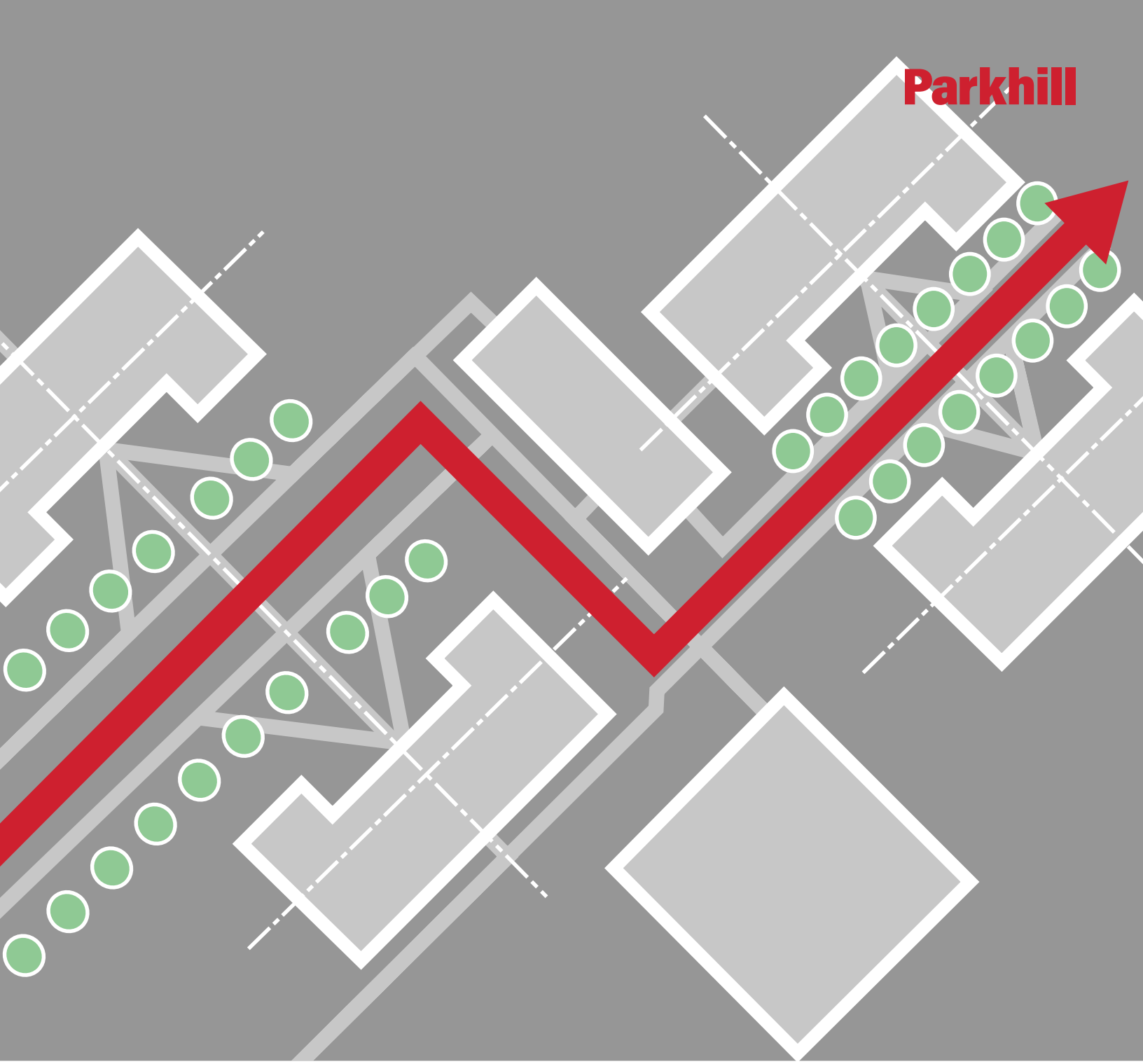


# COMPACT CAMPUSES HELP SAVE MONEY IN HIGHER EDUCATION INSTITUTIONS

July 2020 | Julio Carrillo, Parkhill Senior Planner and Manager

Parkhill

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## ABSTRACT

This paper aims to describe the correlation between compact campus fabrics and financial performance. While highlighting the financial benefits of building compact, it also aims to reflect on the importance of designing human/pedestrian-friendly places.

In a post-COVID19 era, where behavior around the world has shifted to physical distancing, the most common response has been a collective aversion to dense and populated spaces. With increasing evidence supporting that high COVID-19 infection rates are not linked with densely populated places, a challenge is still present for reinforcing the idea of safe, compact, and dense areas.

On a similar supportive note, the article intends to highlight the value of imagining the utilization of outdoor space more prevalently and effectively for student use, common space, and interim learning space during the adaptive period post-COVID in the college and university environment.

