Powering the Future:

Texas Power Sector Pivoting to Climate Resilience

HARC
CLIMATE RISK
AND RESILIENCE

Overview

Investors, regulators, insurance companies and rating agencies recognize the risks associated with climate change impacts and call for greater transparency. Beyond the growing push for decarbonization of the energy system, extreme weather increasingly affects business operations and the bottom line. This includes both acute shocks with highly visible impacts and chronic stresses that slowly chip away at operational efficiency over time. Physical damage to assets and infrastructure and power outages can affect many consumers and are top concerns for many stakeholders, as Texas has experienced more billion-dollar disasters than any other state. Power generation capacity losses due to 'slow burn' climate impacts can be very costly, even if customer-facing impacts are not immediate. Changing energy demand for cooling and heating presents another set of challenges. This position paper calls on stakeholders to act on climate risks in the Texas power sector. Boosting climate resilience provides unprecedented opportunities to transform business as usual. Given the long-life span of energy assets and infrastructure, leveraging critical investment decisions towards resilience opportunities is paramount. Stakeholders need better data and tools to identify, assess, and prepare for climate risk.

About Houston Advanced Research Center (HARC)

HARC is a nonprofit research hub providing independent analysis on energy, air and water issues to people seeking scientific answers. Its research activities support the implementation of policies and technologies that promote sustainability based on scientific principles. HARC is a 501(c)(3) nonprofit organization building a sustainable future in which people thrive and nature flourishes.

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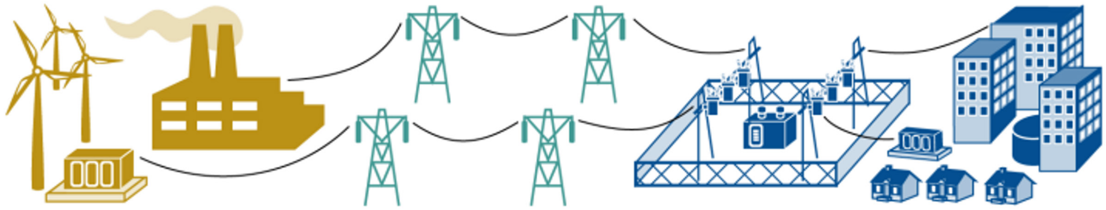
Changing Landscape of Climate Risk Disclosure

Investors, regulators, insurance companies, and rating agencies are calling for greater transparency on climate risks. Driving this growing interest are the significant and growing weather-related costs that are impacting the global economy. The increasing intensity and number of extreme weather events align with climate models that suggest a near to mid-term higher likelihood of more climate shocks and stresses. Investors might make different investment (or divestment) decisions if they had full information on these climate risks. In this way, climate risk transparency enables efficient allocation of capital. If not priced appropriately, climate-related risks undermine the long-term value of investments and destabilize financial systems.[i]

Climate change upends communities and business in ways previously unseen. Natural disasters – such as hurricanes, flash flooding, and icing events – can have devastating impacts far beyond the immediate destruction, resulting in infrastructure failure and supply chain disruptions. Other climate impacts unfold more slowly and gradually, such as rising temperatures affecting efficiency. Further, growing pressures to decarbonize present transition risks owing to policy shifts and market dynamics. This includes risks that relate to corporate reputation and liability, technological competitiveness, and insurance costs. In this context, thriving businesses manage the risks of acute shocks, chronic stresses, and transition risks.

The landscape of corporate climate risk disclosure is changing fast. More and more companies have gone beyond the regulatory guidance on the disclosure of material risks via voluntary reporting tools, such as the Financial Stability Board's Task Force on Climate-Related Disclosures (TCFD) recommendations.[ii] Recently, the U.S. Securities and Exchange Commission (SEC) initiated an effort to further enhance consistency, comparability, and reliability of corporate reporting on climate risks for investors. In March 2022, it proposed rule changes that would require public companies to include certain climate-related disclosures in their and periodic reports, including climate-related risks that are "reasonably likely to have a material impact" on their business operations or financials.

