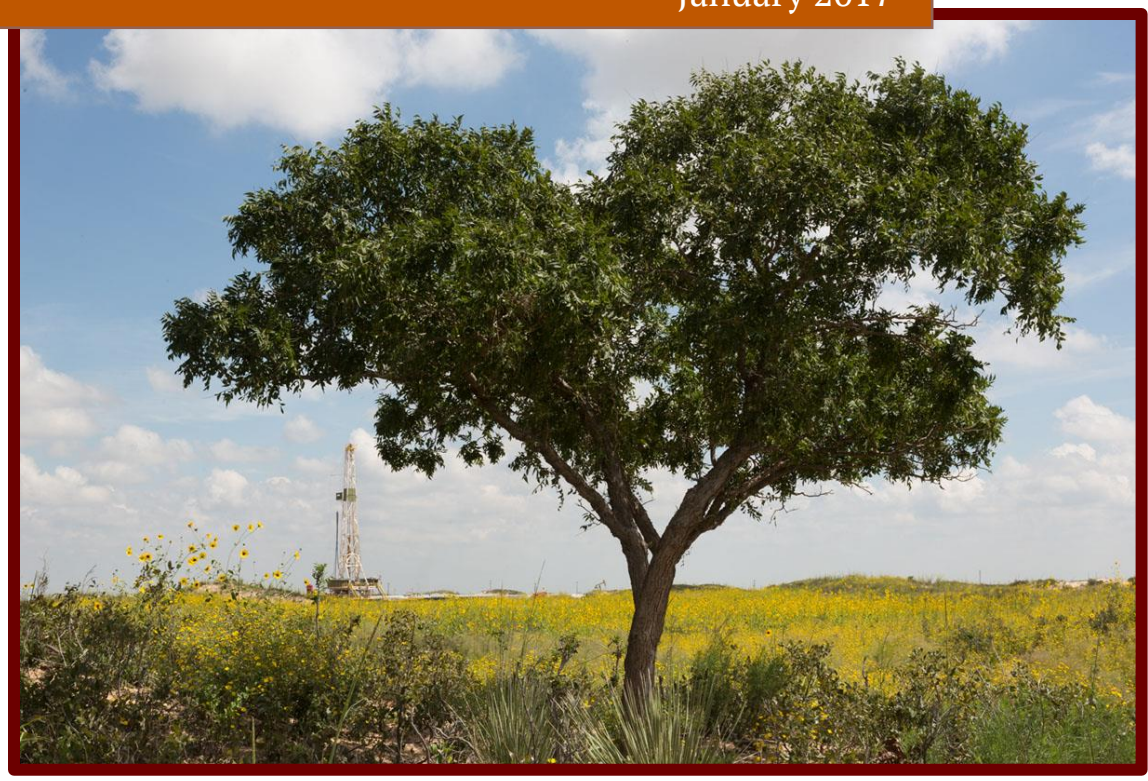
"…and Fountains of Unstinted Wealth Will Gush Forth"

An assessment of the economic benefits of University Lands and commercial activity on Permanent University Fund Lands

January 2017



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Executive Summary

- More than two million acres of west Texas land comprise an important part of the endowment of the University of Texas (UT) and Texas A&M University (TAMU) Systems. These lands **generate substantial revenue each year**, some of which goes into the Permanent University Fund (PUF) and some of which is available for spending through the Available University Fund (AUF).
    - Total revenue for PUF Lands was $856 million in fiscal year 2015 and is expected to be about **$545 million** in fiscal year 2016
    - The value of the PUF stood at **$17.5 billion** as of August 2015, ranking it the largest public university endowment in the United States.
- University Lands (UL) utilizes intensive management, accounting, conservation, and environmental programs to improve and sustain the productivity of the lands, protect the interests of the University Systems, and promote awareness and sensitivity for the environment. In essence, the role of University Lands can be boiled down to one simple phrase: **Texas lands supporting Texas education**.
- The Perryman Group estimates that **on average almost 7,400 persons (on a full-time equivalent basis) are at work on the PUF Lands every day, with a much higher number (often 20,000 or more) spending part of their days there**. Commercial activity includes oil and gas drilling and production as well as surface activity such as grazing leases.
- University Lands is in the **unique situation of controlling both the surface and minerals for millions of acres of land**, much of it in large, contiguous tracts.
    - UL has a very long-term perspective and views its role as one of preserving the land for future generations. This stewardship mindset pervades all aspects of UL operations and philosophy.
    - UL is also uniquely positioned to enhance knowledge of oil and gas reserves and water resources throughout the Permian Basin.
    - UL helps preserve Texas ranching traditions, wildlife habitat, and regional groundwater.
- The **resources provided by the PUF and AUF support and enhance the quality of higher education** in the state of Texas, benefitting students and society as a whole.
    - Students benefit from the PUF and AUF funds in numerous ways ranging from enhanced instruction and facilities to decreased upward pressure on tuition.

  - Research findings enabled by these funds improve quality of life, graduates make significant contributions, and businesses are provided with a steady stream of quality graduates.

- The **economic impact of University Lands and the PUF Lands is multifaceted**. The Perryman Group measured four major channels of economic and fiscal impact: commercial activity, university spending, health care provided, and graduates supported.
  - Over the past five years, **commercial activity** on University Lands generated an estimated average of **$3.5 billion** in gross product per year and supported about **33,600** jobs in Texas (when multiplier effects are considered). The activity also produced an average of **$175.6 million** in State tax revenue and **$78.0 million** in local tax revenues each year over the period.
    - Drilling activity accounted for about 37% of these gross product gains, with an estimated annual impact of nearly $1.3 billion in yearly gross product.
    - Oil and gas production added an estimated **$1.8 billion** in gross product and about **15,300 jobs** to the state economy.
  - When funds in the Available University Fund **are spent by universities**, they generate an estimated **$1.3 billion** in gross product each year and **87,618** jobs.
  - The health sciences and medical institutions within the UT and TAMU Systems provide millions of patient visits and other **health care,** generating an economic impact of an estimated **$12.4 billion** in gross product per year as well as **156,688** jobs.
  - **Graduates** of the UT and TAMU Systems who have benefitted from the funds provided by University Lands over time generate economic activity including an estimated **$255.3 billion** in gross product in the state each year as well as **2.0 million** jobs.

- The Perryman Group estimates that, on average from FY 2011 to FY 2016, commercial activity on PUF Lands and its spillover effects generated local tax revenues of nearly **$40 million** each year in the immediate region, with secondary effects throughout the state. School districts containing PUF Lands or those which were impacted by activity on PUF Lands benefitted the most from the tax revenue, accruing an estimated **$16 million** annually, or nearly $166 per student.

- Through both its direct and indirect benefits to public higher education, University Lands and the PUF Lands contribute significantly to the superior quality of education in the state of Texas. Through supporting the education of students, funds generated on PUF Lands also lead to a more productive workforce and benefits to society as a whole. University Lands manages the PUF Lands in a forward-looking manner designed to preserve and enhance its contributions in perpetuity.

Introduction

"Smite the earth!! Smite the rocks with the rod of knowledge and fountains of unstinted wealth will gush forth."

- ASHBEL SMITH, PRESIDENT, UNIVERSITY OF TEXAS BOARD OF REGENTS, ON THE OCCASION OF THE LAYING OF THE CORNERSTONE FOR THE UNIVERSITY OF TEXAS, NOVEMBER 17, 1882.

About 140 years ago, visionary Texas leaders began to set aside land to fund and support higher education. Now spanning more than 2.1 million acres (an area almost three times the size of Rhode Island) in 19 west Texas counties, the land is a major source of revenue for the University of Texas (UT) and Texas A&M University (TAMU) Systems.

In the early years, the land produced limited income as it was mostly used for cattle grazing leases, and revenue totaled about $40,000 in 1900.[1] However, the iconic 1923 Santa Rita #1 discovery of oil in Reagan County dramatically increased earnings.[2] Since then, billions of dollars from oil and gas leases and royalties have been earned and reinvested in the Permanent University Fund (PUF), the public endowment originally established by the Texas Constitution in 1876 after many fits and starts dating back to the earliest days of the Republic in the 1830s.

Mineral and surface rights for the 2.1 million acres comprising the Permanent University Fund Lands generate income from a variety of sources which is used to support the University of Texas and Texas A&M University Systems.

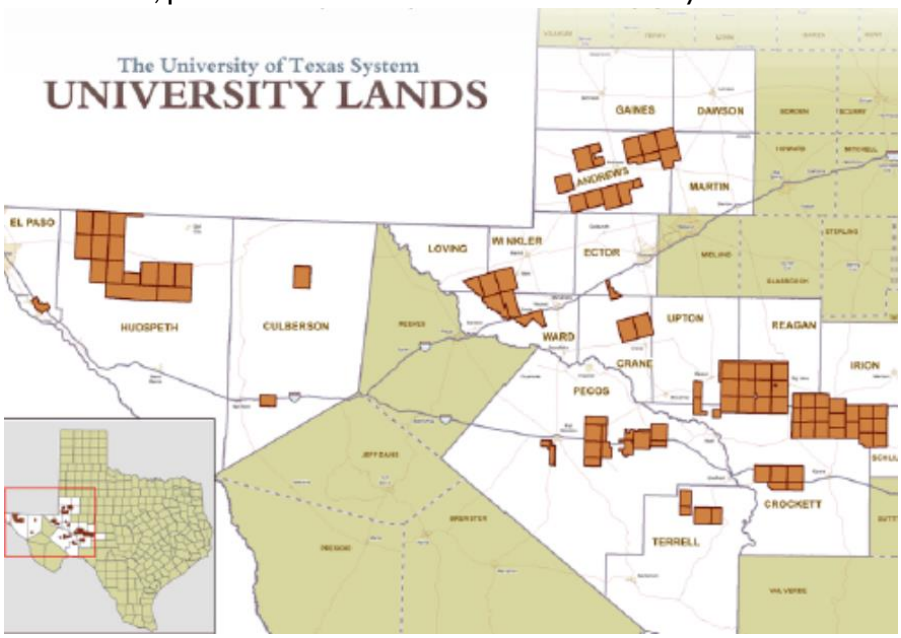
Although the initial grant of one million acres in 1876 and a subsequent one million acres from the Texas Legislature were thought to be largely barren soil, Regent Smith turned out to be remarkably prescient when, more than 40 years after his pronouncements and well beyond his death, the fountains of wealth did indeed gush forth. Moreover, the "rod of knowledge" supported by these lands has brought incalculable benefits to generations of Texans.

Mineral and surface rights for the 2.1 million acres comprising the Permanent University Fund Lands (PUF Lands) generate income from a variety of sources which is used to support the University of Texas and Texas A&M University

Systems. In addition to oil and natural gas drilling and production, surface activities include pipelines and power line easements; grazing, ranching, and hunting; wind farms; a vineyard and winery; airports; public schools; and water sales, among others.[3] The ownership by one entity of both surface and mineral rights for such a vast expanse of land creates a unique situation with a variety of benefits.

University Lands utilizes intensive management, accounting, conservation, and environmental programs to improve and sustain the productivity of the lands, protect the interests of the University Systems, and promote awareness and sensitivity for the environment.

The PUF Lands asset is managed by University Lands (UL), which includes a group of professionals with expertise in fields such as range management, land management, accounting and finance, information technology, oil and natural gas reserves, hydrology, and other pertinent areas. The stated mission of UL is "to maximize the revenue from the Permanent University Fund (PUF) Lands by applying intensive management, accounting, conservation and environmental programs which improve and sustain the productivity of the PUF Lands, protect the interests of The University of Texas System and promote awareness and sensitivity for the environment."



The Perryman Group (TPG) was recently asked to quantify the economic benefits of these lands and their importance to higher education in Texas. This report and the accompanying Appendices present the results of this analysis.

The Role of University Lands

In essence, the role of University Lands can be summarized in one simple phrase: **Texas lands supporting Texas education**. Managing the 2.1 million acres of PUF Lands is a substantial undertaking involving overseeing some 10,000 miles of pipelines, thousands of oil and gas leases covering nearly 1.6 million acres, hundreds of oil and gas companies, nearly 4,000 easements, more than 1,000 commercial leases, daily deposits and reports to the Texas Comptroller, and 14,000 regulatory and related documents uploaded (2014).

In essence, the role of University Lands can be boiled down to one simple phrase: Texas lands supporting Texas education.

Every day, The Perryman Group estimates that on average almost 7,400 persons are at work on PUF Lands when viewed on a full-time equivalent basis, with a much higher number (often 20,000 or more) spending a portion of their workdays on the PUF Lands. These oil and gas company employees, oilfield service workers, ranchers, ranch hands, retail clerks, teachers, administrators, and other personnel depend on the Lands for their livelihoods and places of work.

University Lands promotes a hands-on and proactive approach to the ecological and environmental stewardship of its resources. In order to maintain high environmental standards, University Lands manages relationships between environmental and regulatory agencies, University Lands personnel, and lessees of the land. Specifically, University Lands ensures compliance with current environmental regulations and best practices by coordinating relationships with the US Fish and Wildlife Service, the Texas Habitat Conservation Foundation, the Texas Commission on Environmental Quality, the Natural Resource Conservation Service, and the Texas Railroad Commission. Furthermore, University Lands personnel take part in the Texas Comptroller's Interagency Task Force on Economic Growth and Endangered Species and frequently involve Texas A&M's Institute of Renewable and Natural Resources in meaningful efforts.[4]

Every day, The Perryman Group estimates that on average almost 7,400 persons are at work on PUF Lands when viewed on a full-time equivalent basis, with a much higher number (often 20,000 or more) spending a portion of their workdays on the PUF Lands

Any firm seeking to do business on the PUF Lands receives documentation of policies and contact information including a field manual for oil and gas operations

(in English and Spanish), rate and damages description and schedule, notification of the process for royalty payment, groundwater management plan, information regarding UL's public website, lease forms and rules, and other relevant documents. The field manual includes specific rules on topics ranging from speed limits to rights-of-way to required reporting. It includes helpful information such as best practices and procedures as well as complete contact information. New oil and gas operators generally participate in meetings at the University Lands offices to discuss rules and expectations, build cooperative relationships, and ask and answer any questions.

University Lands supervises uses of PUF Lands by conducting frequent inspections and monitoring recommended corrective action. The staff of University Lands also closely oversees any construction performed on the Lands. Additionally, the University Lands oil-field spill policies exceed Texas' regulatory requirements, and University Lands requires that all oil spills and even produced water spills be reported. Moreover, University Lands reserves the right to perform unannounced lease inspections to evaluate environmental compliance, and more than 1,500 of these inspections have been performed since 2008.[5]

In order to gain an understanding of philosophies and practices regarding University Lands management, Dr. Ray Perryman and Virginia Johnston Gleghorn, The Perryman Group's project manager for this analysis, (1) spent multiple days in meetings and discussions with a variety of senior-level staff members at University Lands, (2) visited several locations including a site which had been remediated following the cessation of oilfield operations, (3) attended a meeting with a new lessee in which policies and practices were extensively discussed, (4) exchanged extensive correspondence wherein information was provided and questions were asked and answered, and (5) reviewed publicly available reports and data regarding University Lands and the PUF Lands, as well as in-house operational and accounting materials. Without exception, the University Lands staff exhibited a willingness and ability to answer any and all inquiries, as well as a culture that reflects the highest professional standards.

University Lands is in the unique position of controlling both the surface and minerals for millions of acres of land, much of it in large, contiguous tracts.