With the challenge for utilization of open spaces, we acknowledge the need to reinforce the benefits of social interaction in safe and friendly open spaces. Outside of our human confinements during the COVID-19 pandemic, there is a great amount of opportunity for healthy interaction within our urban realm.

For Planners and Urban Designers, who design urban places that are inspired by the health and safety interactions for humans, the incorporation of financial and economic concerns is also a highly important piece of their design process. COVID-19 has highlighted that economic vitality and human interaction are basic parts of the vitality of a community. With this reflection at hand, this paper looks into Planning and Placemaking aspects and their relationship with economic/financial performance.

Correlations found in this study suggest that compact campuses tend to provide a high potential for savings to higher education institutions. This study is built upon the reaffirmation of compactness as an efficient way of building cities and communities. This sustainable approach provides not only environmental benefits but also positive social and economic performance.

We acknowledge that, in this specific case study of 12 academic institutions, the dynamics of campus compactness might differ a little from large cities and communities. Although, some of the institutions in this analysis represent a significant portion of the economic and social vitality of their cities and/or communities.

From this analysis, we deduct that building a compact campus is one of many factors that will contribute to long-term and short-term savings for academic institutions. We have listed some strategies at the end of the paper to summarize a few points that these institutions should take into consideration in future planning and construction of buildings.


## SYSTEMS THEORY & COVID-19

While most contemporary planners and urban designers recognize modern-era sprawl as one of the most inefficient approaches of our history of planning cities and campuses, there has been a general reference to the value of equilibrium between a compact campus and an overly-broad campus. The reflection upon planning in the 1960s, when plans were often very broad and Miesian/Corbusian in their layouts, sparked a conscious concern about rational, non-sprawling growth. Richard Dober in his 1963 (and 1996 et. al. later editions) book Campus Planning lays down a critique of Eero Saarinen's simile about campus planning:

- "The first requirement for an adequate campus design is a general design form which can adapt itself to future change, and at the same time maintain its integrity as a design."
- "Eero Saarinen supposed a campus plan should grow like a baby – in all directions – a dangerous supposition: what will the [grown] man be like?"

COVID has made it highly evident that our environment is interconnected between various aspects, such as health, safety, economy, social interaction, and more. The complexity of these interactions and interconnectedness, support the conceptual approach of Systems Planning Theory. This fundamental insight from the Comprehensive Planning approach has inspired this article to investigate relationships between a few of these "systems".

In a multi-institutional study led by the University of Hong Kong[1], COVID-19 indoor contraction was studied to quantify the risk of educational institutions and the relationship with the transmission of the disease. Although this study focuses on indoor contraction, it touches on the value of well-built outdoor spaces as alternatives to indoor common space, student life/student union space, and where climate and weather afford instructional space. This multi-institutional article supports the growing evidence that outdoor airflow and the presence of natural UV light as a viricidal agent is an extremely effective way of combating COVID spread.

This research from Chinese institutions reported that, based on the review of some 7,324 cases of COVID-19 contraction, only one case was confirmed to have been contracted outdoors.

## COMPACT CAMPUSES AND THEIR SAVINGS POTENTIAL

In Texas, there are more than 200 higher education institutions, with campuses areas in a big spectrum of size and enrollment populations. Some of these institutions represent a big percentage of their local community in terms of land expansion and economic development.

This study is built upon the reaffirmation that there are quantifiable benefits from building compact and connected communities, in contrast with increasing inefficiencies from sprawl-like patterns (for example, city cores vs. suburbs). These benefits have either fiscal, financial, social, or environmental impacts.

As higher education institutions provide increased space for learning, the pressure of efficiency in terms of financial performance is higher and requires further study. In order to look at this efficiency pressure, Parkhill's analytics team has developed a model that approximates estimated savings based on the compactness of building fabric for 12 campuses in Texas.

Because the primary goal for THECB (Texas Higher Education Coordinating Board) is to increase the population attending higher education institutions, we see the increased burden on universities to find ways of saving money while still providing buildings and infrastructure for their growing student populations.

In this era of post-COVID-19, where density is challenged due to the way diseases spread in highly populated cities, this study responds proactively to these new challenges while providing a summary of alternatives that could represent quantifiable savings for higher education institutions.

We have ranked 12 campuses in Texas in terms of their building fabric compactness and associated potential savings. This ranking represents not only an informative way for the comparison of campus compactness between them but also a way to look at alternate avenues for increasing financial performance (savings). In sum, the campuses that have a lower compactness score have inherently a great savings potential for their immediate and long-range planning future. While campuses with a higher compactness score are apparently taking advantage of the potential savings of compact building fabric, there is limited room for improvement in terms of more compact build-out. On the other hand, institutions with lower scores have an amazing opportunity within reach and with a very straight-forward strategy for future planning and construction of infrastructure. Texas Tech University and Texas A&M University could benefit the most in addressing compactness appropriately.

