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Tulsa's Energy Industry in 2012:
Industry Definition and Economic Impact

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Tulsa Energy Industry Economic Impact: Summary of Key Findings

Oklahoma's resilient economic recovery stands in contrast to the perpetually disappointing national economic conditions. Much has been said of the role of the energy industry in the state's recovery with the talk often centered on Oklahoma City. Often missing from the conversation is a discussion of Tulsa's position as an energy industry leader, as well as the energy sector's still dominant role in Tulsa's economic profile and future economic development.

This report shows the Tulsa economy to be much more diversified and private sector-dependent than the state as a whole, and thus more significantly impacted by national conditions. Still, despite the impact of the recent recession, Tulsa remains the state's leading economy on many per capita measures.

The energy industry is defined here as a collection of exploration and production-related sectors and their upstream, midstream and downstream complementary sectors. The broad energy sector as defined and studied here is significantly responsible for Tulsa's continuing economic growth. The Tulsa regional energy industry is defined and characterized by employment and output levels in the Tulsa economy and the resulting economic impacts estimated. Among the key findings are the following.

- The Tulsa MSA energy industry (as defined in the body of the report) is estimated to consist of 56,023 jobs, with over half of those in primary business support and related manufacturing professions.

- Through the spillover, or multiplier process, it is estimated that the energy industry in Tulsa contributes to regional economic activity in general by supporting 189,103 jobs, \$12.77 billion in labor income, and \$31.02 billion in local value added.
- The multipliers associated with the custom definition of the energy industry reflect substantial local linkages between industries. The existing linkages are residual effects of Tulsa's history as a major energy center and suggest the potential for significant economic returns to the city from further development of this existing energy complex.
- In selected city-to-city comparisons, Tulsa remains the state's highest performing economy as indicated in the bullets below:
 - In 2010, Tulsa gross metro product – a measure of the market value of final goods and services produced or the value added by local activity – was an estimated \$44.8 billion dollars.
 - Per capita private industry GDP – a measure of local value added per private sector job – stood at \$43,243. By comparison, this represents a \$574 (1.3%) gap above the value added per private sector job in Oklahoma City, although the gap has narrowed from its 2008 peak of \$2,953.
 - In 2011, per capita personal income was \$2,234 (5.6%) higher in Tulsa than in Oklahoma City, down from its 2008 peak of \$3,182.
 - In the fall of 2012, average weekly earnings of a Tulsa private sector job was \$836.50 – over \$74 (9.7%) higher than that of a private sector job in Oklahoma City. The private sector weekly earnings gap was down from its peak of \$137.68 before the impacts of the recession were manifest.

Tulsa Energy Sector: Industry Definition and Economic Impacts

Introduction

Tulsa once enjoyed recognition as the oil capital of the world. Oil exploration and production stood as the centerpiece of a dynamic, wealth-generating economy. Today, Houston claims the title of oil capital of the world while Tulsa has designated a section of its downtown as The Oil Capital Historic District. While the oil boom days of the start of the previous century – that precipitated a 5,000% increase in population in just 20 years – have certainly passed, the energy industry continues to play a dominant role in the local economy today. What is also clear, however, is that today’s energy industry is not so easily defined as oil production, or even oil and natural gas production. Rather, the energy industry is comprised of exploration and production of fuels ranging from oil and natural gas to wind and solar to biofuels. The industry includes electric generation from hydro, coal, and natural gas as well as construction (oilfield, pipeline and utility infrastructure) and maintenance of high-efficiency transmission systems.

Today’s energy industry includes refining, wholesale and retail distribution, support manufacturing and business services. The Tulsa energy industry is so significantly layered that it is difficult even to reach a consensus definition of what exactly constitutes “the energy industry”. The aim of this report is to provide such a definition and examine the role of the industry in the Tulsa economy, including baseline measures of employment and spillover economic impacts.

