Energy Infrastructure

EEP

11

UTA

Initiative

Shift to resilient, low-carbon energy infrastructure

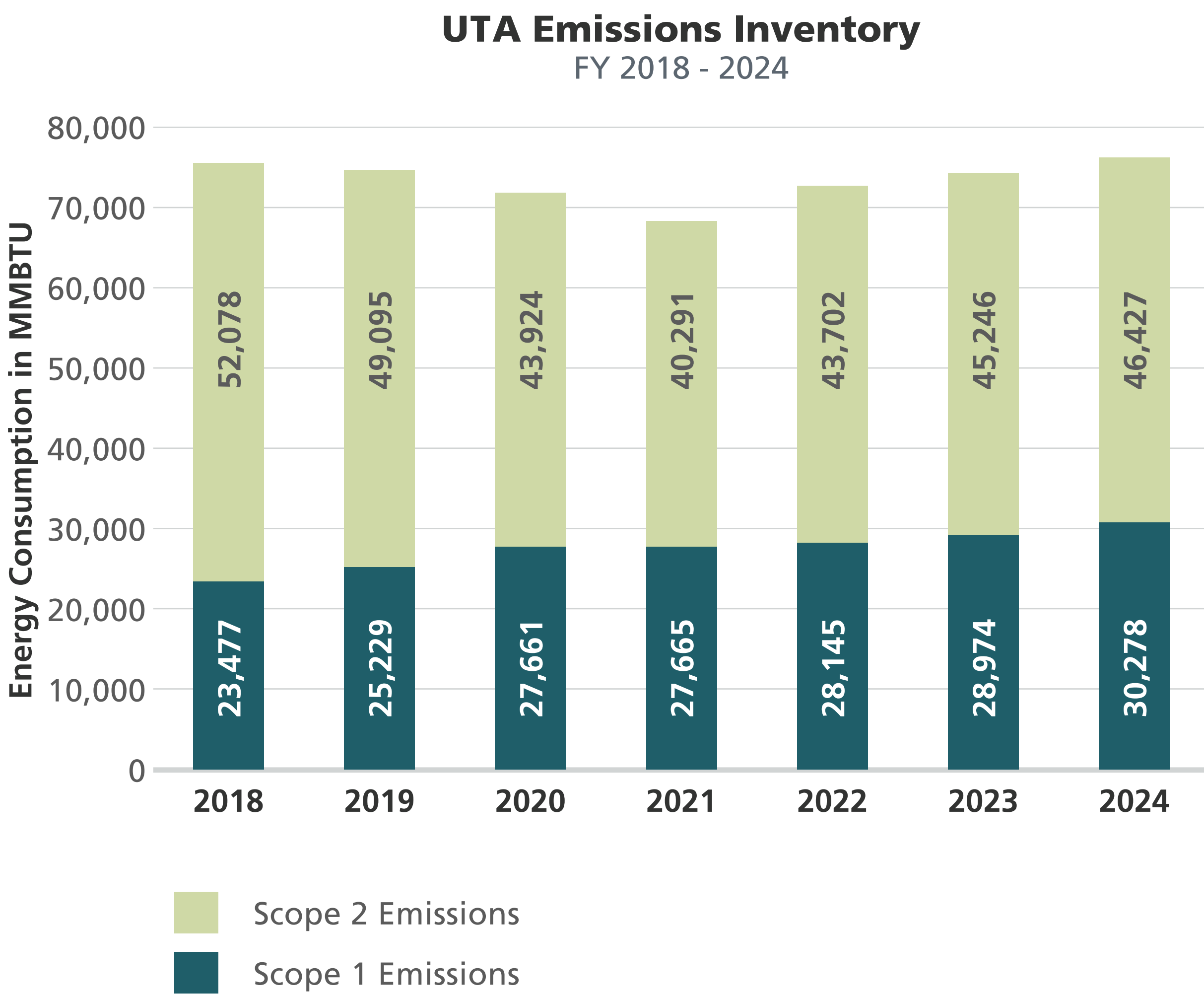
LEAD: **Office of Facilities Management**
with support from the Office of Sustainability

Definition

The key element of UTA's future is charting a path toward low-carbon operations. This section is an integration of much of what has been discussed before: high-performance buildings, improving resiliency on campus, understanding the constraints around the Texas grid, and tying them together to create a cohesive narrative around transitioning the university away from fossil fuels. This plan proposes a hybrid solution, leaving some legacy infrastructure in place to accommodate unforeseen peaks and extreme scenarios, but focuses primarily on the development of low-carbon options to guide UTA's future development.

