



HOUSTON CLIMATE CHANGE REPORT

1931-2024

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Introduction

The purpose of this report is to analyze the changes in Houston's climate over the past eighty years and discuss the city's impact on these changes through industry and policy. Houston is located on the Northern portion of Texas's coastline and is one of the state's major urban centers. It is the fourth most populous city in the United States and the largest in the American south. Additionally, the landmass of the Greater Houston area is approximately the same size as the state of Massachusetts (City of Houston, 2025a). Therefore, understanding the nature of Houston's environment, politics, and economy is crucial to becoming familiar with the current structure and future prospects for southerners and Americans at large.

Howdy, Y'all: The Demographics of 'Y'all'

As of 2024, the city of Houston alone (not including the surrounding municipalities) is home to over 2.3 million people. Its population is young, with only 12% over the age of 65. Unfortunately, almost 20% of residents are living in poverty. A break down of the diversity of Houston can be seen below (United States Census Bureau, 2024).

Race	Percentage of Population
White only	23%
Black only	23%
Hispanic or Latino	44%
Two or more races	19%
Native American or Asian only	8%

These quick figures paint a picture of a city that is extremely diverse in race and economic background, with a clear lean towards the younger end of the spectrum for adults. This population is projected to continue to grow well into the next decade, indicating all the more reason to study its environmental impact (City of Houston, 2025a).

Bayou City: The Local Environment

Houston has been lovingly nicknamed ‘Bayou City’ for the multiple bayous that run through its neighborhoods. However, like its population, the Greater Houston area is the most ecologically diverse major urban area in the nation. This includes forested areas typical of East Texas, bottomlands near all the rivers, savannah to the northwest, prairies through the center of Houston proper, which is of course crisscrossed with bayous, coastal marshes, and estuaries and bays next to the Gulf of Mexico (Houston Wilderness).

Being on a southern coastline of the United States, Houston naturally has a subtropical climate with high humidity, mild winters, and sweltering summers. Its most common natural disasters include flooding and hurricanes, though a derecho also hit Houston last summer, causing serious damage to the northwest and downtown regions with its high wind speeds. Because it is further inland than Galveston and bordering coastal towns, it is often less affected by the hurricanes that make landfall nearby. However, the residents of Houston are well versed in hurricane preparedness and whether their neighborhood typically takes on significant flooding during these types of events.

Space City: Major Industries

Houston has also been nicknamed ‘Space City’ because it is home to NASA, the National Aeronautics and Space Administration. Murals of cowboy astronauts are not uncommon to find on buildings and the catch phrase “Houston, we have a problem,” which refers to an Apollo 13 astronaut’s communications to ground control, is still popular in American culture.

Nevertheless, Houston is at the forefront of several other industries. In fact, it is home to 23 Fortune 500 companies. Houston’s port brings in the most international tonnage to the United

States and is ranked second for total tonnage. This is assisted by the significant trucking firms and rail systems. However, after the space industry, Houston is probably most well-known for its energy sector. In 1981, this sector employed around 85% of the city's workforce. Today, that has shrunk to closer to 50% as the technology, medical, and manufacturing sectors have significantly increased (City of Houston, 2025b).

Despite the decrease of energy in the makeup of the economic activity of Houston, the city is still called "the energy capital of the world," (Roberts, 2021). This is in part due to the increase in fracking, and therefore oil exports, over the last decade or two. Most of Houston's fracking activity occurs on offshore oil platforms.

Fracking is a method of drilling for hydrocarbons that pushes what is called "drilling mud," or simply "mud" at high pressure down the drill string, or pipeline, to remove rock cuttings and clean the drilling tool as the fluid is pushed back up to the surface. Fracking raises a few environmental concerns. The first is that it releases methane, one of the most impactful greenhouse gases, into the atmosphere. Second, because the drilling mud is actually a mixture of water, clay, and other chemical additives, it can contaminate ground water if the drilling comes in contact with an aquifer. Lastly, fracking can contaminate soil and agricultural land for similar reasons. With Houston's fracking occurring mostly offshore, contamination of ground water and soil is not a concern. However, oil spills due to oil platform accidents have been known to happen, including the Deepwater Horizon accident in 2010, the largest oil spill in the history of marine oil drilling.