We find the impacts to be significant and positively exaggerated by the history Tulsa enjoys as an energy center. It is an economic history that has left in place inter-industry linkages that are key to maximizing the economic contributions of the energy sector and offer tremendous economic returns from further development within the regional energy industry. The report concludes with

a brief economic overview of the MSA to provide context to the magnitude of the impacts and the importance of the existing energy industry relationships.

Tulsa Energy Industry: Definition and Economic Impacts

Tulsa is home to manufacturing, marketing, and distribution activities that are not always seen as belonging to the energy industry. Likewise, alternative energy research, development, and manufacturing in Tulsa belong in the energy industry, but its impacts are difficult to measure. Indeed, exactly what collection of activities belongs in the definition of the energy industry is not well-established. Two reports stand out as offering guidance. In a report prepared for the American Petroleum Institute, researchers at PricewaterhouseCoopers estimated the economic impacts of the oil and natural gas industry on the U.S. economy. Their efforts begin with a definition of the industry reported in the table below.

Definition of the Oil and Natural Gas Industry: PwC 2009 Report	
NAICS Sector	NAICS Brief Description
211	Oil and Gas Extraction
213111	Drilling Oil and Gas Wells
213112	Support Activities for Oil and Gas Operations
2212	Natural Gas Distribution (Private and Public Sector)
23712	Oil and Gas Pipeline and Related Structures Construction
32411	Petroleum Refineries
324191	Petroleum Lubricating Oil and Grease Manufacturing
32412	Asphalt Paving, Roofing, and Saturated Materials Mfg.
4247	Petroleum Wholesalers
486	Pipeline Transportation
44711	Gasoline Stations with Convenience Stores
447319	Other Gasoline Stations
45431	Fuel Dealers

The industry definition above is clearly the major portion of Tulsa’s regional energy industry, but is only a subset nonetheless. There are other industries excluded from the PwC definition that

belong in the energy industry. A similar exercise conducted by the Iowa Workforce Development examining the new landscape of energy-related employment opportunities in the state compiled a broader list of sectors comprising a custom definition of the energy industry. The list includes nearly all of the sectors included in the PwC report as well as the following.

Definition of the Energy Industry: Iowa Workforce Development	
NAICS Sector	NAICS Brief Description
221111	Hydroelectric Power Generation
221112	Fossil Fuel Power Generation
221113	Nuclear Electric Power Generation
221119	Other Electric Power Generation
221121	Electric Bulk Power Transmission
221112	Electric Power Distribution
221210	Natural Gas Distribution
221310	Water Supply and Irrigation Systems
221320	Sewage Treatment Facilities
221330	Steam and Air-Conditioning Supply
237130	Power/Communication Systems Construction
237990	Other Heaving Construction
238211-238212	Residential and Nonresidential Electric Contractors
238221-238222	Residential and Nonresidential Plumbing/HVAC
325193	Ethyl Alcohol Manufacturing
325110	Petrochemical Manufacturing
324191-324199	All Other Petroleum and Coal Products
325188	All Other Basic Inorganic Chemicals Manufacturing
333414	Heating Equipment Manufacturing
333415	AC, Refrigeration, and Forced Air Heating Manufacturing
333611	Turbine Generator and Generator Set Units
335121-335122	Residential and Nonresidential Lighting Fixtures Mfg.
335311	Electric Power and Specialty Transformers Manufacturing
335312	Motor and Generator Manufacturing
335313	Switchgear and Switchboard Apparatus Manufacturing
335314	Relay and Industrial Control Manufacturing
335999	Miscellaneous Electrical Equipment Manufacturing
541330	Engineering Services
541380	Testing Laboratories
541690	Other Technical Consulting Services
562213	Solid Waste Combustors and Incinerators
811219	Other Electrical Equipment Repair Services
811310	Commercial Machinery Repair/Maintenance Services

Any attempt to better understand the role of the energy industry in the Tulsa economy requires an acceptable definition to be established where no concordant definition exists. Building on the lists provided in tables above, a custom definition of the energy industry for the purposes of this report is constructed and reported below. This list will serve as the collection of sectors whose combined impacts to Tulsa area employment, labor income, and output are estimated in an Input-Output economic model. The list of sectors is divided into two groups: the first is categorized as direct energy production and includes oil and gas exploration, extraction, support, and electric power generation; the second subgroup is categorized as primary support industries. These industries are the upstream, midstream and downstream complements to direct energy production and include activities such as manufacturing, transportation, distribution, retail/wholesale fuels, and construction.