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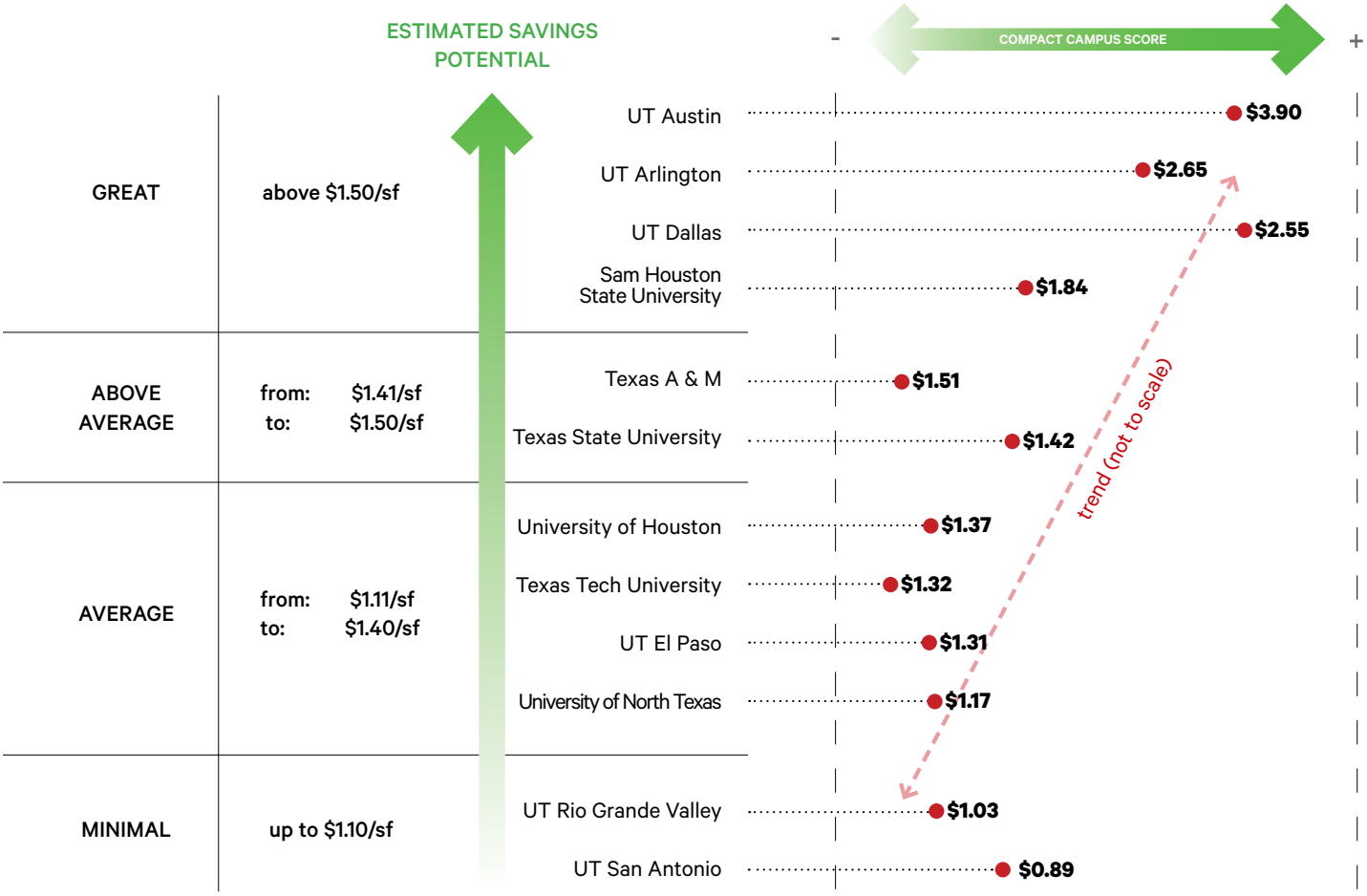
Figure 1 | Summary




## COMPACT SCORES AND THEIR RELATION TO THE POTENTIAL FOR SAVINGS

Figure 1 shows the summary of the study and the main takeaways for the 12 campuses in the analysis. Note the estimated savings per square foot are based on proportional allocations to the Total Cost of Ownership (TCO) over a 40-yr period. Savings correlations were calculated for 2 scenarios that allow further reinforcement of the correlation trend. The 2 scenarios were estimated for future new construction (short-term savings) and for a 40-yr TCO (long-term savings). Both saving potential scenarios are compared with the compact score of each campus to reaffirm the correlation (a trend in savings).

The basic definition of compactness values is derived from building proximity statistics. The statistics help us define the level of compactness of each of the campuses in the study. The heatmaps showcased in the following images are the graphic results of the proximity analysis from each of the 12 campuses. This was used to determine the score level of the compactness of each campus

Compactness score is a measure of comparison between all the samples (12 campuses). While limited to only 12, this score provides an idea of performance ranges between them. It is expected that an increase in sample size (additional campuses) will reshape these scores but won't substantially switch the ranking between the campuses studied.
The details for the compactness scoring methodology is explained later in this paper. This score represents a proximity measure between buildings within their "core" campuses.

