

# Manufacturing and Electric Power Water Use in Texas

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## Introduction

The purpose of this analysis is to examine trends in water use and water use intensity for the manufacturing and electric power industry in Texas.

## National Perspective

Nationally, water use by the United States has been declining for decades. The following graph is taken from the U.S. Geological Survey's 2015 publication entitled Estimated Use of Water in the United States in 2010. It shows that total use peaked around 1980 as both agricultural irrigation and total power plant withdrawals began a slow decline. Figure 2 further illustrates how total water use vs. gross domestic produce has leveled out. The implementation of the clean water acts and rising water and wastewater costs have been a major influence on this. Figure 3 shows this relationship for national manufacturing.

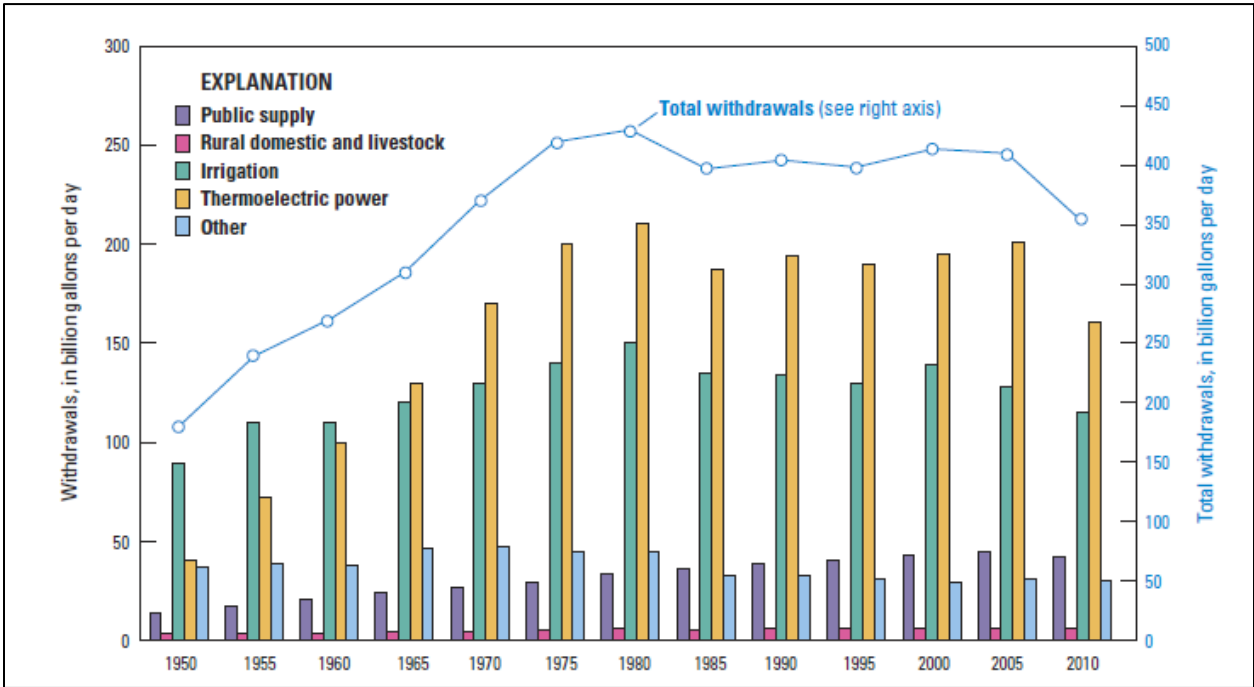


Figure 1. Total Water Use in the United States. Source: USGS 2015

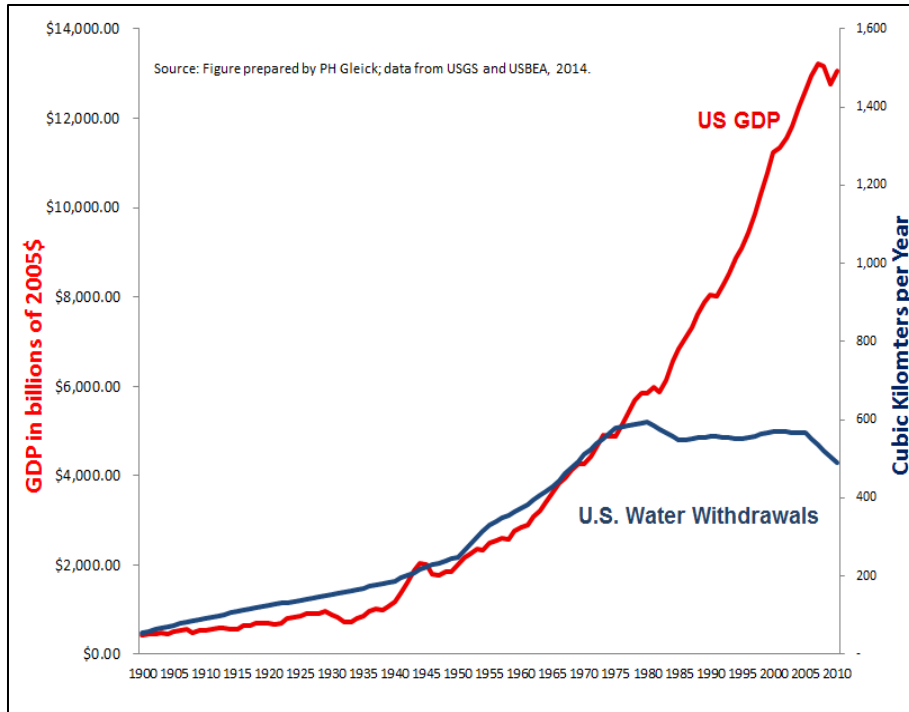


Figure 2. National Water Use vs. GDP

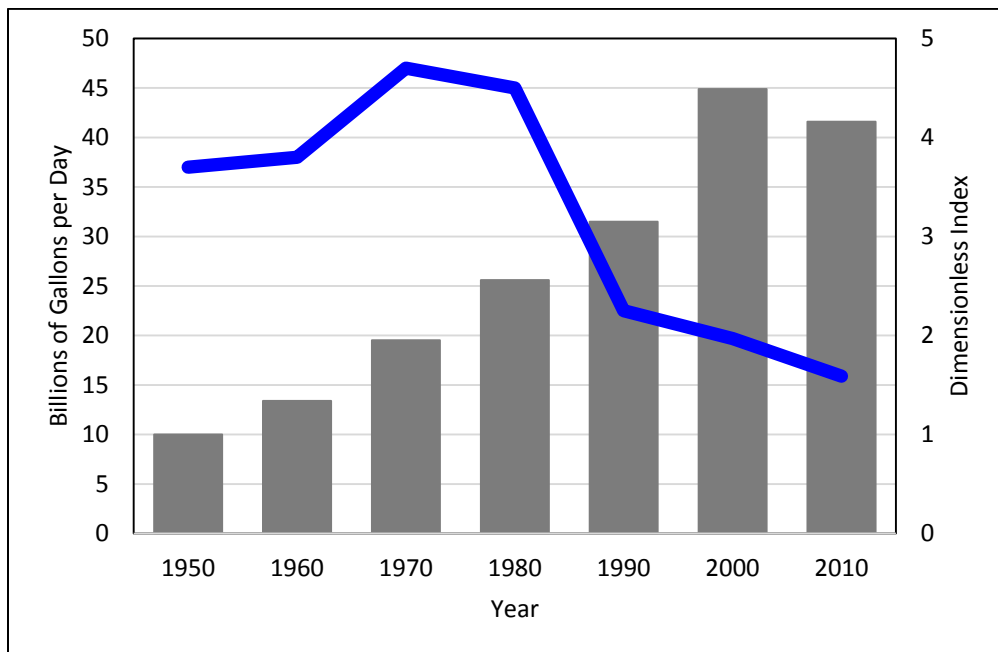


Figure 3. US Industrial Water Use vs. Output Index. Source: Bureau of Economic Analysis and US Geological Survey

Texas Manufacturing and Electric Power Generation are significant when compared to other States. We rank number one in electric power production and number two in manufacturing output. Figures 4. and 5. Summarize the manufacturing and power output of Texas.