Resilience Co-benefits

- Shrinks Carbon Footprint
- Grows Green Jobs & Opportunities
- Supports Community Health
- Enhances Environmental Quality
- Increases Energy Efficiency
- Establishes UTA as a Regional Leader



UTA's Energy & Emissions Journey

While UTA has continued to improve its overall building efficiency, and drive down utility consumption, the fact of the matter is: UTA is a growing campus, changing to meet the needs of the future. In that growth, it has continued to increase carbon emissions on a year-to-year basis since 2018, as outlined in the adjoining chart. With additional growth on the horizon, it is crucial to understand how UTA can both grow and change, while adopting practices that allow for a reduction in total emissions. This will require a focus on efficiency, as well as a migration away from fossil-fuel based resources as much as possible.

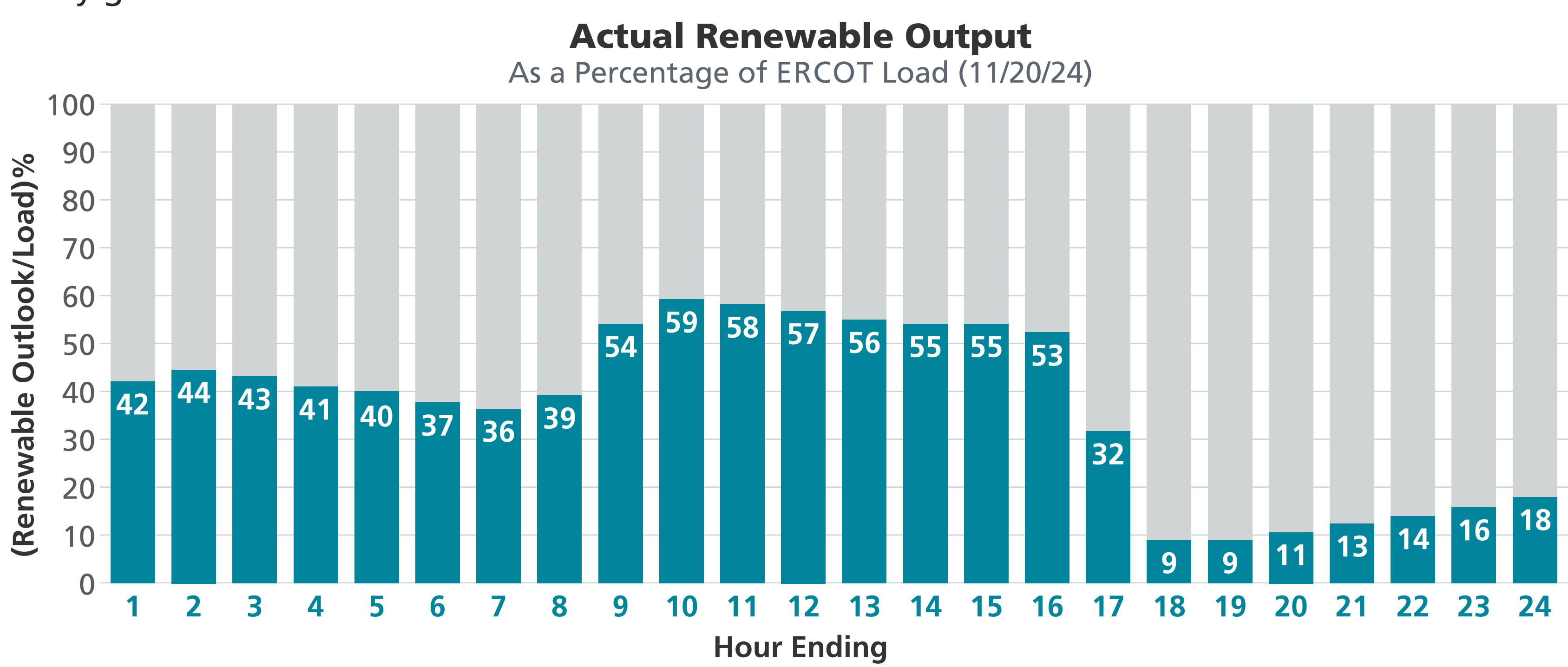
Existing Conditions

The Texas Grid & Energy Distribution

The state of Texas operates a deregulated energy market, making suppliers and distributors of energy separate entities. Local utilities are responsible for distribution and maintenance of utility assets, and retail suppliers handle generation and coordination with the local utility.

