

Freezing Fossil Fuels- Winter Storm Uri and The Use of Fossil Fuels

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ABSTRACT

Winter storm Uri, which swept across Texas in February 2021, brought to light a series of systemic failures in the state's infrastructure that had profound and far-reaching consequences. This study follows the storm's formation and the ensuing gas and power failures in Texas. This case study will also explore the impacts on human life and economic impacts. The study highlights disruptions in supply chains, business operations, and damages, while also emphasizing environmental repercussions, particularly the excessive flaring and venting of natural gas, resulting in extremely heightened emissions. Finally, the study investigates the role of climate change in intensifying extreme weather events in the region, thus exacerbating vulnerabilities in existing infrastructure and reliance on fossil fuels emphasizing the urgent need to reevaluate infrastructure resilience and reduce dependency on fossil fuels to mitigate vulnerabilities in the face of evolving climatic conditions.

BACKGROUND [1] [2]

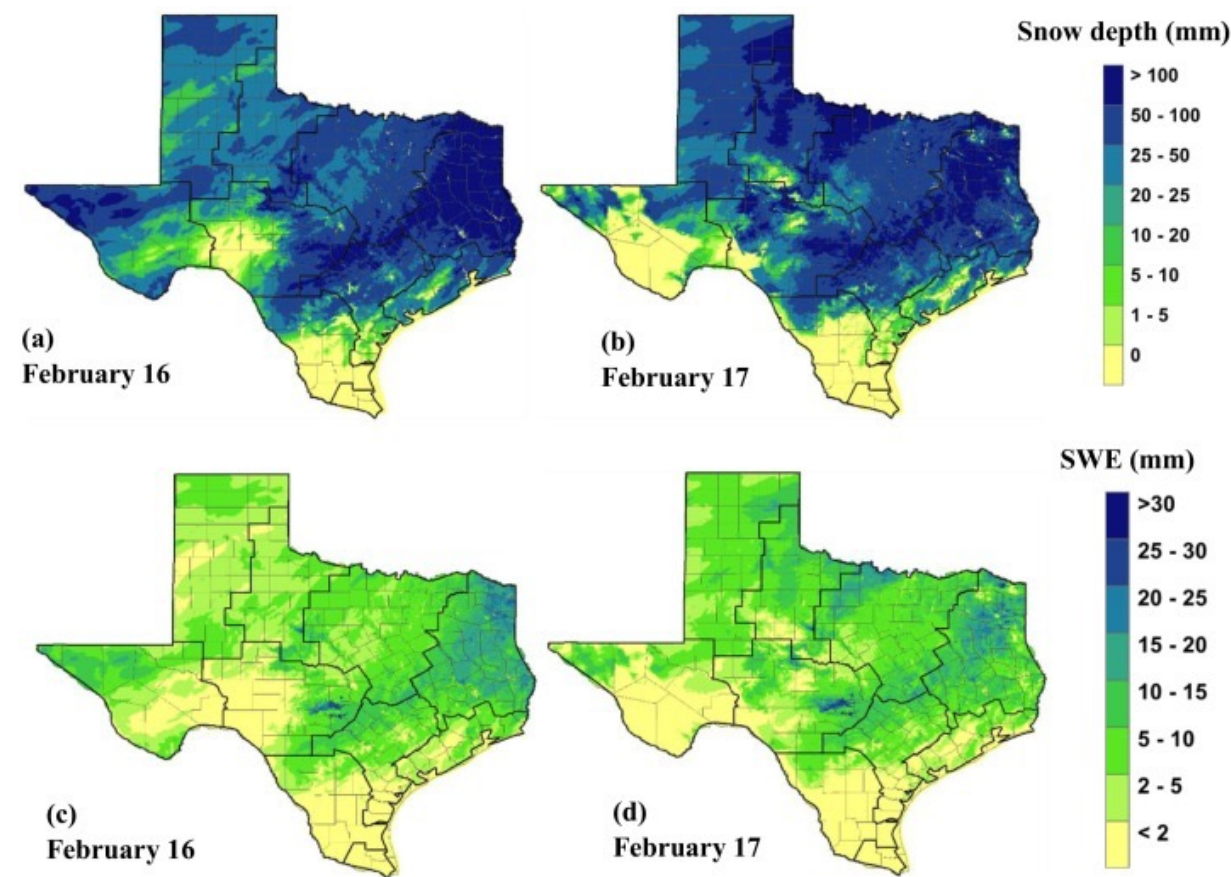
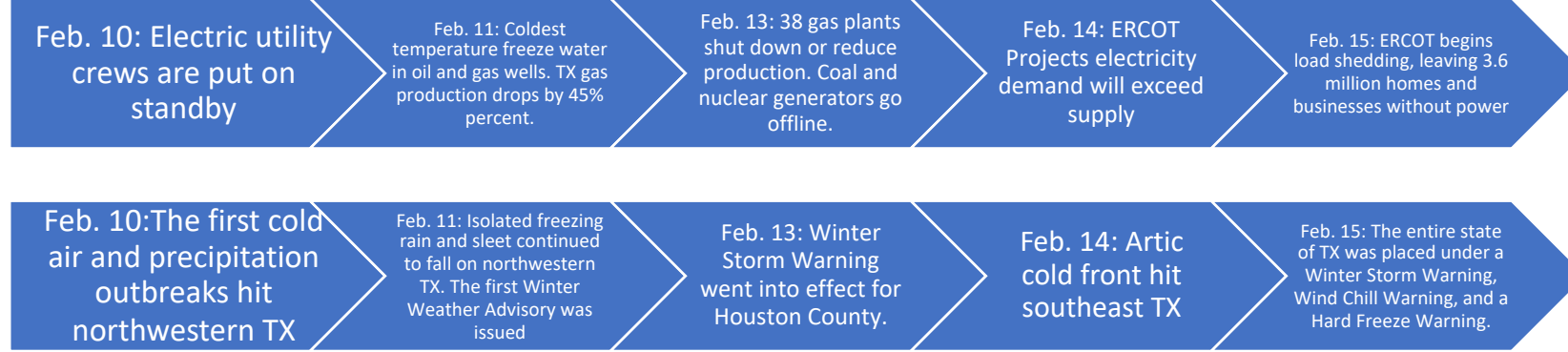


