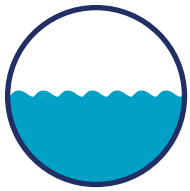
NATURAL GAS DEVELOPMENT

SAVES TEXAS WATER

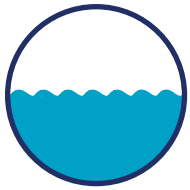
A NORTH TEXANS FOR NATURAL GAS SPECIAL REPORT

KEY FACTS

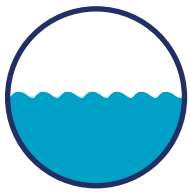
Natural gas-fired electricity generation saves far more water than what's used during production, including water used for hydraulic fracturing, or 'fracking.' When compared to other major sources of baseload power, natural gas uses between 60 and 70 percent less water.



Water used in energy development amounts to a little more than one percent of all water used in Texas. Water used for fracking specifically amounts to only about 0.5 percent.



Water use for energy development in Texas is expected to decline significantly -- more than 16 billion gallons per year -- in the coming decades.



Natural gas provides a critical and flexible backstop for intermittent renewable power that's increasingly being added to the Texas electric grid. Since renewables are also non-water-intensive, this further helps reduce water consumption in Texas.

Natural gas production has been an economic boon for Texas. This is especially true in North Texas, which is home to the Barnett Shale, one of the largest producing natural gas fields in the world. According to a study released in 2014 by the Perryman Group, the Barnett Shale has helped support more than one million Texas jobs since 2001, generating $120 billion in total economic impact over the same period, and $11.2 billion in tax revenue for local governments.

The fact that energy production is a key part of the Texas economy is nothing new. But natural gas development in Texas has another important benefit that is often overlooked: it helps conserve precious water resources.

This report examines how increased use of Texas-produced natural gas helps save water; how water used in the energy development process compares to other uses in Texas; and how natural gas complements intermittent renewables, which are also non-water-intensive.

POWER GENERATION

NATURAL GAS IS GROWING IN IMPORTANCE AS A SOURCE OF ELECTRICITY IN TEXAS, AND IT IS A CRITICAL PART OF THE STATE'S GENERATION PORTFOLIO. THIS HAS PROVIDED CHEAPER ENERGY BILLS AND ENVIRONMENTAL BENEFITS, INCLUDING LOWER AIR EMISSIONS. IN ADDITION TO THESE BENEFITS, IT ALSO USES LESS WATER THAN OTHER COMMON SOURCES.

Scientists and environmentalists have long recognized the water-related benefits of natural gas. Writing about the U.S. Environmental Protection Agency proposal called the "Clean Power Plan" (CPP), Kate Zerrenner of the Environmental Defense Fund (EDF) observed an important and sometimes overlooked benefit to moving toward lower-carbon fuels, such as natural gas:

> "Switching to more natural gas is another way Texas can meet the CPP requirements while cleaning our air and ***reducing our water consumption.***"

A 2013 study by researchers at the University of Texas at Austin (UT), published in the journal Environmental Research Letters, quantified these water savings. Based on an analysis of water use data from national and state regulatory bodies, the UT researchers concluded that water savings linked to natural gas are significant:

> "Since the 1990s, the primary type of power plant built in Texas has been the natural gas combined cycle (NGCC) plant with cooling towers, which uses fuel and cooling water more efficiently than older steam turbine technologies. About a third of Texas power plants are NGCC. ***NGCC plants consume about a third as much water as coal steam turbine (CST) plants.***"

Moreover, the study concludes that by shifting its power generation mix toward more natural gas, ***Texas could reduce its freshwater consumption by 53 billion gallons per year.*** As EDF's Zerrenner has noted, this is 60 percent of the entire water footprint of coal generation in the state.

> "The bottom line is that boosting natural gas production and using more natural gas in power generation makes our electric grid more drought resilient."
>
> –Dr. Bridget Scanlon, Jackson School of Geosciences, Bureau of Economic Geology, University of Texas at Austin

According to data compiled by researchers from the University of Colorado at Boulder and the National Renewable Energy Laboratory, the life cycle water consumption of natural gas – from production through combustion for electricity – is between ***60 and 70 percent less than other baseload power sources*** on a gallons-per-megawatt-hour (gal/MWh) basis.

WHAT ABOUT FRACKING?

