ERCOT Interconnection

Long-Term Transmission Analysis 2010 – 2030 Interim Report Volume 1: Project Status Update

Long-Term Study Task Force
Electric Reliability Council of Texas, Inc.

Topic A and B Phase 1 Report
August, 2011

Federal Acknowledgement and Disclaimer

This material is based upon work supported by the Department of Energy [National Energy Technology Laboratory] under Award Numbers DE-OE-0000340 and DE-OE-0000341.

ERCOT Disclaimer

ERCOT Long-Term Transmission Analysis: 2010 – 2030 Interim Report

Executive Summary

In April, 2010, the Electric Reliability Council of Texas, Inc. (ERCOT) received grant funding from the Department of Energy (DOE) to conduct interconnection-wide long-range transmission planning for the Texas Interconnection. The funds obtained from the DOE are being used to augment and enhance the existing long-range planning efforts for the ERCOT region. The grant funding is intended to support analysis of the long-term needs of the ERCOT system, extend the technical knowledge and capabilities of ERCOT staff, and expand the existing ERCOT planning stakeholder process to include additional representatives from State regulatory agencies, legislative personnel, and non-governmental organizations interested in long-range planning and energy issues. The ultimate intent of this transmission planning study is to identify transmission projects that meet system needs and are cost-effective over the long-term.

This report provides an interim status update for the overall project. It is separated into two volumes. The first volume provides a discussion of the current status of the project, the contributions from stakeholders to date, and a summary of future work expected to be completed by the conclusion of the grant funding in 2013. The second volume provides a description of the tools and processes that have been acquired or developed, and the technical analysis that has been completed for the project.

In order to facilitate participation in the long-range planning process, ERCOT created a new subgroup of the existing Regional Planning stakeholder group, called the Long-Term Study Task Force. This group has met generally on a monthly basis. The earlier meetings were focused on introducing stakeholders to specific long-range planning issues, such as new technologies, environmental regulations or water availability in ERCOT. More recent meetings have included discussions of the new tools and processes and initial results of resource expansion analysis. During this study period ERCOT has developed a tool to reduce the complexity of the ERCOT grid to facilitate long-range transmission analysis, selected and implemented tools to analyze the economic viability of potential future resources, developed a process to select appropriate locations for new resources on the transmission grid, and conducted an initial review of worst-case analysis of potential import capacity needs into fast-growing urban areas in ERCOT.

The Long-Range Study Task Force reached general consensus on an initial future scenario for resource expansion and transmission planning analysis – a Business as Usual scenario, characterized by no significant market or regulatory changes from current conditions. Analysis of this scenario is underway.

Much work still needs to be accomplished by the stakeholder committee; in fact, the next twelve months will likely be the most important period for stakeholder contributions. This will

be the point in the study during which the future scenarios will be determined and new technologies for consideration in these scenarios will be selected. The timeline below indicates that most of the input from stakeholders will be required in the next 12 months in order to meet the next project deadline in December 2012.

Milestone	Kick-off Meetings	Draft Interim Report due to DOE	Interim Report due to DOE	LTSA for State Legislature	Draft Final Report	Final Report due to DOE
Timeline	April, 2010	June, 2011	August, 2011	December, 2012	April, 2013	June, 2013
Work Product	Initial Development Business as Usual Case (BAU) & Modeling		Alternative Scenario Development & Modeling		Final work product	
Stakeholder Process	Monthly introductory meetings		Quarterly LTS meetings with interim workgroup meetings			

Specifically, ERCOT is seeking continued assistance from the stakeholder community in the following areas:

- Development of a robust set of potential future scenarios, including system specific transmission plans.
- Provision of operational performance and financial data for solar generation technologies
- Input into the market potential for demand-side resources and energy-efficiency programs in future scenarios
- Provision of operational and financial data regarding energy storage technologies
- Development of potential growth forecasts of electric vehicle use, and the possibility of electrification of other parts of the transportation industry
- Evaluation of proposed methods to quantify changes in operational risk resulting from integration of new technologies, and assessment of methods to identify long-term cost-effective transmission solutions.

Through this three-year effort, the ERCOT stakeholder community can ensure that long-range transmission planning is focused on the correct issues, is appropriately assessing potential impacts due to technological advancement, changing market and regulatory forces and that ERCOT has the capability to identify the best long-term solutions that meet the transmission needs of the Texas Interconnection.

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1 Introduction

The Electric Reliability Council of Texas, Inc. (ERCOT) received grant funding from the Department of Energy (DOE) as part of the American Recovery and Reinvestment Act (ARRA, 2009) in April, 2010, to conduct interconnection-wide long-range transmission planning for the Texas Interconnection, also known as the ERCOT Region. By State law, passed in 2005, ERCOT is required to conduct a review of generation and transmission needs in the ERCOT Region by the end of each even-numbered year; ERCOT had completed two long-range studies when they applied for the DOE grant. These past efforts were narrow in scope due to limited staff and competing priorities.

The funds obtained from the DOE are being used to augment and enhance the existing long-range planning efforts for the ERCOT region. Approximately two-thirds of the grant funding is intended to perform analyses of the long-term needs of the ERCOT system and to extend the technical knowledge and capabilities of ERCOT staff to provide this analysis. The remaining grant funding is intended to support expansion of the existing ERCOT planning stakeholder process to include additional representatives of State regulatory agencies and legislative personnel, as well as representatives of non-governmental organizations interested in long-range planning and energy issues.

This report provides an interim status update for the study process. It is separated into two volumes. This first volume provides an overall update on the intent of the project, a discussion of the current status of the project, the contributions from stakeholders to date and a summary of future work expected to be completed by the conclusion of the grant funding in 2013. The second volume provides a description of the technical analysis and associated tools necessary for extending the ERCOT capability to conduct long-range transmission planning. Initial technical efforts have been focused on acquiring and implementing the foundational tools required to conduct scenario analysis, i.e., to evaluate the economic viability of potential future resource additions given specific assumptions regarding future market conditions, to site these resource additions in potential locations in the transmission grid and to determine the cost-effectiveness of a variety of potential transmission solutions. These new tools and processes are described in Volume 2, along with the results of their implementation on an initial "Business as Usual" future scenario, in which current market conditions are expected to continue throughout the next twenty years. This enhanced tool-kit is foundational to the next level of analysis – a detailed scenario review of potential future grid requirements.

1.1 Project Intent

There are three primary goals of this ongoing three-year long-range planning effort:

1) To provide relevant and timely information on the long-term system needs in the ERCOT Region to inform nearer-term planning and policy decisions
2) To expand ERCOT long-term planning capabilities by developing new tools and processes that can be used in this and future studies, including extension of the

planning horizon, incorporation of operational reliability considerations and more detailed analysis of the economic viability of emerging technologies

3) To facilitate enhanced stakeholder involvement and input into the ERCOT long-range planning process in a manner that is consensus-seeking, sustainable and consistent with the established ERCOT stakeholder framework.

The ultimate intent of this long-range transmission planning effort is to meet the system need for transmission capacity in a manner that is cost-effective over the long-term.

The need for transmission capacity is generally driven by future load patterns (customer demand) and the set of resources that are expected to serve these loads. It is the changes in future resources and future load patterns that will result in the need for changes in transmission topology.

Given that the future is unknown, future system needs must be evaluated through scenario analysis – the development of potential future scenarios, each of which is considered possible, though not certain. Through a review of transmission needs across a range of possible future scenarios the relationships between changing market forces and changing system needs can be illuminated. Also, transmission projects that provide versatility, i.e., are cost-effective under varying future scenarios, can be identified.