As a result of this, universities and municipal entities in Texas have formed a consortia of power generation purchasing which negotiates rates for the members. This is one of the largest power purchasing contracts in the state, working directly with utility generators.

The Texas grid currently has a significant deployment of renewables, largely utility-scale wind energy and photovoltaic (solar) energy projects. Annually, the highest concentration of renewables in the grid is in the shoulder seasons - fall and spring, with as high as 59% of loads being met in the shoulder seasons by renewable energy. Opportunities for solar development on campus have been evaluated, but do not meet the magnitude of the challenge, as it relates to migrating to a campus as large as UTA off of fossil fuels.



Future Grid State & Projected Emissions

When evaluating future conditions, there are several factors that have outsized impacts on possible futures, including the development of utility-scale renewable energy. Projections for the Texas grid are promising, with some estimates showing a passive reduction in carbon emissions of nearly 84% through coal plant retiring and replacement with utility scale renewable energy. This passive reduction is highly dependent on the continued expansion of utility scale renewable energy at the rate that has been seen over the last ten years, as well as the continued economics of renewables improving as it has over the same time period. Renewable energy, by kilowatt-hour, is currently the cheapest energy resource to develop in the state of Texas, and similarly making it the largest growing portion of the Texas grid, by a wide margin. This bodes well for UTA, as the ability to receive passive benefits of the grid transitioning to renewable sources directly impacts the university's largest source of emissions. Partnership with the grid, as an investment in the grid's long-term transition to renewables, is a key strategy for infrastructure modernization, outlined in later sections.