Given the contribution of parking structures in compactness of the building fabric, the analysis in this article estimates a reduction of scores for campuses that have a high proportion of parking structures. A good example of this is the University of Texas (Austin), which has areas assigned to garages that add up to approximately 14.26% of all square footage; while Texas Tech has only 2.65% of parking structures. Therefore, this model reduces approximately 1.8 score

points to UT Austin, but only 0.4 points to Texas Tech. The reduction of the score is proportionally allocated to the number of parking garages for each campus.

Compact scores for each campus are used to have a base for correlation between the cost of ownership of all these academic institutions. The financial performance of the 12 campuses is compared with the compact scores of these to estimate their correlation.

## SAVINGS: UT AUSTIN, UT ARLINGTON AND UT DALLAS RANK IN THE TOP 3

Our study finds that a higher score in compactness (a measure of proximity between buildings) directly correlate to potential savings in new construction of buildings, and long-term TCO (total cost of ownership). The higher the compactness score, the higher the savings potential.

Savings in new construction are estimated based on a cost per building per campus. This report expands upon this assumption to clarify the methodology for potential savings. Savings in TCO per student are based on a projected 40-year model, accounting for current (2018) enrollment numbers.

A TCO model assumes several variables that help in predicting future costs. Savings in this study are estimated as a proportion of the TCO numbers per each campus.

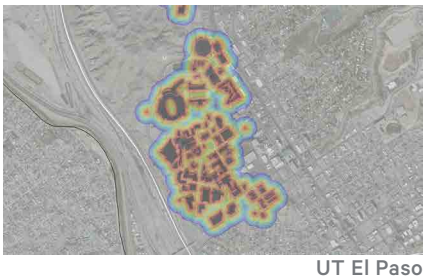
Figure 3 shows the performance of these 12 campuses in terms of estimated savings based on the long-term scenario (estimated 40-yr TCO), and their current state of campus compactness.

The doughnut chart (Figure 4) shows the current proportional distribution of open space and its relation to the number of students. In this last graphic, a high number means the campus has a high potential of improving human interaction outside building footprints

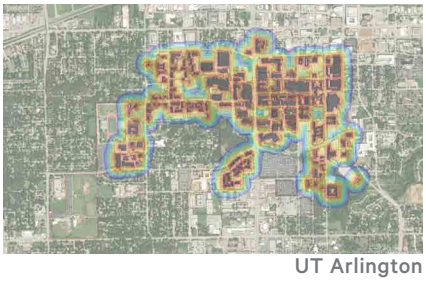
Figure 2 | Heatmaps

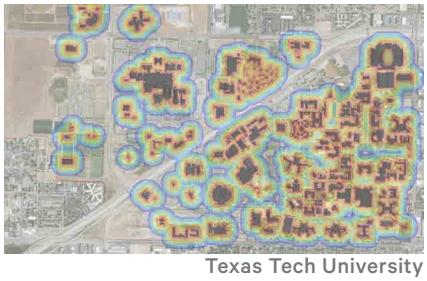

UT San Antonio

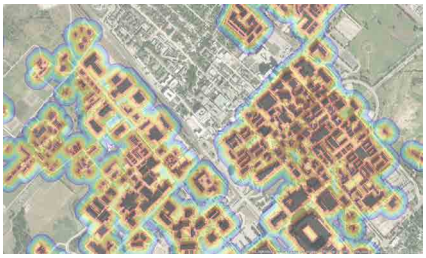

UT Rio Grande Valley

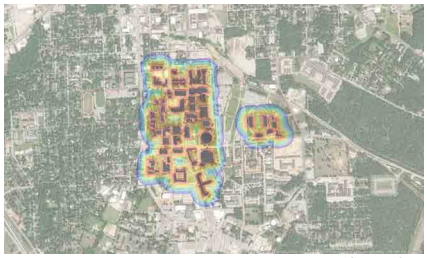

UT El Paso

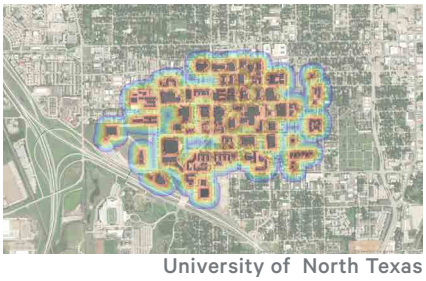

UT Austin

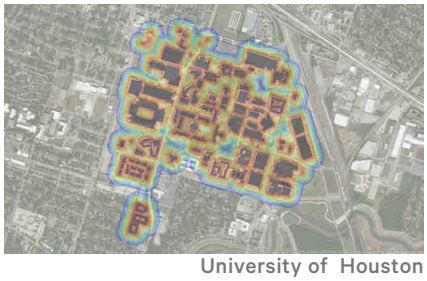

UT Arlington


Texas Tech University


Texas A&M


Sam Houston State University


University of North Texas


University of Houston


Texas Sate University


UT Dallas

if the campus starts improving its compactness score.