In order to estimate the general economic impacts resulting from the annual operations of this broadly-defined energy industry, baseline measures of employment by sector are required. For each sector identified below, employment estimates represent the evaluation of multiple data sources, including the Bureau of Labor Statistics, Bureau of Economic Analysis, U.S. Census Bureau, and the Implan structural matrices of the Tulsa MSA economy. In nearly all sectors, there is consensus across sources.

What emerges from the initial employment estimates is a picture of a uniquely layered energy industry, with more jobs in primary support activities (e.g. manufacturing and construction) than in extraction and power generation. Today's energy industry in Tulsa is much less visible to the naked eye than it would have been in previous decades. The opaqueness of the industry notwithstanding, economic models suggest it continues to be the centerpiece of the regional economy, supporting just over 56,000 direct jobs in the MSA.

Tulsa MSA: Energy Industry Total Employment	
Sector Categories	Total Employment
Exploration, Production, and Generation	26,732
Primary Support and Related Manufacturing	29,291
Total MSA Energy Direct Employment	56,023

The first subset of industries consists of direct exploration, production, extraction, and power generation. This collection of NAICS sectors likely resembles conventional definitions of the energy industry and accounts for 26,732 Tulsa MSA jobs.

Tulsa MSA: Energy Sector Industry Definition and Employment Estimates		
NAICS Code	Exploration, Production, and Generation Activities	Tulsa MSA Employment
211	Mining: Oil and Natural Gas Extraction	18,546
2211	Utilities: Electric Power Generation	1,491
2212	Utilities: Natural Gas Distribution	2,546
212	Mining: except Oil and Gas	375
213111	Drilling Oil and Gas Wells	536
213112	Support for Oil and Natural Gas Operations	3,238
Total: Exploration, Production, and Generation		26,732

The core of energy activity represented by the traditional sectors above is complemented in the local economy by specialty manufacturing, construction, and technical services operations. These sectors include refinery, component parts manufacturing, downstream power installation, wholesale, and retail activities. While integral to the local economy, these operations often occur in industrial parks, manufacturing centers, and office buildings not readily identifiable as key pieces of the energy industry. In fact, they quietly account for an additional 29,291 jobs in the specific sectors reported below. It should be noted again that the sectors to be included in the definition of the energy industry are not well-defined and the current industry definition and employment estimates almost certainly exclude some activities directly engaged in the energy industry.

Tulsa MSA: Energy Sector Industry Definition and Employment Estimates		
NAICS Code	Primary Manufacturing and Other Support Activities	Tulsa MSA Employment
32411	Petroleum Refineries	977
486	Pipeline Transportation: Oil, Natural Gas, and Other Fuels	857
541330	Petroleum engineering services (Engineering services)	2,428
541990	Pipeline Inspectors and Other Technical Services	471
<i>Subtotal: Refining and Distribution</i>		<i>4,733</i>
447	Gasoline Stations	2,742
4247	Petroleum and Petroleum Products Wholesalers	536
45431	Fuel Dealers	85
<i>Subtotal: Wholesale and Retail Fuel Dealers</i>		<i>3,363</i>
221330	Steam and Air-Conditioning Supply	N/A
236210	Industrial Building Construction	695
23712	Oil and Gas Pipeline and Related Structures Construction	596
237130	Power and communication system construction	395
237990	Other Heavy Construction, Including Horizontal Drilling	323
238210	Electrical and Other Wiring Installation Contractors	2,660
238220	Nat. gas piping installation (Plumbing & HVAC contractors)	3,144
<i>Subtotal: Energy Construction and Contractors</i>		<i>7,813</i>
331110	Iron or Steel Tubing (Pipe) Mfg. and Other Ferroalloy Mfg.	1,241
3241	Petroleum Products Mfg. - Asphalt Paving, Roofing, etc.	165
332420	Oil Storage, including Gas Cylinders and Metal Tank Mfg.	323
332410	Heat Exchangers	3,569
333132	Oil and Gas Field Drilling Machinery and Equipment Mfg.	2,433
333249	Petroleum refining and Other Industrial Machinery Mfg.	24
333414	Heating Equipment	394
333415	AC, Refrigeration, and Forced Air Heating	1,300
333618	Natural Gas Engines Manufacturing	39
33391	Oil Pump and Air and Gas Compressor Manufacturing	2,858
334515	Energy Measuring Equipment Manufacturing	23
33512	Residential Electric Fixtures and Specialty Transformers	27
335312	Motor and Generator Manufacturing	308
335313	Switchboard and Switchgear Apparatus	234
335314	Relay and Industrial Control Manufacturing	111
335999	Other Miscellaneous Electrical Equipment	315
333611	Turbine Generator and Generator Set Units	18
<i>Subtotal: Energy Support and Related Manufacturing</i>		<i>13,382</i>
Total: Primary Support and Related Activities		29,291