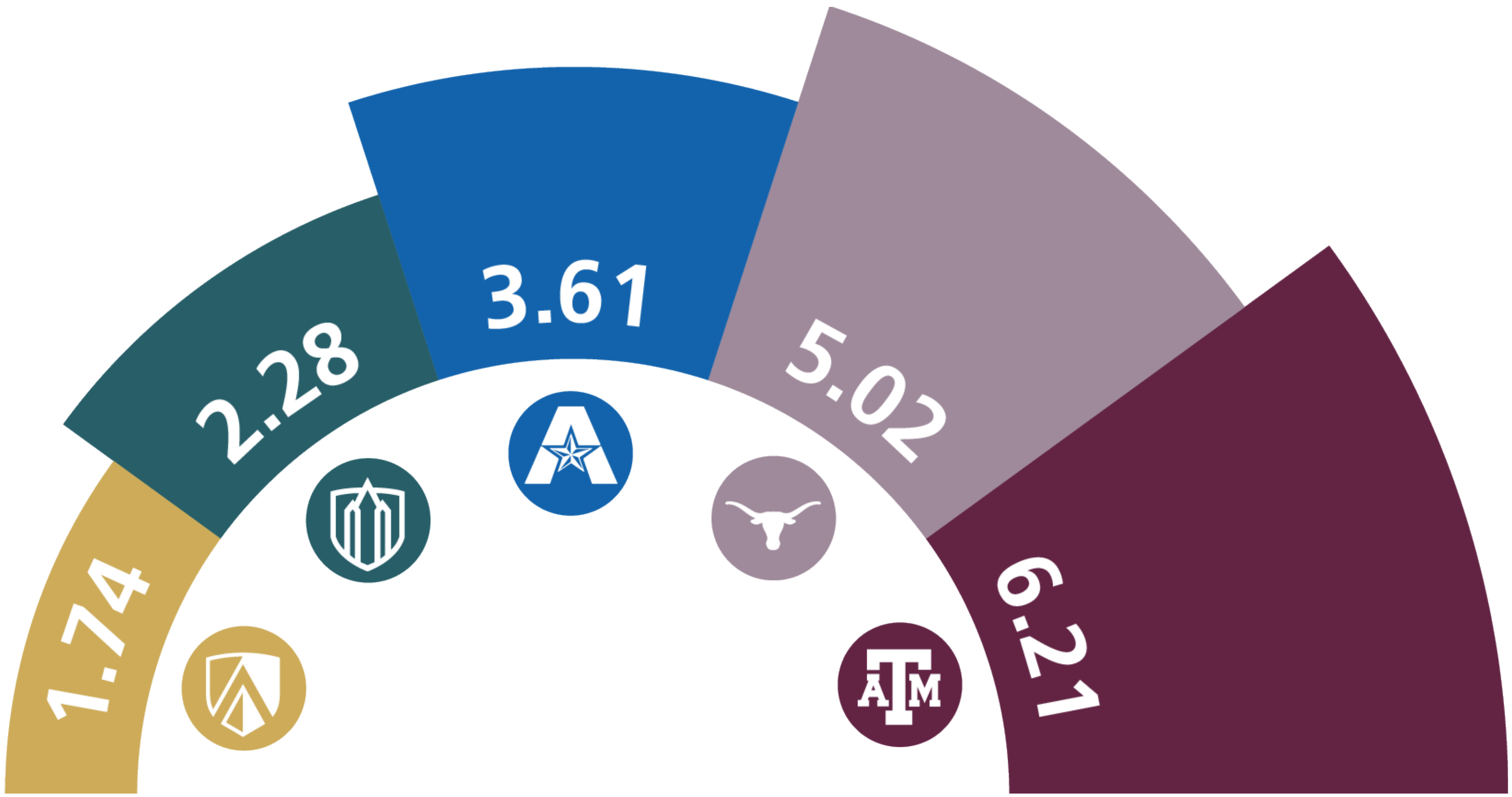
Campus Utility Constraints

As UTA continues to grow to meet an expanding student population, as well as increased utility needs for research and development, the existing campus infrastructure systems need upgrades. As part of the campus master plan, developed in parallel with this effort, existing campus infrastructure is being improved and expanded to serve these future needs. This growth presents great opportunities to improve efficiency, drive down utility consumption, and develop infrastructure systems that are both resilient, and able to operate sustainably into the future.

UTA

Peer Benchmarking

As part of UTA's reporting for AASHE STARS program, metrics are available from which the University can measure itself against its peers, and set aspirational targets based on those around them. As outlined in the diagram below, UTA currently has additional opportunities to establish itself as a leader within large Texas universities as it relates to carbon emissions.



Scope 1 & 2 Emissions Per Weighted Campus User

In Metric tons CO_2e

Campus Infrastructure Growth & Demand Reduction

Electricity Consumption

Future electricity demand on campus is a major focus point for adequately serving the campus needs. As technology continues to integrate with our lives and work, electrical service to power that technology becomes more and more essential. When evaluating UTA's future state, it is crucial to consider how the deployment of electric vehicles, high-intensity computational resources, increased plug loads from personal phones and computers, as well as the electrification of building operations will impact our future electrical demand.

Future electrical consumption will require an aggressive expansion of current electrical service, as outlined in the physical master plan. Dedicated high voltage feeders from the utility provider, as well as a robust expansion of UTA's electrical transformer capacity are proposed to meet these needs.

In tandem with growing needs, it is important to understand where the University can better serve current needs. As discussed in the High-Performance Buildings chapter, building energy conservation measures will be essential to avoiding the overload of existing and future campus circuits. These energy conservation measures free up much needed capacity from current resources.

Comprehensive building utility metering at UTA presents a great opportunity to make informed, focused decisions about the implementation of energy efficiency measures. These systems allow for a better insight into current building performance, as well as opportunities for high-efficiency system integration, without having to overspend on oversized, expensive equipment. With a dedicated energy manager at UTA, this existing and future campus energy data will be essential to the successful implementation and tracking of the Energy Efficiency Plan's energy strategies.

Steam To Hot Water Conversion

Based on current plant health reports, steam boilers are well maintained but aging, and currently operating at approximately 75% efficiency. Current condensing boilers see nominal efficiencies of over 90%, some reaching as high as 95%. Replacement with high efficiency boiler technologies at the building level alone will have significant utility savings, even before building conservation measures are taken.