Results

Climate Data

The data for this analysis was recorded at Hobby Airport, located just east of downtown. The data includes daily temperature minimum, maximum, and average, as well as the amount of precipitation in inches.

Average Temperatures

A loess regression line was fitted to the annual average temperature, showing an overall increase in average temperature since 1931 (Figure 1). A few years with significantly lower average temperatures can be seen. These are 1942-1946. This is a global phenomenon that is linked, but not explained by, the significant bombings of World War II (Robock and Zambri, 2018).

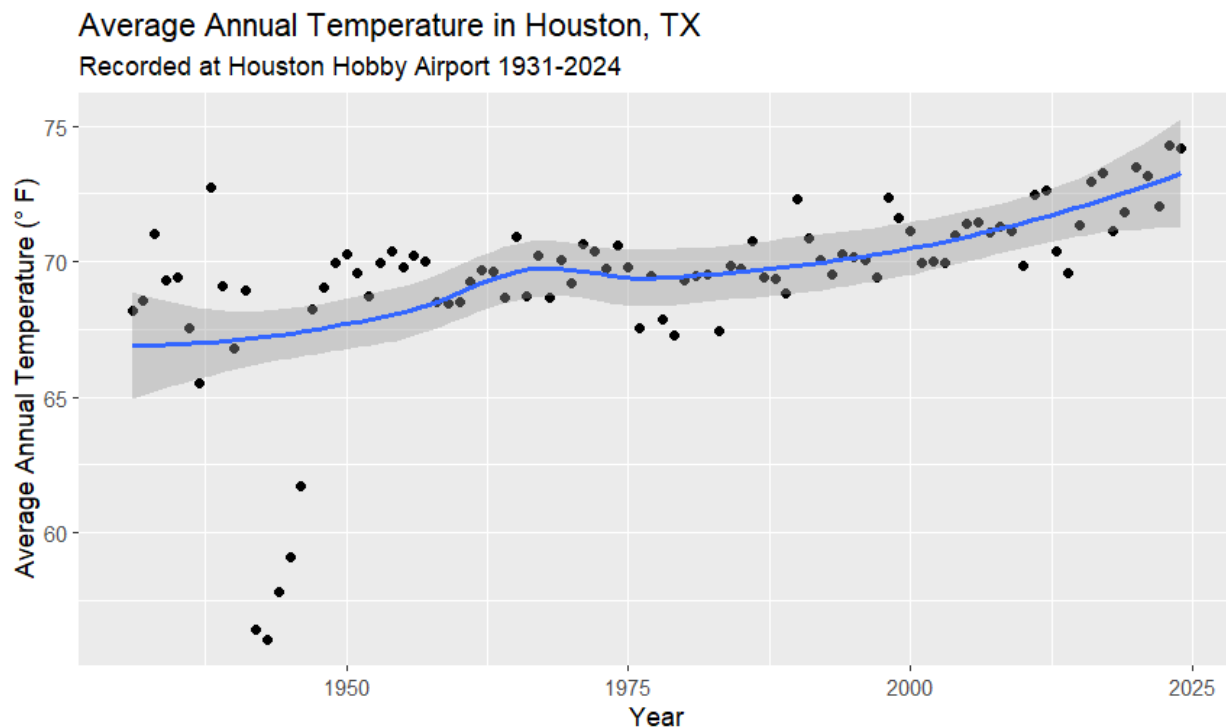


Figure 1 Average Annual Temperature in Houston (1931-2024)

To make sure that the positive trend in average temperature was accurate and not a result of the anomalies of the 1940s, those datapoints were removed and the set was plotted again with a new regression line (Figure 2). This resulted in another clearly positive trend in the average annual temperature. This increase in temperature is likely a result of global climate change as there are no other obvious reasons for this longstanding trend.