Protection of PUF Lands

University Lands is in the **unique position of controlling both the surface and minerals for millions of acres of land**, much of it in large, contiguous tracts. Moreover, University Lands has a very long-term perspective and views its role as

one of preserving the land for future generations. This stewardship mindset pervades all aspects of University Lands.

Because of the scope of the PUF Lands, oil and gas companies have an incentive to be extremely responsive to requests and conditions of University Lands given the high likelihood that they will seek to lease other PUF Lands acreage in the future. Unlike most individual landowners, University Lands personnel deal with issues such as oil and gas leases and related topics on a daily basis and are experts in key areas. Protection of the land includes innovative and specific policies, such as rules for remediation of surface damage which provide for seed mixtures optimized by county and precise instructions for planting them. Many of these policies have become a widely accepted standard in the Permian Basin region, with other landowners asking for similar treatment and crafting leases with similar terms.

With University Lands personnel regularly inspecting the land, problems can be identified and solved in a timely manner. Sophisticated interactive geospatial information systems allow field staff to precisely map locations, document issues, and identify easements. The result is a level of oversight difficult for individual landowners to replicate.

Oversight of University Lands

The UT System Board of Regents oversees University Lands. The University Lands Advisory Board, which was created in 2014, provides strategic direction regarding operations and management. The Advisory Board includes UT and TAMU regents as well as oil and gas industry experts.

In February 2015, the UT System Board of Regents authorized the hiring of the first chief executive officer of University Lands, Mark A. Houser, a highly experienced executive with oil and gas corporations. The restructuring was due in part to the rapid increase in oil and gas activity on the PUF Lands as technological advances allowed for recovery from additional reservoirs. It became apparent that an expert in oil and gas was needed to help ensure optimal management of the PUF Lands, focusing on the life of the asset (reserves) and determining oil and gas levels accordingly. Other initiatives and business activities are also part of the change in strategy, with a goal of enhancing long-term revenues and reducing commodity price-based swings. New potential initiatives, such as solar power generation, are under consideration and development to further increase the long-term contribution of the Lands.

The position of University Lands within the overall structure of the UT System allows for management of the PUF Lands in accordance with the priorities of the UT and TAMU Systems with added expertise from industry experts. Through this process, the long-term value of the PUF Lands asset can be maximized.

Enhancement of Knowledge of Oil and Gas Reserves and Water Resources

University Lands is uniquely positioned to enhance knowledge of oil and gas reserves and water resources throughout the Permian Basin. As landowner for millions of acres, University Lands has full access to well logs, core samples, and other drilling information as well as detailed production data and is in the process of compiling an extensive library of such material. Seismic surveys covering hundreds of square miles are also available. Typically, this information is closely controlled by the companies involved, as it is proprietary and can contain trade secrets and other details which may be valuable in a highly competitive market segment. With firms operating independently, it is possible that inefficiencies could arise, but because University Lands has knowledge from all operators on its lands, developments can be better planned and scheduled to optimize outcomes.

The accumulation of a large and complete set of information by UL allows for better understanding of the Permian Basin region, and experts in relevant geosciences have been hired by University Lands to analyze the available data while maintaining confidentiality. A very experienced team of professionals in University Lands' Houston office are analyzing current and potential plays from a Permian-wide perspective. In this way, University Lands can better understand and optimally produce its oil and gas reserves. In addition, this holistic approach can improve productivity throughout the Permian Basin. In addition, this deep understanding of the reserves and their recovery can inform decisions by University Lands regarding potential operators by allowing for comparisons of results obtained by various firms.

University Lands' public website includes a large amount of information provided by operators. The website is updated daily, with a six-month delay on the release of certain information to protect individual company confidentiality and intellectual property. Recent data indicate the website receives about 57,000 page views per month.

Water resources are also documented. A groundwater database allows for searches of water wells, and logs provide information regarding aquifers. Hydrological studies and 3-D hydrologic modeling allow for more efficient use of water resources for long-term sustainability.

Preservation of Texas Ranching Traditions

Many of the people with grazing leases have been on PUF Lands for many years and, in some cases, for generations. These families embody the spirit of Texas ranching and preserve these traditions. High fencing for game management is prohibited, as are exotic animals. The result is traditional ranching in the richest historical sense, including a deep love of the land.

University Lands shares costs for certain types of improvements, helping ensure long-term sustainability. University Lands also employs several range conservationists who work with ranchers to protect the land.

Preservation of Wildlife Habitat

The PUF Lands are home to numerous species of wildlife, including blue and bob white quail and many other birds, mule and white tail deer, various reptiles and amphibians, bighorn antelope, raptors, mountain lions, coyotes, javelina, bobcats, red and gray foxes, cottontails, and jackrabbits. These animals are free to roam large expanses of open land, virtually none of which will ever be developed. In some cases, such as the dunes sagebrush lizard, University Lands has worked closely with other stakeholders to craft plans to preserve habitats for specific species.

Management of Water Resources

Groundwater is essential to all activity on and near PUF Lands, and the management of this invaluable resource is a high priority. In January 2013, University Lands implemented its Groundwater Management Plan to help manage groundwater withdrawal in a way that assures continued availability and prudent usage.[6]

The Plan also provides policies and guidelines for conducting technical research; drilling wells; and producing, protecting, and conserving groundwater; as well as increasing the transparency of operations through public information.[7] Operators must follow the Plan's guidelines and are required to self-report "cumulative water volumes produced from all operator-owned and/or operated water wells" on University Lands on a monthly basis, irrespective of whether the wells are active.[8]

University Lands examines several factors in order to manage groundwater withdrawals effectively.[9] Among these considerations are the "economic impact of conservation measures," "the degree and effect of groundwater mining," and "the hydrological characteristics of the aquifers within the lands."[10] While University

Lands believes that it is best equipped to manage the groundwater on its property, its policies coincide with those of Groundwater Conservation Districts, Groundwater Management Areas, and Regional Water Planning Groups; several of these entities are located on PUF Lands.[11]

University Lands not only secures water reserves for its own operations, but also enters into contracts to provide water for many other uses.[12] For example, University Lands provides water contracts for municipalities, non-University wells, highway construction, and industrial purposes.[13] Municipalities are the biggest consumers of University Lands' water supply, using an estimated 28 million gallons of water per day in 2012.[14]

Drilling and fracking oil wells also require substantial quantities of water. University Lands encourages the use of alternatives, such as water from deeper aquifers which are typically untapped or lower quality water (such as having a higher saline content).

To put water use in perspective, Texas Water Development Board (TWDB) data indicate that Texas used 4.7 trillion gallons of water in 2013.[15] In comparison, the water used by wells on PUF Lands between 2012 and 2014 amounts to only 0.1% of what the state uses in a single year.[16] While water use information is not available for 2014, the past three years for which data are available reveals that Texas used approximately 15.8 trillion gallons of water.[17] From February 2012 to December 2014, University Lands used about six billion gallons of water in its operations.[18] Stated differently, the water used by University Lands during this period is approximately equal to only 0.03% of that used in the entire state over an equivalent three-year time span.[19] Furthermore, from 2011 to 2013, the total water usage among all industries for counties that are home to University Lands' wells was more than 857 billion gallons.[20] This information translates into University Lands' wells being responsible for approximately 0.7% of all water usage in these counties despite extensive oil and gas and grazing operations.[21]

Commercial Activity on PUF Lands

As noted, commercial activity includes oil and gas drilling and production as well as surface activity. During FY 2016, deposits to the PUF and AUF from commercial activity on PUF Lands totaled **$557.2 million**.

Oil and Natural Gas Drilling and Production

Since 1923, when oil was first discovered on University Lands, oil and gas development has been a key source of income for the PUF, as University Lands leases the land for mineral development and receives a royalty off any production. Of the approximately 2.1 million acres, nearly 1.6 million were under lease for oil and gas development in 2014.

More than 25,000 wells have been drilled on University Lands to date, with approximately 6,000 completed in the past decade.[22] According to the University Lands' Well Library, of these wells, at least 9,943 are currently producing oil and gas.[23] In fiscal year 2015, there were 494 wells drilled, 298 of which were horizontal.[24] A total of more than 1,500 horizontal wells have been drilled to date.[25] In 2015, gross daily production was approximately 220,000 barrels per day.[26]

Drilling and related activity generates royalty payments not only for oil and natural gas, but also for water and brine. Payments are received for lease sales and rentals, sale of mineral deposits, and damage income (payments for making changes to University Lands). During FY 2016, nearly $462.1 million in oil and gas royalties were received; in FY 2015, these royalties totaled more than $759.9 million. In addition, $21.3 million in oil and gas lease sales were received. In total, oil and gas drilling and related activity on PUF Lands generated $806.7 million in FY 2015 and $512.3 million in FY 2016.

Recent reserve reports indicate that total proved reserves of oil on PUF Lands are likely to trend upward for several years before beginning to decline. The most speculative estimate (possible reserves) indicates a pattern of increasing reserves and activity completions throughout the 20-year time horizon.

However, technological advances have the potential to increase recoverable amounts and alter drilling patterns. For example, a 2009 reserve report projected

that proved reserves as of year-end 2016 would be less than half of what the most recent reserve report estimates them to actually be.

Surface Activity

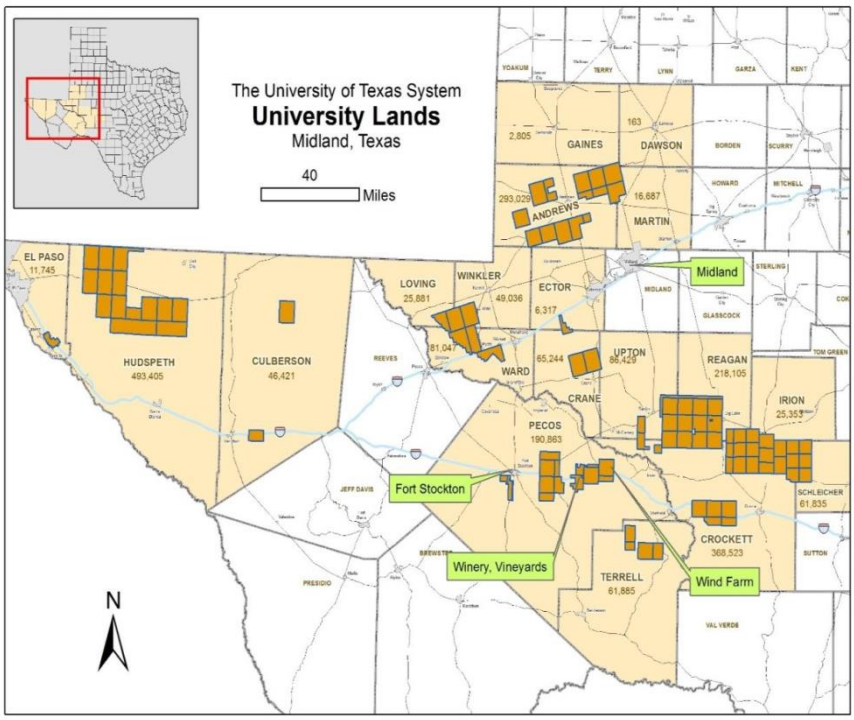
The land serves many purposes aside from the production of oil and gas, and significant revenue from surface activity flows to the Available University Fund (AUF). University Lands earned over $49.6 million from grazing leases, land easements, and other activity in FY 2015 and nearly $44.9 million in FY 2016. The University Lands Surface Group is responsible for monitoring surface activity and ensuring compliance with State and federal regulations.[27]

Wind Farms

Since the western Texas plains are ideal for wind farming, University Lands has dedicated a portion of PUF Lands to the supply of clean energy to thousands of Texans, while also providing funding for the University Systems.[28] University Lands has long been committed to increasing the use of renewable energy and has had two operational wind farms since 2001.[29] The two winds farms, Indian Mesa and Woodward Mountain Wind energy centers, are both primarily located in Pecos county and are operated by Next Era Energy resources.[30] The Indian Mesa Center is a 82.5-megawatt wind generation plant with 126 660-kilowatt turbines, and Woodward Mountain Wind Energy Center is a 160-megawatt wind generation plant with 242 600-kilowatt turbines. Together, they are capable of generating enough power to supply more than 93,000 homes.[31]

Vineyard and Winery

Tapping into the land's resources, University Lands developed an "experimental vineyard for wine grape research" in 1974.[32] By the early 1980s, the Ste Genevieve vineyard, along with a multi-million dollar winery, had been founded on approximately 1,000 acres.[33] It is now leased and is currently the largest winery in Texas and one of the largest grape producers in the state.[34]



Grazing, Hunting, and Recreational Leases

From the beginning, PUF Land has been leased out to ranchers for grazing leases. In the 1970s, University Lands developed a long-term grazing lease policy "designed … to help foster sustainable rangeland production" in which the leaseholder signs a 10-year contract for grazing rights as well as "hunting and recreational rights."[35] Leaseholders pay grazing fees based on livestock numbers and "the average market value obtained from the preceding year from July through October for 400 to 500 pound steers and 60 to 70 pound feeder lambs."[36] While the leaseholders are responsible for infrastructure improvements, University Lands has shared the cost of many improvements using money from "surface damages obtained from energy development."[37] In total, there are over 110 grazing leases that cover parts of 17 Texas counties. University Lands earned more than $4.5 million in FY 2016 from grazing lease payments.

Economic Impact of Activity on PUF Lands

The economic impact of University Lands and the PUF Lands is multifaceted. The Perryman Group measured **four major channels of economic and fiscal impact**: commercial activity, university spending, health care provided, and graduates supported.

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All of these economic effects, in turn, generate increased **tax receipts** to the State and to local government taxing entities such as cities, counties, and school districts. Business activity leads to tax revenue in a variety of ways including retail sales and franchise taxes. In addition, property values are enhanced, thus leading to incremental property tax collections.

In this section, summary results of The Perryman Group's analysis of the economic benefits of these four aspects of activity on PUF Lands are presented. Appendices 2 and 3 provide additional detail, including effects by major industrial group.

Commercial activity on PUF Lands leads to increases in business activity in communities across West Texas and, in fact, the entire state. When multiplier effects are considered, benefits are even more substantial and occur across all major industry segments.

Summary of Commercial Activity on PUF Lands	
Oil and Natural Gas Drilling	More than 1,000 wells in 2014
Oil and Natural Gas Production	About 4 million barrels per month
Grazing and Other Agriculture	More than 100 leases
Hotels	Two hotels
Winery	Winery and vineyard
Wind Farms	Two farms
Retail Establishments	Several stores and restaurants
Schools	Public schools in Tornillo and Fabens
In addition to these commercial activities, other municipal and other public sites which involve little employment on an ongoing basis are present on PUF Lands including all or portions of small airports, recreational sites, and similar locations.	

It should be noted that other benefits, such as those associated with pipelines, tank farms, and water resources, are fully captured as indirect or spinoff impacts from the major sources of activity.

The second major area of economic impact is **university spending** of money generated on PUF Lands. Revenue from surface leases and certain other categories flows immediately to the Available University Fund and is dispersed for spending by the universities. The PUF is also used to underwrite debt for construction projects and decreases the cost of borrowing. University operations and construction generate a substantial economic stimulus. A third and related area is the health care received through the medical schools and academic health centers within the UT and TAMU Systems.