Both ends of the spectrum: Texas State University and Texas Tech University are showcased below (left and right respectively) to help deduct that the principal cause of building separation is surface parking lots and road infrastructure. A high number of surface parking lots translate to a high potential for repurposing and building compact.

## ESTIMATING SAVINGS: SHORT AND LONG TERM

TCO savings (long-term) and New Construction savings (short term) provide 2 different perspectives for each campus in this study. These 2 scenarios are described below.

**New construction** savings are estimated on a proportional allocation to current estimated costs per buildings on each campus. We have estimated a cost per building per each campus with regression from the TCO numbers. These costs per buildings are obtained based on the amount of building square footage and building footprints within the extent of the campuses in the study. From these cost deductions, a proportional allocation to the price/ building is allotted to estimate the savings/SF of new construction for each specific campus.

From these findings, we can deduct that buildings that are located within 50' and 150' of existing buildings will contribute to compactness score; therefore, contributing to overall potential savings. We assume that buildings need to be larger than 50,000 SF to have a significant effect on savings or contribution to the compactness score. These and other assumptions are described in the next section of this report.

The figure 6 chart shows the trend line correlation between potential savings in new construction based on compactness scores.
This correlation (trend line in red) suggests that a higher compact score is associated with a higher savings

Figure 3 | ESTIMATED SAVINGS POTENTIAL PER SQUARE FOOT (WITHOUT IMPROVING COMPACTNESS SCORE)

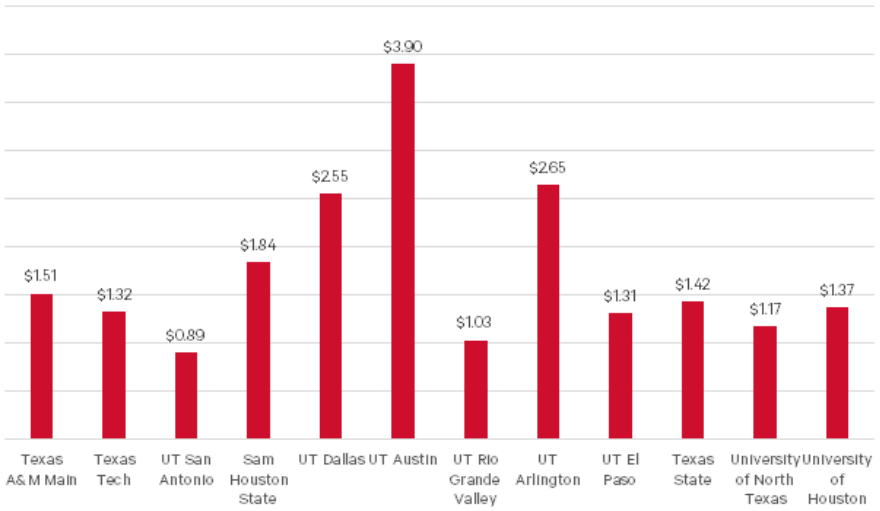



Figure 4 | ESTIMATED ACREAGE OF OPEN SPACE PER 100 STUDENTS (CURRENT)

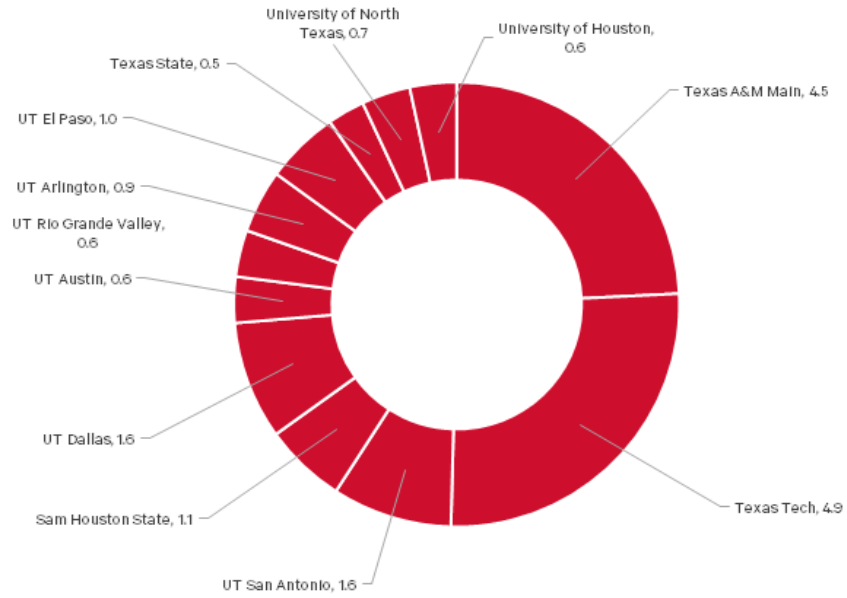
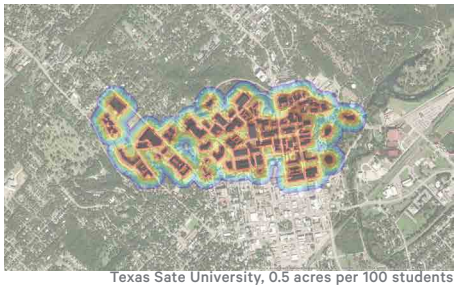
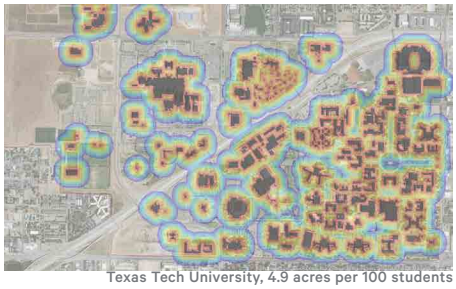



