Drivers and Draft Scenarios Developed by Stakeholders During January 23-24 LTSA Workshop

Main Drivers Developed by Stakeholders

Drivers	Brief Description
1. Economic Conditions	US and Texas economy, regional and state-wide population, oil & gas, and industrial growth, LNG export terminals, urban/suburban shifts, financial market conditions and business environment
2. Environmental Regulations and Energy Policies	Environmental regulations including air emissions standards (e.g., ozone, MATS, CSAPR), GHG regulations, water regulations (e.g., 316b), and nuclear safety standards; energy policies include renewable standards and incentives (incl. taxes/financing), mandated fuel mix, solar mandate, and nuclear re-licensing.
3. Alternative Generation Resources	Capital cost trends for renewables (solar and wind), technological improvements affecting wind capacity factors, caps on annual capacity additions, storage costs, other DG costs, and financing methods.
4. Natural Gas and Oil Prices	Gas prices are a function of total gas production, well productivity, LNG exports, industrial gas demand growth, and oil prices. Oil prices are dependent on global supply and demand balance, spread of horizontal drilling technologies. Oil and gas prices will affect drilling locations within Texas.
5. Transmission Regulation and Policies	New policies around transmission build-out, interconnections to neighboring region and cost recovery
6. Generation Resource Adequacy Standards	Economically-determined versus mandated reserve margins and flexible resource requirements
7. End-Use/New Markets	End use technologies, efficiency standards and incentives, demand-response, changes in consumer choices, DG growth, increase interest in microgrids
8. Weather and Water Conditions	May affect load growth, environmental regulations and policies, technology mix, average summer temperatures, frequency of extreme weather events, water costs

Scenarios Developed by Stakeholders

During the January 23 LTSA Workshop, stakeholders identified a set of 10 initial scenarios for further development and discussion

1. Current Trends
2. Global Recession
3. High Economic Growth
4. High Efficiency / Distributed Generation
5. High Natural Gas prices
6. Stringent Environmental Regulations / Solar Mandate
7. Low Global Oil Prices
8. LNG Export Growth
9. High System Resilience
10. Water Stress

1. Scenario: Current Trends

Economic Growth

- Migration to TX along I-35 corridor
- Growth in south Texas
- Industrial growth in Houston, I-35, Midland/Odessa, Valley
- ~1.5% load growth – high growth in near term then tapering off in long-term
- LNG growth based on permits existing – needs review
- Oil production rates follow trend in recent EIA projections for Texas

Environmental Regulation

- MATS and 316B are implemented by 2016
- CSAPR Hybrid
- Greenhouse gas regulation set with flexibility
- No other major changes in environmental regulations

Alternative Generation

- Solar: 1000 MW / year
- Wind capacity addition limit: 3,000 MW/yr
- Capacity factor wind – rely on historical data from ERCOT
- Capital cost wind ~$2,000/kW
- Capital cost solar ~4.4% reduction/year
- Overall renewable growth driven by economic entry
- No production tax credit beyond 2013
- No change to existing investment tax credit policy

Gas/Oil Prices

- EIA reference case or best available gas and oil price forecasts

Story:

Same old, same old. The recent population and economic growth in Texas continues in the near future, fueled largely by the continued growth of the oil and gas sector and the relative robust Texas economy compared to the rest of the U.S. World oil prices high enough to keep increasing oil production in the short-term, keeping domestic natural gas prices relatively low. With low gas prices, several LNG export terminals are built between 2014 and 2024. Modest wind growth continues based on economics without production tax credits. Capital costs for solar continues to decline at a slower rate than recent history. No required reserve margin is set for ERCOT and the environmental regulations continues to be moderate, with no explicit federal carbon tax or required national cap and trade, but greenhouse gas emissions become regulated beyond 2016.

Implications for ERCOT:

- Continued modest economic and therefore load growth in Texas.
- Growth in oil production and population across the state leads to new transmission needs
- Continued increased renewables leading to reliability (inertia) issues
- No major generation retirements triggered by stringent environmental regulations.