A well-vetted and repeatable long-range planning process provides ERCOT with the capability to:

- Review transmission technologies that may be part of long-term cost-effective solutions, even though they require higher up-front expenditures
- Allow stakeholders and regulatory personnel to consider the appropriate planning horizon both for near-term and long-range planning
- Provide initial indications of the possibility of significant changes in system conditions resulting from changes in market conditions, capabilities of technology or market participants and/or the costs or capabilities of generation technologies.

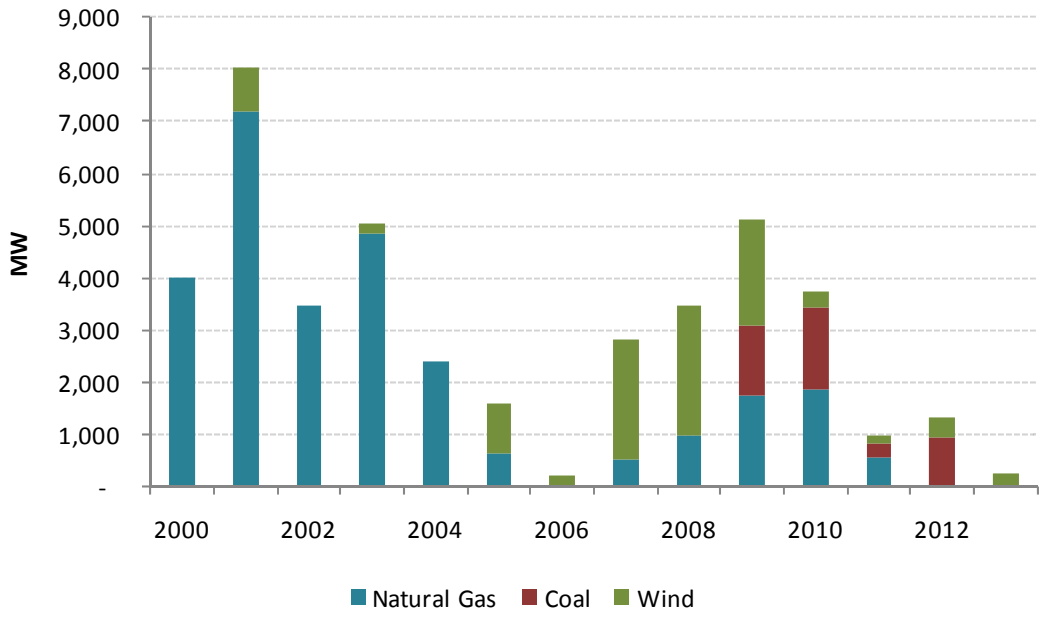
This capability will be fully robust only with informed participation by a full spectrum of stakeholder interests.

2 Interconnection Background

The Texas Interconnection, as suggested by the name, resides entirely within the State of Texas. The smallest of the three interconnections in the United States, it encompasses approximately 75% of the land area of Texas, and approximately 85% of the customer demand. The Electric Reliability Council of Texas, Inc. (ERCOT) is a not-for-profit organization, regulated by the Public Utility Commission of Texas and under the oversight of the Texas Legislature, which is responsible for overseeing the reliable transmission of electricity over the entire Texas Interconnection. As the independent system operator for the Texas Interconnection, ERCOT is also responsible for facilitating the wholesale and retail electricity markets.

The ERCOT grid consists of approximately 40,500 miles of 69-kilovolt (kV), 138-kV and 345-kV transmission circuits. The peak load of 65,776 megawatts (MW) in ERCOT was recorded on August 23, 2010. There are currently approximately 550 generation units on the ERCOT system, providing approximately 74,000 MW of on-peak generation capacity.

Figure 1: ERCOT Historical Capacity Additions



As shown above in Figure 1, capacity additions over the past 10 years have consisted primarily of natural-gas, coal, and wind generation. Annual additions have ranged from 200 MW to roughly 8,000 MW.

There are limited ties between ERCOT and the surrounding interconnections. Two asynchronous ties provide approximately 820 MW of intertie capacity between the Texas and

the Eastern Interconnection and three asynchronous ties provide approximately 300 MW of intertie capacity with the transmission system in Mexico. There are approximately 2,900 MW of generation capacity that can switch their output between the Texas Interconnection and the Eastern Interconnection.

The ERCOT system has a significant amount of natural gas generation. Because of the relative spot price of this fuel, natural gas generation sets the marginal wholesale cost of electricity in most settlement periods. There is approximately 44,600 MW of natural gas generation; 18,900 MW of coal generation; and 5,100 MW of nuclear generation on the system. There is also approximately 9,500 MW of wind generation capacity currently operational in the ERCOT system. The maximum amount of instantaneous wind generation in ERCOT was 7,355 MW (14.6% of customer demand), recorded on June 19, 2011. The previous record was 7,227 MW (26% of customer demand), recorded on December 11, 2010. Smaller amounts of hydro, solar and biomass are also installed on the ERCOT system. Energy Efficiency programs, per SB1125, equate to 128 MW in 2011 as listed in the May 2011 Capacity, Demand and Reserves report. Market mechanics also include load as a capacity resource capable of meeting certain ancillary service requirements. These resources include Controllable Load Resources (formerly known as LaaRs) which provide roughly 1,000 MW of capacity and are deployed when an Energy Emergency Alert is implemented.

A nodal market redesign was launched on December 1, 2010, implementing locational marginal pricing at more than 8,000 nodes, a day-ahead energy and ancillary services co-optimized market and day-ahead and hourly reliability unit commitment. ERCOT is also currently performing financial settlement for more than 2 million advanced meters, expected to expand to over 6 million in the next several years.

More information regarding the ERCOT and the Texas Interconnection is available at the ERCOT web-site, http://www.ercot.com.

2.1 ERCOT Planning Process

ERCOT has an established planning process that has resulted in significant on-going investment in new transmission infrastructure. The Regional Planning Group (RPG) is an open stakeholder committee consisting of a broad range of market participants that provides input and review of ERCOT planning activities with respect to transmission. The RPG meets regularly to vet and discuss transmission optimization, development, and study. The RPG process is governed by ERCOT planning guides and protocols publicly available at http://www.ercot.com/mktrules/guides/planning/.

The ERCOT Board of Directors, which is composed of 5 independent Board members and 8 members that represent different segments of the market stakeholder community, provides oversight to the independent transmission project analyses conducted by ERCOT planning staff. The Board determines the standards of review, the relative priority of transmission enhancement, reviews the criticality of certain projects, and endorses specific projects for implementation. The ultimate decision on the need for, and routing of, specific transmission

projects is made by the Public Utility Commission of Texas (PUCT), which gives great weight to the endorsement of the ERCOT board in assessing the need for a new transmission project.

This planning process, alongside the efforts of transmission service providers in actual construction, has resulted in over 8,500 miles of new transmission circuits being installed since 1999. Currently, over 8,000 miles of additional transmission circuits are under study. The transmission improvements resulting from the designation of Competitive Renewable Energy Zones (CREZ) in West Texas and the Panhandle account for approximately 2,300 miles of new 345-kV circuits designed to connect areas of high wind generation potential with load centers in east Texas. These circuits are scheduled to be completed by the end of 2013, just over 8 years since the Texas Legislature passed Senate Bill 20, which authorized the designation of CREZ and the development of a transmission plan to serve these regions.