Figure 5 | OPEN SPACE PER STUDENT



Texas Sate University, 0.5 acres per 100 students



Texas Tech University, 4.9 acres per 100 students

potential. The savings amount has been calculated based on a "flat" cost per square foot and an estimated cost per building on each campus.

**TCO per student savings** is estimated based on the projected 40-year cost of ownership. The estimated savings are deducted from a proportional allocation of the compactness score to the TCO numbers. The savings ratio allocated to each TCO number is proportional to the compactness score. From this deduction, we recognize that enrollment numbers could vary; therefore, highly impacting the savings potential. Hence, a present net value operation helps us determine a cost/SF of new construction based on the 40-yr TCO. TCO calculations are based on all building areas, excluding parking garages and residences.

The correlation between compactness and savings shows that infrastructure built in compact campuses will provide the long-term potential for savings.

Figure 7 shows the trend line correlation between this long-term savings potential and the compactness of a campus.

## COMPACT SCORE METHODOLOGY: PROXIMITY-BASED STATISTICS

Compactness is defined by a measure of proximity of the building fabric of each campus. It is understood that larger campuses tend to have their buildings more dispersed than smaller campuses, so a "normalization" method has been applied in the methodology to diminish this factor in large-campus settings. Additionally, a normalization process was applied to this analysis based on the quantity of building footprints. This way, universities with a high number of buildings were not performing substantially better than universities with fewer buildings.

This methodology looks at the outward rings that are created based on building proximities. The values in analysis

Figure 6 | ESTIMATED SAVINGS PER SF (NEW CONSTRUCTION) VS COMPACTNESS SCORE

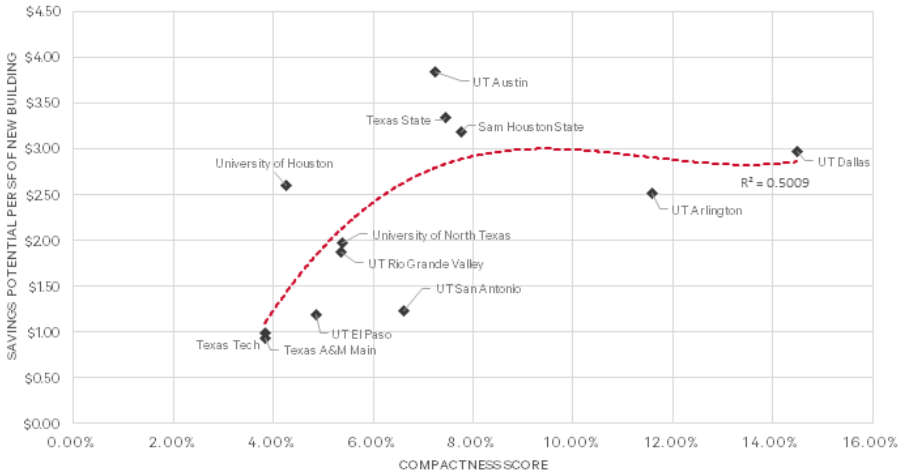
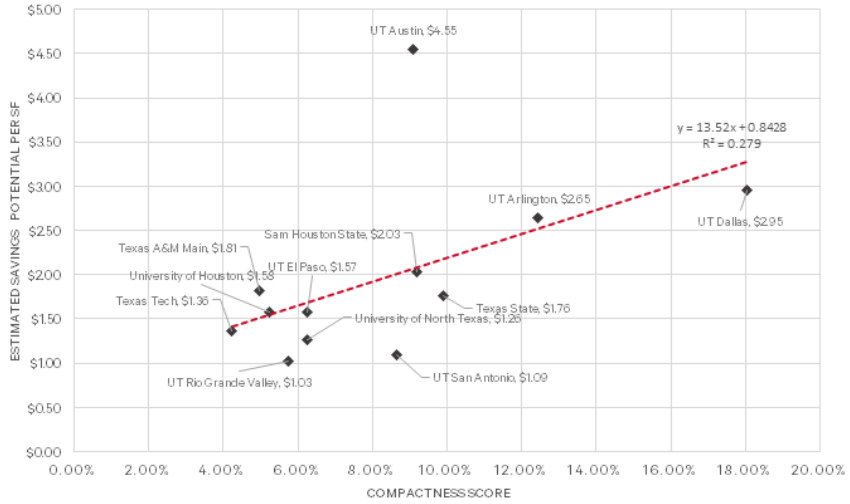