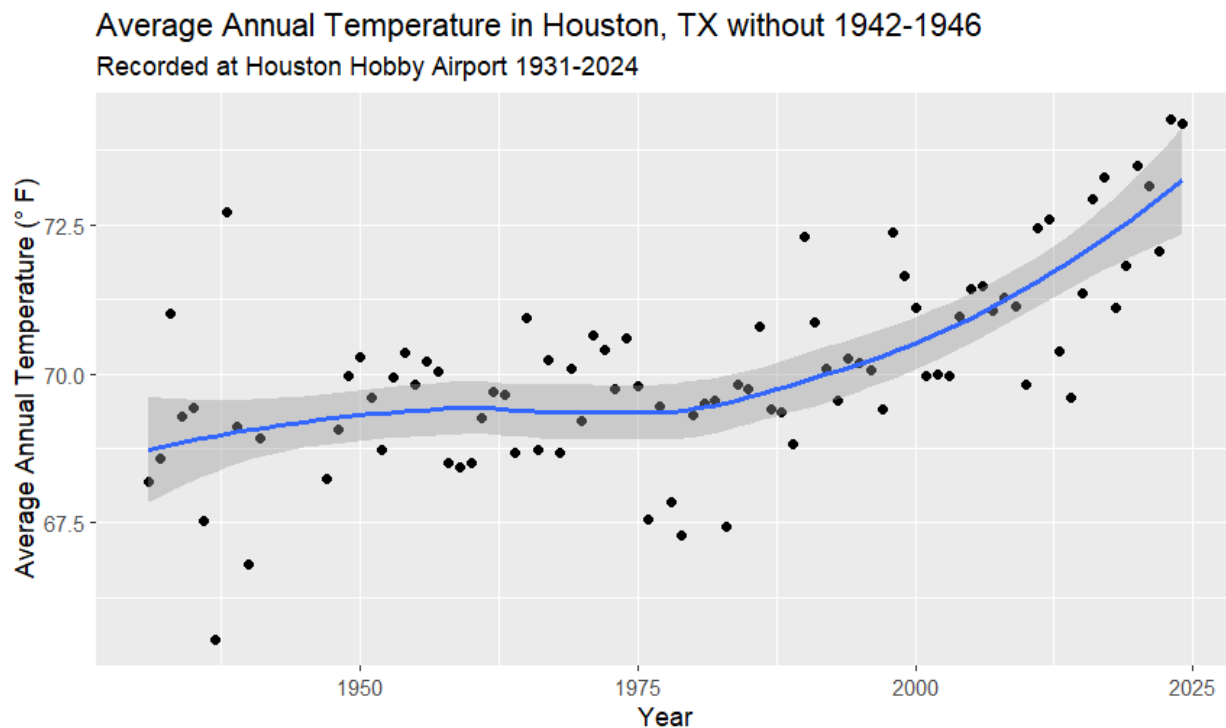


Figure 2 Average Annual Temperature without 1942-1946 as outliers

For further analysis, the data was aggregated into decades and plotted on a bar chart (Figure 3). The anomaly of the 1940s is obvious. However, the trend of increasing temperature over the period of ten years is also shown here from the 1990s. The slight increase in temperature in the 1950s followed by a small decrease until the 1980s is hypothesized to be the result of atomic and hydrogen bomb testing following World War II and the decrease in testing until the fall of the Soviet Union due to international agreements to do so.