ERCOT is required by statute to complete a long-term analysis of generation and transmission needs by the end of each even-numbered year. ERCOT has combined the resources that are allocated to this biennial long-term study with the resources available through the DOE grant funding in order to achieve the goals described above. In the same way, this study is intended to benefit from, build upon, and enhance the established ERCOT planning process.

3 Current Project Status

3.1 Stakeholder Participation

Stakeholder involvement is an essential component of the planning process in ERCOT. The diverse community of ERCOT stakeholders that regularly participate in ERCOT stakeholder meetings provides the varied knowledge-base and technical review that have made transmission planning in ERCOT a success.

Stakeholder participation is also a critical component of the long-range planning process in ERCOT. Stakeholders are needed to provide feedback on assumptions regarding costs and potential implementation of new technologies, of possible changes in market conditions, such as fuel or capital costs, or of possible changes in regulations that affect generation technologies. Stakeholders are required to define the key issues for evaluation as part of the development of future scenarios and to ensure that the information derived from studies is relevant to ongoing market and regulatory discussions. In certain instances, stakeholder-driven working groups develop the vast majority of the input required to reach informed and legitimate decisions.

Although numerous market segments are typically represented at ERCOT planning meetings, representatives of State regulatory agencies (other than the PUCT staff), the legislative community and non-governmental organizations interested in energy planning and land-use issues have not traditionally participated on a regular basis in ERCOT planning meetings. ERCOT believes this is at least partially driven by resource limitations. In other instances, it may be driven by lack of information. Grant funding provided by the DOE is intended to foster increased participation from these groups.

In order to achieve the goals of the grant, ERCOT staff developed a new stakeholder group, the Long-Term Study Task Force (LTSTF), the meetings of which were focused on the analysis and studies described in this report. This group is open to participation by any interested stakeholder or individual. A public email list (LongTermStudy@lists.ercot.com) was also created to provide information to interested stakeholders regarding upcoming meetings, project status and other issues. All members of the existing Regional Planning Group mailing list were added as subscribers to the Long-Term Study list. Other stakeholders can sign up for this list by accessing the ERCOT mailing lists at http://lists.ercot.com.

The LTSTF has convened generally on a monthly basis, meeting 12 times since the start of the grant funding in April 2010. Two voluntary sub-groups of the LTSTF were also formed, one tasked with developing future scenarios, and one tasked with establishing criteria and providing analysis required to incorporate energy efficiency and demand response programs into the long-range scenarios. These working groups have met on an ad hoc basis; the recent work of both groups has been put on hold while ERCOT has implemented the models and processes required to conduct resource expansion and transmission needs analysis for future scenarios.

The LTSTF met for the first time on April 29, 2010. Prior to this meeting, an overview of the long-term study was presented at the ERCOT Board of Directors meeting on March 23, 2010, and at the ERCOT Regional Planning Group meeting on April 16, 2010. The first meeting of the LTSTF included an overview of the proposal accepted by the Department of Energy, and an open discussion with stakeholders regarding what issues should be included in the study and what stakeholders could gain from the analyses.

The meetings held throughout 2010 were designed to inform stakeholders and ERCOT on issues that could have significant impact on future electricity markets, demand and resources. Experts from industry, academia and regulatory agencies were engaged to provide insights into the following issues: load forecasting, water demand projections, customer demand response programs, emerging smart grid technologies, geothermal generation potential and environmental policies and impacts. In addition, the LTSTF began discussions on development of future scenarios at the meeting held on June 18, 2010. An influence diagram (available at: http://www.ercot.com/calendar/2010/06/20100618-LTS) was developed at that meeting, and results from issue boards that had been made available at the previous meeting were reviewed.

After further discussions regarding scenario development at the July 23, 2010 meeting, a Scenario Development Working Group was established to focus on finalizing an initial set of scenarios for analysis. This working group met three times via webex in August and September 2010. At these meetings, stakeholders were asked to propose potential scenarios or specific issues to study and to review possible scenarios proposed by ERCOT. Due to limited participation, the work of this sub-group was rolled back into the parent task force.

Scenario development became the primary focus of the LTSTF at the first meeting in 2011, held on January 10. At this meeting an initial business as usual scenario was proposed, based on the assumption that there would be no changes in current market conditions. The latest fuel forecasts from the Energy Information Agency Annual Energy Outlook were proposed to be included as assumptions in this scenario. This scenario was used to show the implementation of the resource expansion analysis process developed by ERCOT using the PROMOD IV and MarketPower software packages. The meetings on January 10 and March 1 also included discussions of the appropriate sensitivities (alternate scenarios in which only one parameter is changed) desired for study, such that stakeholders have sufficient information regarding the resource expansion tools.

LTSTF meetings have also included discussions regarding other tools and processes being developed as part of the long-range planning process. These processes include the transmission simplification process, the evaluation of economic return of potential future resources, a proposed generation siting methodology and the results of initial evaluations of the need for new transmission capacity following 20 years of load growth in ERCOT.

The following organizations have been represented at stakeholder meetings to date:

Independent Power Producers

- Duke Energy
- E.On
- LS Power
- Luminant Energy
- Nextera Energy
- Panda Power Funds
- PSEG Texas
- Shell
- Tenaska
- Horizon Wind

Transmission Providers

- CenterPoint Energy
- Hunt Transmission
- Oncor
- American Electric Power
- Lone Star Transmission

Municipal/Cooperative Utilities

- Austin Energy
- City of Denton
- CPS Energy
- Golden Spread Electric Cooperative
- Lower Colorado River Authority
- South Texas Electric Cooperative

Power Marketers

- Morgan Stanley

Government/Regulators

- California Energy Commission
- Comptroller of Public Accounts - Texas
- Federal Energy Regulatory Commission
- General Land Office - State of Texas
- Office of the Governor - State of Texas
- Public Utility Commission of Texas
- Texas Commission on Environmental Quality
- Texas Parks and Wildlife Division
- Texas Water Development Board
- Railroad Commission of Texas
- United States Department of Energy
- State Energy Conservation Office

Consultants

- CLEAResult
- Dashiell Corporation
- Navigant Consulting
- Stratus Energy Group LLC
- Good Company Associates
- Virtus Energy

Research and Development

- Center for Commercialization of Electric Technologies
- Oak Ridge National Laboratory

Industry Groups

- Texas Public Power Association
- Texas Renewable Energy Industries Association

Concern Groups

- Environmental Defense Fund
- Heart of Texas Council of Governments
- Texas Competitive Power Advocates
- Wind Coalition
- Public Citizen
- Sierra Club

Other

- Longhorn Power
- Occidental Chemical Corporation
- Tres Amigas, LLC
- General Electric
- Ventyx

LTSTF meetings were held at the ERCOT meeting facility, located near the Austin-Bergstrom Airport. Teleconference services have been provided for meetings of the LTSTF to facilitate participation from individuals who could not travel to the Austin area.

To enhance participation from representatives of State regulatory agencies, ERCOT staff met individually with representatives of the following agencies:

Office of the Texas Comptroller of Public Accounts
Texas Department of Transportation
Railroad Commission of Texas
Texas State Energy Conservation Office
Texas Commission on Environmental Quality
Texas Office of Public Utility Council
Texas Water Development Board
Texas Parks and Wildlife Department

ERCOT staff used these meetings to describe the purpose of the long-term study, to begin a dialogue regarding how the long-term study could benefit State regulatory agencies and to determine the ways in which the agency staff could contribute to the long-term study effort.