FROM THE CAMPUS MASTER PLAN

> **With the Campus' desire to eventually eliminate centralized natural gas fired steam boilers and associated steam/condensate piping distribution throughout campus, the proposed concept is to develop de-centralized heat sources in each new building. Existing buildings would be retrofitted with localized natural gas heating water boilers as maintenance funding is available.**

Shifting Toward Electrification

Electrification, sourced from renewables, is the most effective pathway to a low-carbon future for UTA. Electrification, the process of replacing fossil fuel-based systems with electric systems, must be paired with renewables or low-carbon power purchasing in order to result in lower overall emissions, but eliminates the fixed carbon cost of operating fossil-fuel based infrastructure on site.

The following pages explore systems for consideration, including various heat pumps, a hybrid system, and rooftop solar generation and energy storage.

Heat Pump Systems

The benefits of electrification come from the ability to develop higher-efficiency systems than traditional fossil fuel-based systems. That being said: all electric systems are not equally efficient. Electric resistance heating puts an incredible strain on the existing electrical infrastructure, and while it is able to be sourced from renewable energy, it should not be considered a viable whole-building heating strategy, even with inexpensive electric rates. Higher efficiency systems, such as heat pump-based systems, should be the standard for future electrification strategies.

Air to Water

Extracts heat from the outdoor air and transfers it to water, which is then used to serve building hot water systems. Air-to-water heat pumps are highly energy-efficient, often producing three to four times more energy than they consume, making them a cost-effective and suitable alternative to traditional, fossil-fuel based heating methods.

Sewage Waste Energy Exchange

Harnesses thermal energy from wastewater for heating and cooling purposes. This process extracts heat from sewage water using a heat exchanger and transfers it to a clean water system via a heat pump. Extracted heat can be used to warm buildings, while the cooled wastewater is returned to the sewer system. These systems can lower operational costs and reduce the carbon footprint of buildings.

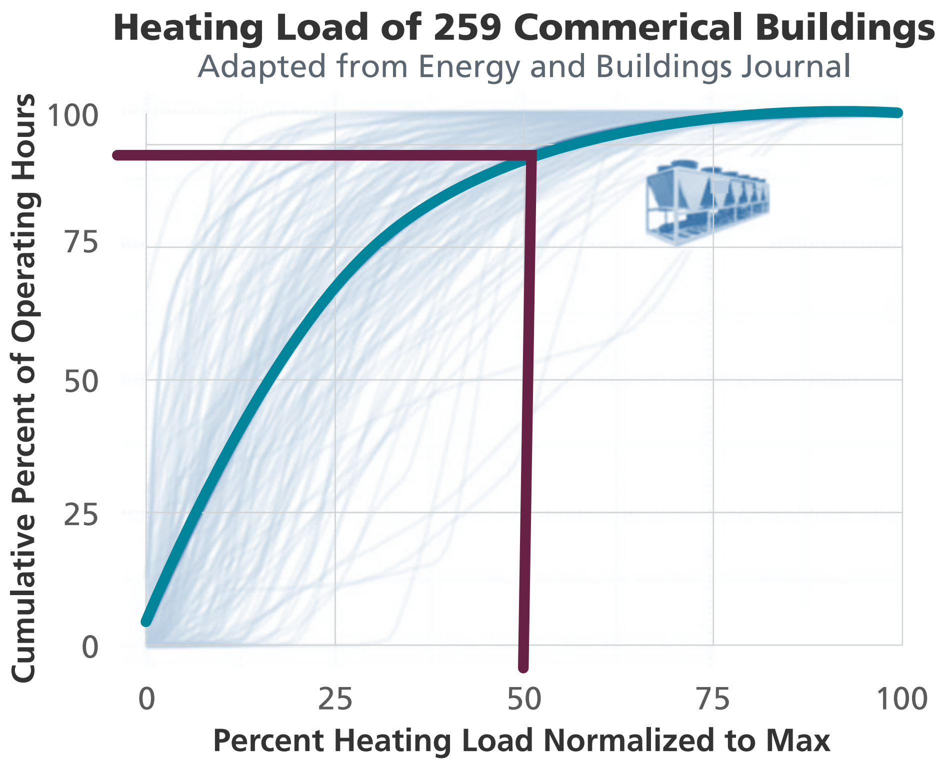
Ground Source Heat Pump

Utilizes stable underground temperatures to provide heating and cooling for buildings. These systems circulate fluid through underground pipes which absorb heat in the winter and release it back into the ground in the summer. Energy is transferred to and from buildings via water-source heat pumps. These systems produce three to six units of heat for every unit of electricity consumed. Although installation costs can be higher than traditional systems, there are long-term savings on energy bills and reduced greenhouse gas emissions.