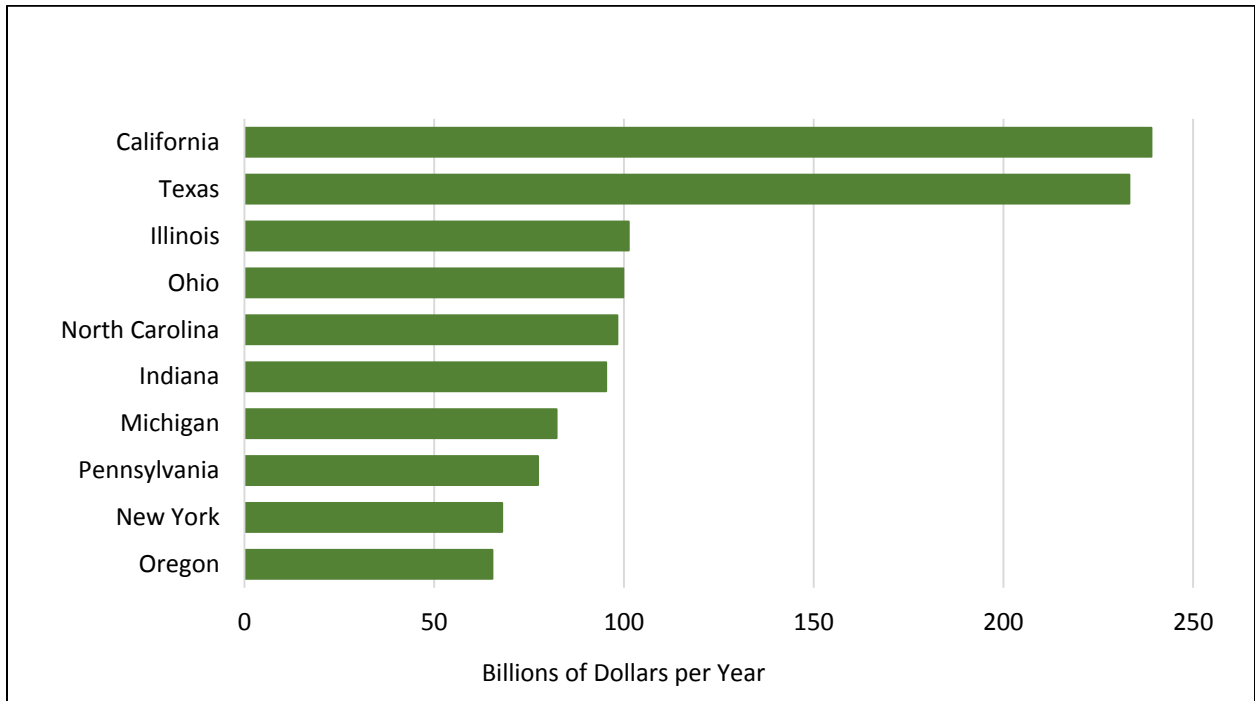


Figure 4. Top Ten States Manufacturing Output in Billions of Dollars in 2013

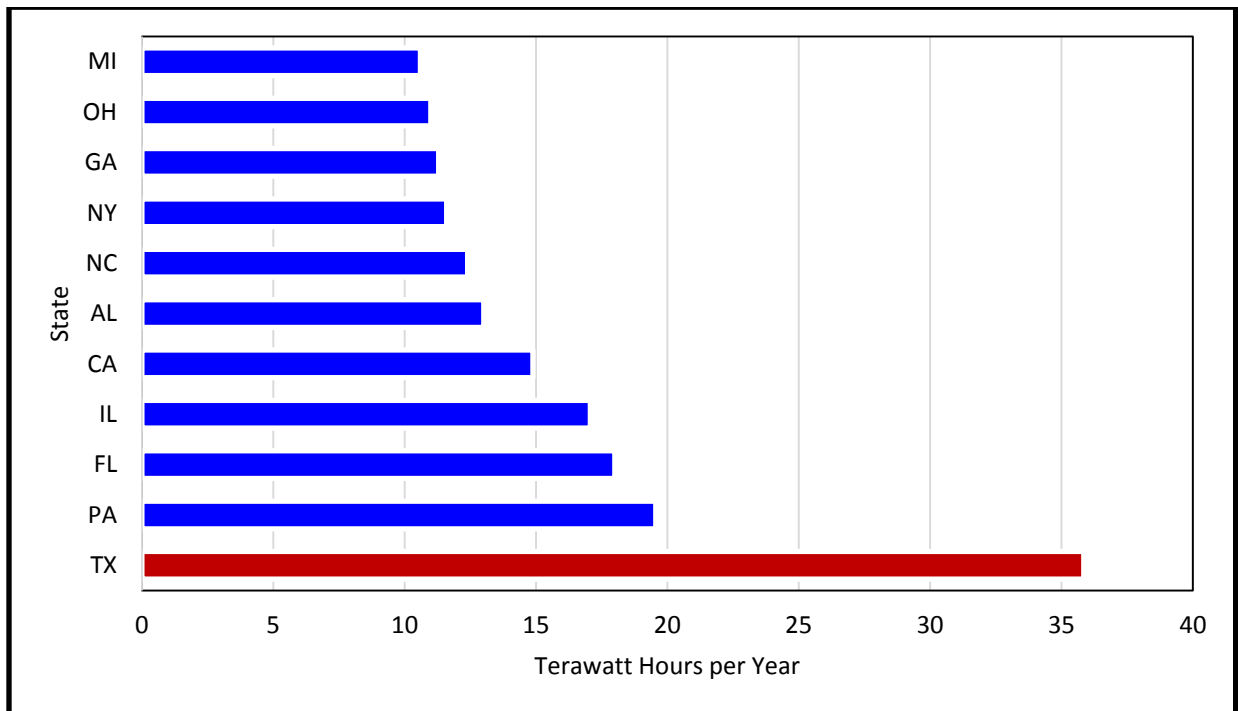


Figure 5. Texas is the largest Electricity Producer in the USA (<https://www.eia.gov/state/rankings/#/series/51>)

From an economic standpoint, manufacturing is the most significant sector on a dollar of output basis. Manufacturing also employs approximately 875,000 Texans.