Figure 7 | ESTIMATED SAVINGS PER SF (LONG TERM) VS COMPACTNESS SCORE



increase by sections based on 30' increments up to the 300' threshold.

The ring areas are measured by campus to understand the behavior of compactness. A standard deviation measure for areas within 90' is put aside and compared with an average deviation of all rings (up to 300').

The larger the difference, the higher slope of the curve; which means a higher compactness/proximity of building fabric (figure 9). The compact building fabric is associated with higher levels of walkability and pedestrian safety.

Additional values of building compact campuses are related to their contribution to safety and CPTED (Crime Prevention Through Environmental Design) principles while diminishing car dependence; therefore, compactness is associated with a more human/pedestrian-friendly environment.

The assumption of proximity efficiency/ score contribution is based on the statistics for the 12 campuses in the study. Areas in the "compact spectrum" are considered within 90' of building facades; therefore, 2 buildings separated more than 210' won't contribute to the overall compactness score.

This study assumes new buildings will need to be 50,000sf or larger to provide a significant contribution to the compactness score. This assumption is based on new building footprint geometry to be a rectangular shape (footprint) with a façade side no smaller than 60' (typical 2-bay academic building and/or residential building).

Figure 8 | METHODOLOGY - GRAPHICS

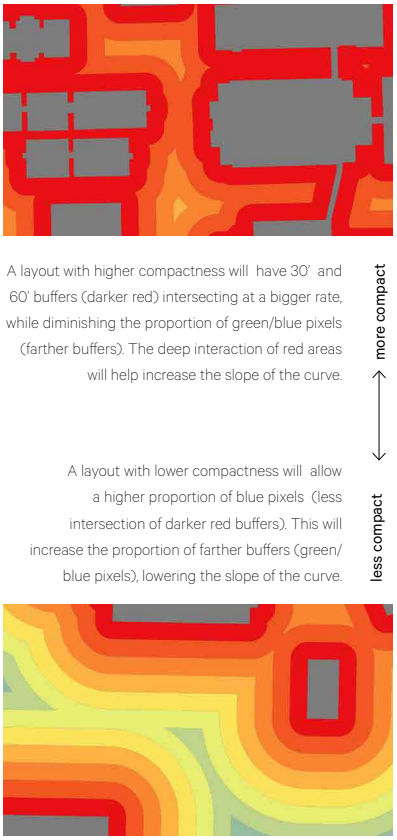
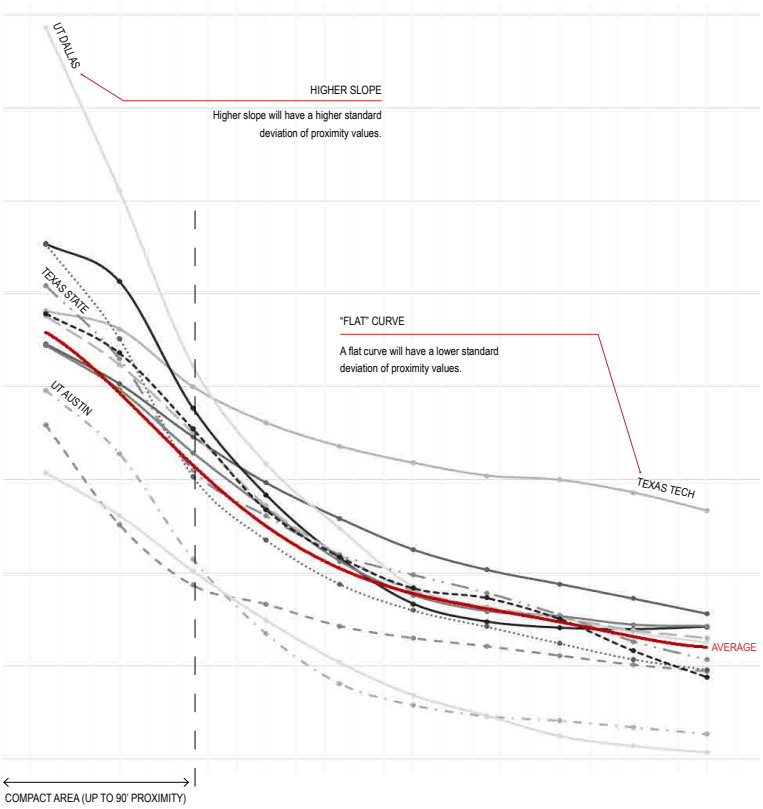



Figure 9 | METHODOLOGY - GRAPHICS



## CONCLUSIONS & NEXT STEPS FOR HIGHER EDUCATION INSTITUTIONS

This study demonstrates the potential correlation of savings and what campus master plan efforts should accomplish in the future. The purpose behind the study is to spark some creativity for repurposing and realigning some campuses that have a high degree of surface lots and road infrastructure since that is likely the principal cause for spreading buildings apart.