Key inancial market stakeholders are taking note of compounding losses due to climate-linked disasters.
Major rating agencies have started factoring climate risks in credit and debt rating assessments. Insurance companies are actively incorporating climate data in their catastrophe models to anticipate changes that may affect their ability to provide or renew coverage. Recently, the U.S. Securities and Exchange Commission (SEC) convened a broad group of stakeholders across the banking and insurance sectors, agricultural and energy markets, data- and intelligence service providers, the environmental and sustainability public policy sector, and relevant academic disciplines. Their report covers climate-related risks in financial markets, including credit-, underwriting-, and liquidity risks.[iii]



Generation	Transmission & Distribution	Consumption
Extreme weather, droughts or (coastal) flooding affect generation potential, thermo-electric cooling efficiency and viability of new assets.	Wind intensity, forest fires, and flooding can cause outages and physical damage to assets, incur efficiency losses, and affect the viability of new infrastructure.	Heatwaves and cold snaps reflect in changing energy demand for (residential) cooling & heating and higher peak loads.

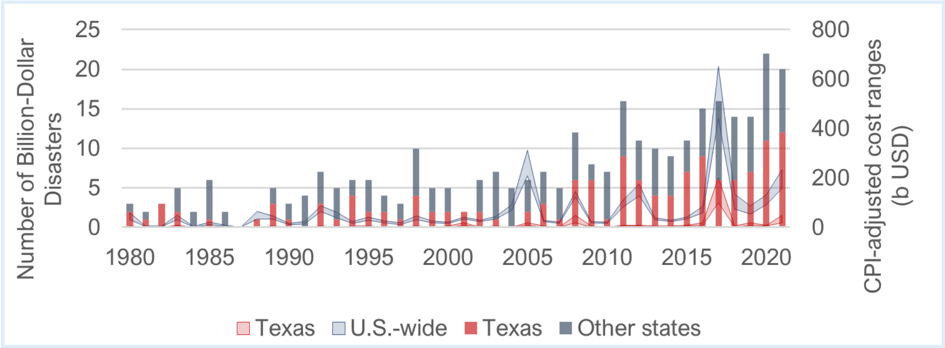
Figure 1 Climate impacts on power sectors. Adapted from Government Accountability Office (2021) based on U.S. Department of Energy (2017) and International Energy Agency (2020).

Climate Impacts in the Texas Power Sector

All trends point in the direction of growing climate impacts in Texas. Over the past two decades, Texas has been hit by billion-dollar weather and climate disasters more than any other state.[iv] The number of 100-degree heat days is expected to double in three decades, where the temperature rise concentrates within cities due to the urban heat island effect.[v] Longer, hotter summers place strains on cooling systems and energy utilities, road surfaces, and water resources. Rainfall becomes less predictable and more intense, causing more frequent floods and extended droughts. Water cycle changes limit freshwater availability for residential, agricultural, and industrial needs and put natural ecosystems at risk. The densely populated Gulf Coast is also exposed to hurricanes, storm surge, and sea level rise, coastal erosion, and flooding.

Climate risks affect all components of the power system, from power demand and supply to grid resilience. Extreme weather and natural disaster cause a growing number of major power outages.[vi] Based on the technologies used, climate risks can result in power generation efficiency losses. [vii] Climate-related curtailments and shutdowns, while not reported systematically, are likely to increase in the future.[viii] Faced with changing peak loads and energy demand for heating and cooling, grid operators have struggled to sustain the reliability of power supply. Texas will need more energy for cooling and slightly less for heating.[ix] Climate change can also contribute to fuel price volatility or supply chain disruptions. Fig. 1 summarizes key climate impacts related to generation losses, power grid reliability and efficiency losses, and energy demand[x].

Climate change is having real inancial impacts in the power sector. Outages can cause critical infrastructure failure and supply chain disruptions that ripple through economies and societies. Beyond direct impacts on power consumers, such impacts are estimated to cost billions of dollars nation-wide. [xi] Plant operators increasingly face difficult trade-offs between sustaining output, operational efficiency, and environmental compliance. Incremental efficiency losses can add up to considerable lost revenue over time, pushing profit margins down. To ensure energy balancing of the grid, operators may require deployment of reserves or impose penalties on market participants unable to deliver electricity at agreed levels. Sharp electricity demand fluctuations also expose utilities to financial risks.