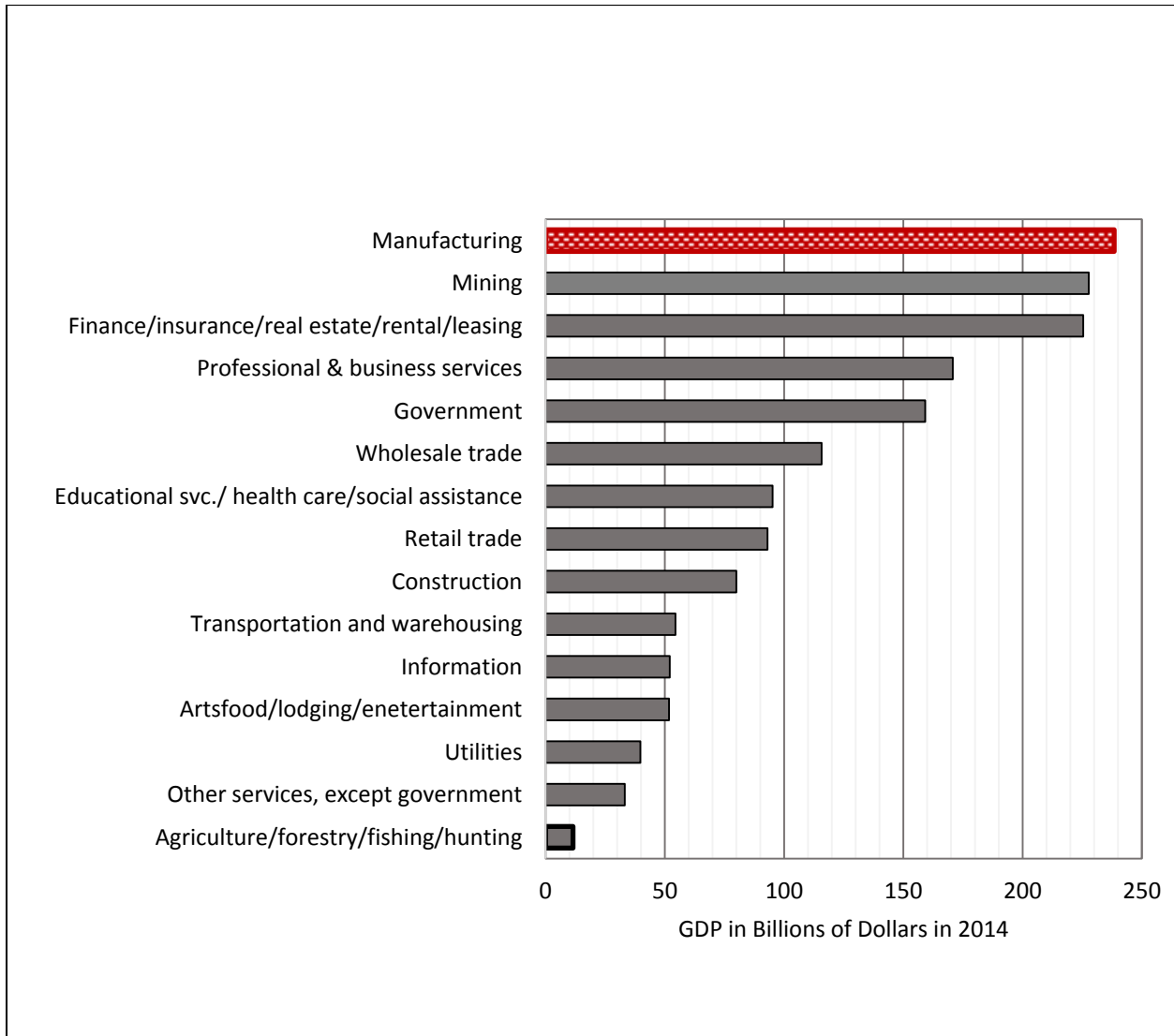


Figure 6. Texas Gross Domestic Product (GDP) in 2014 by Sector. The Texas Total GDP in 2014 =1.65 Trillion Dollars.

With respect to water use, in 2013, manufacturing used 917,324 acre feet and power generation used 444,258 acre feet. Figure 7 shows a breakdown by type of manufacturing user. The top four categories, chemicals, petroleum refining, pulp and paper and Food processing account for 85 percent of manufacturing water use. Primary metals constitutes four percent and “all other” makes up five percent. Figure 8. shows the breakdown of the “other” category in figure 7.

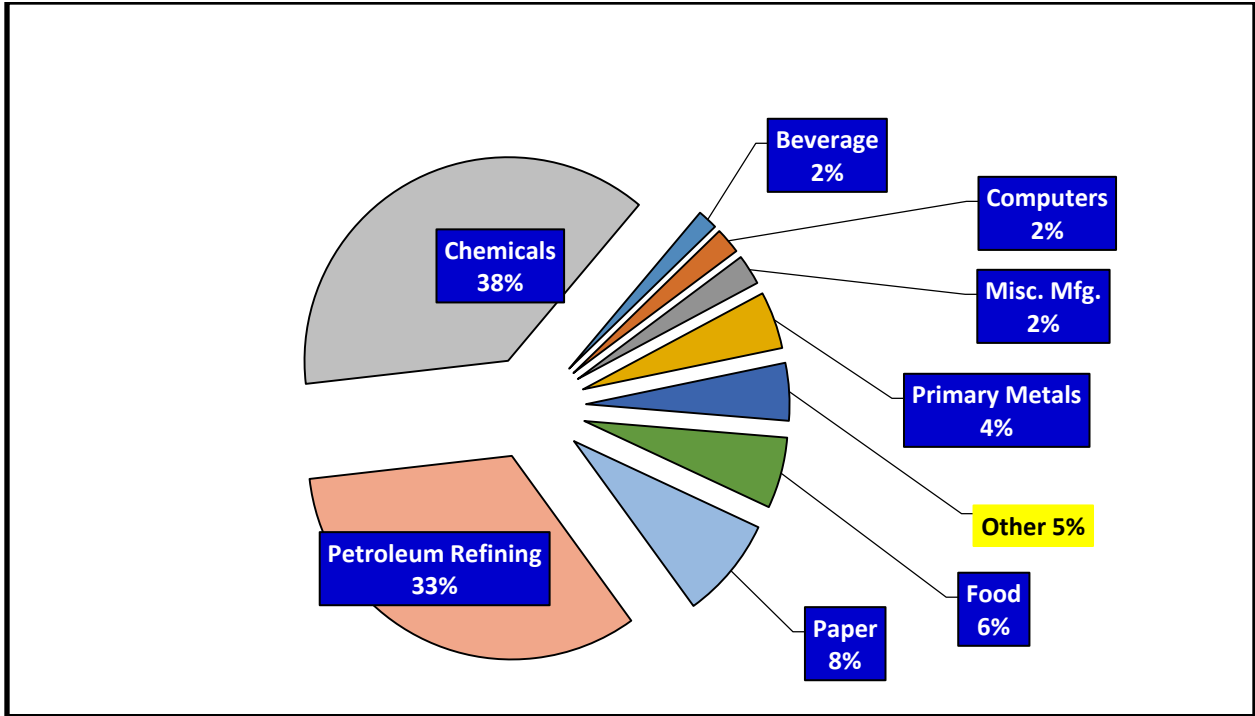


Figure 7. Manufacturing Water Use in Texas in 2013 (917,324 Acre Feet)