Hybrid Systems

A note on heat pump temperature performance – there is a limit at which point, particularly air-source heat pumps, are no longer usable, and require supplemental heating and cooling to meet the full building heating and cooling load. This is an opportunity to utilize the legacy heating and cooling infrastructure, with the opportunity for full electrification beyond those system's usable life. These systems' efficiencies, within their temperature ranges down to -5°F, far exceed the efficiencies of natural gas fired hydronic or electric resistance heating.

An analysis of a commercial buildings survey, published in "Energy and Buildings" Journal in October 2024[28] found that out of nearly 260 buildings surveyed, 90% of the operating hours were served at 50% of the load or below. This illustrates an opportunity for a fundamental shift in how building electrification can be deployed. Existing hot water boilers can be held onto for peak load management, shifted towards meeting those remaining 10% of operating hours, while meeting 90% of operating hours with high-efficiency, heat pump solutions.



28 Insights from hydronic heating systems in 259 commercial buildings | Energy and Buildings

Solar Power Generation & Storage

Solar power, in the form of rooftop photovoltaic systems from both an economic and energy perspective, is not a technology that is best suited for immediate deployment on campus. Evaluations of current consumption at the Engineering Research Building suggest that full deployment of rooftop solar would cover only 7% of the annual utility consumption at the building. Following comprehensive energy conservation efforts on campus, in tandem with the successful implementation of electrified building systems, photovoltaic systems become ideal candidates for remaining roof area, as it can serve to directly offset campus utility consumption.

Within the context of an electrified system, photovoltaics pair ideally with battery storage to help to reduce peaks on heating and cooling systems, and can provide additional cost savings and points of electrical resilience on campus.

Case Study: District Systems Improvements

ENGINEERING RESEARCH BUILDING

See supporting chart in **High Performance Buildings**

Following the study on energy conservation measures at the Engineering Research Building, similar studies were developed to understand the cost and carbon savings of the successful implementation of both the steam to hot water conversion, as well as hybrid electrification.

Steam to Hot Water Conversion

Savings of 5620 MCF of Natural Gas annually just through serving the same need with high-efficiency equipment.

Heat Pump Option

Sizing heat pump for 50% of the building heating load, in order to properly simulate a hybrid system integration accounting for 90% of operating hours.

Heat pump solutions can eliminate up to 50% of total remaining natural gas consumption, while also eliminating an additional 12% of electricity consumption.

Site / Plant Level ECMs

	Electrical Savings kWh	Chiller Plant Electric Savings kWh	Gas Savings kBTU	Total Energy Savings kBTU	Gas Emissions Reduction mT CO2e	Electric Emissions Reduction mT CO2e
Steam to Hot Water Conversion	-	-	5,811,729.9	5,811,729.90	318.48	-
Heat Pump	-	-	10,464,679.29	11,745,737.17	573.46	533.04
Total Emissions Reduction					1,424.99	

Infrastructure Modernization Pathway

Phase 0 - Laying the Groundwork

Goals: Enact immediate-term strategies to understand current performance and opportunities for efficiency

Power

- Install individual electrical building metering, capture annual consumption and maximum demand information broken out by end-use, to be managed by UTA Energy Manager for future development projects
- Understand, with Oncor, feasibility of dedicated UTA electrical feeders

Thermal

Existing Buildings

- Perform stress tests for hot water temperature to understand lowest feasible operating temperature for each building
- Perform ASHRAE Level 2 Audits, and develop “Make Ready” Packages for modernization
- Install BTU Meters at each building to understand current thermal consumption for right-sizing
- Utilize Freely available Scope of Work for Individual Buildings by the DOE Better Buildings Initiative[29]
- Develop internal knowledge base with facilities and operations teams on installation and operation of heat pump-based solutions utilizing ASHRAE Building Thermal Systems Guidelines[30]