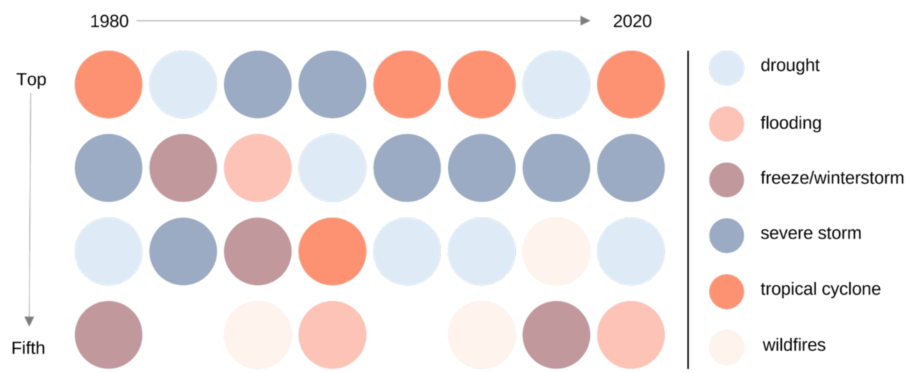


Figure 2a (above) Billion Dollar Natural Disaster Frequency and Costs. *Texas represented 45% of all disasters and between 10-20% of all costs nation-wide.* ***Figure 2b (below) Most costly storms in Texas between 1980 and 2021.*** *Severe storms and tropical cyclones occur frequently and have been costly. Droughts, floods, and freezing are also challenging. (NOAA 2021)*

The Texas power sector is among the nation's most vulnerable to climate shocks and stresses. The devastation of winter storm Uri accelerated a conversation on power reliability impacts in terms of frequency, duration, and scale of service disruptions. Prior to the Winter Storm, the discussion was on whether the state could manage higher summer peak temperatures. Now the obvious question is whether the grid is prepared for both temperature extremes. Operations of thermo-electric power plants, which represent two-thirds of electricity generation in Texas, are increasingly impacted by rising temperatures. The state's power generation capacity is among the most climate-stressed nation-wide, thanks in part to the high water-intensity of power production. Compared to national averages, thermo-electric plants in Texas withdraw four times more water per unit of power produced. Much of this water is released back into rivers and streams after cooling. However, water outflows are increasingly curtailed due to warmer inlet temperatures, resulting in more power plant efficiency losses.[xii]

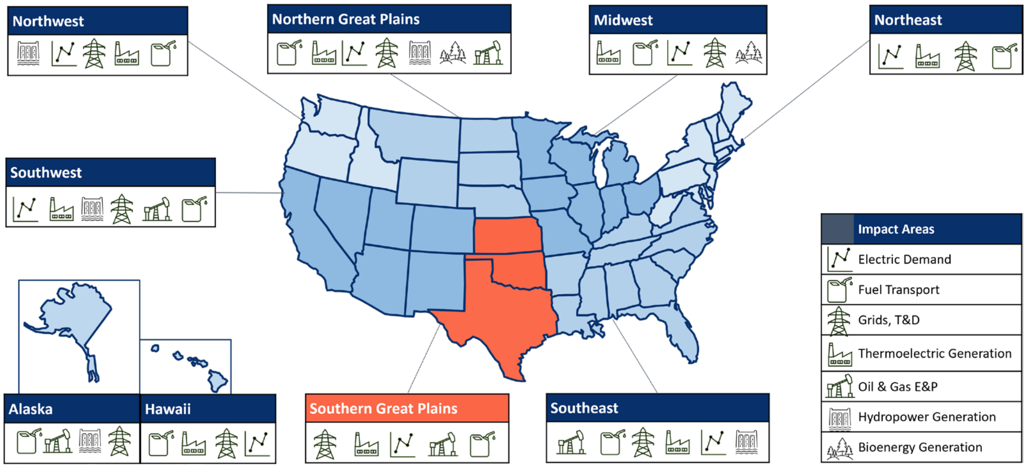


Figure 3 Key climate impacts by region. Sources: U.S. Department of Energy (2016); http://yourfreetemplates.com

Power Sector at the Crossroads

Texas already uses more than 10% of the electricity in the United States and its electricity demand continues to grow (while demand is declining in most other states). These realities suggest grid reliability may require major reductions in electricity demand via distributed energy resources (community and roof top solar, demand response) and energy efficiency. To meet growing demand, the Electric Reliability Council of Texas (ERCOT) anticipates expansions in wind, solar, and gas generation, as well as utility level storage. Research suggests that chronic climate stresses may necessitate additional expansions beyond growing power demand.[13] Moreover, a wave of energy infrastructure assets approaching the end of their useful life is on the horizon (Fig. 4).

Planning (and design) of new capacity presents sector-scale opportunities to pivot towards climate resilience. Power capacity planners tasked with meeting a growing energy demand can leverage investment decisions towards climate resilience – e.g., by choosing a power source less vulnerable to climate risks, deciding on the location of new assets based on more favorable local climate locations, or identifying state-of-the-art technologies for weatherization or resource efficiency. Some low-regret opportunities of tailoring of assets to local climate conditions can also be seized in renovation and maintenance of existing assets and day-to-day decision-making in asset operations.