Transmission Regulation /Policy

- Policy set to reduce constraints
- Increased DC-tie capacity with neighboring region
- Higher reliability standards are set by NERC to avoid load shedding

Generation Resource Adequacy

- No reserve margin set for ERCOT
- Maintain energy-only market
- Economic retirements continues based on economics

End-Use

- Increased need for ancillary services
- Increase penetration of demand response
- Increasing distributed generation

Weather / Water

- No drought situation, but water supply continues to be a concern to existing and new generators.
- No specific increase in electricity consumption due to drought conditions.

2. Scenario: Global Recession

Economic Conditions
- Net population growth in Texas ~1%
- Urbanization with growth concentrated in the major cities
- No industrial growth
- Capital for new generation difficult to obtain
- Little to no GDP growth or net load growth

Environ. Regs. / Energy Policy
- Continuing modest environmental regulations, no significant changes from assumptions under Current Trends
- Government incentives continue for high efficiency appliances
- Continued subsidies for renewables (PTC/ITC)

Alt Gen Resources
- Lower oil/gas prices
- Limited development of wind and solar due to low energy prices
- Nuclear re-licensing
- Slower solar cost decline due to reduced global demand

Gas/Oil Prices
- Lower prices (~$1/mmbtu lower than assumptions under Current Trends)
- Less oil exploration and production
- No LNG development

Story:

Low energy prices threaten the Texas economy. Load growth is limited, resource expansion is limited to gas-fired plants and continued subsidized renewables. Stimulus programs help create incentives for consumers to replace old appliances and increase conservation. Coal plants that rely on coal by rail retire due to lower energy margins.

Implications for ERCOT:
- Slow load growth
- Growth in urban areas greater than in rural areas
- Limited generation development, predominantly gas-fired, subsidized renewables
- Import/export issues between urban areas will need to be addressed
- Stability issues continue to increase due to low system load

Transmission Regs/Policies
- Same as assumed under Current Trends
- Transmission faces lower construction cost per mile

Gen Resource Adequacy Standards
- Retiring of coal plants due to low energy margins
- System inertia issues increase

End - Use
- Customers are more cost conscious, thus more conservation
- Limited growth of new technologies that are still high costs, such as storage
- Low load growth due to increased efficiency and changed customer behavior

Weather / Water
- Same as under Current Trends – no drought conditions, but limited water supply for new generation

3. Scenario: High Economic Growth

Economic Conditions

- High Texas GDP growth
- High population growth (2.5%/yr)
- Pro-business environment
- Industrial growth concentrated in Houston, I-35 corridor, Midlands/Odessa, Lower Rio Grand Valley
- Higher LNG exports than under Current Trends
- Capital is available to support new generation and transmission

Environ. Regs/Energy Policy

- Continued modest environmental regulations, no significant changes from assumptions under Current Trends
- U.S. more focused on developing domestic energy sources

Alt. Gen. Resources

- Renewables are economic and growth occur due to higher gas prices
- More technological improvement than under Current Trends for renewables and storage
- Cap on annual wind capacity growth

Oil/Gas Prices

- Higher (but still relatively low) gas prices than under Current Trends (~$1.5/mmbtu higher than in Current Trends)
- Same oil prices as under Current Trends

Story:

Higher economic growth than under Current Trends. Growth occur throughout Texas driven in large part by oil and gas sector and related upstream and downstream industries.

Implications for ERCOT:

- High load growth
- High urban growth
- High industrial growth, concentrated through I-35 corridor, Midlands/Odessa, and Lower Rio Grand Valley
- Higher costs for new generation and transmission due to high commodity prices
- Potential challenges with generation portfolios keeping pace with load profile changes

Transmission Regs/Policies

- Same as under Current Trends
- Higher cost for Transmission (for both materials and labor)

Gen Resource Adequacy Standards

- Likely to impose a resource adequacy requirement

End-Use

- Growth of household income
- However, more energy-efficient new homes
- Overall efficiency gains are similar as under Current Trends
- Fast adoption of new demand-side technologies

Weather / Water

- Higher water costs, but does not limit growth (e.g., potentially more dry cooling for new generation)

4. Scenario: High Efficiency/ Distributed Generation

Economic
- Same as under Current Trends
- Additional growth in clean technologies