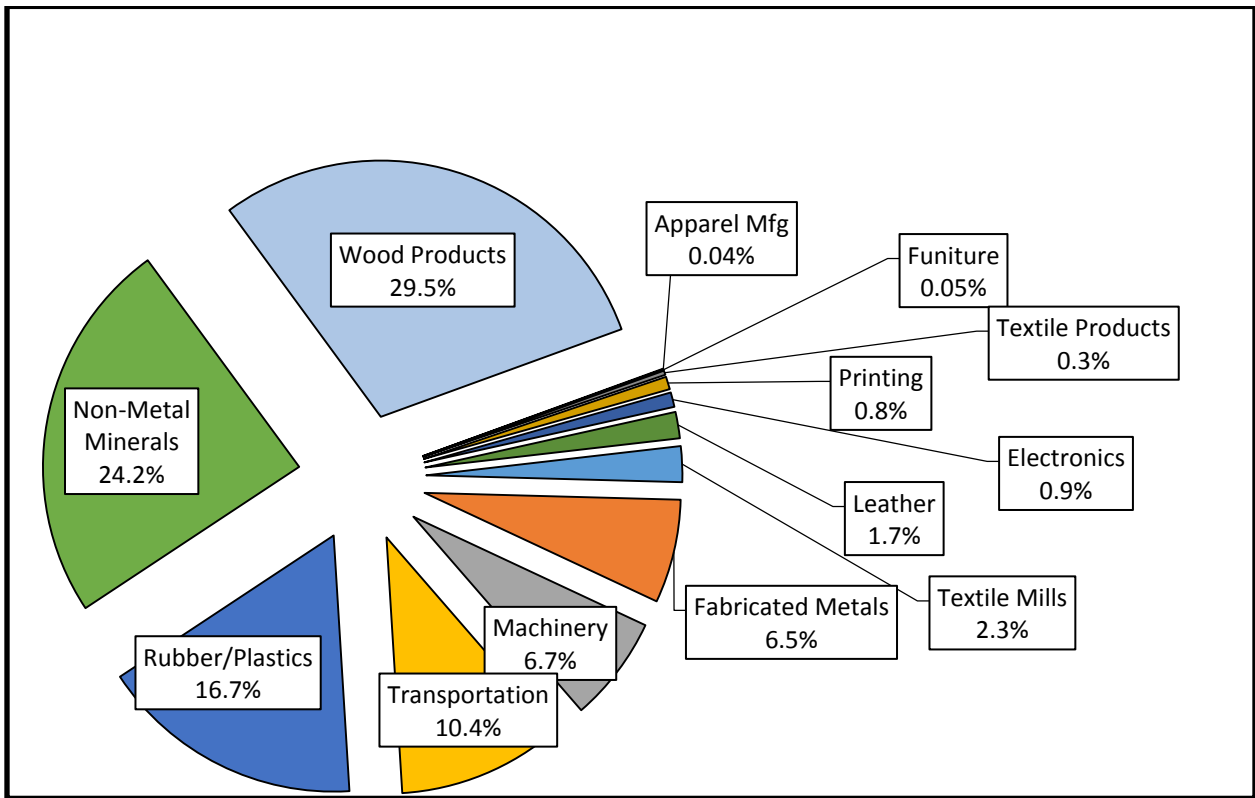


Figure 8. Breakdown of the "Other" Category of Manufacturing Water Use in 2013 Which Equals 5% of Total Manufacturing Use

Texas gross domestic manufacturing output compared to manufacturing water use is one way to examine how water use has changed over time. The US Bureau of Economic Analysis ([http://www.bea.gov/newsreleases/regional/gdp\\_state/gsp\\_newsrelease.htm](http://www.bea.gov/newsreleases/regional/gdp_state/gsp_newsrelease.htm)) changed its base year for inflation adjustment and now records output in inflation adjusted 2009 chained dollars beginning in 1997. Figure 9. shows manufacturing water use vs. manufacturing output in 2009 chained dollars and figure 10. Shows water use divided by output – gallons per dollar of output. The net result is there has been a dramatic reduction in water use per unit of output.

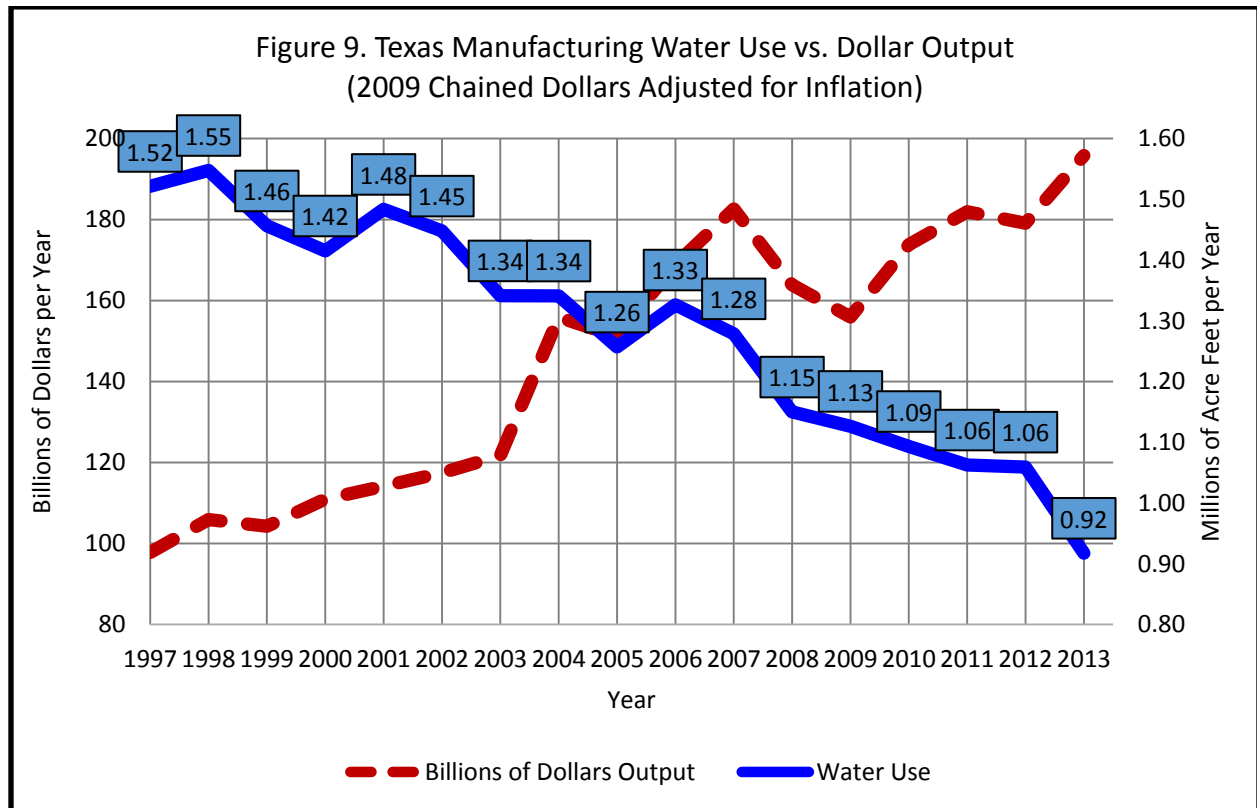


Figure 9. Texas Manufacturing Water Use vs. Dollar Output (2009 Chained Dollars Adjusted for Inflation)