ERCOT also met with representatives of several non-governmental organizations, including Public Citizen, Environment Texas and the Environmental Defense Fund, to discuss the goals of the long-term study process. ERCOT held additional meetings with representatives of Transmission Service Providers to discuss the transmission analysis process and potential system upgrades. Presentations regarding the long-term study have been made at meetings of the Regional Planning Group, the ERCOT Board of Directors and the Wholesale Market subcommittee.

Although participation in the LTSTF meetings by State agency personnel has been substantial, participation by other segments of the stakeholder community has been below expectations. Limited stakeholder participation has resulted in a lack of diverse views being expressed during stakeholder meetings and has hampered ERCOT efforts to solicit market participant opinions. **With roughly 2/3 of the LTSTF process ahead, ERCOT requires additional stakeholder input to define study objectives and input assumptions.** This stakeholder participation will be especially important as the specific assumptions regarding market conditions and the cost and availability of generation and demand-side resources for future scenarios are selected in the coming months.

A fully represented stakeholder community would certainly include all the traditional segments of the industry participating at ERCOT: Generation, Transmission, Load Serving/Distribution entities, Retail Electric Providers, Regulators. But it would also include a set of significant newcomers: those representing alternative generation technologies, demand side aggregation, environmental interests, water, transportation, and a robust set of other potentially affected stakeholders. In ERCOT's judgment, the inclusion of stakeholders in the long-term planning process is a work in progress. Thus far, increased stakeholder participation has added real value. Collaboration in the future will only further improve the planning process and will

highlight the importance of adequate stakeholder reviews and input. Although a significant amount of work has been done by the Long-Term Study Task Force to-date, as shown in the following timeline, the determination of the nature of future scenarios, as well as the choice of specific emerging technologies to include in scenario analysis will be the focus of the next phase of stakeholder meetings. Increased stakeholder participation will be vital to the success of the next phase of the project.

Figure 2: Long Term Study Project Timeline

Milestone	Kick-off Meetings	Draft Interim Report due to DOE	Interim Report due to DOE	LTSA for State Legislature	Draft Final Report	Final Report due to DOE
Timeline	April, 2010	June, 2011	August, 2011	December, 2012	April, 2013	June, 2013
Work Product	Initial Development Business as Usual Case (BAU) & Modeling		Alternative Scenario Development & Modeling		Final work product	
Stakeholder Process	Monthly introductory meetings		Quarterly LTS meetings with interim workgroup meetings			

3.2 Long-Term Planning Processes and Tools Development

One of the primary goals of this planning effort is to develop new tools and processes that can be used in this and future long-range planning studies. Over the past year several new tools were purchased or built and processes have been developed and implemented as part of the initial analysis of the long-range transmission needs of the ERCOT system. These tools and processes are described in detail in Volume 2 of this report. The following is a brief summary of each tool or process, intended to give a status update of the progress made in completing the requirements of the DOE grant-funding.

The first of these tools to be developed is an automated process that simplifies the ERCOT transmission system. Each year, ERCOT and the transmission service providers work jointly to maintain databases that define the expected components of the transmission system for the next five years. All transmission components operated at 69 kilovolts and higher are included. As part of the database development process, the transmission service providers include new components to the extent that they will be required due to load growth in order to maintain a reliable system. As part of the Regional Planning Group process, ERCOT works with

transmission service providers to review the cost-effectiveness of proposed system upgrades above a minimum cost threshold.

The resulting databases describe transmission elements that provide load-serving capability for at least 5 years. Because these databases include 69-kV elements which are primarily load-serving in nature, it becomes increasingly difficult, as the planning horizon is extended and load forecasts increase, to differentiate large-scale long-term system needs from localized load-serving requirements. Previous 10-year planning studies conducted by ERCOT have included a significant effort by several engineers to evaluate model output and develop a simplified system database that can be used to evaluate the cost-effectiveness of potential long-lead time transmission projects. The time required to conduct this simplification process has limited ERCOT's capability to develop long-range planning models for analysis.

ERCOT has developed an automated script, based on specific rules and insights developed as part of previous long-range studies, to simplify the modeled transmission system. In this model, loads and generation from the 69-kV system are represented on the 138-kV system in a manner that illustrates their impact on the higher voltage system; some elements on the 138-kV system are simplified or increased in capacity in order to facilitate the consideration of longer-term needs. A summary of this process was been presented to ERCOT stakeholders at meetings of the Regional Planning Group and the Long-Term Study Task Force. Results of this tool were used as part of the Long-Term System Assessment for ERCOT, a 10-year planning study, completed in December, 2010.

In the summer of 2010, ERCOT issued a Request for Proposals (RFP) for a production-cost modeling tool that could be used for resource expansion analysis. ERCOT's existing tools do not provide clear information regarding the economic return on investment of new resources. Software provided by Ventyx was selected as a result of this RFP process. The software packages acquired from Ventyx include PROMOD IV (an hourly production cost model), MarketPower, (a tool designed to provide a quick analysis of the cost-effectiveness of potential resource options) and the PROMOD IV Analysis Tool (PAT), (an add-on application that provides additional analytical capabilities that complement the output provided by the PROMOD IV tool).

Following acquisition of the PROMOD IV and MarketPower models, ERCOT developed a database of all resources on the ERCOT system, based on non-confidential data regarding the operational parameters and costs of each resource, along with long-range load forecasts. The resulting model has been used to determine likely resource expansions for the initial future scenario and sensitivities. The intent of this tool is not to determine the optimal set of future resources, in a manner similar to an integrated resource plan study. Rather, the intent is to evaluate the economic competitiveness of available resources, based on a range of input assumptions including fuel prices, capital costs of technologies and financing costs. To the extent that specific technologies are found to be competitive and to provide adequate return on investment, they are included in the set of likely future resources for each scenario. In this way, the resource expansion process is designed to mimic the resource development process in the ERCOT market – in which independent developers assess market conditions, develop pro

forma analyses of projects and proceed with those that appear to meet their firm's criteria for return on investment.

ERCOT also developed a process for siting new resources, based on an analysis of resource requirements and existing geographic and regulatory limitations. This process includes a review of natural gas pipeline density, availability of railroads, water availability, air emission restrictions and intensity of solar and wind resources to take into account all of the major factors required for development of different resource technologies. This process has been used to develop lists, by technology, of existing 345-kV buses at which new resources could be connected. Following completion of the resource expansion process for a particular scenario, the likely future resources enumerated through the economic analysis can be sited at specific transmission buses using the information obtained through this process. The resulting transmission database, with new expansion resources, can be used to evaluate cost-effectiveness of transmission projects.

No single transmission model provides all of the information required to determine the effectiveness of transmission solutions. Production-cost models provide estimates of annual costs of fuel, variable operations and maintenance and other variable costs required to serve customer load; these costs can be used to quantify any increases in overall system efficiency resulting for transmission upgrades. However, these models typically use direct-current approximations of alternating current power-flows and thus do not indicate solutions that do not provide adequate reactive power on long transmission circuits or near load centers. Steady-state power flow models calculate full AC solutions, i.e., both real and reactive power-flows, but do so only for one system state, typically a peak-load hour. As a result, a set of transmission planning models is required to provide a complete analysis of the need for, and the effectiveness of, new transmission projects. The models ERCOT is using to evaluate transmission projects are described in Volume 2 of this report.

3.3 Transmission Needs Analysis

Future transmission system needs are defined by customer demand and the changing set of resources that serve that customer demand. In order to define a cost-effective set of transmission upgrades, both loads and resources must be specified. One aspect of changing transmission system needs that can be analyzed, to some extent, independently of other system changes is the need for either additional import capacity or additional local resources in major urban load centers.