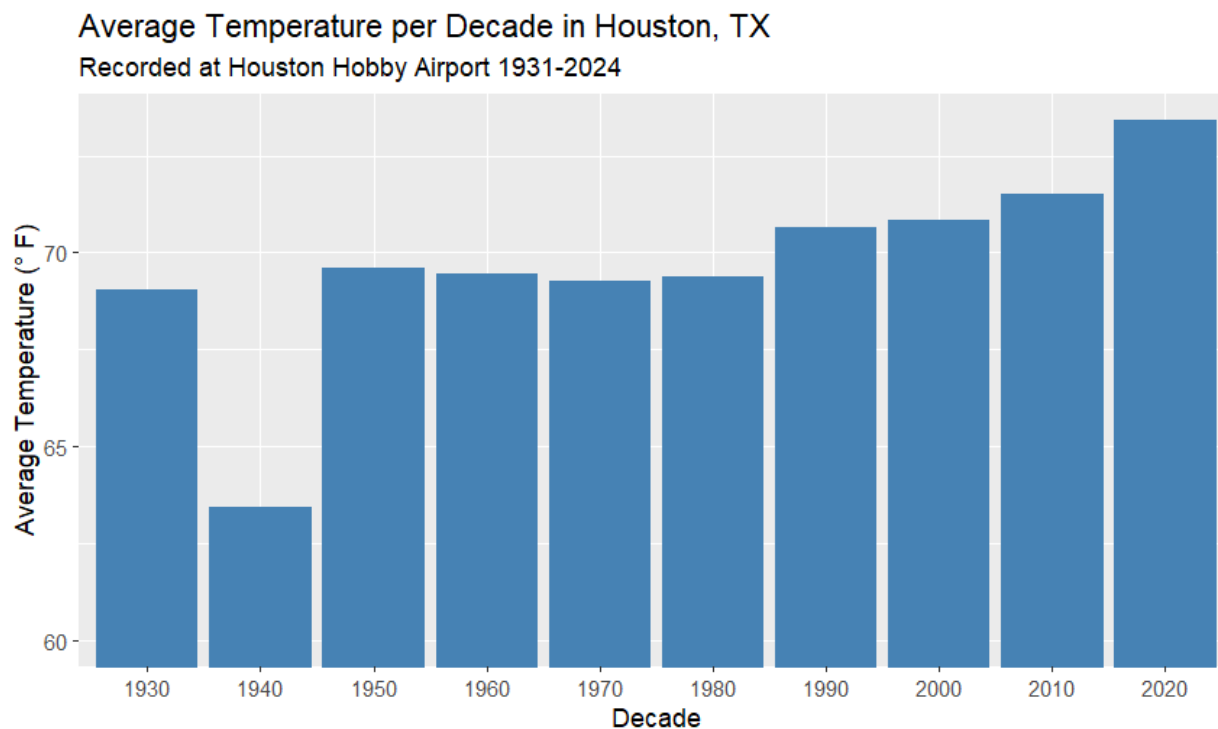


Figure 3. Average Temperature for each Decade in Houston

Annual Precipitation

Because information on drought in Houston specifically was not easily accessible, this section will discuss the history of drought in Texas in general, followed by an analysis of precipitation in Houston.

Texas has experienced many droughts of varying severity. The Great Depression of the 1930s was famously caused by drought and dust storms in the panhandle region. However, the worst droughts in Texas history occurred from 1950-1957. The increase in average temperature seen in Figure 3 contributed to water scarcity across the state. The most recent severe drought in the state occurred from 2010-2014. This was more severe than the drought of the 1950s, which was often considered to be a worst-case scenario, though it was shorter. 2022 was ranked the eleventh driest year in the last 128 years, but this drought was eased by rainfall quickly (Donald

and Grubbs, 2022). This may indicate an increase in both frequency and severity of droughts, though perhaps also a shortening of the drought cycle, providing relief sooner to Texans.

Houston's precipitation seems to follow the general trends of Texas, with the exception of the 1950s drought. Rainfall increased until around 1970, stabilized until around 2000, then began to gradually drop again (Figure 4). This indicates Houston is also experiencing less rainfall in the last decade or two that has been reported across the entire state. This may be partially a result of increasing temperatures, discussed earlier.