Intentionally, we have listed some strategies for campus master planning that would be valuable to higher education institutions:

### 1. BUILD COMPACT

A very effective way to alleviate the burden on infrastructure cost and funding for new construction in higher education institutions is through the provision of "compact campus" measures in campus master plans.

This analysis highlights the importance of compact campuses. The analysis also provides interesting findings related to the estimated density and interaction probability of students within the open spaces of each campus. The open space allocation of each campus to their proportional enrollment population brings to light the high opportunity for lower-scoring / lower-density institutions to improve their financial performance with easier and more achievable means than other campuses.

For these institutions with the high allocation of open space per student, new construction of buildings should be allocated within 50' to 150' from existing buildings. This will contribute to a healthier compactness score. Our planners recommend the introduction of guidelines for campus planning to align with projected future construction locations based on compactness.

While building compact, there will be associated savings related to the reduction of complexity and usage of water for irrigation systems, and cost reduction if physical planting in general; but also the creation of safer outdoor common spaces (per CPTED principles).

### 2. BUILD GREEN

Provide additional guidelines for a more aggressive reduction of heat-island effect and reduction of stormwater runoff.

Compact campuses will help reduce the number of surface parking areas and provide opportunities for integrating passive storm-water management systems. We recognize the financial burden of eliminating surface parking and building parking structures, but the overall long-term financial gain from eliminating surface lots has proven successful in many communities and towns.

### 3. MAINTAIN / APPLY SPACE EFFICIENCY MEASURES

Find additional inefficiencies in space utilization.

COVID 19 has helped evolved digital access to education and programs and is forcing institutions to rethink the use of the entirety of their physical plant inventory for adapted in-person instruction. This will impact directly on the way buildings are programmed in terms of space efficiency per student. Understanding that institutions already have a limited range of financial resources to work with, designing compact campuses may yield benefits both in terms of indoor spaces and outdoor spaces. While we will see a likely increase on efficiency given the increased opportunity for accessing digital education which will considerably help to reduce TCO numbers in the long-term, allocating exterior landscape and hardscape improvement dollars to more compact zones on campus will allow greater design freedom in providing students, faculty, and staff the option for outdoor events and instruction in more conducive, versatile, and less-COVID-risk environments.

### 4. MANAGE/SUPPORT SUSTAINABLE OPERATIONS

Target evolution of existing and future buildings to approximate Net Zero and/or Net Positive goals.

Retrofitting major inefficiencies is key in managing the cost of operations. Innovative funding of green technology and infrastructure could come via the private sector and/or private-public partnerships. Alternate financing mechanisms of this kind will help promote sustainable architecture. A fresh look into alternative funding for infrastructure will support the high-performing approach for institutions that want to save money while promoting an increase in green energy usage.

## 5. MAP CAMPUS POTENTIALS

Invest in mapping and projections of utility needs/site work.

The type of data analysis showcased in this study is just one example of how we can use data as a tool that could help considerably in alleviating costs of future buildings. Since an increase of compactness will put more pressure on utility routes, a comprehensive approach to utility mapping will be highly beneficial to any campus.

## ABOUT PARKHILL'S MULTIDISCIPLINARY APPROACH AND CAPABILITIES

Our Planning Studio is a group of architects, landscape architects, urban designers, and planners dedicated to providing relevant and innovative solutions to our clients. This study is an example of our analytic capabilities that translate to design ideas.

Parkhill professionals are deeply committed to sustainable practices that have an impact on our communities. Our approach to design is focused on the performance of the overall institution rather than separate portions. With further study, we could find additional strategies for the management of cost and the correlation with heat-island related areas, as well as parking/automobile use.

Parkhill is passionate about finding patterns in data. Our analytics capabilities have been extremely useful in our facility management/assessment efforts. With a deep focus on a specific campus, we could find additional patterns that contribute to space efficiency potential; therefore, helping to reduce overall costs.

Parkhill professionals are passionate about innovative technologies and thinking beyond our current crisis. We are proudly a signatory of the Architecture 2030 Challenge, which focuses our practice on designing only high-performing designs to positively contribute to the future generation of buildings.

We are passionate about our work and we use current data beyond the obvious. To successfully plan and provide infrastructure on any campus, Parkhill will take upon the task of analysis of current campus data to overlay existing infrastructure and study the feasibility and potential of compactness of any campus. Our Planning studio will look into big data to find additional patterns for additional efficiency.

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