The fourth major area of economic benefits from University Lands and the PUF Lands is in the support provided to the University Systems as they fulfill their role in providing higher education. The **graduates** of universities and health science institutions within the UT and TAMU Systems contribute substantially to the economy of the state through increased productivity as well as providing enormous benefits to society. While it would be improper to assume that the entire benefit of these graduates is due to the PUF Lands or endowment, there is no doubt that the AUF and PUF enhance the quality of education available in Texas while helping keep tuition lower than it would be otherwise, thereby increasing access and graduates both in terms of numbers and capabilities.

Measuring Economic and Fiscal Impacts

Any economic stimulus, whether positive or negative, generates multiplier effects throughout the economy. In this instance, the various types of commercial activity occurring on PUF Lands lead to multiple rounds of additional economic activity through channels such as the purchase of necessary input goods and services and the spending of wages and salaries. In addition, when universities spend funds generated by the PUF Lands, economic and fiscal benefits arise. Enhanced productivity from graduates supported by the PUF Lands further increase these positive effects.

The Perryman Group first quantified the direct stimulus by type of activity. The associated multiplier effects were measured using The Perryman Group's input-output assessment model (the US Multi-Regional Impact Assessment System, which is described in further detail in the Appendices to this report) developed by the firm about 35 years ago and consistently maintained and updated since that time. The model has been used in hundreds of analyses for clients ranging from major corporations to government agencies. It uses a variety of data (from surveys, industry information, and other sources) to describe the various goods and services (known as resources or inputs) required to produce another good/service. This process allows for estimation of the total economic impact (including multiplier effects) of the increase in business activity related to and supported by University Lands and activity on PUF Lands. The submodels used in the current analysis reflect the specific industrial composition and characteristics of each of the various geographic areas analyzed, fully accounting for spillover effects across areas as well as leakages into out-of-state spending and other diversions.

Results were calculated for counties, the region, and relevant legislative districts. Spillover to nearby metropolitan areas was also estimated. Effects are measured by place of work (rather than place of residence). Results for Loving County show an employment impact larger than the current population of the county, because at the height of the drilling boom there were more people working in the county than living there. Not all counties had all types of activity. For example, there was no oil and gas production in Culberson, Dawson, El Paso, or Hudspeth Counties. Because the level of activity remains fairly consistent over time, The Perryman Group quantified only the current economic benefits of commercial leases.

These total economic effects are quantified for key measures of business activity:

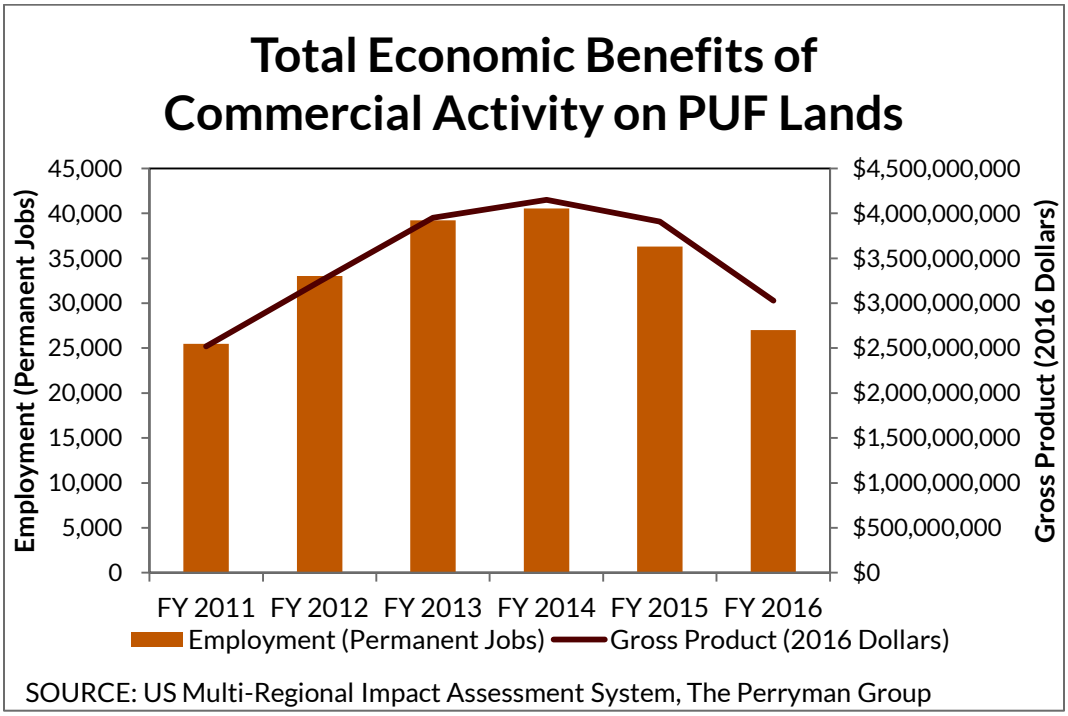
- **Total expenditures** (or total spending) measures the dollars changing hands as a result of the economic stimulus.
- **Gross product** (or output) is production of goods and services that will come about in each area as a result of the activity. This measure is parallel to the gross domestic product numbers commonly reported by various media outlets and is a subset of total expenditures.
- **Personal income** is dollars that end up in the hands of people in the area; the vast majority of this aggregate derives from the earnings of employees, but payments such as interest and rents are also included.
- **Retail sales** is retail spending including restaurants.
- **Job gains** are expressed as permanent jobs for ongoing effects and person-years for cumulative effects.

Increases in economic activity generate additional **fiscal revenues** such as retail sales taxes, income tax, property tax, and other levies. The Perryman Group has developed a model linking increases in economic activity to incremental taxes; in this case, the fiscal benefits were measured for both the State and local government entities.

Monetary values were quantified on a constant (2016) basis to eliminate the effects of inflation. See the remainder of this report, notes to various tables, and Appendix 1 to this report for additional information regarding the methods and assumptions used in this analysis.

Commercial Activity on PUF Lands

The Perryman Group quantified economic benefits associated with oil and natural gas drilling, oil and natural gas production, and commercial leases of various types including grazing, retail, winery and other types of activity over the past five years (FY 2011 through FY 2016). The **total economic benefits of commercial activity** on PUF lands ranged from **$2.5 billion** to **$4.1 billion** in annual gross product and approximately **25,500** to **40,500** jobs.



SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group

Over the past five years (FY 2011-2016), commercial activity on PUF Lands resulted in estimated **total average annual benefits** to the Texas economy from drilling, production, and surface leases of nearly **$3.5 billion** in gross product each year as well as **33,600 jobs**. The activity also produced an average of **$174.9 million** in State tax revenue and **$77.6 million** in local tax revenues each year over the period.

- The average annual benefits of **drilling** activity on PUF lands (over the FY 2011 to FY 2016 time frame) include nearly **$1.3 billion** in gross product per year and **15,039 jobs** in the state as well as **$68.9 million** in State tax revenue and **$32.9 million** in local tax revenues each year.

- The Perryman Group estimates that, on average from FY 2011 to FY 2016, oil and gas **production** activity had an annual impact of over **$1.8 billion** in gross product gains and added about **15,300 jobs** to the state economy. The activity also produced an average of **$89.9 million** in State tax revenue and **$37.4 million** in local tax revenues each year.
- **Surface lease** activity (grazing leases, windfarms, vineyard, schools, hotels, and restaurants) had an annual impact of almost **$0.3 billion** in gross product and added about **3,269 jobs** to the state economy. The activity also produced approximately **$16.1 million** in State tax revenue and **$7.4 million** in local tax revenues each year.

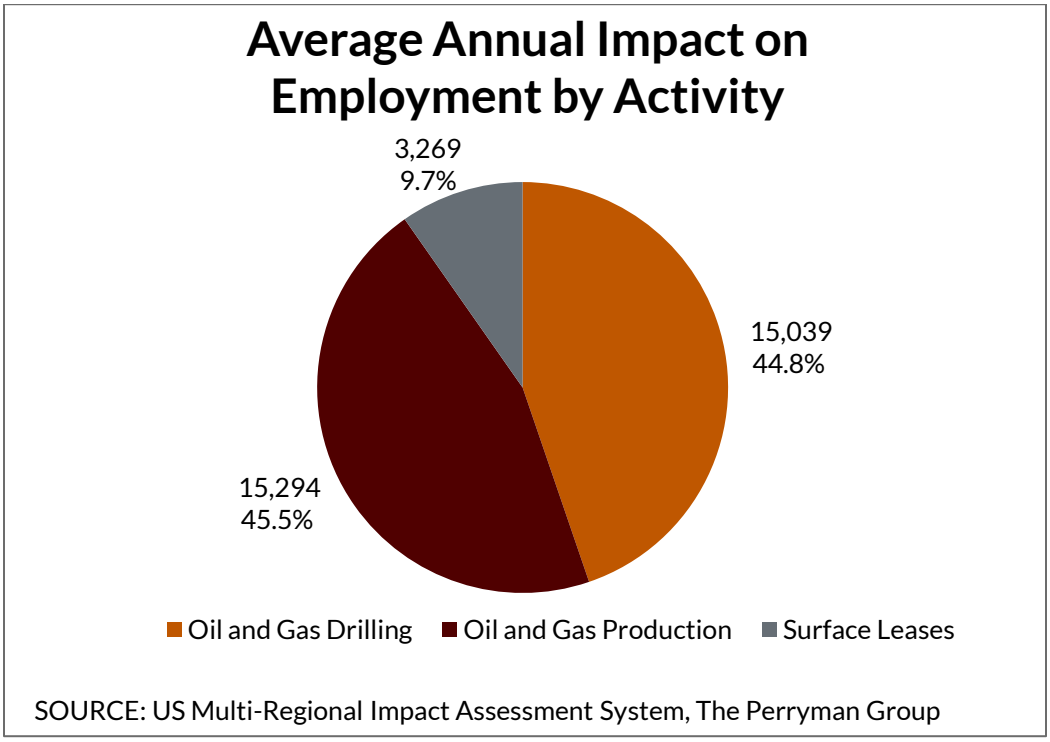
The Average Annual Economic and Fiscal Impact of Commercial Activity on PUF Lands on the State of Texas: FY 2011-2016
(In Billions of 2016 Dollars)

	Drilling	Production	Surface Leases	TOTAL
Total Expenditures	$2.843	$5.539	$0.895	**$9.276**
Gross Product	$1.288	$1.882	$0.297	**$3.467**
Personal Income	$0.872	$1.033	$0.183	**$2.088**
Retail Sales (including Restaurants)	$0.328	$0.404	$0.075	**$0.807**
Employment (Permanent Jobs)	15,039	15,294	3,269	**33,602**
State Tax Revenue	$0.067	$0.090	$0.016	**$0.175**
Local Tax Revenues	$0.033	$0.037	$0.007	**$0.078**

NOTE: Columns may not sum to totals due to rounding.
SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group

Multiplier effects are particularly high for oil- and gas-related activity on PUF Lands because activity such as tank farms, pipelines, and much of water management support the oil and gas industry and are thus captured as secondary effects in the analysis. In fact, The Perryman Group estimates that the multiplier for oil and gas production is 8.766, compared to 5.739 for grazing, 3.817 for the winery, and 2.118 for a public school. The vast majority of economic benefits stem

from oil and gas activities (nearly 90% from drilling and production) as noted in the chart below.



SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group

Results for Counties

The Perryman Group also quantified these effects for each county containing PUF Lands. The results for each county and the regional total are shown in the table below; results by county for oil and gas drilling, production, and surface leases are included in Appendices 2 and 3.

The Average Annual Economic Impact of Total Commercial Activity on PUF Lands by County, FY 2011-2016 (In Millions of 2016 Dollars)					
County	**Total Expenditures**	**Gross Product**	**Personal Income**	**Retail Sales (including Restaurants)**	**Employment**
Andrews	$2,085.911	$776.186	$479.581	$186.788	7,524
Crane	$435.807	$143.633	$83.987	$30.268	1,204
Crockett	$961.254	$347.882	$219.203	$102.298	3,696
Culberson	$11.911	$3.372	$2.205	$1.033	40
Dawson	$0.576	$0.268	$0.186	$0.077	3
Ector	$89.625	$32.143	$19.300	$8.049	301
El Paso	$77.573	$37.520	$24.585	$14.399	522
Gaines	$9.258	$4.102	$2.755	$1.050	46
Hudspeth	$15.580	$4.148	$2.645	$1.287	50
Irion	$366.303	$120.848	$68.769	$26.718	1,027
Loving	$78.406	$21.828	$12.726	$3.323	160
Martin	$289.954	$104.941	$64.654	$25.271	1,008
Pecos	$622.414	$195.572	$109.652	$49.748	1,699
Reagan	$763.771	$276.716	$173.539	$73.137	2,799
Schleicher	$68.288	$24.613	$16.167	$5.367	265
Terrell	$40.503	$12.687	$7.830	$3.036	126
Upton	$258.460	$92.414	$56.993	$21.341	892
Ward	$296.791	$101.982	$59.678	$28.927	947
Winkler	$155.476	$52.549	$31.109	$13.007	470
Regional Total	**$6,627.861**	**$2,353.405**	**$1,435.565**	**$595.126**	**22,779**
SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group					

The following table segments the total employment benefits by county into drilling, production, and surface lease effects to illustrate the relative magnitude of each of these aspects of economic impacts.

The Average Annual Impact of Drilling Activity, Production, and Surface Lease Activity on PUF Lands on Employment in Relevant Counties: FY 2011-2016				
COUNTY	DRILLING ACTIVITY	PRODUCTION	SURFACE LEASES	**TOTAL**
Andrews	4,043	3,321	160	**7,524**
Crane	415	774	16	**1,204**
Crockett	2,009	1,226	462	**3,696**
Culberson	0	0	40	**40**
Dawson	3	0	0	**3**
Ector	104	188	8	**301**
El Paso	0	0	522	**522**
Gaines	31	1	14	**46**
Hudspeth	3	0	50	**50**
Irion	376	609	42	**1,027**
Loving	83	75	2	**160**
Martin	519	461	28	**1,008**
Pecos	87	1,116	496	**1,699**
Reagan	1,687	864	247	**2,799**
Schleicher	155	43	67	**265**
Terrell	7	46	73	**126**
Upton	482	325	85	**892**
Ward	288	589	70	**947**
Winkler	168	299	4	**470**
Regional Total	**10,460**	**9,937**	**2,385**	**22,779**
SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group				

As noted previously, substantial additional surface activity is provided in support of the oil and gas sector and, thus, reflected in the assessments of drilling and production activity.

University Lands Operations

In addition to the economic benefits of commercial activity on PUF Lands, as with any business, University Lands generates economic benefits through the operations of its offices. The Perryman Group estimated the magnitude of these effects based on employment in the Midland office and elsewhere in the state. Results are presented for the Midland MSA and Texas (including effects within the Midland MSA and spillover to other parts of the state) in the table below, with additional detail in Appendix 4B.

The Annual Economic Impact of University Lands Office Operations on the Economy of the Midland MSA and Texas
(In Millions of 2016 Dollars)

	Midland MSA	Texas
Total Expenditures	$14.762	$26.525
Gross Product	$8.674	$14.399
Personal Income	$6.193	$9.948
Retail Sales (including Restaurants)	$2.316	$3.678
Employment (Permanent Jobs)	98	160
State Tax Revenue	$0.444	$0.722
Local Tax Revenues	$0.214	$0.347

SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group

Spillover Effects on Nearby MSAs

Production and other activity on PUF Lands also leads to significant spillover benefits for nearby MSAs (Midland, Odessa, and San Angelo) which are home to a variety of businesses which support the energy sector and its employees (particularly Odessa, which has a high concentration of firms supporting the energy sector). These spillover effects are shown in the table below, with additional detail in Appendix 4C.