ERCOT conducted a reliability analysis of potential transmission needs near the load centers of Dallas/Fort Worth, Houston and the Lower Rio Grande Valley in order to determine the level of transmission improvements that are likely to be required in 2030 to reliably serve peak season loads in these areas. The results of this analysis will be compared to transmission projects developed for specific future scenarios. Given the deregulated wholesale generation market in ERCOT, it is important to balance transmission plans needed to ensure system reliability if resource development does not occur in specific locations against the likelihood that resources will be developed in those areas and defer the need for the additional transmission. Although

some resources are likely to be constructed in or around load centers in ERCOT, such as Dallas, Austin, or Houston, over the next 20 years, it is also possible that no generation will be built in or near all of these load centers. As such, each of these load areas was analyzed to determine the potential system needs should no additional resources be developed nearby. To the extent that, in certain future scenarios, specific resource options that are more likely to be developed in or near load centers are found to be cost-competitive, the associated cost savings resulting from a reduced need for transmission projects can be captured.

Each area was analyzed separately, using several different generation dispatches. Additional generation was modeled remote from the area under study, in order to have sufficient capacity to serve the system load level modeled in each case. While ERCOT also conducted a generation expansion analysis, discussed below, for the Business as Usual scenario, the remote generation used for analysis of the area import needs did not reflect the results of that generation expansion analysis, since these two analyses were conducted in parallel. However, consistency was not required at this stage of the study, since the intent of the area import needs analysis was to determine transmission needs near load centers, independent of expected resource additions. Transmission-element and generation outages were applied as part of the analysis to ensure compliance with applicable reliability standards. To maintain voltage levels, incremental reactive resources were added as needed.

This analysis indicates the likely need for one or two more import pathways into the Dallas/Fort Worth and Houston regions and at least one additional pathway and additional circuits along existing rights-of way into the Lower Rio Grande Valley area if additional resources are not added within those areas. Voltages in the Dallas/Ft. Worth area also benefited from a partial 345-kV loop around the region.

3.4 Scenario Analysis

As a part of the LTS process, ERCOT stakeholders have defined an initial scenario for analysis: a Business as Usual (BAU) scenario. This case is based on the assumption that future market conditions and regulatory requirements are generally consistent with current conditions. The scenario represents a reasonable first step in the long-range planning process. The results of this BAU scenario can be used as a benchmark to evaluate differences with other future scenarios, which will likely involve significant changes from current conditions. A scenario with limited changes from current conditions also provides an opportunity to gain confidence in the new tools and processes that have been implemented as part of this study.

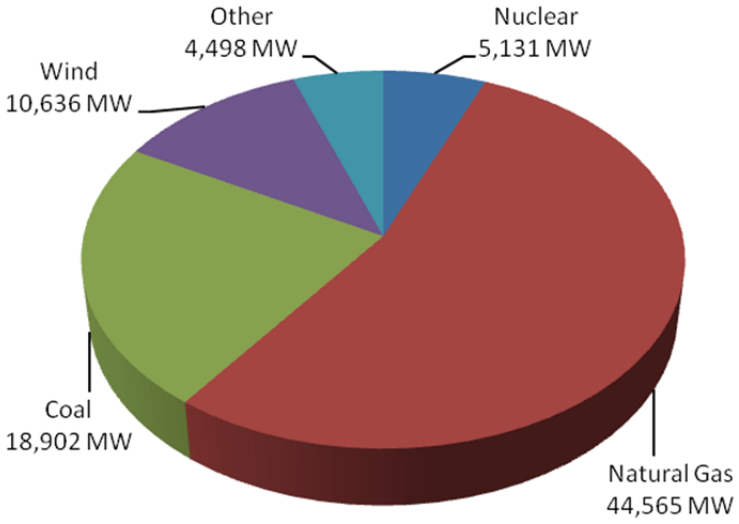
A scenario, such as the Business as Usual scenario, is defined by the set of input parameters that reflect the market conditions and regulatory requirements if that scenario's version of future conditions were to occur. The input parameters used to define a particular scenario might include fuel prices, load growth rates, regulatory incentives/restrictions, technology changes and others. For the Business as Usual scenario, ERCOT worked with stakeholders to construct a near-consensus set of input parameters that reflects the continuation of current conditions. One item about which there was not a consensus was whether the Renewable Energy Production Tax Credit [PTC] would be extended throughout the study horizon as a

Business as Usual scenario input. While it is important to achieve consensus around most of the input parameters that define a particular scenario, it is possible to run a sensitivity analysis around a limited number of key parameters such as this.

As customer demand grows in future years, new resources of various types will be added to the system to the extent that these resources are economic (i.e., they provide sufficient returns through operations to justify investment) given the prevailing market conditions and regulatory requirements. The generation expansion process (described in detail in Volume 2 of this report) is designed to be representative of the deregulated resource development - a key component of the market design in ERCOT. Predicted resource expansion was evaluated for the BAU scenario (both with and without continuation of the PTC), and for the BAU scenario with a higher natural gas price.

ERCOT's existing generating resources are depicted in the following chart:

Figure 3: ERCOT Existing Resources 2010



Potential resource expansion for the BAU case is shown in the following chart. These results are preliminary, as ERCOT works with stakeholders to finalize the incorporation of ancillary services requirements and revenue in the model and the consideration of potential retirements of existing generation. These results suggest that without the Production Tax Credit, no additional wind resources are likely to be developed under current market conditions.

Figure 4: Business as Usual without the PTC Generation Expansion Plan

Description	Units	2010 Actual	2011	2014	2017	2020	2023	2026	2030
CC Adds	MW			-	800	1,600	1,600	4,000	2,800
CT Adds	MW			-	400	3,000	700	500	1,100
Coal Adds	MW			925	-	-	-	-	-
Nuclear Adds	MW			-	-	-	-	-	-
Other Adds	MW			-	-	-	-	-	-
Wind Adds	MW			872	-	-	-	-	-
Annual Capacity Additions	MW			1,797	1,200	4,600	2,300	4,500	3,900
Cumulative Capacity Additions	MW			1,797	2,997	7,597	9,897	14,397	18,297
Reserve Margin	%	21.4	15.9	15.2	8.5	10.2	7.2	9.2	6.2
Coincident Peak	MW	65,776	65,206	73,375	78,869	81,665	85,928	88,318	94,318
Average LMP	$/MWh	34.41	37.42	42.51	56.76	63.23	73.69	81.50	87.75
Natural Gas Price	$/mmbtu	4.38	4.50	4.63	5.10	5.68	6.47	7.35	8.39
Average Market Heat Rate	MMbtu/MWh	7.86	8.32	9.18	11.14	11.14	11.38	11.09	10.46
Natural Gas Generation	%	38.2	41.3	45.8	47.0	49.3	51.0	53.0	59.3
Coal Generation	%	39.5	37.8	36.5	34.3	33.0	31.7	30.6	31.4
Wind Generation	%	7.8	9.2	7.3	8.4	8.0	7.7	7.4	7.6
Scarcity Hours	HRS	-	-	-	29	33	42	49	56
Unserved Energy	GWhs	-	-	-	24.1	39.9	63.9	60.1	68.8

The resources shown in this table as additions in 2014 are units that currently have signed interconnection contracts for transmission service: Sandy Creek, a 925-MW coal plant, and 5 wind units totaling 872 MW (Archer-Young, Gunsight Mountain, Penascal, Senate, and Sherbino Mesa). The other additions shown in the table were developed through the economic generation expansion evaluation. In this table, CC refers to combined-cycle plants, which are highly efficient intermediate to base-load natural gas generation plants, and CT refers to combustion turbines, which are small, more flexible natural gas peaking units.