29 GHG Emissions Reduction Audit Scope of Work Template | Better Buildings Initiative

30 Decarbonizing Building Thermal Systems: A How-to Guide for Heat Pump Systems and Beyond

Phase 1 - Supporting Sustainable Systems Expansion

Goals: Prepare infrastructure for modernization, and develop new buildings to high performance targets

Power

- Work with Oncor to develop additional feeder capacity to meet additional building load, as well as future electrified building load
- Key Moment: At the end of 2027, help to develop "Green Power for Texas" via Texas university power consortia members
- Negotiate 100% renewables purchasing option
- For emergency/disaster preparedness, continue the UTA policy of 100% building backup through generators for selected shelter areas

Thermal

Existing Buildings

- Steam to Hot Water Conversion: Begin to move existing steam heat to decentralized, high efficiency hot water boilers at each building, serving at lowest suitable temperature based on stress testing

New Buildings

- Target IECC 2021 Zero Energy Commercial Building Provision Targets by Building Program
- Target 130°F (or lower) hot water for new buildings
- Build out Phase 1 of cooling loop for new buildings

Phase 2 - Bridging Electrification

Goals: Develop new buildings to high performance targets, focus on existing building efficiency improvements, and continue to prepare infrastructure for modernization

Power

- Continue circuit health upgrades, additional feeder and distribution capacity for future electrified loads
- For emergency/disaster preparedness, continue the UTA policy of 100% building backup through generators for selected shelter areas

Thermal

Existing Buildings

- Steam to Hot Water Conversion: Continue to move existing steam heat to decentralized, high efficiency hot water boilers at each building, serving at lowest suitable temperature based on stress testing
- Focus on Comprehensive Energy Conservation Measures
- Target Circulating Temperatures of 130°F (or lower), increasing coil sizes as needed
- Replacement of existing electric resistance heating with hot water heating where suitable

New Buildings

- Target IECC 2021 Zero Energy Commercial Building Provision Targets by Building Program
- Target 130°F (or lower) for hot water for new buildings
- Build out Phase 2 of cooling loop for new buildings

Phase 3 - Resiliently Electrify UTA

Goals: Swap remaining fossil fuel sources for electrified sources, increase on-site utility resilience

Power

- Evaluate on-site PV and Battery Storage for resilience/demand response opportunities for additional cost savings and peak reduction
- For emergency/disaster preparedness, continue the UTA policy of 100% building backup through generators for selected shelter areas

Thermal

Existing Buildings (and Phase 1 & 2 Buildings)

- Supplement fossil fuel dependent systems with high efficiency heat-pump, electrified systems
- Air-to-Water Heat Pump, SWEE system, based on building-by-building conditions – target incentivized clean energy, heat pump systems