The next step is to estimate the contributions of these 56,023 energy industry jobs to total employment, income, and production in the Tulsa economy. Economic impact analysis relies on estimates of expenditure flows between industries to estimate the total economic activity that results from an initial change in the output of a single industry. In the current context, we are specifically interested in the total economic activity in the Tulsa economy that can be traced back to the output of the energy industry as defined. This perspective is more commonly referred to as economic contributions analysis as it identifies the contributions of a specific industry to the regional economy.

Economic impacts are reported as direct (a measure of the size of the existing industry), indirect (a measure of the impacts stemming from industry linkages within a regional economy), or induced (a measure of the impacts stemming from changes in institutional expenditures).

Economic multipliers offer a quick reference to the extent to which an existing activity is linked to the local economy and will be calculated as the total impact divided by the direct impact.

Economic Contribution of the Energy Industry				
Impact Type	Direct Effect	Indirect Effect	Induced Effect	Total Effect
Employment	56,023	69,559	65,908	189,103
Labor Income	\$5,658,529,730	\$4,577,283,020	\$2,537,366,197	\$12,773,178,947
Total Value Added	\$17,293,747,043	\$8,984,417,322	\$4,743,631,532	\$31,021,795,898
Output	\$39,856,093,236	\$17,465,408,780	\$7,883,424,876	\$65,204,926,893

The economic contribution of the industry is discussed in more detail below, but a review of Tulsa’s general economic measurements offers some context. The data suggest an economy with 553,953 jobs, \$37.16 billion in income, and a gross metro product of \$44.82 billion. The analysis indicates that the contribution of the energy industry accounts for 34% of Tulsa MSA employment and income and 69% of Tulsa MSA gross metro product.

Economic Contribution of the Energy Industry			
Impact Type	Total Effect	Baseline 2010 Values	Total Effect as a Share of Baseline
Employment	189,103	553,953	34.14%
Labor Income (\$ Billions)	\$12.77	\$37.16	34.36%
Total Value Added (\$ Billions)	\$31.02	\$44.82	69.21%
Output (\$ Billions)	\$65.20	NA	NA

Several noteworthy findings emerge from the contributions analysis. First, the direct impact of the collection of sectors deemed to constitute the energy industry account for 56,023 of Tulsa MSA jobs. This represents approximately 1 out of every 6 private sector jobs and 1 out of every 7 total nonfarm jobs. Regional economic databases suggest that every job generates, on average, over \$105,000 in labor income – more than twice the Tulsa MSA all-industry average of \$47,425. The high labor income per job is a direct result of the high value of the output produced in the sectors comprising the energy industry. The combined value added of these sectors (contribution to gross metro product) is nearly \$17.3 billion. This represents nearly \$0.45 out of every dollar of Tulsa MSA gross metro product generated by private enterprises. Indeed, this is the defining characteristic of the industry - high levels of value added and labor income per job. The reality that Tulsa continues to enjoy higher per capita income and higher weekly private sector earnings than all other Oklahoma counties is a direct reflection of the city's history as well as its ongoing reality as an energy center.