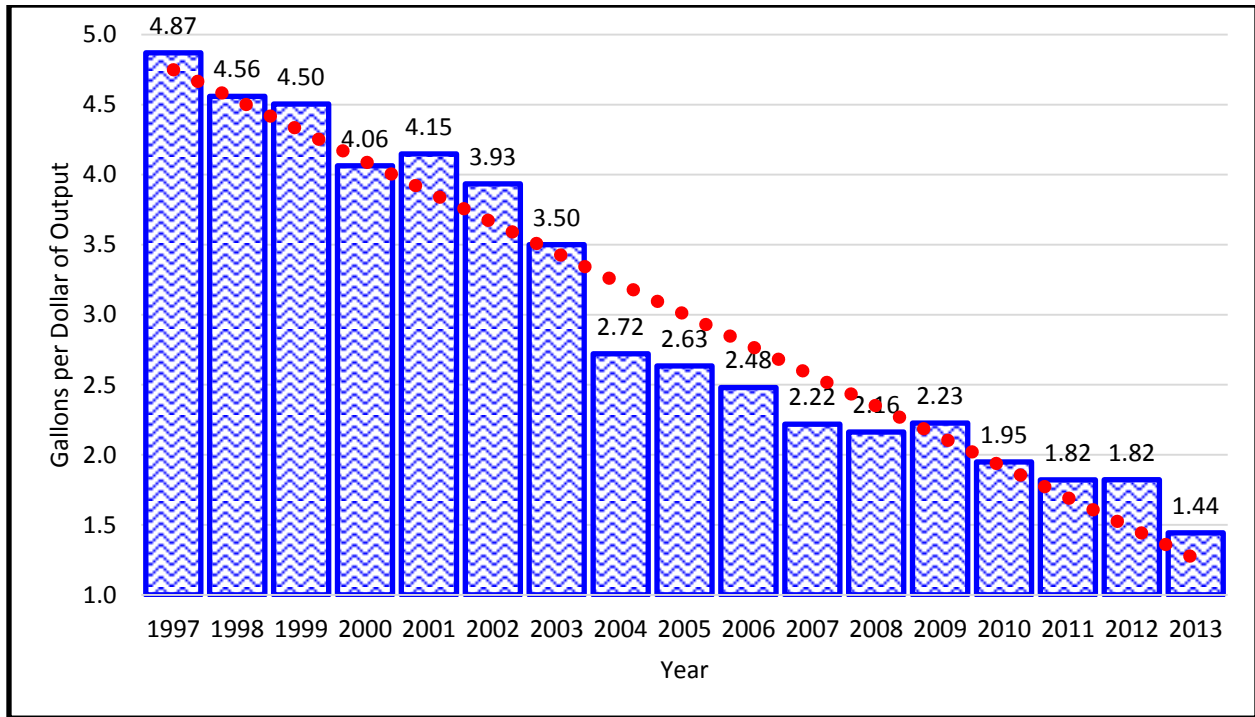


Figure 10. Gallons of Water per Dollar of Output for Manufacturing in Texas (2009 Chained Dollars Adjusted for Inflation)

Seven manufacturing industries have historically been the largest water users. Figure 11. summarizes the changes in use by these seven industries as well as the residual “All Other” category

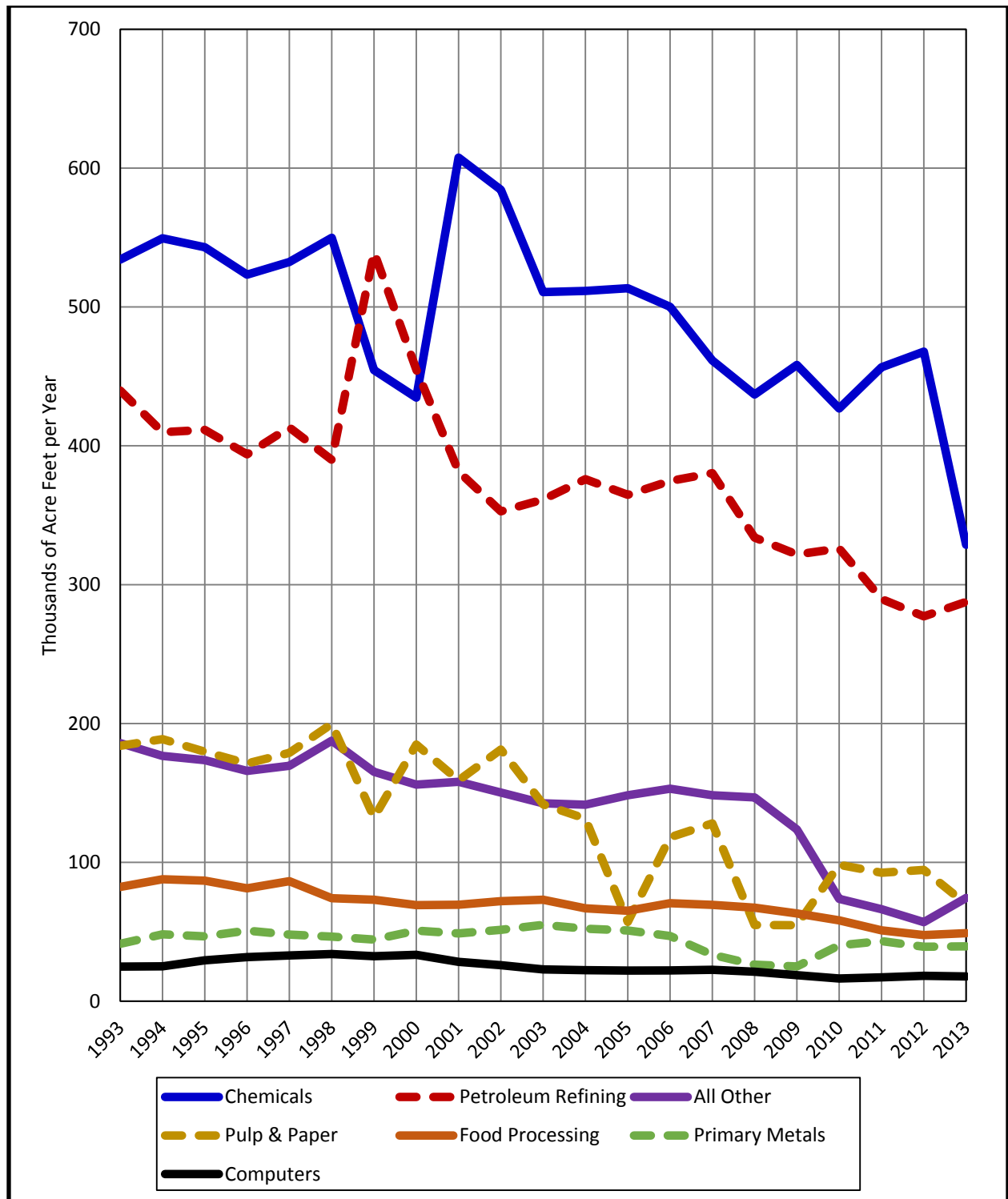


Figure 11. Historical Texas Manufacturing Water Use

Again, using the gross domestic product data from the US Bureau of Economic Analysis and water use data from Texas Water Development Board, estimates of gallons of water per dollar of output were developed. Figure 12. Shows how this analysis breaks down by individual



manufacturing category. To test this, water use by oil refining in Texas was divided by oil refining crude charge to stills, a measure of physical output for Texas. Figure 13. shows that the gallons of water per barrel of output shows identical trends.