Environ. Regs/Energy Policy
- Increase stringency in building codes, with more net zero buildings
- Government provides more incentives for building retrofits to increase efficiency
- Increase in appliance standards increase
- More attractive DR programs/pricing

Alt. Gen. Resources
- Capital cost for wind and solar technologies and CHP decrease faster than under Current Trends
- Improved storage technology and lower cost

Gas Price / Oil Price
- Higher gas prices than under Current Trends: also higher resulting wholesale electricity prices

Story:
Economic growth good enough to allow new investments in efficiency and distributed generation. Customers increase acceptance of EE/DG technologies which leads to widespread market adoption

Implications for ERCOT:
- Lower net load growth compared to under Current Trends
- More market-based programs for demand response
- Widespread of distributed generation creates some operational challenges

Transmission Reg.
- Same as under Current Trends

Gen Resource Adequacy Standards
- Same as under Current Trends

End – Use Customer Acceptance
- More high efficiency homes and buildings built
- Efficiency gains are above those under Current Trends, thus lower net load growth
- Higher installation DG
- Higher DR participation
- More options for microgrids, smart appliances, etc.

Weather / Water
- Above average summer temperatures
- Greater water stresses and higher water costs than under Current Trends.

5. Scenario: High Natural Gas Prices

Economic Conditions
- GDP growth slightly higher than under Current Trends
- Population growth ~2.3%/yr
- Pro-business environment
- Higher LNG exports than under Current Trends
- Reduced Industrial growth (downstream facilities)
- Increased gas exploration in Texas

Environm. Regs / Energy Policy
- Modest environmental regulation, same as in under Current Trends
- No regulatory impediments to LNG exports
- Lower coal plant retirements due to higher energy margin

Alt. Gen Resources
- Renewables are more economic and thereby more growth than under Current Trends
- Annual limit on wind development
- More technological improvements for renewables

Gas Prices / Oil Prices
- Natural gas prices $3.50/mmbtu above Current Trends by 2020
- Oil prices same as under Current Trends

Story:

- Natural gas prices are high, but are below global natural gas prices – thus still continued LNG export as under Current Trends.
- No impediments to LNG exports
- High gas prices also reduce the downstream industrial growth compared to under Current Trends
- Increase in renewable development compared to under Current Trends, due to higher gas and wholesale energy prices

Implications for ERCOT:
- High load growth
- High urban growth
- Reduced downstream industrial growth (in the Houston, Corpus, and coastal areas)

Transmission Regs / Policies
- Same as under Current Trends

Gen Res Adequacy Standards
- Same as under Current Trends

End - Use
- Motivate high energy efficiency at a higher rate than current trends.

Weather / Water
- Same as under Current Trends
- Increased water costs which contribute to the higher cost of producing natural gas

6. Scenario: Stringent Environmental Regulations / Solar Mandate

Economic Conditions

- Moderate economic growth – (some limits on oil & gas development)
- Less oil and gas production than under Current Trends
- Less LNG exports than under Current Trends
- Population growth same as under Current Trends at ~1.5%/yr, in the I-35 corridor and Houston areas but decrease in the Valley (Midland) area
- Increase in industrial production of alternative energy and efficiency-related technologies

Enviro Regs / Energy Policies

- Federal greenhouse gas emission standard implemented
- Federal standard of 25% renewable / energy efficiency
- More stringent ozone standard implemented
- Toxic emissions standards implemented
- Some limits on drilling and associated disposal wells
- Government imposes some water usage limits, raising cost of water
- More dry cooling for natural gas generators
- Moderate carbon tax / price materializes
- Increase nuclear safety concerns than under Current Trends
- Expedited retirements / repowering / upgrades

Alt. Generation Resources

- Continued PTC/ITC through 2020, reducing over time
- Continued decrease capital costs for solar: 3-5% /yr
- Wind capacity factors increase due to technological improvements
- Cap on annual wind generation
- Increased development of storage due to cost reductions for batteries & compressed air
- More financing mechanism are available (e.g.: real estate investment trusts, property-assessed clean energy financing, and others]

Natural Gas Prices

- Moderate increase than under Current Trends
- Same amount of LNG exports as under Current Trends

Story:

- Aggressive action on mitigating environmental impacts of energy sector, including electric generation and oil & gas sectors
- Higher gas, oil, electricity prices, and lower solar, wind, storage costs.
- Assumes more DC ties with neighboring regions and the development of concentrated solar regions that will require solar-CREZ lines to and from west Texas.
- Higher electricity prices drive more adoption of energy efficiency and customer-sited solar PV.
- Uncertain development of new nuclear & geothermal

Implications for ERCOT:

- Challenge in matching generator w/ load
- Reserve & integrate issues
- Potential need for new ancillary services to provide faster & flexible resources
- More transmission for solar CREZ
- Need to develop rules for integrating storage & distributed generation
- Need to address issues associated with adding DC ties to neighboring regions (including NERC and FERC-related issues)

Oil Prices

- Higher oil prices than under Current Trends
- But growth in oil exploration and development limited by stringent environmental regulations

Transmission Regs

- More DC ties such as Tres Amigas / El Paso / Cross Wind
- Solar CREZ to west Texas to take advantage of Pecos / Brewster / El Paso
- Potential ties w/ Mexico

End – Use Customers / Policies

- Continued stringent building code – 10% improvement every 3 years
- More onsite solar penetration –
  - 1000 MW by 2022
  - 3000 MW by 2032
- Existing buildings retrofits – 20% improvement in existing buildings efficiency

Weather & Water

- More extremes helps convince public and politicians to take action
- Higher water costs than under Current Trends, increasing dry-cooling for new generators

7. Scenario: Low Global Oil Prices

Economics
- Texas economy declines [due to low oil production]
- Electricity use declines
- Population declines
- World economy improves

Environmental Regs / Energy Policy
- Same as Current Trends

Alt Gen Resources
- Higher gas prices drive more renewables development
- [Renewables costs same as Current Trends]

Gas / Oil Prices
- Oil prices <$50/barrel, making Texas oil less economic
- NG prices increase by $2-3/mmbtu

Story:

- Increased oil supply or reduced global demand caused global oil prices to drop below $50
- Oil exploration in Texas declines
- Associated gas production declines, gas price increases
- Decline in Texas economy [particularly in certain locations]
- [Exports of oil & gas sector machinery continues, but to a lesser degree]
- [Review Texas experience in 80s]

Implications for ERCOT:
- Decrease electricity use
- Shift in economic activities to non-oil sectors
- ~~[Continued increase in renewables and AS]~~
- Decrease in oil plays activities
- Increase in natural gas plays activities
- Less load growth than in Current Trends, decreasing the need for load-growth based transmission projects
- [If significant generation (including retrofits) and transmission have been built already, reduced load growth than expected could experience significant rate increase.]

Transmission Regs / Policy
- Same as Current Trends

Conventional Gen Res Adequacy Reg
- Same as Current Trends

End - Use
- Increase in efficiency and demand response [due to higher gas and electricity prices]

Weather / Water
- Same as Current Trends

8. Scenario: High LNG Export

Economic Conditions
- High economic growth in Texas, especially industrial growth at gulf coast,
- High growth in oil & gas exploration
- High growth in manufacturing near border & ports
- Growth in immigration to Texas

Environmental Regulations
- Environmental regulations conducive to continued growth in oil & gas production
- [Other environmental regulations are same as in Current Trends]
- Other policies are conducive to LNG export

Alternative Generation
- Same as Current Trends

Natural Gas & Oil Prices
- $10/MMBtu price difference with the rest of world
- High oil prices $100+/barrel
- [Domestic natural gas price could be equal/higher/lower than in Current Trends]

Story:

Very healthy global economy drives high demand for natural gas. Oil & gas exploration in Texas remain high. Abundant natural gas supply spurs large export and industrial growth in Texas.

Implications for ERCOT:
- High electricity load growth on the coast & dry gas basins
- Transmission improvements needed to serve new industrial load and oil & gas load
- Pressure on resource adequacy [due to uncertainties around how to meet the fast growing electric demand]

Transmission Regulations
- Same as Current Trends

Resource Adequacy Standards
- ~~Same as Current Trends~~
- [Could deviate from Current Trends if additional growth from the LNG exports drive faster demand growth than naturally supported by market entry.]