The Average Annual Economic Impact of "Spillover" Effects from Oil and Gas Production on University Lands on the Economy of Nearby Metropolitan Areas, FY 2011-2016
(In Millions of 2016 Dollars)

MSA*	Total Expenditures	Gross Product	Personal Income	Retail Sales (including Restaurants)	Employment
Midland	$79.448	$38.227	$23.146	$8.532	392
Odessa	$746.974	$282.191	$167.731	$81.327	2,936
San Angelo	$389.175	$171.089	$97.186	$27.819	1,675

*MSA is Metropolitan Statistical Area.
SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group

Grand Total Economic Impact for Activity on PUF Lands or Relating to University Lands

Summing the different quantified impacts from activity on or relating to PUF Lands (drilling, production, surface lease activity, University Lands office operations, and spillover to nearby areas) yields a grand total estimate of the benefits of University Lands and activity on PUF Lands for the Texas and regional economies. The grand total economic impact of these activities is shown in the table below.

The Average Annual Grand Total Economic Impact of Activity on and Related to University Lands, FY 2011-2016
(In Billions of 2016 Dollars)

	Regional Economy	Texas Economy
Total Expenditures	**$7.858**	**$9.303**
Gross Product	**$2.854**	**$3.481**
Personal Income	**$1.730**	**$2.098**
Retail Sales (including Restaurants)	**$0.715**	**$0.810**
Employment (Permanent Jobs)	**27,879**	**33,762**
State Tax Revenue	**$0.151**	**$0.176**
Local Tax Revenues	**$0.066**	**$0.078**

SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group

University Spending Effects

In addition to the substantial benefits to the economies of the surrounding area and to the state of Texas as a whole, revenues attributable to PUF Lands are a major source of Texas' funding for public higher education. The financial support provided to UT and TAMU System universities positions Texas above numerous other states on the basis of per-student funding. Furthermore, these funds indirectly benefit other public universities by permitting a larger portion of State funding to become available to universities outside of the UT and TAMU systems. Through these benefits to public higher education, University Lands and the PUF Lands contribute significantly to the superior quality of education in the state of Texas.

When revenues generated on PUF Lands flow to the Available University Fund and are spent by the University of Texas and Texas A&M University Systems, additional economic benefits are realized.

The Perryman Group analyzed financial reports from the University of Texas and Texas A&M University Systems describing the allocation of funds from the AUF as well as debt service for bonds which are supported by assets within the PUF. A representative illustration of economic benefits for Texas was developed based on typical patterns. Results are not based on specific campuses, initiatives, buildings, or other actions; instead, they reflect an approximation of the economic impact of this spending in the aggregate.

The Perryman Group estimates that as AUF funds are spent, they generate almost **$1.3 billion in gross product** and **87,618 jobs each year**.

The Average Annual Economic Impact of the Funds Provided by University Lands on the Economy of Texas, FY 2012-2016
(In Billions of 2016 Dollars)

Total Expenditures	**$2.496**
Gross Product	**$1.265**
Personal Income	**$0.870**
Retail Sales (including Restaurants)	**$0.334**
Employment (Person-Years)	**17,524**
State Tax Revenue	**$0.065**
Local Tax Revenues	**$0.035**

SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group

The cumulative effects since oil and gas development began in 1923 were also quantified. Over this period, approximately $12.7 billion has been deposited into the AUF from PUF Lands revenues (the equivalent of $20.7 billion in constant (2016) dollars). These funds have resulted in **$35.7 billion in gross product**, supported **almost 500,000 person-years of employment**, and generated **dynamic fiscal revenues of about $1.8 billion to the State government and almost $1.0 billion to local taxing authorities throughout Texas.**

The Cumulative Economic Impact of Funds Provided by PUF Lands on the Economy of Texas, FY 1923-2016 (In Billions of 2016 Dollars)	
Total Expenditures	**$70.481**
Gross Product	**$35.710**
Personal Income	**$24.577**
Retail Sales (including Restaurants)	**$9.420**
Employment (Person-Years)	**494,829**
State Tax Revenue	**$1.847**
Local Tax Revenues	**$0.995**
SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group	

Health Care Provided by University Health Facilities

The health sciences and medical institutions within the UT and TAMU Systems are an important aspect of the state's health care provision. With millions of patient visits and cutting-edge treatment options, these medical facilities improve the lives and wellbeing of Texans across the state. (Additional specifics regarding enrollment and patient care by institution are provided in a subsequent section.)

The Perryman Group estimates that the economic impact of this care totals approximately **$12.4 billion** in gross product per year as well as **156,688** jobs across the state (including multiplier effects), with fiscal benefits of **$613 million** to the State and **$277 million** to local governments. A significant percentage of this care is uncompensated, providing much-needed treatment to low-income Texans.

The Annual Economic Impact of Health Care Provided by UT and TAMU System Medical Institutions on the Economy of Texas (In Billions of 2016 Dollars)	
Total Expenditures	**$24.402**
Gross Product	**$12.399**
Personal Income	**$8.529**
Retail Sales (including Restaurants)	**$3.248**
Employment (Permanent Jobs)	**156,688**
State Tax Revenue	**$0.613**
Local Tax Revenues	**$0.277**
SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group	

Graduates

Through supporting the education of students, funds generated on PUF Lands also lead to a more productive workforce. Moreover, **graduates** who benefit from these funds lead to substantial additional economic gains.

The Perryman Group analyzed the impact on the Texas economy produced by students who have graduated from the University of Texas and Texas A&M University Systems and who benefitted from funds generated on PUF Lands.

The Perryman Group estimates that graduates presently working in Texas generate nearly **$255.3 billion in gross product** and **more than 2.0 million jobs annually**. This effect represents approximately one of every six jobs currently held in the state. While it would not be appropriate to attribute all of this activity to University Lands and activity on PUF Lands, the revenues provided by managing and operating these resources contribute notably to the affordability and access of

these institutions for students, as well as the quality of supported educational programs and research initiatives.

The Annual Impact of Graduates of the University of Texas and Texas A&M Systems Who Benefit from the Funds Provided by University Lands on the Economy of Texas (In Billions of 2016 Dollars)	
Total Expenditures	**$527.750**
Gross Product	**$255.297**
Personal Income	**$163.963**
Retail Sales (including Restaurants)	**$62.928**
Employment (Millions of Jobs)	**2.026**
State Tax Revenue	**$12.908**
Local Tax Revenues	**$5.162**
SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group	

State and Local Fiscal Benefits of Activity on PUF Lands

Any economic activity also generates tax receipts. The Perryman Group estimated the average annual fiscal revenue accrued by relevant local taxing authorities from property, sales, and other taxes associated with activity on PUF Lands over the six most recent fiscal years (FY 2011 through FY 2016). To put these revenues in perspective, The Perryman Group also analyzed the yearly tax revenue on a per-capita basis.

The Perryman Group estimates that, on average from FY 2011 to FY 2016, commercial activity on PUF Lands and its spillover effects generated local tax revenues of some **$39.9 million** each year. School districts benefitted the most from the tax revenue, accruing nearly **$16.3 million** annually, or nearly **$166** in revenue per student.

The Estimated Average Annual Fiscal Revenue Accruing to Local Taxing Authorities Arising From Activity Associated with PUF Lands: FY 2011-2016 (In 2016 Dollars)

Taxing Authority	Tax Revenue per Resident or Student	Total Tax Revenue (in Millions)
Counties (1)	$7.16	$9.982
Cities (2)	$32.18	$13.635
School Districts (3)	$165.95	$16.287
Total Average Annual Tax Revenue		**$39.904**

SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group
NOTES: Estimates are based on property, sales, and other taxes accruing to local governments from both direct and spillover effects of activity on PUF Lands. Some approximations and allocations were necessary due to limitations in GIS location system.
(1) Includes counties and other special taxing districts (hospital districts, special purpose districts, etc.)
(2) Reflects primarily spillover effects from activities within unincorporated portions of counties.
(3) Reflects both direct and indirect activity, with allocations within counties based on GIS information.

Annual Tax Revenue for Counties

The Perryman Group quantified tax effects for the 19 counties containing PUF Lands, Midland County (home to the University Lands offices), and Tom Green

County (which receives significant spillover activity). Andrews County benefitted the most overall, with over $1.92 million in annual tax revenue, whereas Loving County was the most impacted on a per-capita basis, collecting approximately $706 per resident each year.

Estimated Average Annual Tax Revenue Accruing to Relevant Counties From Activity on PUF Lands: FY 2011-2016 (In 2016 Dollars)

County (1)	Tax Revenue per Resident	Total Tax Revenue
Andrews	$106.07	$1,920,418
Crane	$132.18	$667,253
Crockett	$297.95	$1,105,404
Culberson	$5.40	$12,082
Dawson	$0.12	$1,665
Ector (2)	$10.69	$1,703,758
El Paso	$0.26	$218,296
Gaines	$0.57	$11,351
Hudspeth	$5.41	$18,295
Irion	$125.83	$195,544
Loving	$706.40	$79,117
Martin	$26.26	$148,133
Midland (3)	$0.72	$115,952
Pecos	$41.89	$678,688
Reagan	$294.29	$1,115,939
Schleicher	$55.21	$177,283
Terrell	$174.75	$146,266
Tom Green (4)	$6.15	$726,691
Upton	$43.02	$157,069
Ward	$27.86	$326,563
Winkler	$57.02	$456,457
Total Average Annual Tax Revenue		**$9,982,223**

SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group

NOTES: Estimates are based on property, sales, and other taxes accruing to local governments from both direct and spillover effects of activity on University Lands. Some approximations and allocations were necessary due to limitations in GIS location system.

(1) Includes counties and other special taxing districts (hospital districts, special purpose districts, etc.)

(2) Includes effects of both direct activity in Ector County and spillover benefits from other areas.

(3) Includes effects of office operations in Midland County and spillover benefits from other areas.

(4) Represents spillover effects of activity in other areas.

Annual Tax Revenue for Cities

For a representative sample of 18 cities that collect taxes and are located in the relevant counties, total tax revenue exceeded those assessed by the counties. The City of Andrews received the highest yearly revenues with an estimated average of nearly $4.6 million; on a per-capita basis, the City of Big Lake benefitted the most, collecting nearly $437 per resident annually.

The Estimated Average Annual Tax Revenue Accruing to Relevant Cities Arising From Activity Associated with PUF Lands, FY 2011-2016
(In 2016 Dollars)

City (1)	Tax Revenue per Resident	Total Tax Revenue
Andrews	$332.91	$4,599,453
Big Lake	$436.52	$1,447,053
Crane	$170.85	$665,450
Dell City	$39.00	$13,768
Eldorado	$57.08	$103,315
Fort Stockton	$130.86	$1,131,833
Kermit	$27.46	$176,671
Lamesa	$0.16	$1,504
McCamey	$156.58	$322,862
Mertzon	$156.87	$118,906
Midland (2)	$2.54	$337,918
Monahans	$25.99	$199,867
Odessa (3)	$21.54	$2,562,715
Rankin	$135.93	$114,722
San Angelo (4)	$16.14	$1,621,444
Seminole	$2.63	$19,606
Stanton	$60.26	$176,913
Van Horn	$10.67	$20,572
Total Average Annual Tax Revenue		**$13,634,573**

SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group
NOTES: Estimates are based on property, sales, and other taxes accruing to local governments from both direct and spillover effects of activity on PUF Lands. Some approximations and allocations were necessary due to limitations in GIS location system.
(1) Reflects primarily spillover effects from activities within unincorporated portions of counties.
(2) Includes effects of office operations in Midland County and spillover benefits from other areas.
(3) Includes effects of both direct activity in Ector County and spillover benefits from other areas.
(4) Represents spillover effects of activity in other areas.

Annual Tax Revenue for School Districts

Of the 28 school districts that contain PUF Lands or which experience spillover effects, Andrews Independent School District collected the most tax revenue, with an estimated annual average of approximately $4.4 million in revenue. Crockett County Consolidated Common School District received the highest annual per-student tax revenue, collecting $2,435, on average, to support its students each year.

Estimated Average Annual Tax Revenue Accruing to Relevant School Districts Arising From Activity on PUF Lands: FY 2011-2016 (In 2016 Dollars)

School District (1)	Tax Revenue per Student	Total Tax Revenue
Andrews Independent School District	$1,106.98	$4,401,350
Buena Vista Independent School District	$361.10	$75,469
Crane Independent School District	$592.50	$679,000
Crockett County Consolidated Common School District	$2,435.91	$2,014,497
Culberson-Allamore Independent School District	$57.81	$25,206
Ector County Independent School District (2)	$58.54	$1,861,143
Fabens Independent School District	$74.91	$177,097
Fort Hancock Independent School District	$34.80	$15,104
Fort Stockton Independent School District	$187.99	$463,206
Grady Independent School District	$1,462.94	$320,384
Grandfalls-Royalty Independent School District	$190.64	$29,168
Iraan-Sheffield Independent School District	$910.92	$471,855
Irion County Independent School District	$2,012.54	$652,062
Kermit Independent School District	$137.31	$200,606
Klondike Consolidated Independent School District	$712.37	$190,203
McCamey Independent School District	$269.01	$155,758
Midland Independent School District (3)	$11.00	$270,077
Monahans-Wickett-Pyote Independent School District	$152.81	$348,872
Pecos-Barstow-Toyah Independent School District	$70.29	$173,826
Rankin Independent School District	$1,325.63	$371,175
Reagan County Independent School District	$1,965.81	$1,777,088
San Angelo Independent School District (4)	$68.27	$1,034,280
Schleicher County Independent School District	$268.42	$154,881
Seminole Independent School District	$10.59	$30,141
Sierra Blanca Independent School District	$58.09	$6,913
Terrell County Independent School District	$549.95	$86,343
Tornillo Independent School District	$55.27	$66,273
Wink-Loving Independent School District	$537.54	$234,905
Total Average Annual Tax Revenue		**$16,286,883**

SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group

NOTES: Estimates are based on property, sales, and other taxes accruing to local governments from both direct and spillover effects of activity on PUF Lands. Some approximations and allocations were necessary due to limitations in GIS location system.

(1) Reflects both direct and indirect activity, with allocations within counties based on GIS information.

(2) Includes effects of both direct activity in Ector County and spillover benefits from other areas.

(3) Includes effects of office operations in Midland County and spillover benefits from other areas.

(4) Represents spillover effects of activity in other areas.

Importance of Funding from PUF Lands

The resources provided by the PUF and AUF support and enhance the quality of higher education in the state of Texas, thus benefitting students and society as a whole. Students gain from the PUF and AUF funds in numerous ways ranging from enhanced instruction and facilities to decreased upward pressure on tuition.

It is also worthy of note that both UT Austin and Texas A&M University are widely regarded as "Tier One" institutions and hold membership in the prestigious Association of American Universities, thus ranking them among the elite educational facilities in the US. These designations indicate the exceptionally high quality and quantity of research and excellence in academic programs emanating from these schools. Rice University, which is privately funded, is the only other school in Texas with these distinctions. The ongoing and consistent funding from the PUF and AUF provide critical resources to assure this level of achievement.