The operations of the energy industry require inputs from sectors in the local economy outside the energy industry. The indirect impacts reported above largely reflect these energy/non-energy sector linkages. Energy industry operations require nearly \$9 billion in value added production (largely from outside the energy industry), generating almost \$4.6 billion in labor income for 69,559 jobs. Note that indirect impacts generate economic impacts consistent with nearly

\$65,804 of labor income per job. These are significant impacts but stand in contrast to the \$105,000 per job within the energy industry. The two sectors enjoying the largest share of the indirect economic impacts are Tulsa's manufacturing and professional and business services.

Finally, the operations generate significant levels of labor income at both the direct and indirect levels, spawning new expenditures by households. The economic impacts associated with these induced expenditures fall heavily on the retail, real estate, and health services sectors and are associated with considerably lower labor income and value added per job.

In total, the operations of the energy industry support 189,103 jobs and \$12.7 billion in labor income (over \$67,000 per job), and just over \$31 billion in regional value added (contribution to Tulsa MSA gross metro product). Again, the disproportionately-high levels of value added per job suggest the energy industry operations could account for as much as \$0.70 of every dollar of the MSA's gross metro product. The combined influences of the indirect and induced linkages can be summarized by the multipliers below.

Tulsa MSA Energy Industry Multipliers	
Impact Type	Multiplier
Employment	3.53
Labor Income	2.26
Total Value Added	1.79
Output	1.64

The estimated multipliers are unique to the custom definition of the energy industry specified previously and represent, in essence, a weighted average of the multipliers of the underlying sectors. The resulting multipliers indicate an industry tightly linked to local production with every 1 energy industry job supporting a total of 3.53 Tulsa MSA jobs and every \$1 dollar of value

added to the local economy from the energy industry ultimately generating a total of \$1.79 of MSA gross metro product.

The estimated impacts and resultant multipliers reflect Tulsa's history as an energy center and decades of organic economic development linking operations within the industry to supporting activities in the broader economy. These linkages remain in place and form a core of operations in the city's economic landscape - and a foundation from which future economic development can emerge.

The economic realities of urban and rural areas have become starkly distinct over the previous forty years. The nearly-uniform distribution of economic activity across the nation's geography has yielded to concentrations of economic activity in amenity rich, high productive urban areas. The geographic distribution of specific sectors and resulting concentration of activities appear to be largely organic, and often not the result of specific economic development intents. Rather, developing an amenity-rich environment that encourages entrepreneurial creativity and facilitates business development creates the economic conditions from which economic development occurs. As Tulsa develops an amenity-rich, creative, and business friendly environment, the reality of the existing energy industry linkages would be expected to manifest themselves as the city develops around its existing economic strengths.