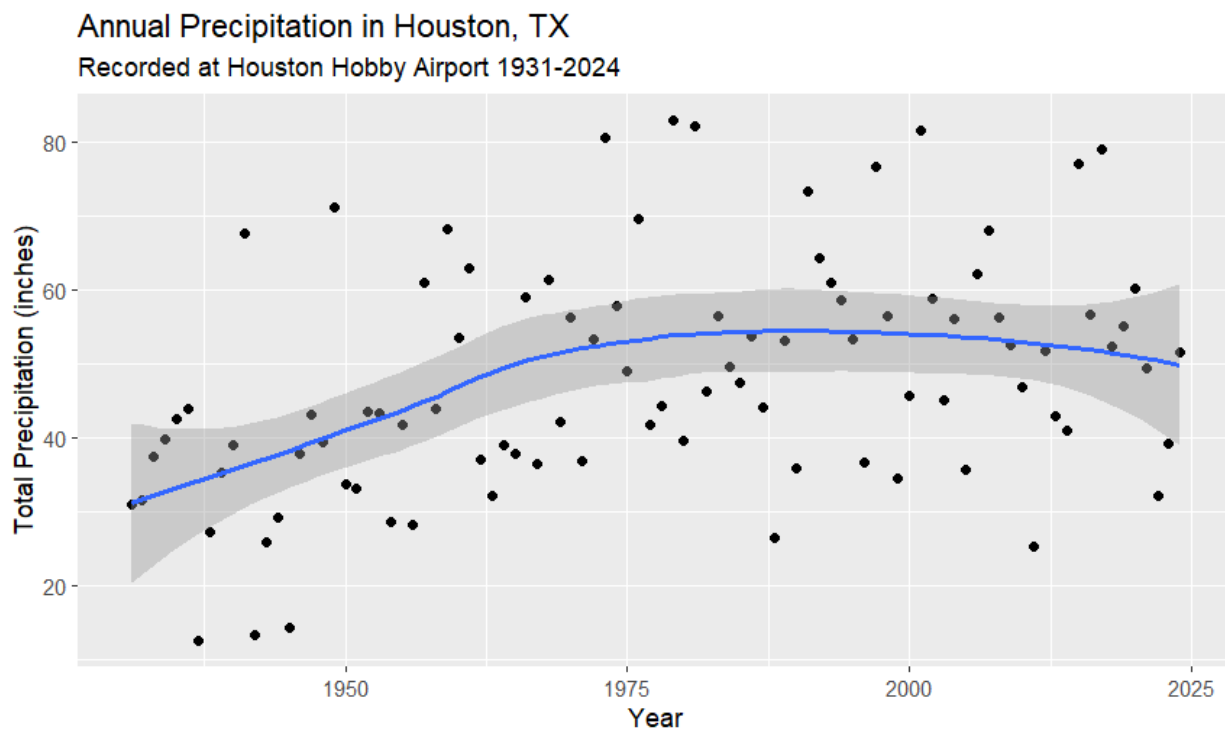


Figure 4 Total Precipitation per Year in Houston

To get a better idea of the long-term trends, the annual precipitation was averaged across decades and found that, with the exception of the 1970s, which was abnormally high on average, the average annual precipitation steadily increased throughout the twentieth century and began to decrease at the onset of the twenty-first century (Figure 5). The rate of decreasing in recent

decades is far quicker than that of the increase before. With the data available for the first half of the 2020s, precipitation is already lowered to levels seen in the 1960s. Of course, the second half of this decade remains to be seen and may turn those numbers around.