Research findings enabled by these funds improve quality of life, graduates make significant contributions, and businesses are provided with a steady stream of quality graduates. In addition, given the reality of finite State of Texas fiscal resources, **the fact that the PUF and AUF help support the state's two largest university systems frees up additional funds for the other public universities in the state**.

The Permanent University Fund

When the PUF was initially established by the Texas Constitution of 1876, the principal of the endowment was designated as the land set apart for the fund and the proceeds from the sale of any lands.[38] In 1926, the Texas Supreme Court ruled that the proceeds from the sale of oil on the land should be considered the same way as proceeds from the sale of land, and therefore added to the principal of the fund.[39] Consequently, all proceeds from mineral royalties and leases (including oil and gas), all gains on investments, and the proceeds from the sale of any lands are reinvested in various bonds and securities.

The PUF was originally established to fund only the UT System, but the Texas Legislature decided in 1931 to also use the fund to support the TAMU System.[40] The total annual income and distribution is now split between the UT System, which receives two-thirds of the amount, and the TAMU System, which receives

the remaining one-third.[41] The PUF is managed by the University of Texas Investment Management Company (UTIMCO), and the market value of the PUF has grown substantially in recent years.

The value of the PUF stood at $17.5 billion as of August 2015,[42] making it the largest public university endowment and the third-largest of all university endowments, trailing only Harvard and Yale.

The Available University Fund

As noted, revenue generated through surface activity on PUF Lands flows to the AUF to be distributed on an annual basis to the University Systems for immediate use. In addition, an annual distribution from the return on investment assets in the PUF endowment occurs. Any interest earned on the AUF is available for use each year as well. The income from surface leases and other sources was nearly $44.9 million in FY 2016.[43]

The first use of AUF funds is for servicing debt in the form of bonds and variable rate notes issued for capital improvements at numerous institutions in the UT and TAMU Systems.[44] Capital improvements include new construction, repairs and renovations, equipment purchases, land acquisitions, and library books and materials.[45]

Importance to the UT and TAMU Systems

Funding stemming from revenue from commercial activity on PUF Lands has a substantial impact on the UT and TAMU Systems. Between 1932 and 2015, the University of Texas System issued nearly $3.75 billion in PUF bonds and variable rate notes.[46] In 2015, the System allocated about $260 million of bond proceeds across its institutions.[47] For the budgeted 2016 fiscal year, AUF transfers of nearly $360 million accounted for 2% of the total revenue received by the University of Texas System.[48] The impact was even greater at UT Austin, where the allocation from the AUF represented over 10% of the total revenue.[49]

The TAMU System allocated $196.5 million to its PUF-eligible institutions in 2015, with the great majority of that amount flowing into Texas A&M University.[50] For the 2016 fiscal year, AUF funds represent 6% of all budgeted revenue for the TAMU System.[51] AUF funds comprised 7% and 12% of the budgeted revenue for Texas A&M University and Prairie View University, respectively, as these schools are able to receive excellence funds in addition to debt service funds for capital

improvements.[52] The funds also represent about 92% of the budgeted revenue for the TAMU System Offices.[53]

Institutions Eligible for PUF Debt Service	
UT System Institutions	**Texas A&M System Institutions**
UT Arlington	Prairie View A&M University
UT Austin	Tarleton State University
UT Dallas	Texas A&M University
UT El Paso	Texas A&M University at Galveston
UT Permian Basin	Texas A&M Health Science Center
UT Rio Grande Valley	Texas A&M University- Central Texas
UT San Antonio	Texas A&M University- San Antonio
UT Tyler	Texas A&M AgriLife Research
UT Southwestern Medical Center	Texas A&M AgriLife Extension Service
UT Medical Branch- Galveston	Texas A&M Engineering Experiment Station
UT Health Science Center- Houston	Texas A&M Engineering Extension Service
UT Health Science Center- San Antonio	Texas A&M Forest Service
UT M.D. Anderson Cancer Center	Texas A&M Transportation Institute
UT Health Science Center- Tyler	Texas A&M University System Offices
UT System Administration	
Source: Available University Fund Reports from UT and TAMU Systems	

The remainder of the AUF funds can only be used by specific institutions within the systems. For example, Texas A&M University, Texas A&M Health Science Center, Prairie View A&M University, and the Texas A&M University System Offices are the only members of the TAMU System that can use remaining AUF funds for operating and excellence budgets.[54] One example of this spending has been the Chancellor's Research Initiative, which uses AUF funds to assist in "the recruitment and hiring of faculty members who will have a transformative impact upon the academic and research missions of the University."[55]

Within the UT System, UT Austin is the only institution that can use the AUF funds for academic excellence purposes.[56] Specifically, UT Austin must receive at least 45% of the UT System's share of the annual income and distributions.[57] UT Austin uses these funds for various enhancements, including "library enhancement; enhancement of academic department operations; specialized science, engineering, and computing equipment; scholarships and fellowships; and support of special units."[58] UT Austin can also use AUF funds for "other support," as approved by the UT System Board of Regents.[59] For example, the Board of Regents committed an allocation of AUF funds of at least $25 million to help create a medical school at UT Austin.[60] For fiscal year 2016, the Board of Regents also approved allocations to support the UT Research Cyberinfrastructure; growth in

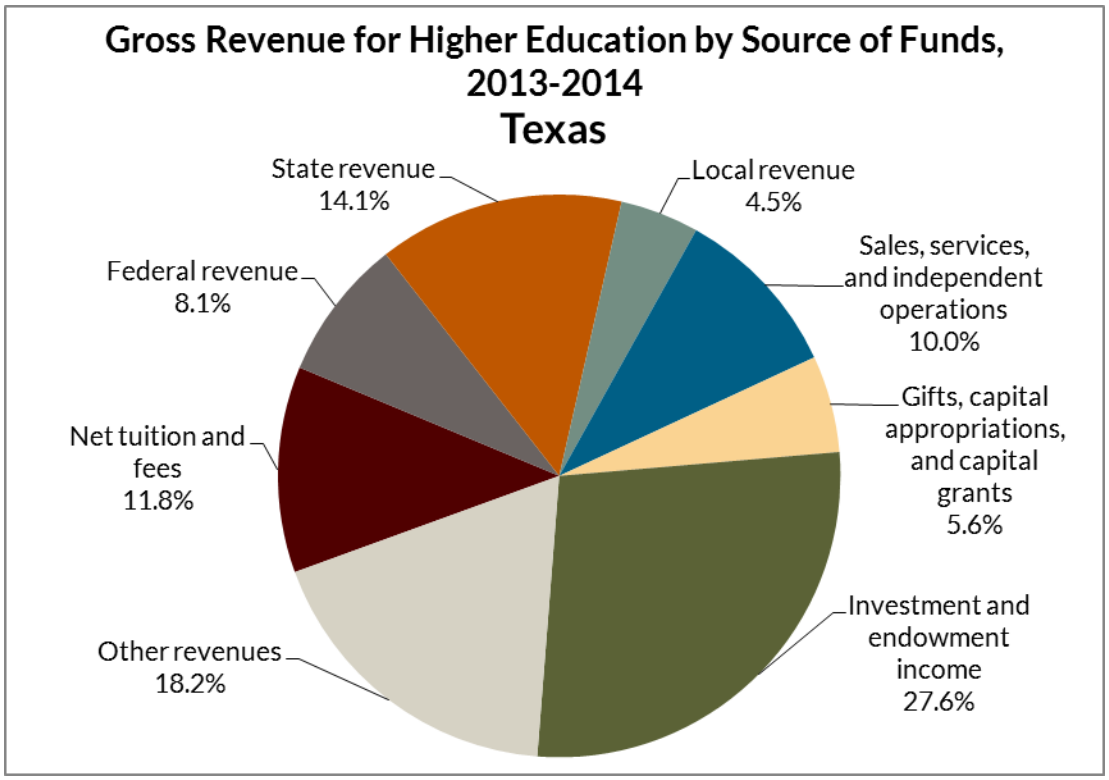
health, research, and administrative computing needs; and online and on-campus enrollment growth.[61] Additionally, the UT System can use AUF funds to pay for an external financial statement audit and for other system-wide initiatives.[62] For example, in fiscal year 2014, the Board of Regents approved the use of $8 million of AUF funds to allow UT institutions to waive or minimize resident undergraduate tuition increases.[63] The Board also approved $16.44 million for the support of PeopleSoft Human Resources/Finance system at eight UT institutions.[64]

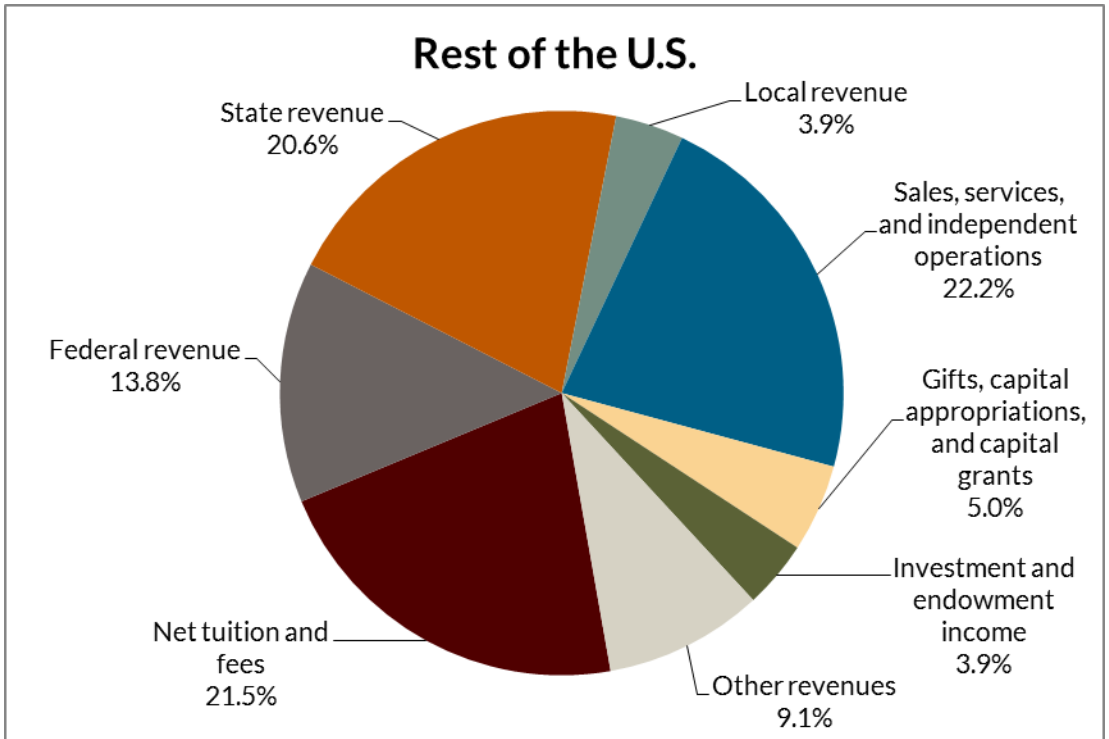
Comparison to Other States

Texas had the second-highest gross revenue for public higher education of all states with almost $35 billion in funds available to public four-year universities in fiscal year 2014, the most recent year for which the US Department of Education has compiled data. California, with about $37.5 billion as of 2014, was the top state in public higher education funding. However, after Texas, gross revenues for other states drop precipitously; Michigan had the third-largest total funds in 2014 with approximately $14.5 billion—less than half of Texas' funding for that year.[65]

Adjusting for the number of students in each state, Texas had the third highest overall funding for public four-year universities in 2014, with $45,013 in higher education revenue per student, behind only Iowa and California. Texas' per-student funding far exceeded the United States as a whole. Compared to the median per-student revenue of $27,155, Texas' funding stood nearly two-thirds higher.[66]

The sources of revenue in each state provide greater insight into the advantages Texas public universities receive from PUF and AUF support. As of 2014, **investment and endowment income brought in $12,425 in funds per student at public four-year universities**, which represents 27.6% of Texas' total per-student revenues that year. The rest of the United States—49 states and D.C. combined—received just four times the revenue from investments and endowments compared to Texas. Proportionally, this source of funding accounted for only 3.6% of the total revenues for public higher education in the remainder of the United States.





Note: Federal, state, and local revenues include grants, contracts, appropriations, and nonoperating revenues. Revenues for public four-year universities only were inlcuded.
Source: U.S. Department of Education, National Center for Education Statistics' Integrated Postsecondary Education Data System.

The PUF and AUF support is a major component of Texas' funding for public higher education, and the endowment and revenues generated on PUF Lands allow the state to fund public universities at a much greater rate per student than numerous other states. In addition, this source of revenue gives Texas the ability to allocate some of its fiscal resources to other public universities and additional needs while still maintaining a sufficient level for higher education purposes.

Because the PUF-backed bonds are rated more highly by ratings agencies than most university bonds and viewed as safer, the UT and TAMU Systems can borrow money at very low interest rates and save millions of dollars each year.

Trends in Enrollment and Graduation at PUF-Funded Institutions

A large and growing number of students attend schools supported by PUF and AUF and benefit from the revenues generated on PUF Lands. The number of students receiving degrees has grown by 18.2% over the past five years for the UT System, with 19.1% expansion over the period for the TAMU System.

As of the Fall 2015 semester, total enrollment across the UT System institutions eligible for PUF debt service was over 221,000 students, including more than 207,000 students at UT System universities. UT Austin had the largest enrollment of any institution in the UT System, with nearly 51,000 students during the Fall 2015 semester.[67]

The University of Texas System
Fall 2015

Institution	Enrollment
U.T. Arlington	37,008
U.T. Austin	50,950
U.T. Dallas	24,554
U.T. El Paso	23,308
U.T. Permian Basin	5,937
U.T. Rio Grande Valley	28,584
U.T. San Antonio	28,787
U.T. Tyler	8,500
U.T. Health Science Center at Houston	4,811
U.T. Health Science Center at San Antonio	3,130
U.T. Health Science Center at Tyler	17
U.T. M. D. Anderson Cancer Center	320
U.T. Medical Branch at Galveston	3,169
U.T. Southwestern Medical Center	2,262
Total	**221,337**

Source: Texas Higher Education Coordinating Board.

There were approximately 53,000 graduates from UT System institutions in the 2014-2015 school year, with over 48,300 from universities and nearly 4,700 from health-related schools. Between the 2010-2011 and 2014-2015 school years, the number of degrees awarded to graduates in the UT System expanded by 8,160, driven primarily by UT Arlington and UT Dallas for the universities and by the UT Medical Branch at Galveston for the health-related institutions. Of the 14 institutions in the UT System, none had a decline in graduates over this period.[68]

For the TAMU System, total enrollment at institutions eligible for PUF debt service was more than 91,000 students as of the Fall 2015 semester, including nearly 88,500 students at the universities. Texas A&M University had the largest enrollment of any institution in the system, with approximately 58,500 students during the Fall 2015 semester.[69]

The Texas A&M System
Fall 2015

Institution	Enrollment
Prairie View A&M University	8,268
Tarleton State University	12,333
Texas A&M University	58,515
Texas A&M University at Galveston	2,324
Texas A&M University-Central Texas	2,466
Texas A&M University-San Antonio	4,564
Texas A&M Health Science Center	2,591
Total	**91,061**

Source: Texas Higher Education Coordinating Board.

In the 2014-2015 school year, there were over 20,500 graduates from the TAMU System, with nearly 20,000 graduating from universities and the remainder graduating from Texas A&M Health Science Center.