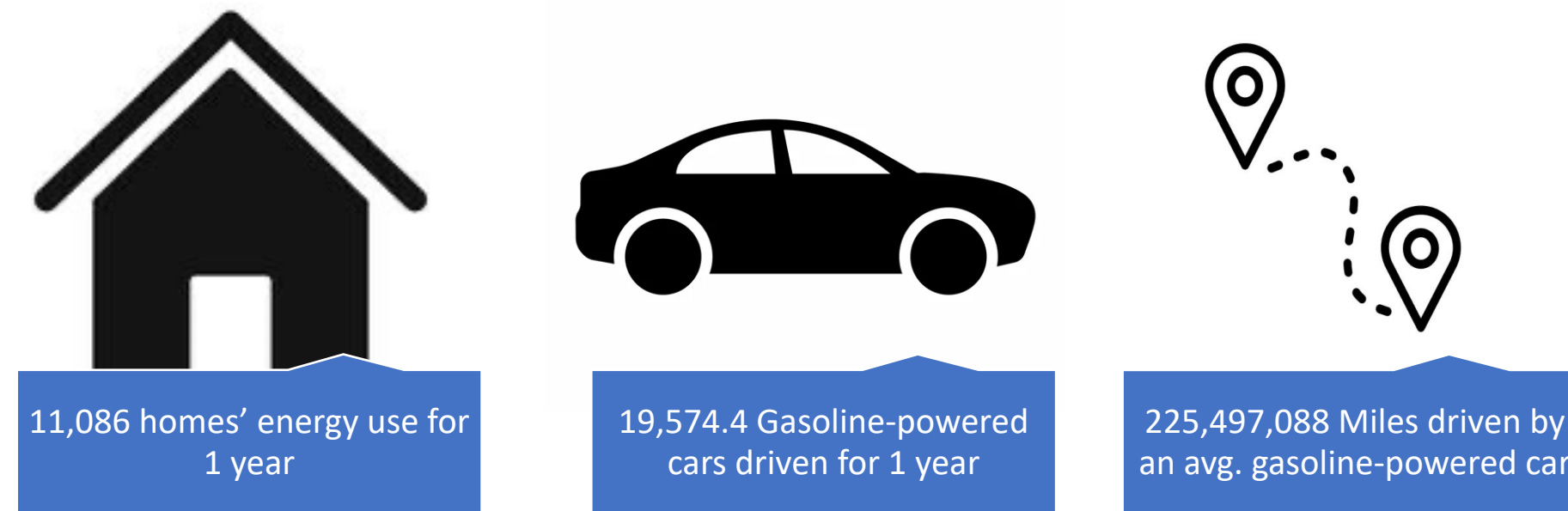
Figure 1: Distributions of the snow depth (a and b) and snow water equivalent during Winter Storm Uri (Science of the Total Environment)