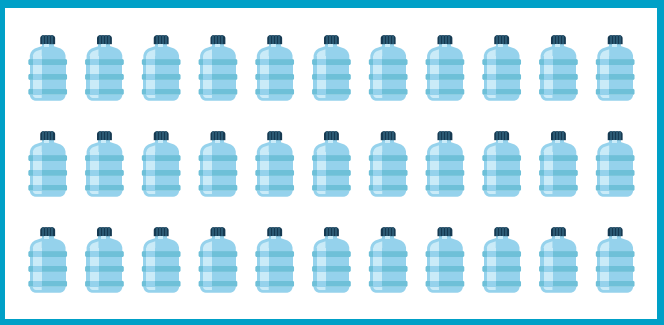
Critics have frequently alleged that hydraulic fracturing ("fracking") requires significant quantities of water, putting precious local resources at risk. While it is true that fracking can require several million gallons of water, that quantity is dwarfed by the amount of water saved by using more natural gas in Texas.

The UT researchers calculated that the use of natural gas to generate electricity ***saves Texas a net 33 gallons of water for every gallon used statewide in the fracking process.***

The UT team further estimated that moving to natural gas-generated electricity saves **25 to 50 times more water** than the amount of water used in the fracking process.

WATER SAVINGS FROM FUEL SHIFT

FOR EVERY GALLON OF WATER USED TO PRODUCE NATURAL GAS THROUGH HYDRAULIC FRACTURING



TEXAS SAVED 33 GALLONS OF WATER BY GENERATING ELECTRICITY WITH THAT NATURAL GAS INSTEAD OF COAL (IN 2011)

Water savings are not the only benefits from shifting power generation toward natural gas. As Paul Faeth, director of energy, water and climate at the Institute for Public Research at the Center for Naval Analyses (CNA), has written:

> "Natural gas is also an important component of Texas' water-saving future. The boom in shale gas fracking, which started in Texas and spread to Pennsylvania and other states, has cut the price of natural gas about 75 percent in the last five years. At current prices, electricity generation from natural gas is much cheaper than coal. Construction of coal-fired power plants has stopped in favor of gas plants, and old coal plants are being converted to gas or shut down across the country…
>
> Fracking is playing a much bigger role in pushing out coal than new regulations. There is a **great water advantage** in moving from coal to gas, too, as natural gas is typically about twice as efficient and so needs just half the water for cooling. **When gas replaces coal in power generation, it not only cuts water use but also eliminates coal's emission of mercury, sulfur dioxide and particulates, and it reduces nitrogen oxide emissions by 90 percent. Carbon dioxide emissions are also cut by 50 percent.**

While the increased and rapid adoption of natural gas as an electricity generation source is good news in terms of water savings, the question remains: *is natural gas development still a major consumer of water at a time when conservation is critical?*

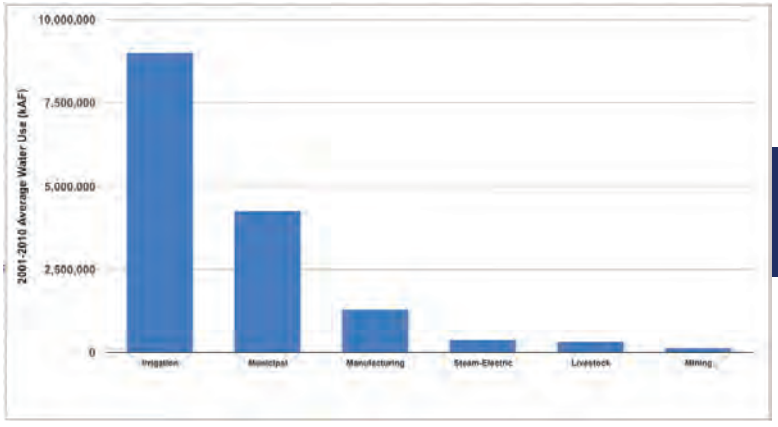
WATER USE IN PERSPECTIVE

WATER USED IN ENERGY DEVELOPMENT AMOUNTS TO A LITTLE MORE THAN ONE PERCENT OF ALL WATER USED IN TEXAS. WATER USED FOR FRACKING SPECIFICALLY AMOUNTS TO ONLY ABOUT 0.5 PERCENT. THIS IS SIMILAR TO THE REST OF THE COUNTRY, WHERE FRACKING ACCOUNTS FOR ABOUT 0.3 PERCENT OF TOTAL U.S. FRESHWATER CONSUMPTION.

Any economic development – be it renewable energy production or home building – requires water, and natural gas development is no exception. The amount that any given industrial process consumes may sound like a lot, but the only way to fully assess the "water footprint" of any source of demand is to put all uses in proper perspective.