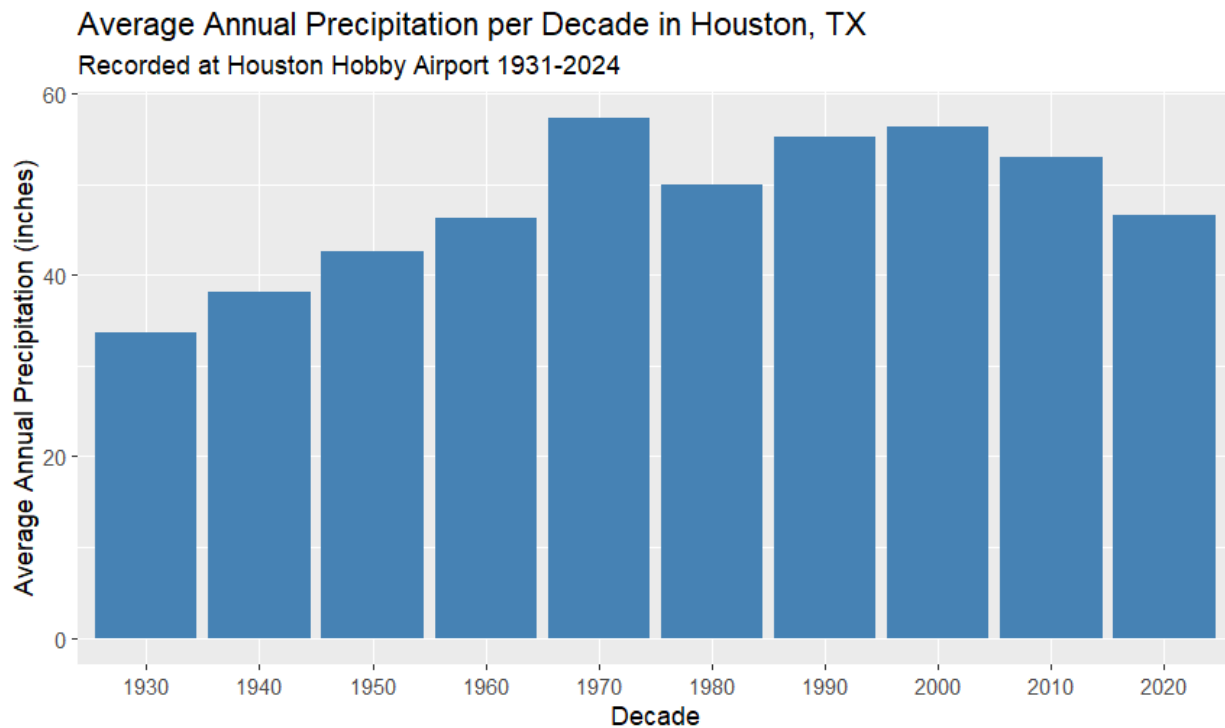


Figure 5 Average Annual Precipitation per Decade in Houston

Because the drought of the 1950s has been recognized as a major urbanizing event of Texas, pushing farmers off their land into cities to find work, the effect of drought on Houston is different than it is for the rest of the state. The city's increasing population for the last several decades is partially due to this, which increases demand for water in the city. However, as seen in the introduction, many rivers and bayous run through the Greater Houston area, allowing Houston to have lessened effects of drought and leaving it to feel the constraints of it last.

Energy Industry Growth

As the energy capital of the world, Houston is home to hundreds of renewable energy companies and is taking a leadership role in the transition to carbon neutral energy. The Greater Houston Partnership, a nonprofit, projected in 2021 that Houston could lose over 650,000 jobs if it continued to rely on hydrocarbons for its throne in the energy industry. However, it also theorized that up to 560,000 jobs could be added by 2050 if Houston took a leading role in the world's energy transition (Greater Houston Partnership, 2021).

Houston has taken this call to action seriously. It seems 2020 was a turning point year for Houston in reflecting on its role in powering the globe and looking toward the future. Startups, relocated businesses, and Fortune 500 companies alike have felt an influx of funding for renewable solutions and dedicated more time and resources towards those goals (Greater Houston Partnership, 2024). Additionally, the Renewable Energy Alliance Houston (REAL) was established in 2020 and aims to facilitate conversations and productivity for increasing renewable energy use in the city and its companies.

Another marker of growth in this field is the solidified position of Green Mountain Energy as a renewable energy provider for residential and commercial properties throughout the city and surrounding areas. In fact, the company even claims Houston is ranked first on the EPA's Green Power Partnership list of 30 Top Local Governments and gets 90% of its energy from solar and wind power, with lots of room to grow (Green Mountain Energy, 2025).