STAKEHOLDERS

- Texas Residents:** Affected by power outages, water shortages, and extreme cold temperatures
- Private Energy Companies/Utilities and their investors:** Experienced disruptions that led to outages
- Environmental Advocacy Groups:** Concerned about the environmental consequences of the storm, more specifically the impacts of the CO₂ and GHG emissions, as well as the storm's impact on wildlife
- ERCOT (Electric Reliability Council of Texas):** Manages the Texas power grid, balances electricity supply and demand
- Renewable Energy Sector:** Experienced disruptions that led to outages
- Local and State Governments:** Coordinated emergency response and relief efforts, pass legislation addressing Winter storm Uri, in charge of public safety and wellbeing

ENVIRONMENTAL IMPACTS OF THE STORM [3]

- Because natural gas wells had no place to send gas, wells vented and/or flared 1.6 billion cubic feet of methane each day for a week. This is equal to 14% of a year's worth of methane emissions.
- One day of venting/flaring is equal to the GHG and CO₂ emissions of:



Figures 2, 3, and 4: Calculations for equivalent Methane in bcf to CO₂ and GHG via the EPA's Coal Mine Methane Converter

HUMAN IMPACTS OF THE STORM [4]

- It is difficult to get an exact count on the lives lost because of the storm, but it is approximated that 246 Texans passed because of Winter storm Uri
- 69% of Texans lost power during the storm, the average disruption lasted 42 hours—31 of those hours were consecutive
- 57% of Texans lost running water, and of that population the average disruption was 52 hours long
- Storm-related financial losses range from \$80 billion to \$130 billion USD

DRIVERS OF IMPACTS

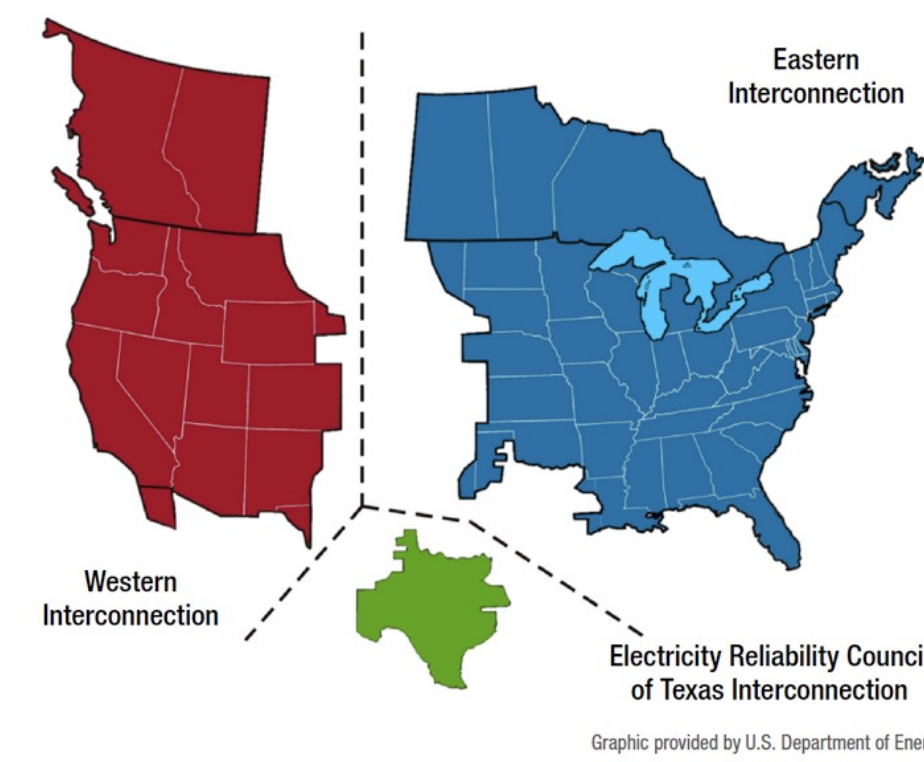


Figure 5: Map of North American Power Grid (U.S. Dept. of Energy)