End - Use
- More potential for industrial demand response
- Same as Current Trends for non-industrial demand response
- More CHP [due to high NG supply]

Weather / Water
- Technology improvement in oil & gas production
- Technological improvements alleviate additional pressure on water supply

9. Scenario: High System Resiliency

Economic Conditions
- Same as in Current Trends
- Companies are more willing to locate in Texas due to perceived highly reliable electricity system

Environmental Regs / Energy Policy
- [Environmental regs and renewables] are the same as in Current Trends
- [Limitations on] generation development near load centers

Alt. Gen
- Same as in Current Trends
- [Perceived reliability issues could result in increased distributed generation and higher backup gen / cogen at the customers]

Gas / Oil Prices
- Same as Current Trends

Story:
- [“Black swan” events on the grid occur more regularly across the US, impacting system reliability]
- Northeast-type events (e.g. blackouts, storms) occur in ERCOT, Rio Grande Valley blackout,
- West Texas load growth continues
- Houston import constraints + challenging reliability events occur
- Regulators have major concerns, generation and load see high risk
- [Value of resilience and system flexibility is broadly recognized and stakeholders are more willing to invest in infrastructure to ensure greater resiliency]

Implications for ERCOT:
- Highly reliable system would drive more load growth
- Reduced congestion risk would lead to greater generation buildout
- System will be able to support major power transfers within ERCOT during highly variable conditions (weather, wind, growth…)
- Highly reliable & flexible system as a result
- [Be able to serve spikes in load growth]

Trans Regs
- CREZ concept applied to load centers
- [Legislative direction or PUCT mandate to increase system resiliency and flexibility beyond traditional planning criteria]
- [Increased reliability standards applied to transmission planning]

Res Adequacy
- Regulators’ desire for a more robust fleet leads to required reserve margin and/or centralized capacity market

End Use
- Same as Current Trends

Weather / Water
- Same as Current Trends

10. Scenario: Water Stress

Economic Conditions

- [Moderate decline in population and economic growth with higher impacts on localities with water intensive industry]
- Increased water and electricity prices
- Productivity and job losses in agriculture
- Potential negative impact on oil & gas extraction
- Impact on local economy

Enviro Regs / Energy Policies

- Required drought management plans and water conservations
- Stringent requirements on power generation water use leads to dry cooling
- Tax breaks for drought resistant generation
- [Other environmental regs are same as Current Trends]

Alt. Generation Resources

- Continued investments in renewables, storage, and dry-cooling [with continued federal PTC/ITC continues]
- Policy incentives for dry-cooling retrofits?]
- Development of co-location desalination and power plants
- [Renewable costs same as Current Trends]

Natural Gas and Oil Prices

- Moderate increase in natural gas prices relative to in Current Trends [$1 – 2/MMBtu]
- Moderate impact on local oil production, but prices are set internationally [at the same price as Current Trends]

Story:

- The rate of population and economic growth moderately declines, due to sustained [multi-year] drought conditions.
- Sustained drought conditions impact water-intensive generation resources (nuclear/coal/steam units), and lead to significant increase [over those in Current Trends] in renewables and storage, dry cooling [on thermal generation], and transmission expansion.

Implications for ERCOT:

- Derating units due to water resource limitations and generation retirements lead to challenges in meeting demand
- Potential need for new ancillary services to meet the needs of integrating new renewable energy generation
- More transmission [will be needed for expansion of renewables [over those in Current Trends]
- [Seriously consider] more interconnections outside ERCOT.

Transmission Regs

- More DC ties to neighboring regions
- Potentially increase in transmission into high solar regions [possibly solar CREZ]
- Increase in transmission due to policy/ regulatory changes resulting from drought

Gen Res Adequacy Standards

- Mandated reserve margin and increased operating reserves
- Demand response [plays a larger role than in Current Trends]

End – Use Customer / Policies

- Increase the development of demand-side management tools [increases EE penetration beyond those in the Current Trends]
- Greater market penetration of time-of-use rates and water smart devices

Weather & Water

- More drought than in the Current Trends
- Hot summers
- Limited water supply