Economic Background

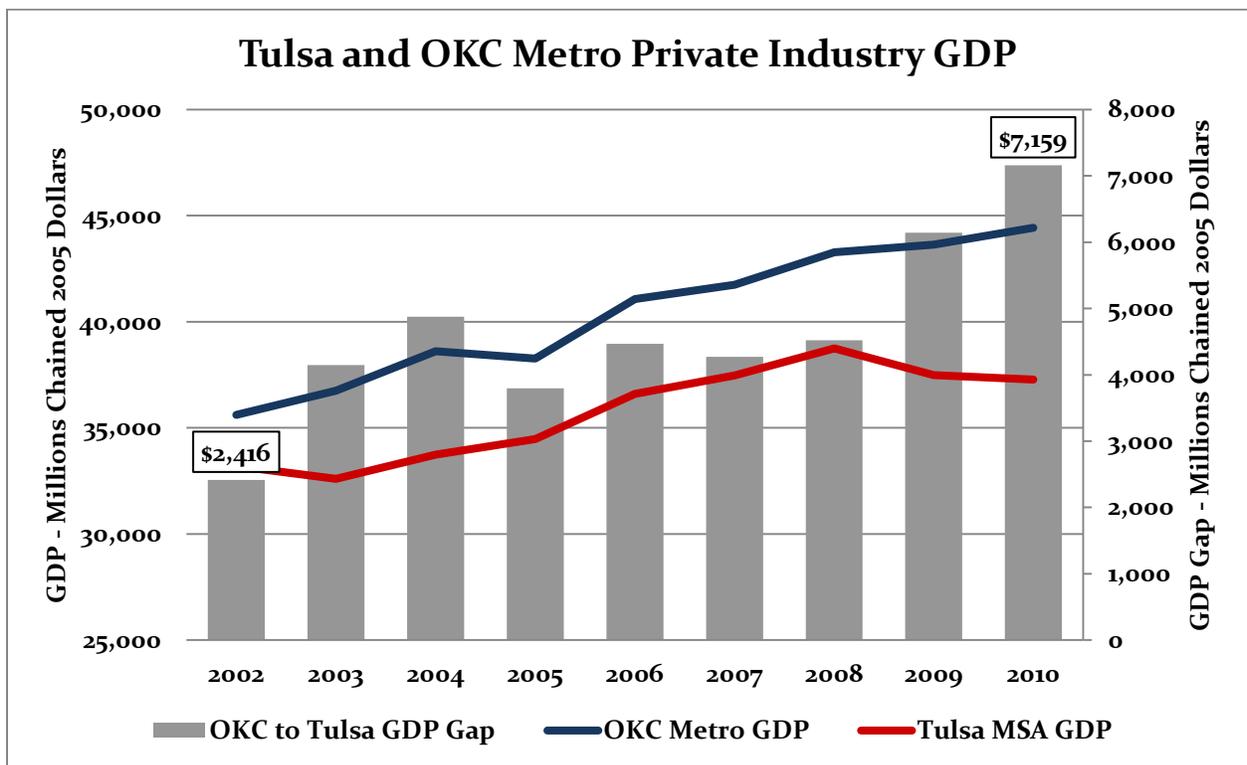
The preceding discussion reveals the strength of the energy industry in Tulsa. The magnitude of the contribution of the industry today is a direct reflection of Tulsa's history as an energy center. Complementary sectors have developed around the industry – sectors like manufacturing, professional services, and distribution. The presence of this complete set of related sectors allows more of the spillover economic impacts from energy industry operations to remain in the local economy than would be expected from other industries. In fact, Tulsa's history as the wealth-generating capital of Oklahoma and oil capital of the world is still visible in current economic measurements presented subsequently.

The great recession of 2008 left residual economic hardships unevenly spread across industries and regions of the nation. Oklahoma stands out among states leading the way into a healthy economic future. An expanding oil and gas industry – in spite of disappointing natural gas prices and a West Texas Intermediate price discount – has led to a manufacturing rebound and buoyed a resilient housing market. While the state was unable to avoid the adverse effects of the financial crisis, the strength it has shown in recovery portends upbeat economic times ahead.

The economic recovery has highlighted differences between the economies of the state's major metro areas; some differences are real, others exaggerated. The strength of the Oklahoma City economy can often leave the impression of weakness elsewhere. This is perhaps nowhere more true than within the energy industry. The concentration of natural gas firms in Oklahoma City – anchored by Devon, Chesapeake, and Sandridge, coupled with the relocation of Continental Resources – can leave the impression that the growing influence of the industry in Oklahoma City must logically be accompanied by a decreasing influence of the industry in the Tulsa economy, but the reality is less transparent.