In fact, the data show that most other industries – and even some household applications – use much more water than does the energy industry, which includes but is certainly not limited to natural gas production.

Dr. Scott W. Tinker, director of the Bureau of Economic Geology at the University of Texas, has shown that irrigation is by far the largest water consumer in Texas, with energy development (a subset of "mining") being the least intensive user. The following chart was developed from his data.



AVERAGE STATE LEVEL WATER USE (ALL CATEGORIES) IN 2001-2010

Beyond this, residential lawns consume 18 times more water than fracking, according to UT professor Rusty Todd.

WATER USE IN DENTON

For a specific illustration at the local level, let's look at the numbers in Denton County. The City of Denton made headlines when it passed an illegal ban on fracking (which was later repealed by the City Council), the culmination of a campaign that used water consumption as a talking point.

But as the historical data below show, concerns about gas industry water usage in Denton County were (and still are) misplaced:

Year	Municipal	Manufacturing	Mining	Steam Electric	Irrigation	Livestock
2013	121,175	294	1,460	55	2,949	748
2012	133,143	292	1,468	86	3,428	684
2011	141,159	303	4,510	23	3,284	798
2010	113,021	365	3,279	80	2,091	799
2009	106,572	411	3,706	126	2,500	918
2008	110,278	455	4,132	122	1,475	883
2007	94,859	378	0	200	1,458	1,190
2006	114,162	440	0	639	2,750	1,160
2005	112,950	414	0	384	2,500	1,703
TOTALS	1,047,319	3,352	18,555	1,715	22,435	8,883

Source: TWDB

WATER USAGE – DENTON COUNTY, TEX. 2005-2013 (THE MOST RECENT YEAR FOR WHICH DATA ARE AVAILABLE); ALL FIGURES ARE IN ACRE-FEET

As the historical data show Denton County's municipal water use was more than 56 times higher than water used for energy development between the years 2005-2012. In 2012 in particular, the numbers are the starkest: municipal uses accounted for 90 percent more water consumption than mining. Irrigation accounted for more than double the water used in oil and gas operations in Denton County.

*STATEWIDE, EXAMINING THE CURRENT TOP TEN GAS PRODUCING COUNTIES, WE SEE THAT MUNICIPAL WATER USE IN 2013 WAS MORE THAN **10 TIMES** THAT OF OIL, NATURAL GAS, AND OTHER MINING-RELATED OPERATIONS:*

Year	County	Municipal	Manufacturing	Mining	Steam Electric (Power)	Irrigation	Livestock
2013	TARRANT	312,726	10,247	7,296	856	4,525	636
2013	WEBB	39,182	29	4,236	145	4,250	956
2013	PANOLA	4,279	813	3,424	0	322	1,057
2013	JOHNSON	21,262	1,397	594	312	663	1,436
2013	DIMMIT	2,447	0	10,186	0	4,520	310
2013	WISE	7,974	222	3,315	2,594	1,300	1,123
2013	DENTON	121,175	294	1,460	55	2,949	748
2013	DEWITT	3,333	230	3,626	0	922	1,458
2013	KARNES	3,844	131	6,057	0	961	774
2013	LA SALLE	1,738	0	8,245	0	5,924	384
2013	TOTALS	517, 960	13,363	48,439	3,962	26,336	8,882

Sources: Texas Railroad Commission and TWDB

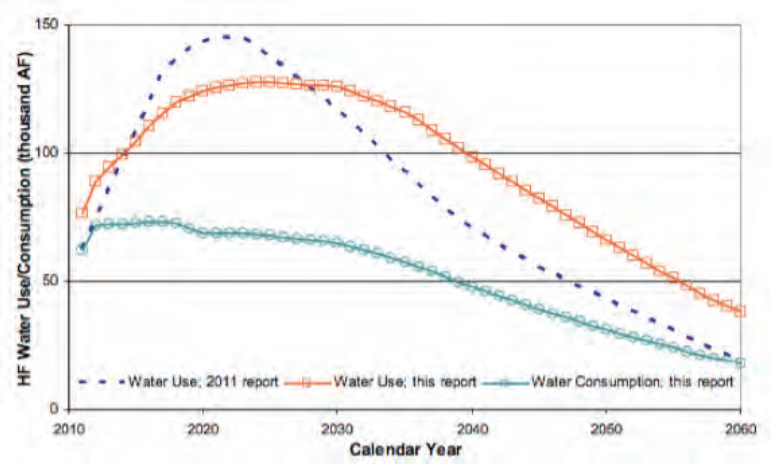
LESS WATER USE IN THE FUTURE

The good news is that, even though energy production is a comparatively small water user, water consumption from energy development is also expected to decline significantly in the coming decades.