The table below shows similar preliminary results for the same scenario, with the Renewable Energy Production Tax Credit, an approximately $20/MWh tax credit that can be obtained for renewable energy facilities for the first ten years of operation. This tax credit is scheduled to end in 2012, but may be extended by act of Congress into future years.

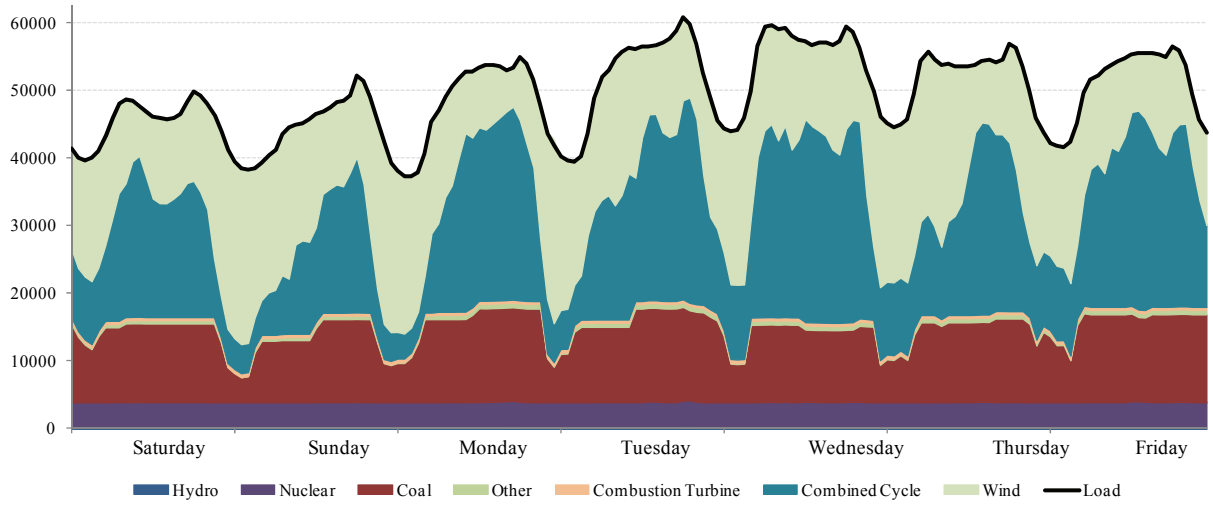
Figure 5: Business as Usual with the PTC Generation Expansion Plan

Description	Units	2010 Actual	2011	2014	2017	2020	2023	2026	2030
CC Adds	MW			-	-	1,600	1,600	800	2,800
CT Adds	MW			-	700	1,500	1,000	500	500
Coal Adds	MW			925	-	-	-	-	-
Nuclear Adds	MW			-	-	-	-	-	-
Other Adds	MW			-	-	-	-	-	-
Wind Adds	MW			872	3,250	7,500	5,000	3,500	6,000
Annual Capacity Additions	MW			1,797	3,950	10,600	7,600	4,800	9,300
Cumulative Capacity Additions	MW			1,797	5,747	16,347	23,947	28,747	38,047
Reserve Margin	%	21.4	15.9	15.2	8.3	9.0	6.9	5.8	2.9
Coincident Peak	MW	65,776	65,206	73,375	78,869	81,665	85,928	88,318	94,318
Average LMP	$/MWh	34.41	37.42	42.51	57.86	66.85	67.00	73.68	78.55
Natural Gas Price	$/mmbtu	4.38	4.50	4.63	5.10	5.68	6.47	7.35	8.39
Average Market Heat Rate	MMbtu/MWh	7.86	8.32	9.18	11.35	11.77	10.36	10.02	9.36
Natural Gas Generation	%	38.2	41.3	45.8	40.7	41.6	40.4	40.3	39.3
Coal Generation	%	39.5	37.8	36.5	34.2	32.3	30.6	29.2	27.3
Wind Generation	%	7.8	9.2	7.3	11.0	16.5	19.7	21.5	24.6
Scarcity Hours	HRS	-	-	-	32	52	37	40	37
Unserved Energy	GWhs	-	-	-	36.2	88.3	60.7	75.9	92.8

This table suggests that with a continuation of the Production Tax Credit, over 25,000 MW of additional wind generation could be installed through 2030. This preliminary analysis does not include consideration of operational reliability limitations, such as unit ramp limitations, minimum system inertia or availability of regulation, spinning reserve, and other ancillary services. When the costs of meeting these operational reliability limitations are incorporated into the analysis, these results may change.

The following graph shows the generation by unit type for a week in March 2030, as determined by the production cost model for the Business as Usual scenario with continuation of the PTC, without consideration of any incremental operational reliability requirements or potential unit retirements. These results show that hourly coal generation across the week ranges from approximately 5,000 to 12,000 MW, and natural gas generation ranges from as little as 3,000 MW to as much as 30,000 MW

Figure 6: Hourly Generation for Week of 3/23-3/29 for BAU with PTC in 2030



The BAU Scenario with high natural gas price incorporates a natural gas price forecast which is $5/MMBtu higher than the BAU case. No other input parameters are changed. As shown in the table below, coal generation is economically competitive in this scenario, along with 6,000 MW of additional wind generation being added in 2014.

Figure 7: Business as Usual with High Natural Gas Price Generation Expansion Plan

Description	Units	2010 Actual	2011	2014	2017	2020	2023	2026	2030
CC Adds	MW			-	-	-	-	-	-
CT Adds	MW			-	-	-	-	-	-
Coal Adds	MW			925	3,000	3,000	3,600	3,000	4,800
Nuclear Adds	MW			-	-	-	-	-	-
Other Adds	MW			-	-	-	-	-	-
Wind Adds	MW			6,872	-	-	-	-	-
Annual Capacity Additions	MW			7,797	3,000	3,000	3,600	3,000	4,800
Cumulative Capacity Additions	MW			7,797	10,797	13,797	17,397	20,397	25,197
Reserve Margin	%	21.4	15.9	15.9	11.5	11.3	9.9	10.3	8.3
Coincident Peak	MW	65,776	65,206	73,375	78,869	81,665	85,928	88,318	94,318
Average LMP	$/MWh	34.41	37.42	77.12	84.54	91.90	98.00	107.28	114.68
Natural Gas Price	$/mmbtu	4.38	4.50	9.63	10.10	10.68	11.47	12.35	13.39
Average Market Heat Rate	MMbtu/MWh	7.86	8.32	8.01	8.37	8.61	8.54	8.69	8.57
Natural Gas Generation	%	38.2	41.3	39.7	36.8	34.7	31.8	29.8	26.3
Coal Generation	%	39.5	37.8	35.5	38.3	41.6	45.3	48.2	52.5
Wind Generation	%	7.8	9.2	12.5	13.2	12.6	12.2	11.7	11.2
Scarcity Hours	HRS	-	-	1	12	22	26	39	46
Unserved Energy	GWhs	-	-	0	7.6	29.0	36.9	44.5	92.5

These results are indicative of the analyses that will be conducted for these and other scenarios as part of this study. As more resource options are included in the resource expansion analysis (including demand-side resources, energy storage and other technologies) this analysis will be used to better understand the relationships between market conditions, regulatory policies and likely resource expansion.