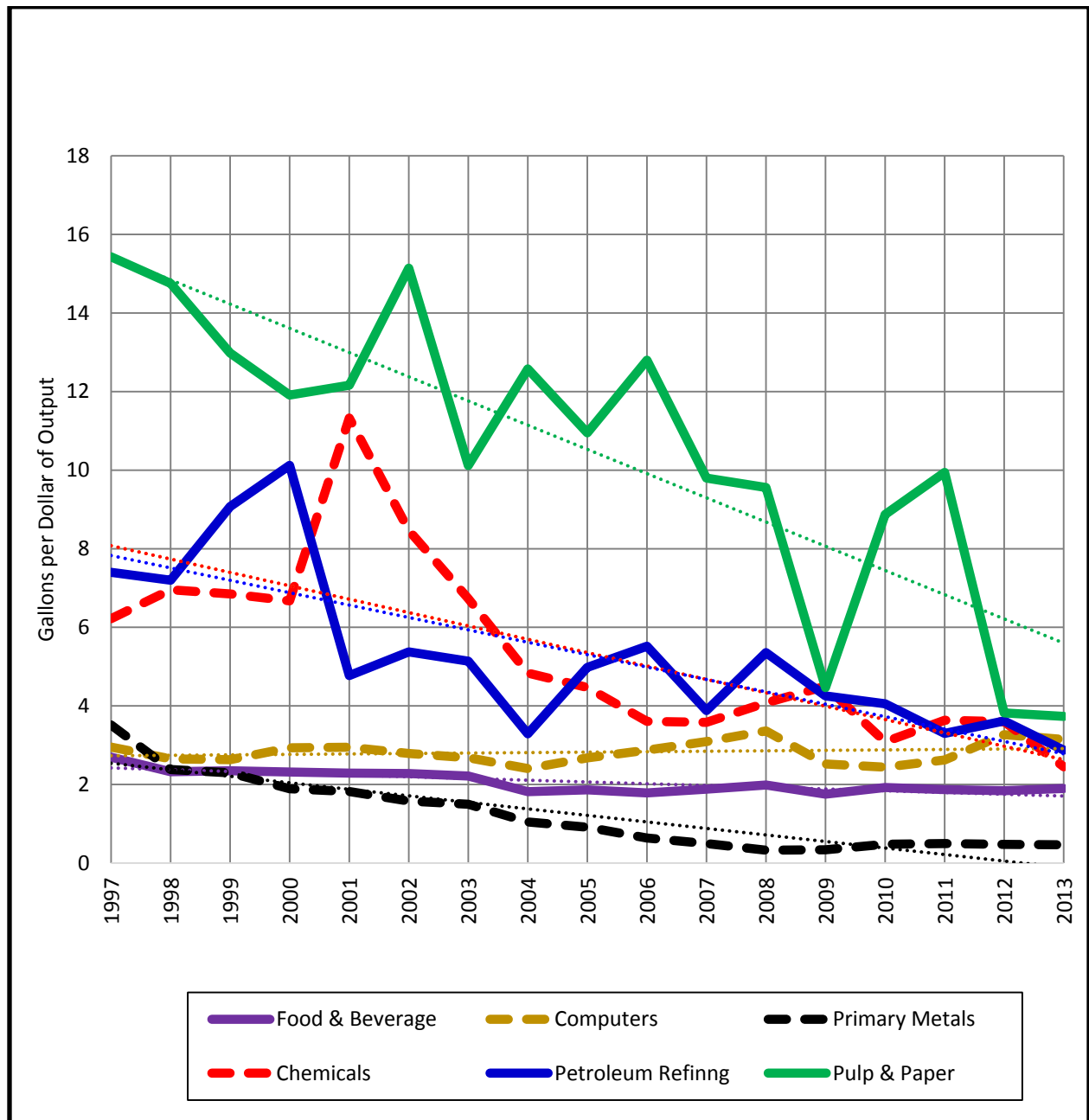


Figure 12. Water Use per Dollar of Output for Texas Industries (Gallons per Dollar of output in 2009 Chained Dollars)

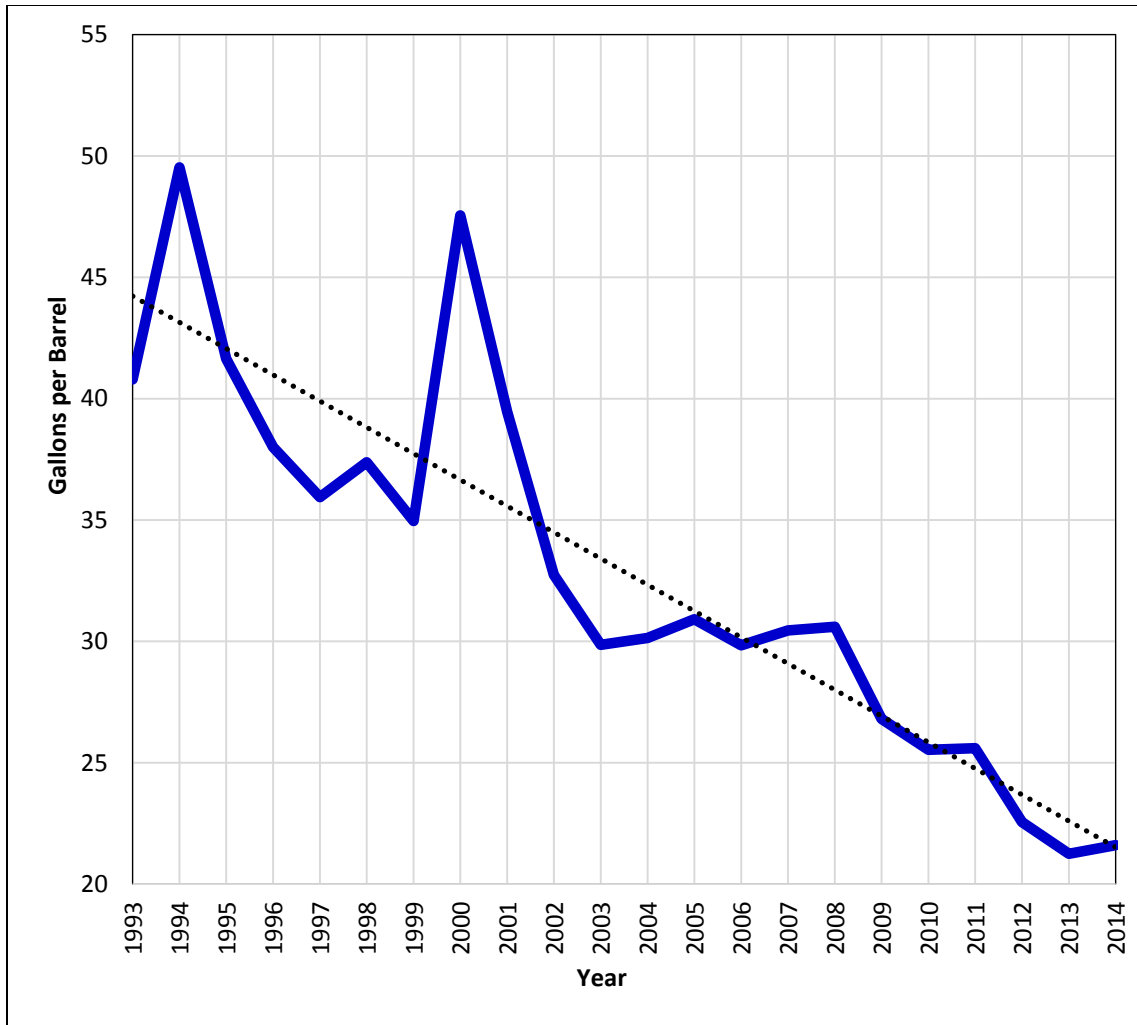


Figure 13. Gallons of Water Used per Barrel of Crude Oil Processes in Texas

One interesting finding of the analysis is the rapid growth of water use in the beverage manufacturing sector. It is assumed that the growth in micro- breweries is a major contributor to this increase (Figure 14.)

Tables A., B., and C. present the data used in the above figures.