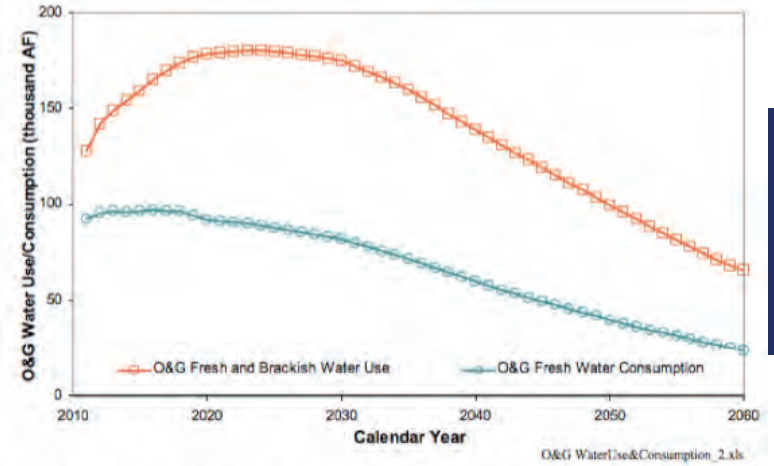
According to a 2013 University of Texas study, not only will Texas save more water as additional natural gas plants come online, but the water used for that same power generation will also decline precipitously.

In his 2012 update on water used by mining-related industries, Dr. Tinker of UT projects that water used for hydraulic fracturing, after a peak in several years, will steadily decline at least until 2060, from almost 125,000 acre-feet per year to less than 50,000 acre-feet per year ***(more than 16 billion gallons per year)***. Fresh water consumption – that is, water not returned to the water cycle after it is withdrawn – will hold steady at its current level of approximately 70,000 acre-feet per year for several years and then significantly decline.

> “ [I]rrigation is the biggest user of water in Texas, accounting for 61 percent. Municipal use follows with 27 percent, then manufacturing at 6 percent, steam electric power at 3 percent and livestock at 2 percent. The last 1 percent is made up of oil and gas and other mining activities. ”
>
> -Barnett Shale Energy Education Council



STATE-LEVEL PROJECTIONS TO 2060 OF HF WATER USE AND FRESH-WATER CONSUMPTION AND COMPARISON TO EARLIER WATER PROJECTIONS.



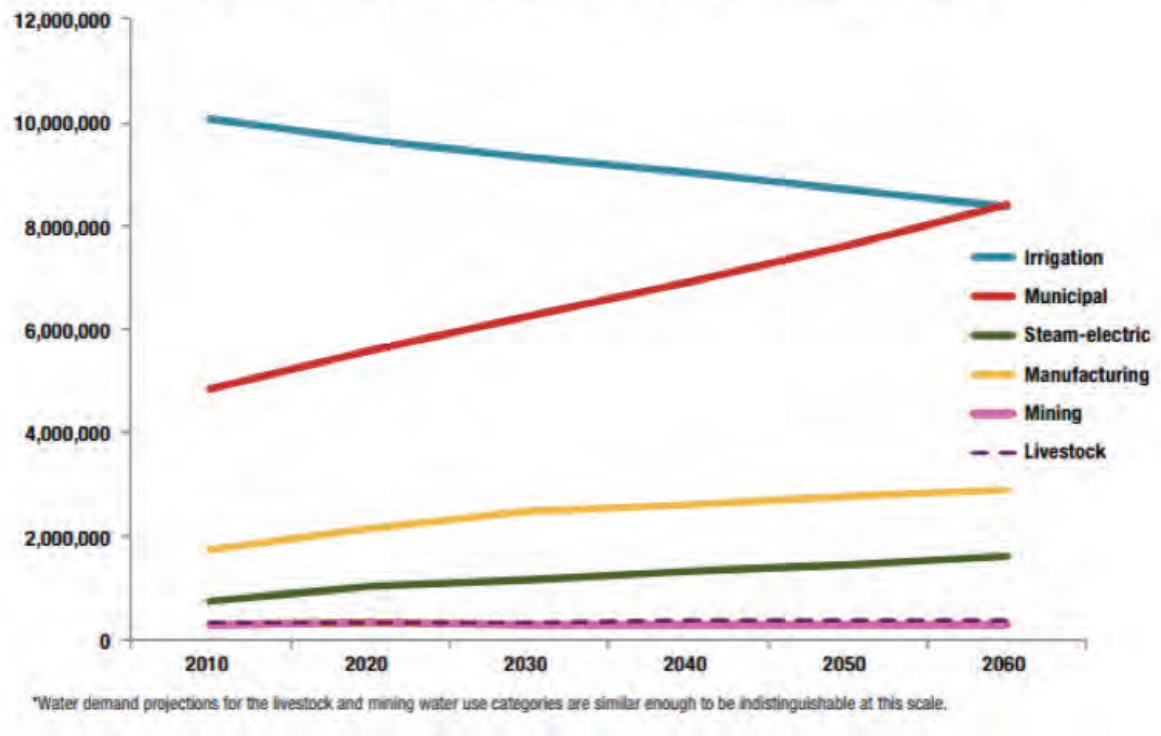
STATE-LEVEL PROJECTIONS TO 2060 OF OIL AND GAS INDUSTRY WATER USE AND FRESH-WATER CONSUMPTION