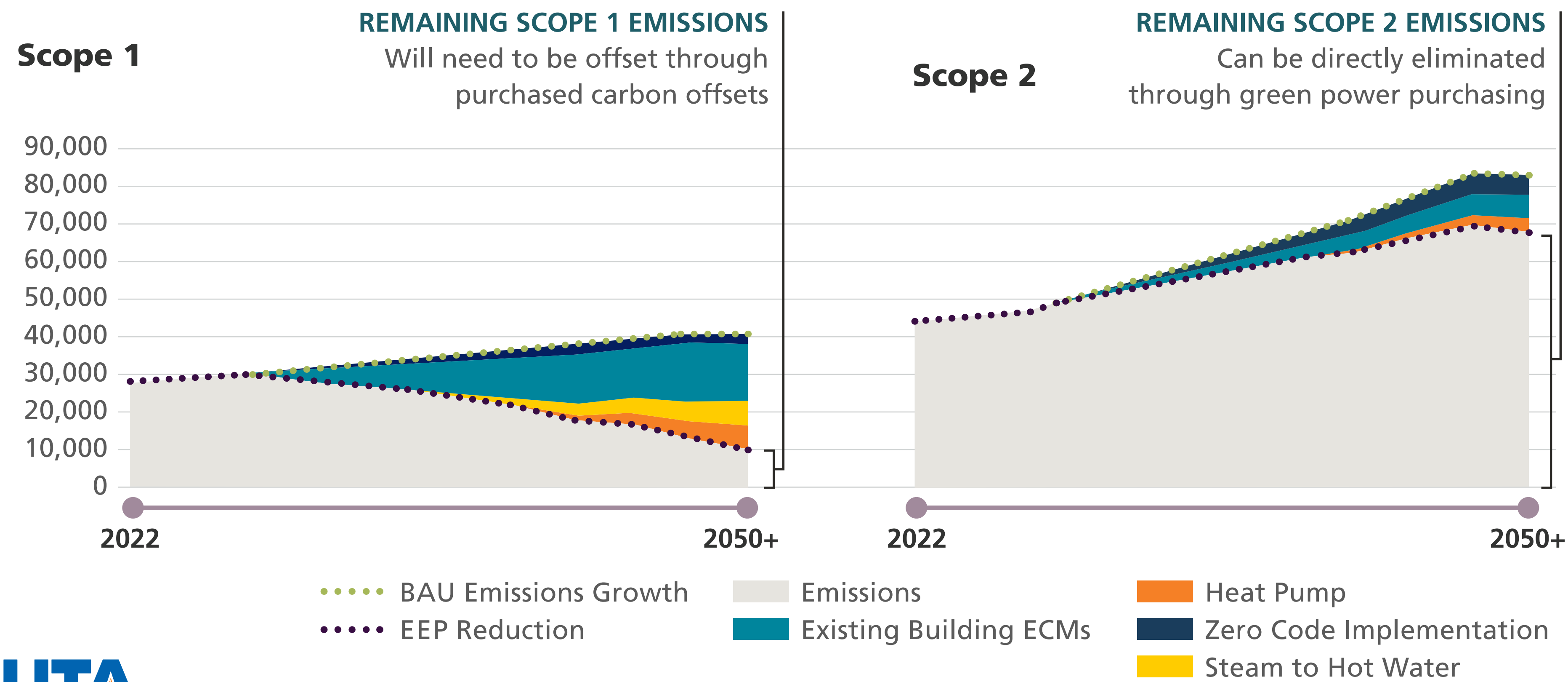
New Buildings

- Target IECC 2021 Zero Energy Commercial Building Provision Targets by Building Program
- Target 130°F (or lower) hot water or lower for new buildings
- Highest efficiency Heating and Cooling systems
- Air-to-Water Heat Pump, SWEE system, based on building-by-building conditions – target incentivized clean energy, heat pump systems
- Build out Phase 3 of cooling loop for new buildings
- Explore Micro-districts to share heating and cooling loads

Understanding the Impact of the Infrastructure Plan

Reducing carbon emissions is as much about load shifting as it is about load reduction. While efforts should be made to reduce energy and resources as much as possible, it is not feasible to completely eliminate them from a building. Because of this, focusing on where resources come from becomes incredibly important. At first glance, it may appear as though switching from natural gas to electricity produces higher emissions, however the key difference is that electricity can be sourced through renewable resources. Green purchasing means that the emissions can be avoided entirely, as though they were never emitted because clean energy was used instead of fossil fuels. It must be stated: all natural gas, no matter the source, emits carbon, and the elimination of scope 1 emissions cannot be achieved without the elimination of natural gas. Given the current grid's reliance on coal, this transition first requires a shift in power purchasing at the University level, in order to prevent a net increase of emissions over current operations.

Emissions Reduction Plan



PRIORITIZATION KEY
NEAR ■ ■ ■ LONG

Lower building-level Energy Use Intensity

ACTION ITEMS 2

Use the EnergyStar Portfolio Manager to benchmark and calculate energy project savings for all campus buildings

Match all purchased electricity generated by fossil sources with Green-e certified RECs

Deepen the granularity of energy data across the campus through building metering

ACTION ITEMS 3

Establish overarching goals and specific, measurable targets related to energy and water at UTA (reducing GHG emissions, water reduction and conservation, etc.)

Move toward hourly energy analysis by metering individual buildings

Assess space utilization across all campus buildings

Transition energy infrastructure on campus

ACTION ITEMS 3

Transition thermal networks to low-temperature hot water at the building

Electrify building operations once power purchasing has been secured

Align major energy projects with campus master plan development

Source 100% low-carbon energy

ACTION ITEMS 3

Utilize university power purchase contract to purchase green energy

Ensure all purchased energy is sourced from verified clean and renewable sources

Deploy solar power generation where possible - Install solar panels across campus including on both roofs/parking and coordinate opportunities for solar to provide shading