliability. An accredited generator has *Effective Capacity* (see definition below).
- + **Ancillary Services:** The services necessary to support grid stability and security, including real-time operating reserves that maintain reliability despite expected and unexpected fluctuation in system demand and supply.
- + **Backstop Resources:** Resources that are held in reserve by ERCOT (i.e., not active participants in the electricity market) and are utilized to maintain reliability if needed due to insufficient other resources.
- + **Bilateral Procurement:** Procurement executed through individual contracts between a generator and an LSE.
- + **Capacity Factor:** The ratio of the electrical energy produced by a generating unit for the period considered relative to the electrical energy that could have been produced at continuous full power operation during the same period.
- + **Centralized Procurement:** Procurement executed through a centralized auction for all supply and demand in the market.
- + **Cost of New Entry (CONE):** The levelized all-in cost of a new resource, including capital expenditures, financing costs, and fixed operations and maintenance. This total cost is often normalized by generator capacity (kW) and then amortized over the life (years) of the resource into a final metric of “dollars per kilowatt per year” (\$/kW-yr). In this study, CONE is used primarily in reference to the marginal capacity resource (calculated through modeling to be a natural gas combustion turbine).
- + **Cost of Retention:** The levelized go-forward costs of an existing resource. In this study, the value refers to the levelized go-forward cost of the reference marginal retention resource (coal).
- + **Demand Response:** Reductions in electricity consumption by consumers in response to economic signals, with the goal of reducing usage during high reliability risk hours.
- + **Dispatchable Energy Credit (DEC):** A credit that is generated when energy or ancillary services are produced/provided from an eligible dispatchable resource. In this study, an eligible dispatchable resource must be able to start in 5 minutes or less, have less than a 9,000 Btu/kWh heat rate, and be able to dispatch continuously for 48 hours or more.
- + **Equivalent Forced Outage Rate on Demand (EFORd):** Measure of the probability that a generating unit will be forced offline (not be available due to forced outages or forced derating) when there is demand on the unit to generate; This is an input in reliability modeling and an important determinant of a resource’s Effective Capacity.

Also available as part of the eCourse

[2023 Renewable Energy Law eConference](#)

First appeared as part of the conference materials for the
18th Annual Renewable Energy Law Institute session
"ERCOT Panel Discussion: Market Redesign"