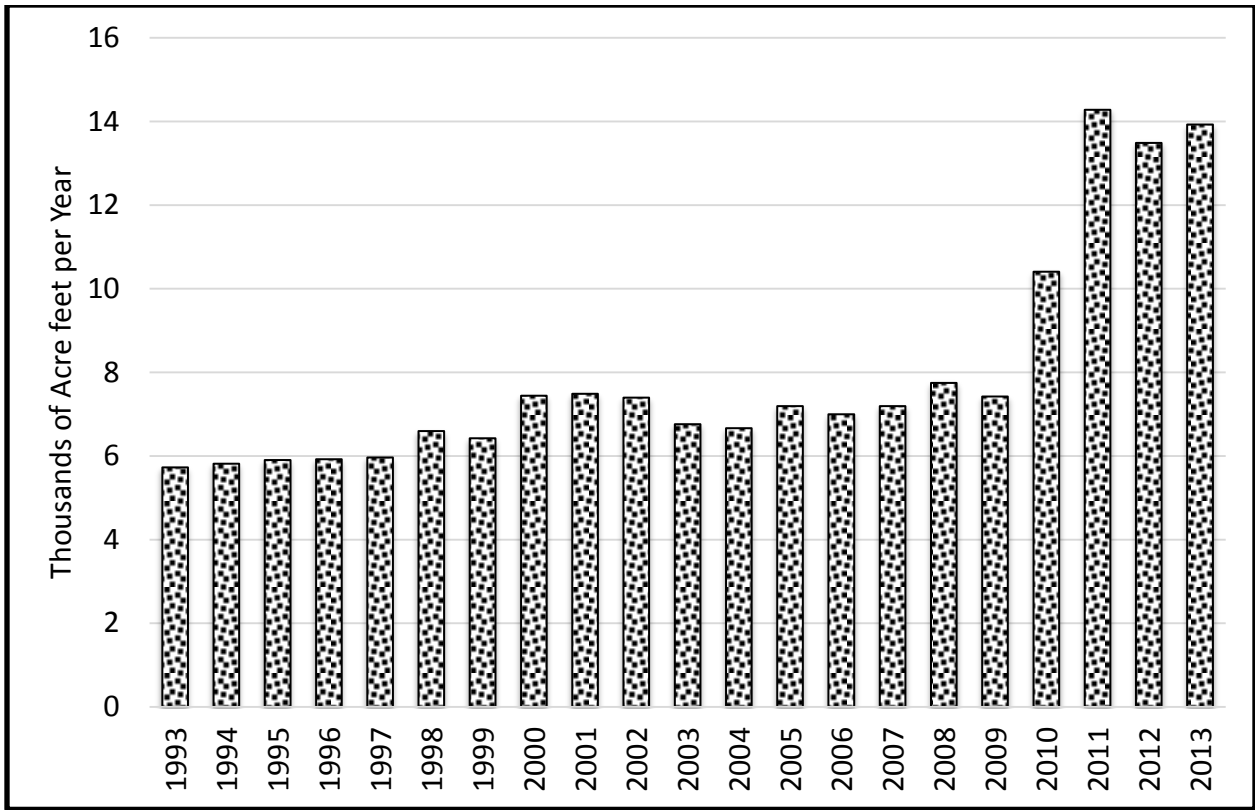


Figure 14. The Rapid Rise of Beverage Manufacturing Water Use in Texas

Tables A., B., and C. summarize the information presented in the graphics above

Table A. Water Use per Dollar of Output for Texas Industries  
(Gallons per Dollar of Output)

Year	Food & Beverage	Computers	Primary Metals	Chemicals	Petroleum Refining	Pulp & Paper
1997	2.70	2.95	3.52	6.22	7.40	15.43
1998	2.33	2.65	2.38	6.96	7.20	14.75
1999	2.35	2.63	2.30	6.85	9.07	12.98
2000	2.32	2.93	1.89	6.67	10.12	11.91
2001	2.29	2.95	1.82	11.33*	4.77	12.16
2002	2.28	2.79	1.58	8.47	5.37	15.14
2003	2.21	2.68	1.50	6.73	5.14	10.12
2004	1.82	2.41	1.05	4.83	3.29	12.58
2005	1.87	2.68	0.91	4.47	4.98	10.95
2006	1.79	2.87	0.64	3.61	5.52	12.80
2007	1.88	3.09	0.50	3.58	3.88	9.80
2008	1.99	3.36	0.33	4.08	5.36	9.56
2009	1.76	2.52	0.34	4.50	4.25	4.47
2010	1.92	2.44	0.48	3.08	4.05	8.87
2011	1.87	2.62	0.50	3.64	3.30	9.94
2012	1.84	3.27	0.48	3.60	3.62	3.82
2013	1.90	3.15	0.46	2.45	2.88	3.73

- Anomaly in gross output from Dept. of Commerce

Table B. Goss Domestic Product for Major Water Using Industries in Texas in Millions of  
2009 Chained Dollars

Source: Bureau of Economic Analysis

Year	Food & Beverage	Petroleum Refining	Chemical	Pulp & Paper	Computers	Primary Metals
1997	\$11,168	\$18,195	\$27,894	\$3,631	\$4,441	\$1,639
1998	\$11,310	\$17,646	\$25,755	\$4,173	\$6,363	\$1,814
1999	\$11,033	\$19,370	\$21,626	\$4,005	\$6,288	\$1,836
2000	\$10,782	\$14,648	\$21,228	\$3,706	\$8,746	\$2,062
2001	\$10,947	\$26,051	\$17,481	\$3,122	\$8,722	\$2,343
2002	\$11,350	\$21,395	\$22,491	\$3,023	\$10,606	\$2,128
2003	\$11,739	\$22,918	\$24,724	\$2,779	\$11,969	\$1,992
2004	\$13,176	\$37,238	\$34,478	\$3,017	\$16,259	\$2,836
2005	\$12,636	\$23,868	\$37,428	\$2,685	\$18,164	\$2,220
2006	\$14,144	\$22,129	\$45,171	\$2,504	\$24,024	\$2,322
2007	\$13,258	\$31,928	\$41,996	\$2,374	\$21,863	\$2,243
2008	\$12,312	\$20,314	\$34,923	\$2,054	\$26,085	\$2,643
2009	\$13,113	\$24,645	\$33,183	\$2,414	\$24,003	\$2,894
2010	\$11,627	\$26,213	\$45,093	\$2,176	\$27,302	\$2,492
2011	\$11,371	\$28,605	\$40,909	\$2,125	\$28,346	\$2,657
2012	\$10,800	\$24,968	\$42,341	\$1,818	\$26,812	\$2,957
2013	\$10,780	\$32,594	\$43,654	\$1,848	\$27,702	\$3,488

Table C. Annual Manufacturing Water Use in Texas for Six Largest Sectors  
*Thousands of Acre Feet per year*

Year	Food & Beverage	Petroleum Refining	Chemicals	Pulp & Paper	Computers	Primary Metals
1997	92.41	413.27	532.38	183.94	32.89	47.93
1998	80.74	389.93	549.85	188.75	33.97	46.50
1999	79.52	539.37	454.58	179.68	32.34	44.32
2000	76.65	454.95	434.71	171.19	33.37	50.79
2001	76.90	381.50	607.58	178.83	28.26	48.78
2002	79.42	352.84	584.43	199.69	25.87	51.39
2003	79.77	361.34	510.69	132.22	22.88	54.96
2004	73.55	375.98	511.58	184.82	22.28	52.16
2005	72.34	364.74	513.51	159.06	22.05	50.95
2006	77.55	374.72	500.08	181.23	22.09	46.94
2007	76.52	380.27	461.47	141.74	22.54	33.37
2008	75.06	333.91	436.98	131.39	21.21	26.27
2009	70.64	321.72	458.29	57.08	18.68	25.01
2010	68.58	326.03	426.86	118.04	16.31	40.25
2011	65.30	289.67	456.58	128.03	17.11	43.27
2012	61.06	277.15	467.83	54.83	18.23	39.18
2013	62.88	287.60	328.72	54.67	17.84	39.51

Electric power generation and water use did not follow the trends observed with manufacturing water use. Water use per kilowatt of generation actual had an increasing trend as seen in Figure 15. Table D presents the actual data. Water use is based on Texas Water Development Board data and generation is based on information from the US Energy Information Administration (<https://www.eia.gov/electricity/data/state/>).