The news focus on nuclear energy in Houston is not nearly as prolific; it all points to the same spot: The South Texas Project Electric Generating Station (STP). This is a nuclear power plant that is actually 90 miles southwest of Houston in Matagorda County. Therefore, the actual plant would not represent Houstonians, but its power provides 44% of the energy provided by

Constellation Energy, one of Houston's largest energy companies. Because it is located on the coast, the main concern for safety and operations is hurricanes. However, their website boasts a fantastic Storm Team and a success on all accounts during the 2017 Hurricane Harvey, the worst storm the region has seen in over a decade (South Texas Project Nuclear Operating Company, 2025). Therefore, the nuclear sector of the energy industry is small but solid in the Greater Houston area and its neighbors.

Waste Management

2020 was also a year of reckoning for Houston's waste management practices. Approximately two thirds of waste generated in the city is by commercial buildings, leading to focusing on things like training employees on waste segregation for increasing recycling, composting, and reusing materials (City of Houston, 2019, p. 6; Frontier Waste Solutions, 2024). As of 2020, the City of Houston has an action plan to reduce their waste generation by 25% and increase recycling by 45% by 2040 (City of Houston, 2025c).

Effects of Climate Change on Houston

Environmental Impact

Climate change has affected Houston by decreasing rainfall and increasing temperatures. Additionally, extreme weather events such as hurricanes and derechos have become more common than they were twenty years ago. The changes in climate have significantly affected Houstonians' sense of personal safety, property management, and cost of living.

Public Health Impact

The largest concerns for public health impact by climate change is the extreme heat that occurs on a now regular basis for Houston in the summer. Houstonians looking to do activities

outside or that have HVAC units go out without warning (as they often do) face a significant risk of heat exhaustion, heat stroke, and other heat related issues. Public education can help with Houstonians recognizing and treating symptoms of these common illnesses in themselves and others.

The other concern mentioned earlier in this paper is a decrease in water availability paired with an increase in population. While water availability is less of a concern for Houston, where several rivers drain into the Gulf of Mexico, the rate of decline in freshwater across the state of Texas is concerning. These issues can (and are) dealt with through water restrictions for things like yards and educating the public on the importance of conserving water in their daily tasks. Finally, getting refinery and manufacturing companies in the area that use water in their processes to agree to sustainable practices is key.

Economic Impact

The economic impact of climate change on Houston is significant, both in scenarios where a real response to the crisis is made and where no response at all is considered. Houston has the opportunity to use this crisis to its advantage as the energy capital of the world. However, if the city takes a more business as usual route, Houstonians will suffer continued and increased damage to homes and workplaces through hurricanes and storms, increased homelessness as the cost of living rises and essential resources like water are harder to obtain, and an overall breakdown of the local economy as fossil fuels run out.

Clutch City? A Plan of Action

Houston is also known as “clutch city,” referring to the city’s (and often its sports teams’) ability to “come in clutch” with exactly what you need at exactly the moment you need it. I think

this term applies to Houston's role as the energy capital of a world on the precipice of a complete climate crisis. The city has jumped into action to address sustainability amongst its waste management, prolific energy industry, and other areas.

Houstonians can take many steps towards reducing their carbon footprint. By utilizing energy from companies like Green Mountain Energy, segregating their waste, and continually demanding better practices from their employers, significant progress can (and has been) made towards a cleaner Houston.

Conclusion

I learned a lot about my city over the course of this project. If anything, it has made me even more proud to be a Houstonian. Because Houston is known as an oil and gas town – I've even heard it referred to as the 'Carcinogenic Coast' – I did not have high hopes on finding much sustainability. As it turns out, Houston is a model city for prioritizing and implementing climate friendly practices. It gives me hope for the energy industry and world at large that industry leaders and governments are taking the concern of climate change seriously.

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