The resources derived from the resource expansion analyses will be placed at locations on the transmission system using the resource siting methodology. With these resources in place, ERCOT will identify transmission projects that cost-effectively meet the needs of the system. This transmission needs analysis will represent the core of the study – in each of the identified scenarios, what transmission projects are likely to be needed in order to maintain system reliability. The import study that has been conducted is only a worst-case initial view of what transmission upgrades may be needed if all future resources are sited remote from load centers. While it is important to understand how extreme the transmission needs could be, this is not a substitute for the transmission analysis that will be conducted in the next months for the Business as Usual case and then for all of the identified scenarios. In each of these scenarios, some of the resources are likely to be sited near loads and some remote to loads, depending on resource characteristics, market conditions and regulatory assumptions. In addition, these same forces will lead to changes between scenarios in customer demand and in load and storage technologies.

Each scenario is likely to have a different set of transmission projects which comprise the lowest cost long-term solution (for the specified set of resources) to maintain system reliability. As these solutions are developed, they can be compared to each other and to the worst-case import solutions to develop an understanding of the relationships between specific market and regulatory changes and the need for and cost of transmission improvements.

4 Future Work

The next step for this project is the development of scenarios that will span the range of potential market futures. Participants in the Long-Term Planning Task Force will finalize these scenarios for analysis, based on work previously performed and described in this document, as well as future discussions. **Increased stakeholder involvement in the Long-Term Planning Task Force will be necessary for this scenario development process to be successful.**

Important decisions for these future scenarios include determination of the pricing and availability of demand-side resources to be used as model input assumptions, potential growth of electrification of the transportation sector, selection of other new technologies to include in the resource expansion analysis, availability of interconnection capacity between ERCOT and surrounding interconnections, and potential impacts of future regulatory changes (e.g. greenhouse gas legislation or renewable portfolio standards.) **ERCOT staff will rely on the Long-Term Planning Task Force to define and incorporate these issues into the study.**

ERCOT has recently engaged a Facilitator to serve as a liaison with the broad stakeholder community. Under this arrangement, Paul Hudson, a former Chair of the Public Utility Commission and advisor to the Texas Governor, has agreed to work closely with ERCOT to identify and reach out to affected constituencies. This outreach effort attempts to both engage with non-traditional participants in the effort and increase the level of expert input to the LTS process.

ERCOT and the Facilitator are currently engaging stakeholders to determine ways to increase stakeholder involvement and maximize the relevance of the planning studies to market stakeholders and regulatory personnel. Current proposals include:

- Increase market participants' awareness of the Long-Term Study through public discourse, one-on-one meetings and discussions
- Increase connections with existing stakeholder groups in ERCOT
- Increase the use of time during Regional Planning Group meetings for Long-Term Study discussions
- Create working groups with specific project assignments (such as a demand-side group) or reaching agreement with existing ERCOT stakeholder groups to complete assignments for the Long-Term Study
- Provide more frequent and informative written communication with stakeholders
- Provide direct education of non-traditional participants in the planning process
- Facilitate the stakeholder role as both resources in and customers of the process.

ERCOT is continuing to develop and improve the tools for long-term planning studies. These tools include the transmission system simplification tool, the PROMOD IV and MarketPower tools for generation expansion analysis, the load forecasting model and the set of models and maps for transmission planning. Detailed descriptions of these tools are provided in Volume 2

of this report. **Careful review by ERCOT stakeholders of the intent and implementation of these tools would be beneficial to ensuring that these tools meet the planning needs of the ERCOT system.**

Additional work is required to ensure that variable generation is being appropriately modeled in the long-term studies. **ERCOT currently needs additional information regarding the likely generation patterns for solar generation technologies**. As solar projects are completed in ERCOT, operational data will become available. An analysis of the accuracy of solar forecasting techniques is required in order to incorporate the effects of solar generation forecasting error into production cost modeling.

Considerable work has been conducted to evaluate wind generation forecasting error and methods to incorporate this into production cost modeling. This work is described in Volume 2 of this report. **Additional work will be required in order to reflect geographic correlation effects of day-ahead wind forecasting error.**

Since the start of the analysis of potential Competitive Renewable Energy Zones in 2006, ERCOT has been using a set of generic wind generation patterns based on average weather year conditions for a variety of locations throughout the state of Texas. These wind generation patterns are now outdated due to changes in wind turbine technologies, wind generation development and advances in meteorological modeling techniques. **ERCOT will be reviewing the possibility of updating these wind generation patterns as part of the work remaining for this grant-funded study.**

Water availability is a significant issue that needs to be incorporated into scenario analysis. ERCOT is currently working with Sandia National Laboratories to develop a model of water availability throughout ERCOT; the results of this effort will be presented to the Long-Term Study Task Force for review.

Additional analysis is required in order to incorporate energy efficiency, demand-side resource and storage technologies into the production cost modeling process. Characteristics and costs of demand-side products need to be considered, and the types, capabilities and potential locations of storage devices that may be developed in ERCOT need to be determined, as well as how these resources will be operated, what services they will provide and how they will be funded. The potential growth of electric vehicle use will also need to be considered. **These discussions will be conducted with the Long-Term Planning Task Force, the Demand-Side Working Group, and the Emerging Technologies Working Group.**

A major focus of the next year will be the development and/or acquisition of tools to quantify the operational reliability of the ERCOT independent of current ancillary service definitions. ERCOT staff has been evaluating possible methods to conduct this analysis, and will present options for review at future meetings of the Long-Term Planning Task Force. The intent of this effort will be to develop a set of tools that will allow a comparison of operational reliability across scenarios with different resource types and customer demand patterns. The Long-Term Planning Task Force will be tasked with defining minimum reliability levels, if these are needed. Using these operational reliability criteria, resource sets determined through economic

expansion analysis for specific scenarios may be adjusted to reflect the need for additional technologies that cost-effectively increase operational reliability.

Additional analysis and stakeholder review is required in the development of the process whereby transmission projects will be developed and assessed. The intent of the study is to develop cost-effective transmission solutions for future system needs. In order for a set of transmission improvements to be sufficient, they must allow the system to be operated reliably, in accordance with North American Electric Reliability Corporation (NERC) standards and ERCOT protocols. In order for these solutions to be cost-effective, they must meet reliability requirements while minimizing the sum of the cost of the transmission upgrades and the long-term annual system cost to serve load (system production costs). ERCOT has traditionally studied system needs by defining transmission projects to meet reliability requirements and then searching for alternative projects, or incremental projects, that reduce system production costs.

As part of the long-term study, the means by which adequate, cost-effective sets of transmission upgrades are identified will be reviewed, with the intent that the resulting analysis will improve all transmission planning studies conducted in ERCOT.

Appendix: Long Term Study Interim Report Volume I and II Stakeholder Comments

Stakeholder Comments and Responses to the Interim Draft Report

ERCOT was pleased with the response from the stakeholder community to help improve the Long-term Study process through comments received on the interim draft report. Those commenting included the following individuals/organizations:

- American Electric Power (AEP)
- Austin Energy
- CLEAResult
- Lone Star Transmission
- Lower Colorado River Authority (LCRA)
- Luminant Energy
- Oncor
- Public Citizen
- Railroad Commission of Texas
- Reversal Films
- Save Our Scenic Hill Country Environment, Inc
- Sierra Club – Lone Star Chapter
- Texas Commission on Environmental Quality
- Transmission Adequacy Consulting
- Virtus Energy
- Xtreme Power

ERCOT has updated the report where appropriate to reflect stakeholder feedback. Many of the comments outlined desires for modeling particular inputs, sensitivities, or scenarios. ERCOT, with the assistance of the stakeholder community, intends to develop these desires into specific, achievable modeling objectives.

General themes and responses to the comments are described below.