More than 312,000 students are attending higher education institutions which are benefiting from revenues from PUF Lands. Every year, about 73,500 graduate and enter the workforce, including 5,200 from health-related institutions. The benefits of this education to individuals, families, companies, the economy, and society are profound.

Health Institutions

The six health institutions that are part of the University of Texas System provide essential care to millions of Texans each year. Thousands of students attend these

institutions, and millions of dollars are devoted to research on an annual basis. The AUF and PUF help fund these efforts.

In total, UT System hospitals and clinics had nearly 7.4 million outpatient visits in fiscal year 2016.[70] There were 13,709 students and 9,519 faculty members of the health institutions in FY 2016, and $1.695 billion in total research expenditures in FY 2015.[71] In fiscal year 2014, nearly 4,200 degrees were awarded to graduates of the UT System health institutions.[72]

UT Southwestern includes UT Southwestern Medical School, UT Southwestern Graduate School of Biomedical Sciences, and UT Southwestern School of Health Professions. The schools train about 3,600 students each year, and "faculty and residents provide care to more than 100,000 hospitalized patients, 600,000 emergency room cases, and oversee approximately 2.2 million outpatient visits annually."[73]

At UT Medical Branch at Galveston, in a typical day, "3,300 students are educated, 16 babies are delivered, 181 patients in the ER/Trauma Center are treated, 365 telemedicine encounters are conducted, and 2,782 patients in primary & specialty care outpatient clinics are cared for."[74]

At UT Health Science Center at Houston, there were nearly 1.5 million outpatient visits in 2014. There were 4,556 total students in the Graduate School of Biomedical Sciences, the McGovern Medical School, the School of Biomedical Informatics, the School of Dentistry, the School of Nursing, and the School of Public Health.[75]

The University of Texas Health Science Center at San Antonio is comprised of five schools: the School of Medicine, Nursing, Dentistry, Health Professions and the Graduate School of Biomedical Sciences.[76] Fall 2015 enrollment was 3,130, plus 984 residents and post-graduate trainees.[77] The Health Science Center supports 1.2 million patient visits each year, and it is ranked first in Texas for aging research funding from the National Institute on Aging. [78]

The University of Texas MD Anderson Cancer Center is ranked the top hospital for cancer care in the nation by U.S. News & World Report's "Best Hospitals" survey.[79] In 2015, MD Anderson cared for more than 135,000 patients and provided uninsured or underinsured Texans more than $186 million in uncompensated care.[80]

UT Health Northeast (The University of Texas Health Science Center at Tyler) is comprised of the School of Medical Biological Sciences and the School of Community and Rural Health.[81] Graduate medical education residency programs

and various clinical rotations are also offered.[82] This UT Health institution is the only university medical center in Northeast Texas.[83]

The TAMU health science center includes the College of Medicine, College of Dentistry, Institute of Biosciences and Technology, School of Rural Public Health, Irma Lerma Rangel College of Pharmacy, and College of Nursing.[84] The health science center operates eight campuses located in Bryan-College Station, Corpus Christi, Dallas, Houston, Kingsville, McAllen, Round Rock, and Temple.[85]

In academic year 2014-15, Texas A&M Health Science Center enrolled a total of 2,602 students (a 5.4 % increase from the prior year) and awarded a total of 756 degrees (a 2.3 % increase from the prior academic year).[86]

Projected Economic Impact of Activity on PUF Lands

The Perryman Group also estimated the economic impact of activity on PUF Lands over the next five fiscal years (through FY 2021).

Projected Economic Impact of Total Commercial Activity on PUF Lands

The Perryman Group estimates that, on average from FY 2017 to FY 2021, University Lands' total commercial activity on PUF Lands (including drilling, oil and gas production, and surface leases) will have an annual impact of over **$3.2 billion** in gross product each year as well as over **29,400 jobs** in Texas. The activity is also projected to produce an average of **$159.8 million** in State tax revenue and **$69.3 million** in local tax revenues each year through 2021. It should be noted that the oil and gas drilling and production forecasts are consistent in all respects with the reserve estimates discussed previously.

The results for the regional and Texas economies are shown below (full results including industrial detail can be found in Appendix 3).

The Projected Average Annual Economic Impact of Total Commercial Activity on PUF Lands, FY 2017-2021
(In Billions of 2016 Dollars)

	Regional Economy	Texas Economy
Total Expenditures	**$5.963**	**$9.028**
Gross Product	**$2.006**	**$3.226**
Personal Income	**$1.162**	**$1.876**
Retail Sales (including Restaurants)	**$0.480**	**$0.730**
Employment (Permanent Jobs)	**17,356**	**29,437**
State Tax Revenue	**$0.126**	**$0.160**
Local Tax Revenues	**$0.053**	**$0.069**

SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group

Projected Spillover Effects for Nearby MSAs

As noted, University Lands also has an economic impact through the operation of its offices in Midland, Texas as well as spillover effects from oil and gas production to nearby metropolitan areas (which is concentrated in Odessa due to the high numbers of firms supporting the energy sector). While the economic effects of University Lands' office operations are assumed to remain constant each year, The Perryman Group projected the spillover effects to the Midland, Odessa, and San Angelo MSAs for the next five fiscal years. The average annual economic impact from these spillover effects are shown in the table below (full results can be found in Appendix 4D).

The Average Annual Economic Impact of "Spillover" Effects from Oil and Gas Production on PUF Lands on the Economies of Nearby Metropolitan Areas: FY 2017-2021
(In Millions of 2016 Dollars)

MSA*	Total Expenditures	Gross Product	Personal Income	Retail Sales (including Restaurants)	Employment
Midland	$73.192	$35.130	$20.802	$7.805	352
Odessa	$724.502	$263.197	$154.427	$73.343	2,684
San Angelo	$367.501	$161.565	$90.127	$25.117	1,549

*MSA is Metropolitan Statistical Area.
SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group

Projected Grand Total Economic Impact of University Lands and Activity on PUF Lands

Combining the projected benefits of commercial activity, UL office operations, and spillover effects yields an estimate of the total projected gains in business activity. The Perryman Group found that the average annual business activity associated with activity on and related to University Lands and the PUF Lands over the FY 2017-2021 period is likely to include **$3.2 billion in gross product** and **29,597 jobs** in Texas, with benefits concentrated in the region.

The Average Annual Projected Grand Total Economic Impact of Activity on and Related to PUF Lands: FY 2017-2021 (In Billions of 2016 Dollars)		
	Regional Economy	**Texas Economy**
Total Expenditures	$7.143	$9.055
Gross Product	$2.475	$3.241
Personal Income	$1.434	$1.886
Retail Sales (including Restaurants)	$0.588	$0.734
Employment (Permanent Jobs)	22,039	29,597
SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group		

Projected Impact of Funds Provided by PUF Lands

Over the next five years, The Perryman Group estimates that the spending of the funds generated by activity on PUF Lands by universities will likely lead to gains in business activity in the state of nearly **$1.4 billion in gross product** and close to **19,300 jobs** (average annual over the 2017-2021 period).

The Average Annual Projected Economic Impact of the Funds Provided by PUF Lands on the Economy of Texas, FY 2017-2021 (In Billions of 2016 Dollars)	
Total Expenditures	**$2.748**
Gross Product	**$1.393**
Personal Income	**$0.958**
Retail Sales (including Restaurants)	**$0.367**
Employment (Permanent Jobs)	**19,296**
State Tax Revenue	**$0.072**
Local Tax Revenues	**$0.039**
SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group	

Effects of Restrictions on the Use of PUF Lands

As noted, University Lands is dedicated to preserving and protecting the PUF Lands resource. Policies and procedures are carefully crafted and oversight is extensive and comprehensive. Even so, there have at times been calls to further limit development on PUF Lands. The Perryman Group analyzed several of these issues and estimated the potential negative economic effects that would result from additional restrictions. Total cumulative impacts through 2040 for total reduced drilling and production are described below, with additional industry-level detail and effects for drilling and production individually included in the Appendices.

Hydraulic Fracturing

Hydraulic fracturing, more commonly known as "fracking," is a completion technique used after drilling to enhance recovery from certain formations. The roots of the process can be traced to the late 1940s,[87] and since that time, more than 1.2 million wells in America have been completed using this process.[88] The technique is most commonly paired with horizontal drilling, and the two processes may be combined to make it possible to reap a wealth of resources from shale rock formations that were previously inaccessible.

Essentially, fracking involves injecting a highly pressurized mixture of water, sand, and chemical additives to create small fissures in shale formations in order to enable and enhance recovery of oil and natural gas. Fracking is also used to stimulate the flow from water wells and is opening possibilities for the commercial use of geothermal wells, which are wells that allow water to be pumped down into the earth's crust, heated, and returned to the surface to produce electricity.[89] Furthermore, the EPA uses fracking to clean superfund sites, areas of land that have been determined to have been contaminated by hazardous waste.[90]

However, despite its many useful functions, the use of fracking techniques has been a controversial issue in recent years. For example, the chemical additives used in the water-based solution, which is injected into the rocks, have been a point of contention.[91] However, approximately only 0.5% of the water solution is made

up of chemicals.[92] The additives are used to "alter the surface tension of the water" and "control the growth of bacteria" that can corrode pipes.[93] These substances are common products used by millions of households every day.[94] For those who are interested in learning which additives are used in the fracking processing, the US Department of Energy and the Ground Water Protection Council have made that information available to the public on a well-by-well basis via a nationwide database: FracFocus.org.[95]

As for rumors of groundwater contamination in the summer of 2015, the US Department of the Interior released a statement to Congress confirming that it had "not seen any impacts to groundwater as a result of hydraulic fracturing."[96] Before that, in 2011, the Environmental Protection Agency reported that it did not know "of any proven case where the fracking process itself affected water."[97] Additionally, several state environmental agencies have confirmed that the technology used in fracking is safe.[98]

There have also been some concerns expressed that fracking may cause earthquakes.[99] However, experts have concluded that these events are rare and non-threatening.[100] In fact, since its beginning in the 1940s, fracking is believed to have perhaps caused only two small seismic events.[101]

Based on estimated reserves and other information, The Perryman Group estimates that if a ban on hydraulic fracturing in Texas were implemented, cumulative lost business activity from 2017 to 2040 due to decreased activity on PUF Lands would include some **$33.4 billion** in lost gross product and nearly **311,000** foregone person-years of employment in Texas.

The Projected Cumulative Adverse Impact Associated with Foregone Oil and Gas Drilling and Production on PUF Lands from Implementing a Ban on Hydraulic Fracturing on Business Activity: FY 2017-2040 (In Billions of 2016 Dollars)		
	Regional Economy	**Texas Economy**
Total Expenditures	**($65.126)**	**($90.201)**
Gross Product	**($22.752)**	**($33.421)**
Personal Income	**($13.560)**	**($19.761)**
Retail Sales (including Restaurants)	**($5.571)**	**($7.617)**
Employment (Person-Years)	**(207,933)**	**(310,946)**
State Tax Revenue	**($0.417)**	**($0.593)**
Local Tax Revenues	**($0.209)**	**($0.299)**
SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group		

EPA Regulations

The Perryman Group also analyzed the potential losses associated with implementing restrictive policy as proposed by various environmental groups. These proposals include more restrictive rules covering a number of aspects of oil and gas drilling and production, many of which are in direct conflict with the Energy Policy Act of 2005.

Using a study of the potential losses associated with implementing such regulations as partial basis, The Perryman Group estimated a decrease in business activity associated with reductions in drilling and production on PUF Lands of **$6.8 billion** in gross product and over **63,100** person-years of employment over the FY 2017-2040 time period.

The Projected Cumulative Adverse Impact Associated with Foregone Oil and Gas Drilling and Production on PUF Lands from Implementing Restrictive EPA Policies on Business Activity: FY 2017-2040 (In Billions of 2016 Dollars)		
	Regional Economy	**Texas Economy**
Total Expenditures	($13.221)	($18.312)
Gross Product	($4.619)	($6.785)
Personal Income	($2.753)	($4.012)
Retail Sales (including Restaurants)	($1.131)	($1.546)
Employment (Person-Years)	(42,213)	(63,126)
State Tax Revenue	($0.085)	($0.120)
Local Tax Revenues	($0.042)	($0.061)
SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group		

Water Use

Water management has become a greater concern with scarce supplies and growing needs. In the oil and gas sector, operators have begun utilizing water management best practices and new technologies to recapture, recycle, and reuse water from production operations.[102] These new practices allow operators to help conserve fresh water supply resources by reducing the amount of fresh water required for hydraulic fracking jobs.[103]

For instance, many operators are increasing their use of oilfield wastewater.[104] Many fracking jobs create large volumes of flowback fluid (a water based solution containing clays, chemical additives, dissolved metal ions and total dissolved solids that flows back to the surface during a hydraulic fracking job).[105] If operators can recover a portion of the flowback fluid to reuse in additional jobs, they can reduce the amount of fresh water consumed, decrease costs, and increase sustainability.[106] The reuse of wastewater also decreases disposal and transportation costs for operators, as they no longer have to transport the wastewater to an approved disposal well.[107] In Pennsylvania, geological factors limit the number of available disposal wells, so operators capture and reuse more than 85% of the flowback fluid.[108]

Another strategy being utilized by operators is replacing fresh water used in fracking jobs with brackish water (water that is a mix of fresh water and salt water).[109] Since the process of desalinization is costly, brackish water is not an ideal resource for most uses of fresh water, such as drinking water and agriculture.[110] Recent technological developments enable oil and gas operators to use higher-salinity water from sources (such as brackish and brine aquifers) without compromising the fracking process.[111] By substituting brackish water for fresh water in fracking jobs, operators can again reduce fresh water consumption.[112]

In general, there is no "one-size-fits-all solution" for water management by oil and gas operators, so each solution must be evaluated at a firm level.[113] In Texas especially, water availability can vary significantly depending on the geographic area. Although for the state as a whole,oil and gas activity development accounts for a very small use of available water, in some locations, including west Texas, water use in oil and gas activity may comprise a significant portion of total requirements. University Lands' groundwater management plan (previously described) includes provisions designed to encourage use of sources of water (such as deep aquifers which are more saline) not typically utilized, thereby decreasing the use of fresh water.

The Perryman Group analyzed the potential economic cost of a restrictive policy for groundwater use based on typical cost increases associated with alternative sources of water and the response by the industry to higher drilling costs. The likely reduction in drilling and production on PUF Lands could be expected to lead to losses of an estimated **$2.3 billion** in gross product and nearly **21,700** person-years of employment over the FY 2017-2040 period.