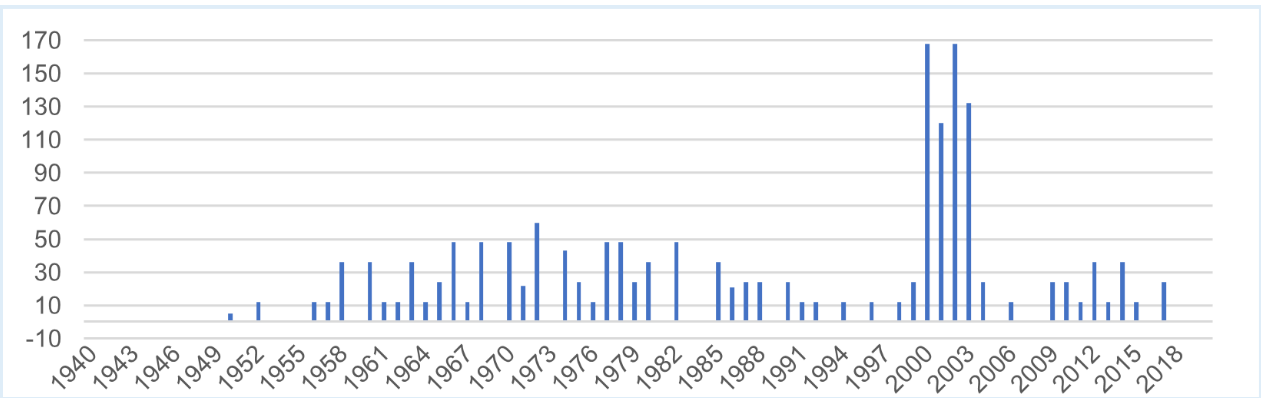


Figure 4 Commissioning year of powerplant assets in Texas, 2020 EIA data
Approximately 80% of the thermo-electric power plants in Texas will have reached the end of their useful life by 2045, assuming a life span of 40 years.

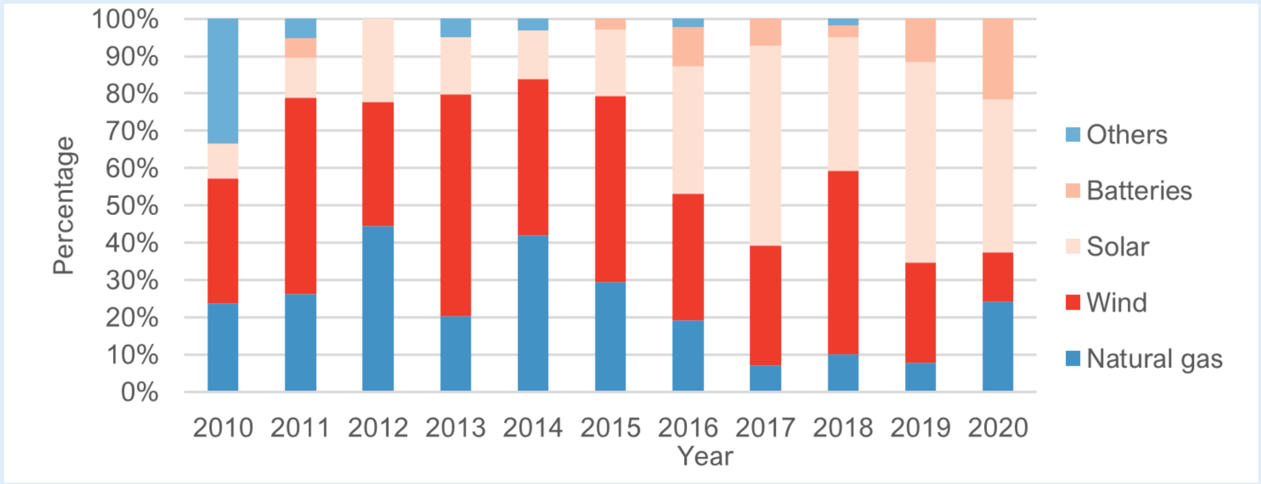


Figure 5 Power asset investments in Texas by energy source. *EIA-860 data of historical power asset investments in Texas. EIA data 2010-2020*

As the Texas power sector continues to pursue an energy-secure future, a range of pathways lie ahead. Some may reduce exposure and vulnerability to climate risks by design, others may result in short-term gains with higher costs incurred by climate impacts down the line. Early signs of change are on the horizon. For example, more than half of all capacity of proposed electricity generators in Texas will come from renewable sources, mainly wind and solar, which are less vulnerable to water scarcity (Fig 5). Battery storage is becoming more economical and experiencing rapid growth across the grid. Thermo-electric power generators are increasingly efficient, which includes smaller water footprints for cooling.