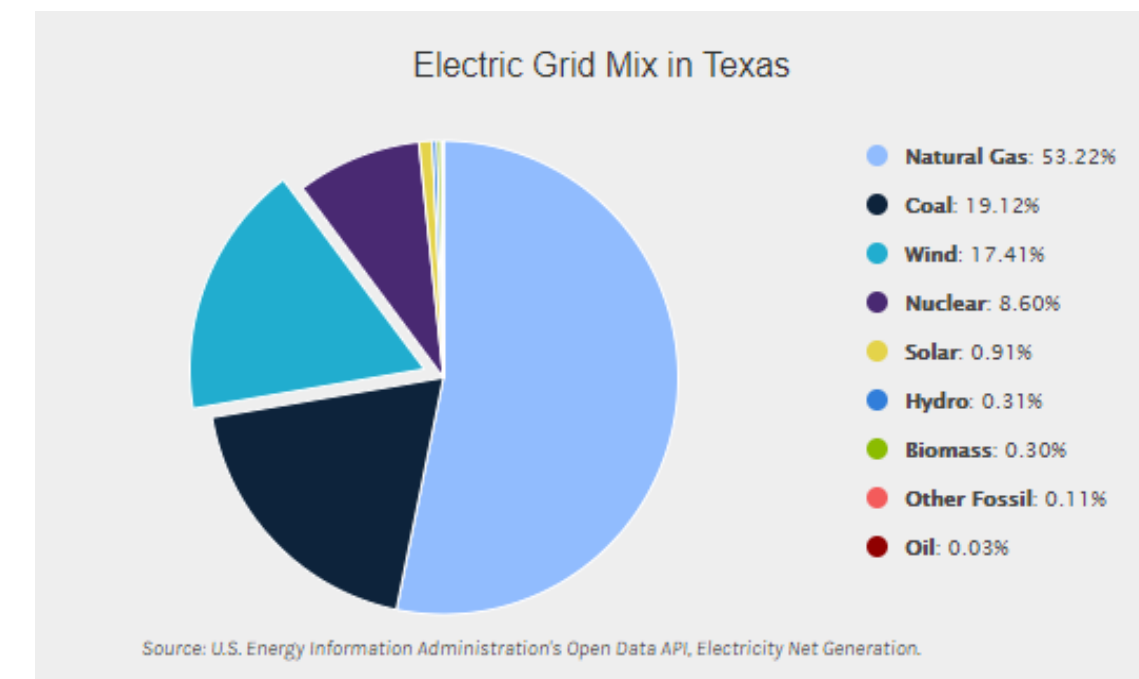


Figure 6: Map of Electric Grid Mix in Texas (US EIA)

- Texas, unlike the lower 48 states in the US, does not rely on the Eastern Interconnection and the Western Interconnection grids for its energy needs. Instead, it uses its own independent energy grid known as the Electricity Reliability Council of Texas or ERCOT
- Nearly 90% of the state's population depends on ERCOT for electricity services**
- The cold temperatures brought by Winter storm Uri brought unprecedented escalation in energy demand, as people needed to heat their homes. The **combination of increased demand, lack of support from other energy grids, and reduced supply forced the ERCOT grid to its limits, leaving many without power**
- About 50% of Texas is powered by natural gas, 20% by coal, another ~20% by wind and solar, and 10% by nuclear energy. Overreliance on fossil fuels without a diverse energy mix, including sufficient investment in renewable sources and energy storage, left the grid more vulnerable to extreme weather events**
- Because of its usual climate, Texas energy infrastructure is not built to safeguard against freezing conditions.** The extreme conditions brought by winter storm Uri caused Texas power plants, natural gas systems, and wind turbines to freeze, **preventing residents from receiving the heat and electricity they needed during the increasingly cold weather**

CONCLUSIONS

- Winter storm Uri highlighted the importance of having adaptive infrastructure capable of withstanding diverse and extreme weather conditions, especially with the rise in climate-change related natural disasters. Texas can address the failures that caused Winter Storm Uri to cause such extensive damage by:
- Increasing energy efficiency
 - Implementing demand responses
 - Increasing access to cleaner energy and decreasing reliance on natural gas and other fossil fuels
 - Learning from past mistakes
 - Fostering more public input
 - Upgrading and weatherize the grid and powerplants to withstand new extreme weather conditions

TEACHING THE CASE

Learning Objectives

What long-term solutions could be considered to make Texas' energy infrastructure more resilient to weather events?

How do we manage the transition to renewable/cleaner energy sources during times of climate uncertainty and increasing frequencies and severities of natural disturbances?

Pre-Class Activity

Students should read case study in its entirety, as well as supporting documents on Texas' existing energy sources

Students will answer questions about the state's energy portfolio and how it contributed to the vulnerabilities exposed during Winter Storm Uri

In-Class Activity

Break students into stakeholder groups and develop a set of energy policies that address possibly diversifying energy sources and climate uncertainty

Stakeholder group will present their energy policy to the class, there will be debate moderated by the TX government group who will vote on a winning policy

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