The Projected Cumulative Adverse Impact Associated with Foregone Oil and Gas Drilling and Production on PUF Lands from Implementing a Restrictive Water Use Policy: FY 2017-2040 (In Billions of 2016 Dollars)		
	Regional Economy	**Texas Economy**
Total Expenditures	($4.545)	($6.295)
Gross Product	($1.588)	($2.332)
Personal Income	($0.946)	($1.379)
Retail Sales (including Restaurants)	($0.389)	($0.532)
Employment (Person-Years)	(14,510)	(21,699)
State Tax Revenue	($0.029)	($0.041)
Local Tax Revenues	($0.015)	($0.021)
SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group		

Wildlife Conservation

The dunes sagebrush lizard (also known as the sand dune lizard) is a small reptile which inhabits portions of western Texas and eastern New Mexico.[114] The lizard is only found in a swath of sandy dunes laden with shinnery oak, which is a brushy tree growing two or three feet high.[115] The oaks, however, have massive root systems which stabilize the dunes and allow areas for the reptiles to hunt, shelter, and reproduce.[116] The lizard's range falls in ranch land and involves part of the oil-rich Permian Basin of western Texas.[117]

In 2010, the U.S. Fish and Wildlife Service (FWS) proposed listing the sand dune lizard as an endangered species with associated habitat protection.[118] Listing the reptile as an endangered species would have ramifications for oil and gas companies, as well as for farmers and ranchers who raise crops and livestock in the region. In 2012, the FWS withdrew its request after determining that voluntary conservation efforts by oil and gas operators and private landowners would be adequate for the lizard's preservation.[119] The FWS has offered little, if any, data indicating that the number of sand dune lizards is falling.[120] In fact, in 2013, an environmental toxicology professor at Texas Tech University led a study that examined the three risk factors to the reptile's habitat: "contamination of dune sand as a result of oil industry activity, usage of the herbicide Tebuthiuron by

ranchers on shinnery oak habitats where the lizard resides, and weather patterns affecting the size of sand grains in dunes where the lizard nests." The study found that none of these risk factors had a significant impact on the lizard's population.[121] For now, with conservation measures in place, the FWS is not pursuing having the reptile listed as an endangered species.[122]

The Texas Conservation Plan, developed by the Comptroller of Public Accounts, was put into effect in 2011 and protects 650,000 acres in New Mexico and Texas, covering 88% of the sand dune lizard's habitat.[123] The goal of the plan is to "facilitate continued and uninterrupted economic activity in the Permian Basin, which accounts for over 20% of national domestic energy production," while promoting compliance with the Endangered Species Act (ESA) in response to the proposed listing of the reptile by the FWS.[124] The plan focuses on avoiding activity that would further degrade the habitat, reclamation of lizard's habitat to reduce fragmentation, and removal of mesquite that is encroaching into shinnery oak dunes.[125] While the plan has a 30-year term, beginning at the time of the FWS's approval, the FWS has the ability to renew it beyond that period.[126]

The conservation plan has achieved a delicate balance between protecting the lizard and still allowing for some activity in the lizard habitat. However, activity is constrained within the habitat area. Some 20,000 acres of PUF Lands are designated as dunes sagebrush lizard habitat.

The Perryman Group estimated the effects of the restriction on development based on the magnitude of acreage set aside; projected drilling, production, and reserves in the proximate area; and likely reductions in drilling and production in the affected area. Losses over the FY 2017-2040 period were found to include **$2.0 billion** in gross product and about **18,800** person-years of employment.

Projected Cumulative Adverse Impact Associated with Foregone Oil and Gas Drilling and Production on PUF Lands due to Dunes Sagebrush Lizard Habitat: FY 2017-2040 (In Billions of 2016 Dollars)		
	Regional Economy	**Texas Economy**
Total Expenditures	**($3.927)**	**($5.439)**
Gross Product	**($1.372)**	**($2.015)**
Personal Income	**($0.818)**	**($1.192)**
Retail Sales (including Restaurants)	**($0.336)**	**($0.459)**
Employment (Person-Years)	**(12,539)**	**(18,751)**
State Tax Revenue	**($0.025)**	**($0.036)**
Local Tax Revenues	**($0.013)**	**($0.018)**
SOURCE: US Multi-Regional Impact Assessment System, The Perryman Group		

Conclusion

The 2.1 million acres of PUF Lands is an amazing resource benefitting students, families, businesses, and communities. In addition, University Lands is a careful steward of the acreage, preserving it for future generations.

Commercial operations on PUF Lands include drilling and production of oil and gas, grazing operations, a winery, airports, and wind farms. This activity generates billions in business activity within the state of Texas as well as millions in tax receipts to the State and local governments. In fact, The Perryman Group estimates commercial activity on PUF Lands generated an estimated **$3.5 billion** in gross product each year and supported about **33,600** jobs in Texas (on an average annual basis over the past five years with multiplier effects included). The activity also produced an average of **$175.6 million** in State tax revenue and **$78.0 million** in local tax revenues each year over the period.

This substantial impact is only one of the multiple aspects of the economic and fiscal benefits of University Lands. The Perryman Group estimates that when funds in the Available University Fund are spent by universities, they generate an additional **$1.3 billion** in gross product each year and **87,618** jobs. Even beyond these sizable benefits, graduates of the UT and TAMU Systems who benefit from the funds provided by University Lands generate an estimated hundreds of millions in gross product in the state each year as well as millions of jobs.

The story of these lands is a truly remarkable saga. **Indeed, "fountains of unstinted wealth" have gushed forth and will continue to do so. The "rod of knowledge" they support is essential to the future of Texas, and their prudent management will assure their sustainability for generations to come.**

Endnotes

[1] Osbourne, James, Oil Boom Sends Gusher of Cash to Texas Universities, *Dallas Morning News*, June 2, 2014, http://www.dallasnews.com/business/energy/20140531-oil-boom-sweeps-money-to-texas-universities.ece; Smyrl, Vivian Elizabeth, Permanent University Fund, *Handbook of Texas Online*, Texas State Historical Foundation, June 15, 2010, http://www.tshaonline.org/handbook/online/articles/khp02.
[2] Smyrl, Vivian Elizabeth, Permanent University Fund, *Handbook of Texas Online*, Texas State Historical Foundation, June 15, 2010, http://www.tshaonline.org/handbook/online/articles/khp02.
[3] Houser, Mark, University Lands: Crafting a Strategy for Mutual Success, March 3, 2016, http://www.utlands.utsystem.edu/forms/pdfs/PartnerForum/20160303/UniversityLands_Crafting_a_Strategy_for_Mutual_Success_Houser.pdf, p. 4.
[4] Environment, University Lands, (n.d.), http://www.utlands.utsystem.edu/environment.aspx.
[5] Environment, University Lands, (n.d.), http://www.utlands.utsystem.edu/environment.aspx.
[6] Groundwater Management Plan, University Lands, January 2013, http://www.utlands.utsystem.edu/forms/pdfs/Groundwater_Management_Plan.pdf, p. 4, 9.
[7] Groundwater Management Plan, University Lands, January 2013, http://www.utlands.utsystem.edu/forms/pdfs/Groundwater_Management_Plan.pdf, p. 4; Water, University Lands, (n.d.), http://www.utlands.utsystem.edu/water.aspx.
[8] Rate and Damage Schedule, University Lands, September 1, 2016, http://www.utlands.utsystem.edu/forms/pdfs/rate_damage_schedule.pdf, p. 10.
[9] Groundwater Management Plan, University Lands, January 2013, http://www.utlands.utsystem.edu/forms/pdfs/Groundwater_Management_Plan.pdf, p. 10.
[10] Groundwater Management Plan, University Lands, January 2013, http://www.utlands.utsystem.edu/forms/pdfs/Groundwater_Management_Plan.pdf, p. 10.
[11] Groundwater Management Plan, University Lands, January 2013, http://www.utlands.utsystem.edu/forms/pdfs/Groundwater_Management_Plan.pdf, p. 4.
[12] Water Contracts, University Lands, (n.d.), http://www.utlands.utsystem.edu/water_contracts.aspx.
[13] Water Contracts, University Lands, (n.d.), http://www.utlands.utsystem.edu/water_contracts.aspx
[14] Strickland, Megan, University Lands, Legislatures and Regulators Mull Water Rules, The Daily Texan, April 12, 2013, http://www.dailytexanonline.com/news/2013/04/12/university-lands-legislature-and-regulators-mull-water-rules.
[15] Fitzsimons, Fay, Debunking Environment Texas' Flimsy Anti-Fracking UT Lands Report, Energy in Depth, September 9, 2015, https://energyindepth.org/texas/debunking-environment-texas-anti-fracking-ut-lands-report/.
[16] Fitzsimons, Fay, Debunking Environment Texas' Flimsy Anti-Fracking UT Lands Report, Energy in Depth, September 9, 2015, https://energyindepth.org/texas/debunking-environment-texas-anti-fracking-ut-lands-report/.
[17] Fitzsimons, Fay, Debunking Environment Texas' Flimsy Anti-Fracking UT Lands Report, Energy in Depth, September 9, 2015, https://energyindepth.org/texas/debunking-environment-texas-anti-fracking-ut-lands-report/.
[18] Fitzsimons, Fay, Debunking Environment Texas' Flimsy Anti-Fracking UT Lands Report, Energy in Depth, September 9, 2015, https://energyindepth.org/texas/debunking-environment-texas-anti-fracking-ut-lands-report/.
[19] Fitzsimons, Fay, Debunking Environment Texas' Flimsy Anti-Fracking UT Lands Report, Energy in Depth, September 9, 2015, https://energyindepth.org/texas/debunking-environment-texas-anti-fracking-ut-lands-report/.
[20] Fitzsimons, Fay, Debunking Environment Texas' Flimsy Anti-Fracking UT Lands Report, Energy in Depth, September 9, 2015, https://energyindepth.org/texas/debunking-environment-texas-anti-fracking-ut-lands-report/.
[21] Fitzsimons, Fay, Debunking Environment Texas' Flimsy Anti-Fracking UT Lands Report, Energy in Depth, September 9, 2015, https://energyindepth.org/texas/debunking-environment-texas-anti-fracking-ut-lands-report/.
[22] Well Library, University Lands, accessed October 5, 2016, http://www.utlands.utsystem.edu/Wells/WellSearch.aspx.
[23] Well Library, University Lands, accessed October 5, 2016, http://www.utlands.utsystem.edu/Wells/WellSearch.aspx.
[24] Houser, Mark, University Lands: Crafting a Strategy for Mutual Success, March 3, 2016, http://www.utlands.utsystem.edu/forms/pdfs/PartnerForum/20160303/UniversityLands_Crafting_a_Strategy_for_Mutual_Success_Houser.pdf, p. 10.
[25] Houser, Mark, University Lands: Crafting a Strategy for Mutual Success, March 3, 2016, http://www.utlands.utsystem.edu/forms/pdfs/PartnerForum/20160303/UniversityLands_Crafting_a_Strategy_for_Mutual_Success_Houser.pdf, p. 4.

[26] Houser, Mark, University Lands: Crafting a Strategy for Mutual Success, March 3, 2016, http://www.utlands.utsystem.edu/forms/pdfs/PartnerForum/20160303/UniversityLands_Crafting_a_Strategy_for_Mutual_Success_Houser.pdf, p. 8.
[27] Surface Operations, University Lands, (n.d.), http://www.utlands.utsystem.edu/surface_act.aspx; Houser, Mark, Houser: University Lands' Policies Safeguard Irreplaceable, Invaluable State Asset, Houston Chronicle, September 25, 2015, http://www.chron.com/opinion/outlook/article/Houser-University-Lands-policies-safeguard-6530991.php.
[28] Long, Alberto, Wind Farms on University Land Contribute to Renewable Energy, Give Back to UT, The Daily Texan, April 12, 2013, http://www.dailytexanonline.com/news/2013/04/12/wind-farms-on-university-land-contribute-to-renewable-energy-give-back-to-ut.
[29] Renewable Energy, University Lands, (n.d.), http://www.utlands.utsystem.edu/renewables.aspx; Long, Alberto, Wind Farms on University Land Contribute to Renewable Energy, Give Back to UT, The Daily Texan, April 12, 2013, http://www.dailytexanonline.com/news/2013/04/12/wind-farms-on-university-land-contribute-to-renewable-energy-give-back-to-ut.
[30] Indian Mesa Wind Energy Center Fact Sheet, NextEra Energy Resources, (n.d.), https://www.nexteraenergyresources.com/pdf_redesign/Indianmesa.pdf; Woodward Wind Energy Center Fact Sheet, NextEra Energy Resources, (n.d.), https://www.nexteraenergyresources.com/pdf_redesign/woodwardmountain.pdf.
[31] Long, Alberto, Wind Farms on University Land Contribute to Renewable Energy, Give Back to UT, The Daily Texan, April 12, 2013, http://www.dailytexanonline.com/news/2013/04/12/wind-farms-on-university-land-contribute-to-renewable-energy-give-back-to-ut; Texas Section Society for Rangeland Management, Outstanding Contribution to Rangeland Management, Rangelands, (n.d.), http://www.rangelands.org/texas/awards/2015/2015_Outstanding_Contribution_Range_Management_Steve_Hartman.pdf.
[32] Groundwater Management Plan, University Lands, January 2013, http://www.utlands.utsystem.edu/forms/pdfs/Groundwater_Management_Plan.pdf, P. 6.
[33] History, Ste Genevieve, (n.d.), http://www.stegenwines.com/story/history.html; Groundwater Management Plan, University Lands, January 2013, http://www.utlands.utsystem.edu/forms/pdfs/Groundwater_Management_Plan.pdf, P. 6.
[34] Texas Section Society for Rangeland Management, Outstanding Contribution to Rangeland Management, Rangelands, Society for Range Management, (n.d.), http://www.rangelands.org/texas/awards/2015/2015_Outstanding_Contribution_Range_Management_Steve_Hartman.pdf.
[35] Texas Section Society for Rangeland Management, Outstanding Contribution to Rangeland Management, Rangelands, Society for Range Management, (n.d.), http://www.rangelands.org/texas/awards/2015/2015_Outstanding_Contribution_Range_Management_Steve_Hartman.pdf.
[36] Texas Section Society for Rangeland Management, Outstanding Contribution to Rangeland Management, Rangelands, Society for Range Management, (n.d.), http://www.rangelands.org/texas/awards/2015/2015_Outstanding_Contribution_Range_Management_Steve_Hartman.pdf.
[37] Texas Section Society for Rangeland Management, Outstanding Contribution to Rangeland Management, Rangelands, Society for Range Management, (n.d.), http://www.rangelands.org/texas/awards/2015/2015_Outstanding_Contribution_Range_Management_Steve_Hartman.pdf.
[38] The Texas Constitution, Article VII, Section 11.
[39] PUF Timeline 1921-1926, UTIMCO Website, (n.d.), http://www.utimco.org/scripts/internet/puf_timeline8.asp.
[40] Smyrl, Vivian Elizabeth, Permanent University Fund, *Handbook of Texas Online*, Texas State Historical Foundation, June 15, 2010, http://www.tshaonline.org/handbook/online/articles/khp02.
[41] Available University Fund Report, December 2015, The University of Texas System Office of the Controller, p. 4.
[42] Smyrl, Vivian Elizabeth, Permanent University Fund, *Handbook of Texas Online*, Texas State Historical Foundation, June 15, 2010, http://www.tshaonline.org/handbook/online/articles/khp02; The Permanent University Fund (PUF), University Lands Website, (n.d.), http://www.utlands.utsystem.edu/puf.aspx.
[43] Available University Fund Report, December 2015, The University of Texas System Office of the Controller, p. 4.
[44] Available University Fund Report, December 2015, The University of Texas System Office of the Controller, p. 6-7; The Texas A&M University System Available University Fund Report, December 2015, The Texas A&M University System, p. 1.
[45] The Texas A&M University System Available University Fund Report, December 2015, The Texas A&M University System, p. 1.
[46] Available University Fund Report, December 2016, The University of Texas System Office of the Controller.
[47] Available University Fund Report, December 2016, The University of Texas System Office of the Controller, p. 2.
[48] The University of Texas System Operating Budget Summaries, Fiscal Year 2016, August 2015, http://www.utsystem.edu/cont/Reports_Publications/summaries/2016/FY2016BudgetSummaries.pdf, p. 10.
[49] The University of Texas System Operating Budget Summaries, Fiscal Year 2016, August 2015, http://www.utsystem.edu/cont/Reports_Publications/summaries/2016/FY2016BudgetSummaries.pdf, p. 18.