Clarifications and Updates to the Interim Report:

ERCOT received feedback that some of the industry specific terminology would be best defined in a glossary. ERCOT has added a glossary in the appendix of Volume II.

Others requested that ERCOT present the generation expansion results with a brief assessment of the capacity additions made in the ERCOT region over the past 20 years. ERCOT has included a graph representing generation additions in Section 2 of Volume I.

One stakeholder requested clarification on the development of the Load Forecast used for the 2030 models. ERCOT derived a weather-zone-specific forecast based on historical weather data and non-farm employment. This Forecast was then disaggregated by county, proportionate to the population in that county and the total population in the weather zone. Thereafter, ERCOT assigned the loads in that county to each bus proportionate to the loading on each bus, as represented in the Steady State Working Group (SSWG) 2016 Case.

Certain stakeholders requested clarification on the term "energy-limited resource" and why this term was used exclusively to describe wind energy. In the PROMOD IV and MarketPower models, an energy-limited resource is a resource that is non-dispatchable. In the case of wind units, these units are entered into the models with a predetermined amount of generation using a specified wind pattern. Remaining thermal units will dispatch assuming that the generation output from the energy-limited resources is a must-take transaction. ERCOT discussed with stakeholders the need to exclude other non-wind energy limited resources until adequate operational and capital information could be acquired, reviewed, and modeled. Other non-wind energy limited resources will be included in future scenarios.

Other stakeholders desired clarification about the ERCOT-developed process for determining future generation construction. Specifically, stakeholders questioned why ERCOT elected to perform pro forma analysis and generation siting independently, in a subjective fashion, rather than utilize MarketPower to determine generation sites and economics.

ERCOT elected to use MarketPower to determine the number and the type of generators built in a given year without consideration of transmission congestion and bus specific prices. While MarketPower does include functionality to site generators, it cannot include more subjective considerations for a generation build. For example, water availability, local emissions standards, fuel transportation infrastructure, locational marginal prices (LMP's), and other considerations may affect where new generation may be sited. ERCOT staff elected to apply these considerations manually, rather than utilizing MarketPower, to better understand the factors influencing the expansion plan.

Numerous stakeholders questioned how the knowledge gained from the long term study process would be incorporated with shorter-term study horizons. As the LTS progresses towards its objectives, namely, improvement of the planning process, opportunities for integration with nearer-term planning horizons will be thoroughly discussed with the stakeholder community.

Certain stakeholders also seek clarification on the difference between scenarios and sensitivities. In the scenario development process, scenarios were defined as a set of assumptions and inputs that would be unique to a themed future. For example, a high economic growth scenario may contain assumptions consistent with the theme as titled (high load growth, decreased natural gas supply, high employment, etc.). A sensitivity may be an individual variant of an assumption of input, to be studied as part of that scenario in the context of a base case / change case approach. For example, the "Business as Usual" scenario studied the assumptions and inputs associated with limited changes in current policies and input assumptions with a "high natural gas price" sensitivity. The high natural gas price sensitivity was studied as a change case, modifying the price of fuel, holding all other BAU considerations constant. Future scenario/sensitivity analysis may include single or multiple sensitivities to the extent that discernible differences exist as a result of testing a particular sensitivity.

Stakeholders provided updated information of certain counties with non-attainment zone status. ERCOT has used this information to update the list of non-attainment zone counties.

This did not impact generation siting for the BAU, based on the sites previously chosen, as ERCOT had elected to not site generators in counties identified as potential future non-attainment zones.

ERCOT received requests for clarification on the development of future, scenario-specific transmission plans. ERCOT intends to use methods utilized in previous transmission planning projects for this study. Specifically, this process will include: identification of system reliability needs; evaluation of likely cost-effective economic projects; and utilization of both of these analyses to develop a unified transmission plan that cost-effectively meets system reliability requirements.

Numerous stakeholders suggested that recent announcements for development of incremental renewable resources be modeled in the BAU scenario. ERCOT, as instructed by the Long-Term Study Task Force, included all resources with an executed interconnection agreement that was scheduled to be on-line by 2013 in the scenario development process.

Study activities in progress:

ERCOT received feedback from stakeholders regarding transmission reliability analysis considerations. For example, one Transmission Service Provider requested that ERCOT evaluate reliability needs of the ERCOT System without the Fayetteville – Zenith 345kV project in service. ERCOT has modified Area Reliability Studies to determine the impact of the proposed study change. The results will be reviewed with the incumbent transmission providers. The modified cases also will be posted to the ERCOT Planning and Operations Information web-site.

Numerous stakeholders suggested that ERCOT continue its review of the reliability needs of the ERCOT region with the incumbent transmission providers. ERCOT will continue to explore the feasibility of the reliability projects and alternatives with ERCOT Transmission Providers.

Other Transmission Service Providers suggested that further investigation into the reliability needs of the South Texas Area may benefit the long-term study. Specific suggestions called for ERCOT to review potential resource developments in the area, import limitations of Laredo and Valley area, export limits (should incremental resources site in the valley), and other intra-regional extra-high voltage projects. ERCOT is reviewing its reliability analysis of the Rio Grande Valley in light of these suggestions.

Stakeholders also suggested that the I-35 Corridor, from San Antonio, through Austin, and as far north as Waco merits further study of long-term transmission needs. ERCOT agrees with this recommendation, and has continued preparing the reliability analysis for this region for initial review by the incumbent Transmission Service Providers.

Generally, Transmission Service Providers also suggested that ERCOT consider using existing rights-of-way and structures, where practical, to expand transmission capacity. ERCOT is reviewing opportunities for such projects with the incumbent Transmission Service Providers.

Other Stakeholders suggested that ERCOT's approach of testing multiple dispatches and regional generation outages (G-1) was appropriate. ERCOT is continuing to review its selection

of dispatches for each reliability analysis case and will continue to post updates to the Planning and Operations Information web-site.

Numerous stakeholders suggested that ERCOT consider retirements of existing generators within the ERCOT region. ERCOT staff is currently evaluating potential methodologies to determine the economic viability of existing units. The proposed methodology will be discussed with the long-term study stakeholders.

Numerous stakeholders requested that ERCOT consider the reliability implications of integration of high levels of wind generation. Storage solutions and ancillary services procurement needs were of particular interest to stakeholders. ERCOT is currently determining methods of evaluating the economic and reliability implications of increased ancillary services and storage capacity.

Enhancements and Considerations for future scenarios:

ERCOT received numerous comments regarding inputs and sensitivity data to be modeled in future scenarios. Recommendations included modeling the following:

- Expanded DC Interconnections between ERCOT and Neighboring Systems
- Extreme and flat natural gas prices
- Expanded consideration of Energy efficiency, Load Resources, Demand Response, Storage, and geothermal capacity
- Identification of “transmission-friendly” generation interconnection areas
- Updated and/or region specific capital costs for various generation technologies
- Inclusion of the recently passed EPA regulations
- Increased coastal wind capacity with region-specific economic assumptions
- Continued uncertainty in financial markets/limited access to capital required for resource development
- Extreme system conditions , e.g. high wind/low load
- Specific Policy Analysis, e.g. renewal and/or expansion of the Production Tax Credit
- Improved Reserve Margins
- Substituting various levels of demand-side resources to offset localized transmission infrastructure improvement needs

ERCOT is committed to developing robust scenarios considering all of the above recommendations to the extent that data is available and fits within the constraints of modeling capabilities. Stakeholder participation to define these expanded scenarios is essential and will be coordinated in the coming months of the Long-Term Study process.