In its 2012 State Water Plan, the Texas Water Development Board provided statewide perspective and projections, which indicated that "mining" would account for ***only 1.3 percent of water demand in Texas by 2060.***

TABLE 3.3. SUMMARY OF WATER DEMAND PROJECTIONS BY USE CATEGORY FOR 2010–2060 (ACRE-FEET PER YEAR)

Category	2010	2020	2030	2040	2050	2060	Percent of 2060 Demand
Municipal	4,851,201	5,580,979	6,254,784	6,917,722	7,630,808	8,414,492	38.3%
Manufacturing	1,727,808	2,153,551	2,465,789	2,621,183	2,755,335	2,882,524	13.1%
Mining	296,230	313,327	296,472	285,002	284,640	292,294	1.3%
Steam-electric	733,179	1,010,555	1,160,401	1,316,577	1,460,483	1,620,411	7.4%
Livestock	322,966	336,634	344,242	352,536	361,701	371,923	1.7%
Irrigation	10,079,215	9,643,908	9,299,464	9,024,866	8,697,560	8,370,554	38.1%
Texas	**18,010,599**	**19,038,954**	**19,821,152**	**20,517,886**	**21,190,527**	**21,952,198**	

And while municipal water use is projected to rise steadily, overall "mining" use -- which includes more than just oil and gas development -- is expected to hold steady as the ***lowest-demand industry.***



*Water demand projections for the livestock and mining water use categories are similar enough to be indistinguishable at this scale.

COMPLEMENTING RENEWABLES

NATURAL GAS PLANTS SUPPLY "PEAKING POWER" TO HELP KEEP NON-WATER-INTENSIVE RENEWABLES – PARTICULARLY WIND – VIABLE WHEN THEIR INHERENT LIMITATIONS PREVENT THEM FROM MEETING MARKET DEMAND.

Researchers at UT have also observed an ancillary water-saving benefit linked to the use of natural gas: its ability to act as a "backstop" for renewables, in particular the steadily increasing use of wind-based electricity generation in Texas.

Texas leads the nation in installed wind generation capacity, which provides 96 percent of renewable generation in the state. However -- as is the case with solar power -- wind output is neither consistent nor controllable, and it is not always matched to electricity market demand. Natural gas, which can be brought online almost instantly, is therefore a vital complement to this renewable platform.

According to the UT study:

> "Natural gas, now ~50% of power generation in Texas, enhances drought resilience by increasing the flexibility of power plant generators, including gas combustion turbines to complement increasing wind generation and combined cycle generators with ~30% of cooling water requirements of traditional steam turbine plants. These reductions in water use are projected to continue to 2030 with increased use of natural gas and renewables."

In other words, when the wind doesn't blow, natural gas generators insure that electricity is available when needed. Given the low cost of natural gas, this means the state can achieve an important blend of consumer energy savings and reduced air emissions.

CONCLUSION

While abundant and inexpensive natural gas is a game changer for Texas' economy and for the U.S. march toward energy independence, natural gas also has a positive role to play in making our state more drought resilient.

This report has demonstrated that Texas natural gas helps save significant amounts of water, which is especially important in times of drought. While natural gas development does use water, the amount used pales in comparison to the water savings that natural gas-generated power provides.

Natural gas, which currently generates about half of Texas' power, will only become more important in the future, as the state's population continues to grow and the need for affordable, reliable power increases.