[50] The Texas A&M University System Available University Fund Report, December 2015, The Texas A&M University System, p. 5.
[51] FY 2016 Executive Summary, Budget for Fiscal Year Ending August 31, 2016, The Texas A&M University System, https://www.tamus.edu/assets/files/budgets-acct/pdf/Executive%20Budget%20Summary/FY2016/FY2016Budget.pdf.
[52] FY 2016 Executive Summary, Budget for Fiscal Year Ending August 31, 2016, The Texas A&M University System, https://www.tamus.edu/assets/files/budgets-acct/pdf/Executive%20Budget%20Summary/FY2016/FY2016Budget.pdf.
[53] FY 2016 Executive Summary, Budget for Fiscal Year Ending August 31, 2016, The Texas A&M University System, https://www.tamus.edu/assets/files/budgets-acct/pdf/Executive%20Budget%20Summary/FY2016/FY2016Budget.pdf.
[54] The Texas A&M University System Available University Fund Report, December 2015, The Texas A&M University System, p. 2.
[55] The Texas A&M University System Available University Fund Report, December 2015, The Texas A&M University System, p. 2.
[56] Available University Fund Report, December 2015, The University of Texas System Office of the Controller, p. 7.
[57] Available University Fund Report, December 2015, The University of Texas System Office of the Controller, p. 7.
[58] Available University Fund Report, December 2015, The University of Texas System Office of the Controller, p. 7.
[59] Available University Fund Report, December 2015, The University of Texas System Office of the Controller, p. 8-9.
[60] Available University Fund Report, December 2015, The University of Texas System Office of the Controller, p. 8.
[61] Available University Fund Report, December 2015, The University of Texas System Office of the Controller, p. 9.
[62] Available University Fund Report, December 2015, The University of Texas System Office of the Controller, p. 7, 10-13.
[63] Available University Fund Report, December 2015, The University of Texas System Office of the Controller, p. 10.
[64] Available University Fund Report, December 2015, The University of Texas System Office of the Controller, p. 10.
[65] Revenues (in thousands) of Public Postsecondary Institutions Using GASB Standards by State Source of Funds for Fiscal Year 2014 (Results Limited by: Level of Institution), IPEDS Trend Generator, U.S. Department of Education – National Center for Education Statistics' Integrated Postsecondary Education Data System, (n.d.), http://nces.ed.gov/ipeds/trendgenerator/tganswer.aspx?sid=6&qid=13.
[66] Number of Students Enrolled in Postsecondary Institutions Annually by State for 2013-14 (Results Limited by: Sector of Institution), IPEDS Trend Generator, U.S. Department of Education – National Center for Education Statistics' Integrated Postsecondary Education Data System, (n.d.), http://nces.ed.gov/ipeds/trendgenerator/tganswer.aspx?sid=2&qid=2.
[67] Texas Higher Education Enrollments, Texas Higher Education Coordinating Board, http://www.thecb.state.tx.us/reports/DocFetch.cfm?DocID=6952&Format=XLS.
[68] Degrees Awarded – by award level, curriculum area (all CIPs) by institution for selected institution(s), year(s), award level(s), Texas Higher Education Coordinating Board, http://reports.thecb.state.tx.us/approot/dwprodrpt/gradmenu.htm.
[69] Texas Higher Education Enrollments, Texas Higher Education Coordinating Board, http://www.thecb.state.tx.us/reports/DocFetch.cfm?DocID=6952&Format=XLS.
[70] Fast Facts 2016, https://www.utsystem.edu/sites/utsfiles/documents/strategic-initiatives/fast-facts-2016/fast-facts-2016-ql-2016-07.pdf.
[71] Fast Facts 2016, https://www.utsystem.edu/sites/utsfiles/documents/strategic-initiatives/fast-facts-2016/fast-facts-2016-ql-2016-07.pdf.
[72] The University of Texas System Office of Health Affairs, https://www.utsystem.edu/offices/health-affairs
[73] About Us: Facts and Figures, UT Southwestern Medical Center, http://www.utsouthwestern.edu/about-us/facts/
[74] The University of Texas Medical Branch at Galveston, The University of Texas System, https://www.utsystem.edu/institutions/university-texas-medical-branch-galveston
[75] About UTHealth, UTHealth: The University of Texas Health Science Center at Houston, https://www.uth.edu/index/about.htm
[76] UT Health San Antonio, http://www.uthscsa.edu/
[77] Health Science Center Facts, UT Health Science Center San Antonio, http://uthscsa.edu/op/vital/
[78] Health Science Center Facts, UT Health Science Center San Antonio, http://uthscsa.edu/op/vital/
[79] Why MD Anderson, The University of Texas MD Anderson Cancer Center, https://www.mdanderson.org/patients-family/becoming-our-patient/why-md-anderson.html
[80] Institutional Profile, The University of Texas MD Anderson Cancer Center, https://www.mdanderson.org/about-md-anderson/facts-history/institutional-profile.html
[81] Degree Programs, UT Health Northeast: The University of Texas Health Science Center at Tyler, https://www.uthealth.org/academic-and-medical-education/degree-programs
[82] Academic & Medical Education, UT Health Northeast: The University of Texas Health Science Center at Tyler, https://www.uthealth.org/academic-and-medical-education
[83] About Us, UT Health Northeast: The University of Texas Health Science Center at Tyler, https://www.uthealth.org/about-us
[84] 2016 Annual Check Up, Health Science Center: Texas A&M University, https://www.tamhsc.edu/about/checkup/index.html

[85] 2016 Annual Check Up, Health Science Center: Texas A&M University, https://www.tamhsc.edu/about/checkup/index.html
[86] 2016 Annual Check Up, Health Science Center: Texas A&M University, https://www.tamhsc.edu/about/checkup/index.html
[87] Just the Facts, Energy in Depth, https://energyindepth.org/just-the-facts/.
[88] Just the Facts, Energy in Depth, https://energyindepth.org/just-the-facts/.
[89] Just the Facts, Energy in Depth, https://energyindepth.org/just-the-facts/; Hot Rocks, The Economist, August 16, 2014, http://www.economist.com/news/business/21612193-why-geothermal-new-fracking-hot-rocks.
[90] Just the Facts, Energy in Depth, https://energyindepth.org/just-the-facts; What are the Superfund Site "NPL" Statues?, TOXMAP, (n.d.), http://toxmap.nlm.nih.gov/toxmap/faq/2009/08/what-are-the-superfund-site-npl-statuses.html.
[91] Just the Facts, Energy in Depth, https://energyindepth.org/just-the-facts.
[92] Just the Facts, Energy in Depth, https://energyindepth.org/just-the-facts/.
[93] Just the Facts, Energy in Depth, https://energyindepth.org/just-the-facts/.
[94] Just the Facts, Energy in Depth, https://energyindepth.org/just-the-facts/.
[95] Just the Facts, Energy in Depth, https://energyindepth.org/just-the-facts/.
[96] Just the Facts, Energy in Depth, https://energyindepth.org/just-the-facts/.
[97] Just the Facts, Energy in Depth, https://energyindepth.org/just-the-facts/.
[98] Just the Facts, Energy in Depth, https://energyindepth.org/just-the-facts/.
[99] Just the Facts, Energy in Depth, https://energyindepth.org/just-the-facts/.
[100] Just the Facts, Energy in Depth, https://energyindepth.org/just-the-facts/.
[101] Just the Facts, Energy in Depth, https://energyindepth.org/just-the-facts/.
[102] Boyd, Danny, Water Management, Recycling, Treating Practices Enable Operators To Conserve Freshwater Supply Resources, The American Oil & Gas Reporter, March 2015, http://www.aogr.com/magazine/cover-story/recycling-treating-practices-enable-operators-to-conserve-freshwater-supply.
[103] Boyd, Danny, Water Management, Recycling, Treating Practices Enable Operators To Conserve Freshwater Supply Resources, The American Oil & Gas Reporter, March 2015, http://www.aogr.com/magazine/cover-story/recycling-treating-practices-enable-operators-to-conserve-freshwater-supply.
[104] Gay, Marcus Oliver and Andrew Slaughter, Water management, a new paradigm for the oil and gas sector, IHS Market Energy Blog, January 13, 2014, http://blog.ihs.com/q11-water-management-a-new-paradigm-for-the-oil-and-gas-sector.
[105] Gay, Marcus Oliver and Andrew Slaughter, Water management, a new paradigm for the oil and gas sector, IHS Market Energy Blog, January 13, 2014, http://blog.ihs.com/q11-water-management-a-new-paradigm-for-the-oil-and-gas-sector.
[106] Gay, Marcus Oliver and Andrew Slaughter, Water management, a new paradigm for the oil and gas sector, IHS Market Energy Blog, January 13, 2014, http://blog.ihs.com/q11-water-management-a-new-paradigm-for-the-oil-and-gas-sector.
[107] Gay, Marcus Oliver and Andrew Slaughter, Water management, a new paradigm for the oil and gas sector, IHS Market Energy Blog, January 13, 2014, http://blog.ihs.com/q11-water-management-a-new-paradigm-for-the-oil-and-gas-sector.
[108] Gay, Marcus Oliver and Andrew Slaughter, Water management, a new paradigm for the oil and gas sector, IHS Market Energy Blog, January 13, 2014, http://blog.ihs.com/q11-water-management-a-new-paradigm-for-the-oil-and-gas-sector.
[109] Gay, Marcus Oliver and Andrew Slaughter, Water management, a new paradigm for the oil and gas sector, IHS Market Energy Blog, January 13, 2014, http://blog.ihs.com/q11-water-management-a-new-paradigm-for-the-oil-and-gas-sector.
[110] Boyd, Danny, Water Management, Recycling, Treating Practices Enable Operators To Conserve Freshwater Supply Resources, The American Oil & Gas Reporter, March 2015, http://www.aogr.com/magazine/cover-story/recycling-treating-practices-enable-operators-to-conserve-freshwater-supply; Gay, Marcus Oliver and Sarah Fletcher, Hydraulic Fracturing, The American Oil & Gas Reporter, May 2014, http://www.aogr.com/web-exclusives/exclusive-story/strategies-assure-water-availability.
[111] Gay, Marcus Oliver and Sarah Fletcher, Hydraulic Fracturing, The American Oil & Gas Reporter, May 2014, http://www.aogr.com/web-exclusives/exclusive-story/strategies-assure-water-availability.
[112] Gay, Marcus Oliver and Andrew Slaughter, Water management, a new paradigm for the oil and gas sector, IHS Market Energy Blog, January 13, 2014, http://blog.ihs.com/q11-water-management-a-new-paradigm-for-the-oil-and-gas-sector.
[113] Davis, Carolyn, U.S. Unconventionals Water Management Now $8B Market, Say IHS, Water & Wastewater International, November 8, 2013, http://www.waterworld.com/articles/wwi/print/volume-28/issue-5/regional-spotlight-us-caribbean/fracking-wastewater-management.html.
[114] Dunes Sagebrush Lizard *Sceloporus arenicolus*, WildEarth Guardians, (n.d.), http://www.wildearthguardians.org/site/PageServer?pagename=species_reptiles_sand_dune_lizard&AddInterest=1103#.V-wplPArKUk.
[115] Dunes Sagebrush Lizard *Sceloporus arenicolus*, WildEarth Guardians, (n.d.), http://www.wildearthguardians.org/site/PageServer?pagename=species_reptiles_sand_dune_lizard&AddInterest=1103#.V-wplPArKUk.

[116] Dunes Sagebrush Lizard *Sceloporus arenicolus*, WildEarth Guardians, (n.d.), http://www.wildearthguardians.org/site/PageServer?pagename=species_reptiles_sand_dune_lizard&AddInterest=1103#.V-wplPArKUk.
[117] Dunes Sagebrush Lizard *Sceloporus arenicolus*, WildEarth Guardians, (n.d.), http://www.wildearthguardians.org/site/PageServer?pagename=species_reptiles_sand_dune_lizard&AddInterest=1103#.V-wplPArKUk.
[118] Landmark Conservation Agreements Keep Dunes Sagebrush Lizard off the Endangered Species List in NM, TX, U.S. Department of the Interior, June 13, 2012, https://www.fws.gov/southwest/es/Documents/R2ES/NR_for_DSL_Final_Determination_13June2012.pdf.
[119] Groups struggle to preserve habitat of West Texas lizard, The Daily Texan, April 12, 2013, http://www.dailytexanonline.com/news/2013/04/12/groups-struggle-to-preserve-habitat-of-west-texas-lizard; Endangered and Threatened Wildlife and Plants; Withdrawal of the Proposed Rule to List Dunes Sagebrush Lizard, Federal Register, Vol. 77, No. 118, June 19, 2012, https://www.gpo.gov/fdsys/pkg/FR-2012-06-19/pdf/2012-14818.pdf; Denny, Jemma, The Texas Conservation Plan: The Good, The Bad, and the Lizard, Ecosystem Marketplace, June 18, 2012, http://www.ecosystemmarketplace.com/articles/the-texas-conservation-plan-the-good-the-bad-and-the-lizard/.
[120] Davis, John, Texas Tech Dunes Sagebrush Lizard research Used in Senator's Plea to Postpone Endangered Listing, Texas Tech University, December 2, 2011, http://today.ttu.edu/posts/2011/12/texas-tech-dunes-sagebrush-lizard-research-used-in-senators-plea-to-postpone-endangered-listing.
[121] Groups struggle to preserve habitat of West Texas lizard, The Daily Texan, April 12, 2013, http://www.dailytexanonline.com/news/2013/04/12/groups-struggle-to-preserve-habitat-of-west-texas-lizard.
[122] Davis, John, Texas Tech Dunes Sagebrush Lizard research Used in Senator's Plea to Postpone Endangered Listing, Texas Tech University, December 2, 2011, http://today.ttu.edu/posts/2011/12/texas-tech-dunes-sagebrush-lizard-research-used-in-senators-plea-to-postpone-endangered-listing.
[123] Landmark Conservation Agreements Keep Dunes Sagebrush Lizard off the Endangered Species List in NM, TX, U.S. Department of the Interior, June 13, 2012, https://www.fws.gov/southwest/es/Documents/R2ES/NR_for_DSL_Final_Determination_13June2012.pdf; Implementing the Texas Conservation Plan for the Dunes Sagebrush Lizard, Texas A&M University, (n.d.), https://irnr.tamu.edu/media/392711/dsl.pdf.
[124] Texas Conservation Plan for the Dunes Sagebrush Lizard (Sceloporus Arenicolus), Fish and Wildlife Service, September 27, 2011, https://www.fws.gov/southwest/es/documents/r2es/tx_cons_plan_dsl_20110927.pdf, p. 1.
[125] Texas Conservation Plan for the Dunes Sagebrush Lizard (Sceloporus Arenicolus), Fish and Wildlife Service, September 27, 2011, https://www.fws.gov/southwest/es/documents/r2es/tx_cons_plan_dsl_20110927.pdf, p. 1, 11-12, 38, 49.
[126] Texas Conservation Plan for the Dunes Sagebrush Lizard (Sceloporus Arenicolus), Fish and Wildlife Service, September 27, 2011, https://www.fws.gov/southwest/es/documents/r2es/tx_cons_plan_dsl_20110927.pdf, p. 16.