HARC stands ready to support stakeholders on their journey to plan response to climate risks and avoid stranded assets. This includes support to stakeholders in the infrastructure sector to strengthen capabilities to monitor exposure of assets and infrastructure to physical climate risk. To support the industry in becoming more climate resilient, HARC has developed a climate analytics platform, called Pythias Analytics. Pythias allows energy companies to conduct a system, portfolio and/or asset-level risk assessment and to identify climate risk mitigation strategies and opportunities. The power sector can leverage three key opportunities to pivot towards climate resilience:

1

Unlock the potential of climate analytics to empower stakeholders for climate risk monitoring. Strengthening capabilities and access to better data and tools enables scenario development on climate trends at the intersection in policy, technology, and markets. This is a critical first step for informed decision-making to mitigate trade-offs in operations, asset performance, and financial sustainability.

2

Leverage investment decisions to seize opportunities related to climate resilience. Given the long lifespan of energy assets and infrastructure, it is important to integrate climate considerations early on in their life cycle. Specific opportunities for investment in capabilities and best available technologies can be seized for both new/replacement and existing capacity (e.g., operations, renovation, and maintenance).

3

Strengthen whole-of-sector perspectives to minimize ripple effects of climate impacts in the power sector. Collaborative development of broad-based scenarios on how climate risks may affect power supply, demand, and infrastructure can yield efficiency gains. Any system is only as strong as the weakest link and coordinated efforts can be key to avoid cascading climate risks in the power sector.

Further Reading

[i]The White House (2021). *Roadmap to build a climate-resilient economy.* U.S. Climate-Related Financial Risk Executive Order 14030. Available online: https://www.whitehouse.gov/wp-content/uploads/2021/10/Climate-Finance-Report.pdf

[ii]EY (2021). *Global Climate Risk Disclosure Barometer: If climate disclosures are improving, why isn't decarbonization accelerating?* Available online: ey-if-the-climate-disclosures-are-improving-why-isnt-decarbonization-accerlerating.pdf; Global Affairs Associates (2020). Gathering momentum: Climate-related reporting by Fortune 500 companies headquartered in Texas.

[iii]U.S. Commodity Future Trading Commission (2020). *Managing climate risk in the U.S. financial system: Report of the Climate-Related Market Risk Subcommittee.* Available online: CFTC's Climate-Related Market Risk Subcommittee Releases Report | CFTC

[iv]HARC analysis of NOAA data on billion-dollar national disaster frequency and costs between 1980-2021. National Centers for Environmental information, Billion-dollar weather and natural disasters, obtained via: https://www.ncdc.noaa.gov/billions/time-series/TX.

[v]Texas A&M University Office of Texas State Climatologist (2020), Assessment of Historic and Future Trends of Extreme Weather in Texas, 1900-2036.

[vi]HARC analysis of major electric disturbance incidents reported to the Department of Energy between 2016-2020. Annual Summaries Electric Disturbance Events (OE-417), obtained via: https://www.oe.netl.doe.gov/OE417_annual_summary.aspx

[vii]National Renewable Energy Laboratory (2016). *Water-Related Power Plant Curtailments: An Overview of Incidents and Contributing Factors.* Available online: Water-Related Power Plant Curtailments: An Overview of Incidents and Contributing Factors (nrel.gov).

[viii]U.S. Global Change Research Program (2018). *Fourth National Climate Assessment: Impacts, Risks, and Adaptation in the United States* (Volume: II, Chapter 23: Southern Great Plains). Available online: https://nca2018.globalchange.gov/chapter/23/.

[x]U.S. Government Accountability Office, *Electricity Grid Resilience: Climate Change is expected to have far-reaching effects and DOE and FERC should take actions.* Report to Congressional Requesters. Available online: https://www.gao.gov/products/gao-21-346.

[xi]HARC analysis of environmental performance indicators for thermo-electric cooling between 2016-2020. Thermal Cooling Summary Data (EIA-923), obtained via: https://www.eia.gov/electricity/data/water/.

[xii]National Renewable Energy Laboratory (2022). Water and Climate Impacts on ERCOT Long-Term Systems Assessment. Available online: https://www.nrel.gov/docs/fy22osti/79581.pdf.