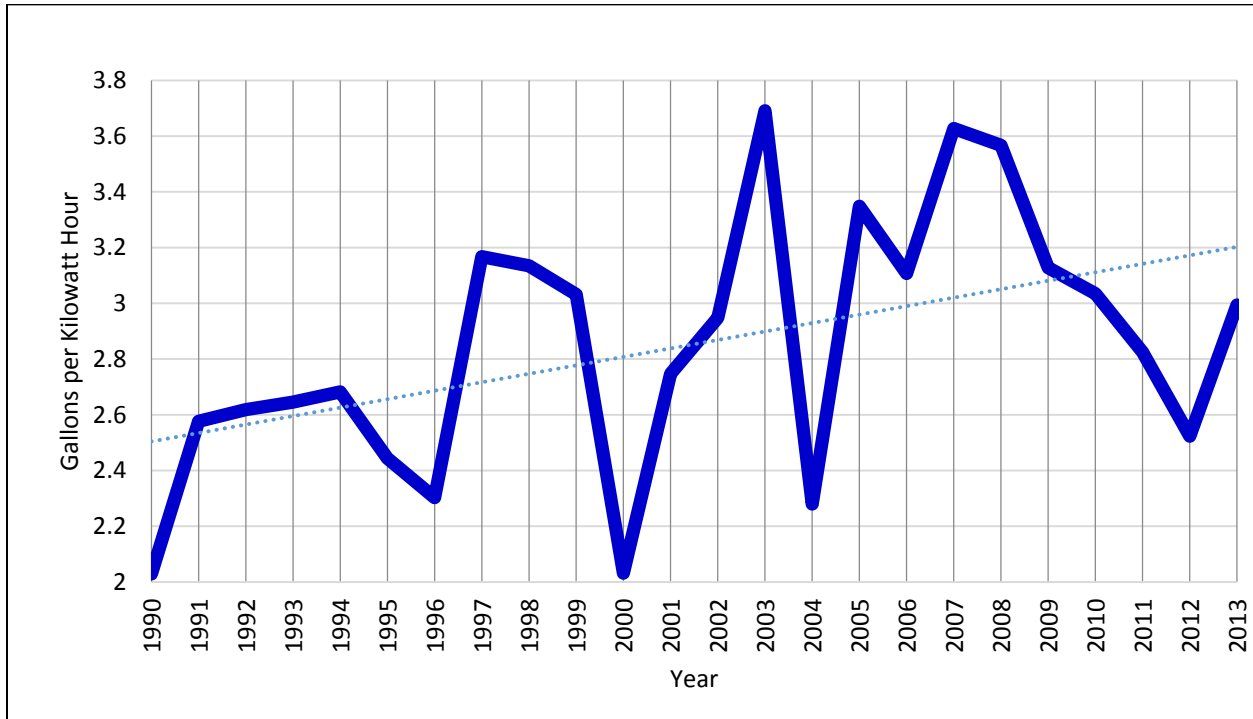


Figure 15. Gallons per Kilowatt Hour of Generation in Texas

Figure 16. shows the change in the mix of fuels used over the period from 1990 through 2013.

Table D. Historic Electric Power Generation, Water Use and Gallons per kWh for Texas			
Year	Megawatt Hours per Year	Acre Feet per Year	Gallons per Kilowatt Hour
1990	281,559,635	425,945	0.49
1991	286,328,708	341,047	0.39
1992	290,292,313	340,232	0.38
1993	299,688,715	347,656	0.38
1994	307,179,524	351,499	0.37
1995	317,636,246	398,913	0.41
1996	328,948,933	438,408	0.43
1997	336,319,510	325,890	0.32
1998	355,320,164	347,855	0.32
1999	358,944,744	363,310	0.33
2000	336,319,510	507,977	0.49
2001	372,580,002	416,206	0.36
2002	385,628,542	401,461	0.34
2003	379,199,685	315,299	0.27
2004	390,299,132	525,413	0.44
2005	396,668,722	363,607	0.30
2006	400,582,878	395,632	0.32
2007	405,492,296	343,065	0.28
2008	404,787,781	348,257	0.28
2009	397,167,910	389,726	0.32
2010	411,695,046	416,335	0.33
2011	435,476,924	473,174	0.35
2012	429812509.8	522831	0.40
2013	433380165.7	444258	0.33



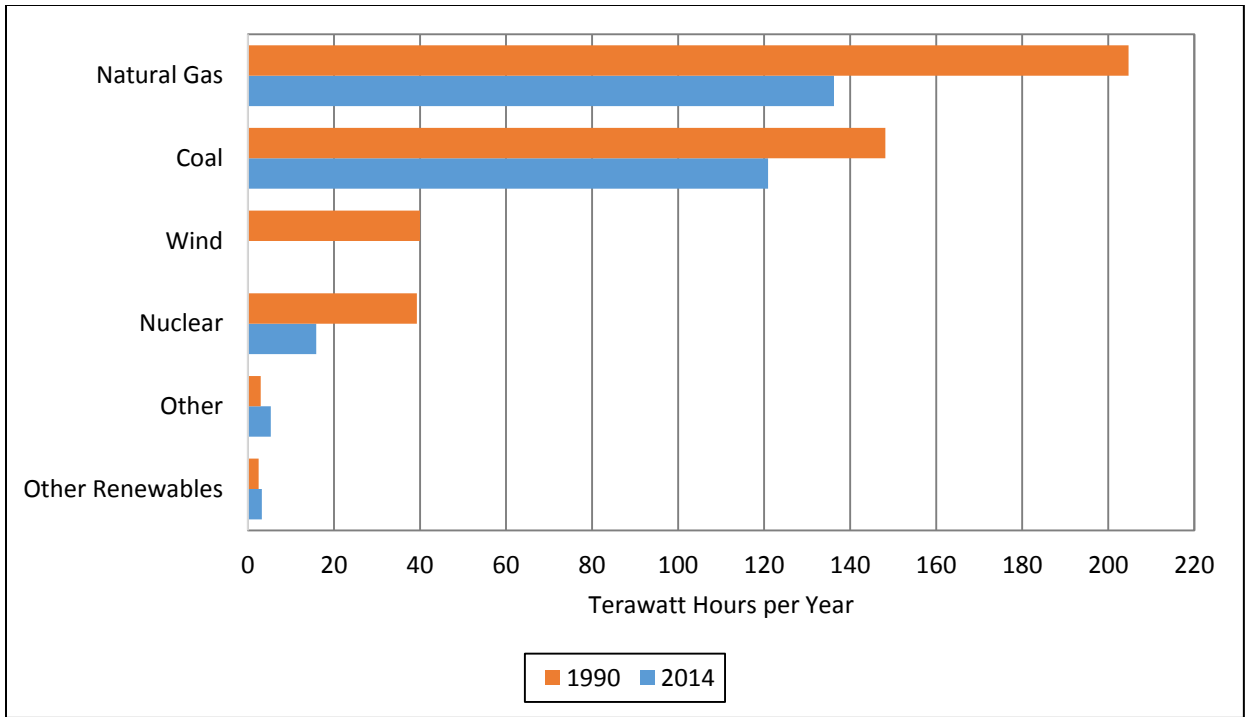


Figure 16. Electric Power Generation in Texas by Fuel Type