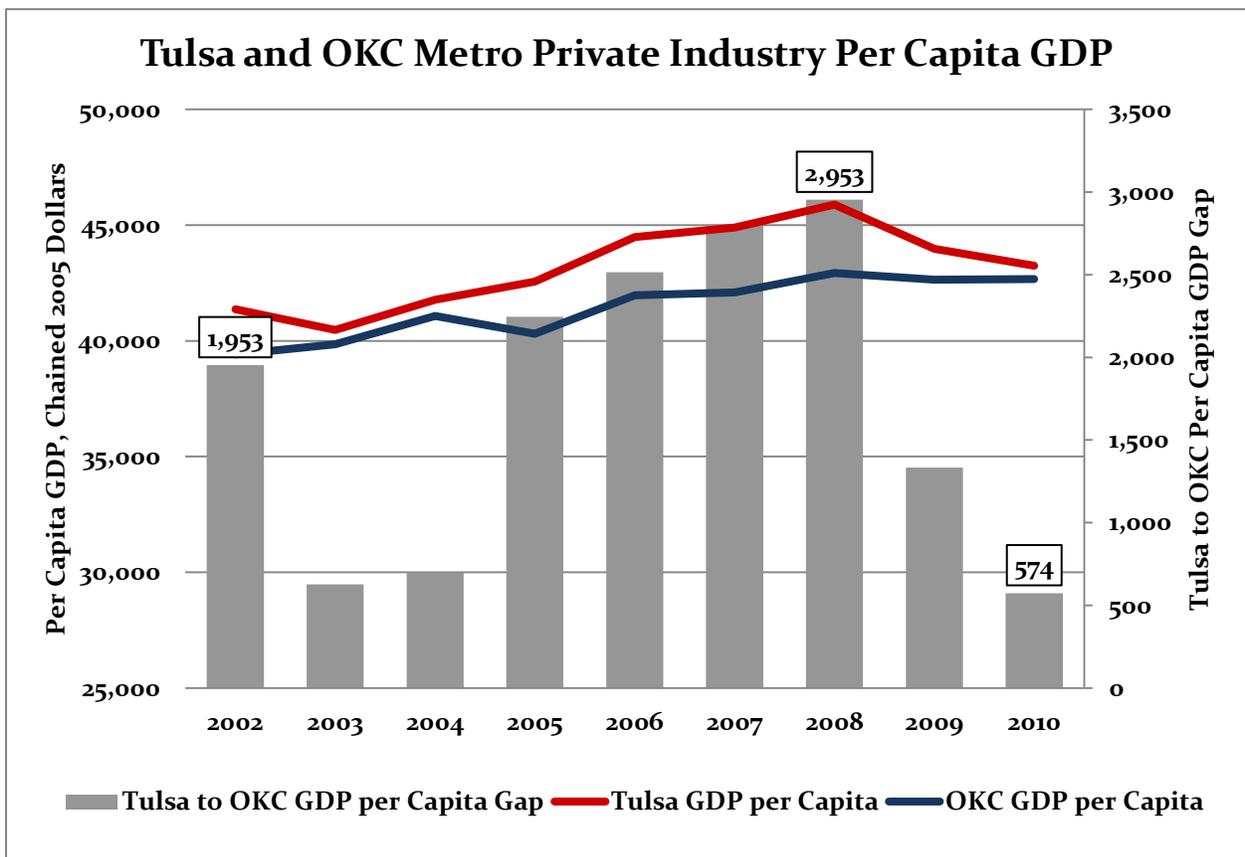
This paper also highlights some key features of the economic relationship between Tulsa and Oklahoma City, including (to some) surprising areas of strengths in Tulsa. It should be noted explicitly that the comparison to Oklahoma City only serves to provide some context to Tulsa's current economic state and recent history. The comparison is in no way intended to imply an economic competition where the fortunes of one city must necessarily come at the expense of the other. In fact, economic development within the state and national trends of urbanization and growth along the I-35 corridor from San Antonio to Kansas City suggest a bright economic future for both metropolitan areas.

Gross Metro Product is a measure of the regional production of final goods and services, or the value added to production by local firms. Regional measures of metro product are notoriously difficult to estimate and often lack much meaning when viewed in isolation. But consistency of methodology does allow for a meaningful comparison between metro areas.

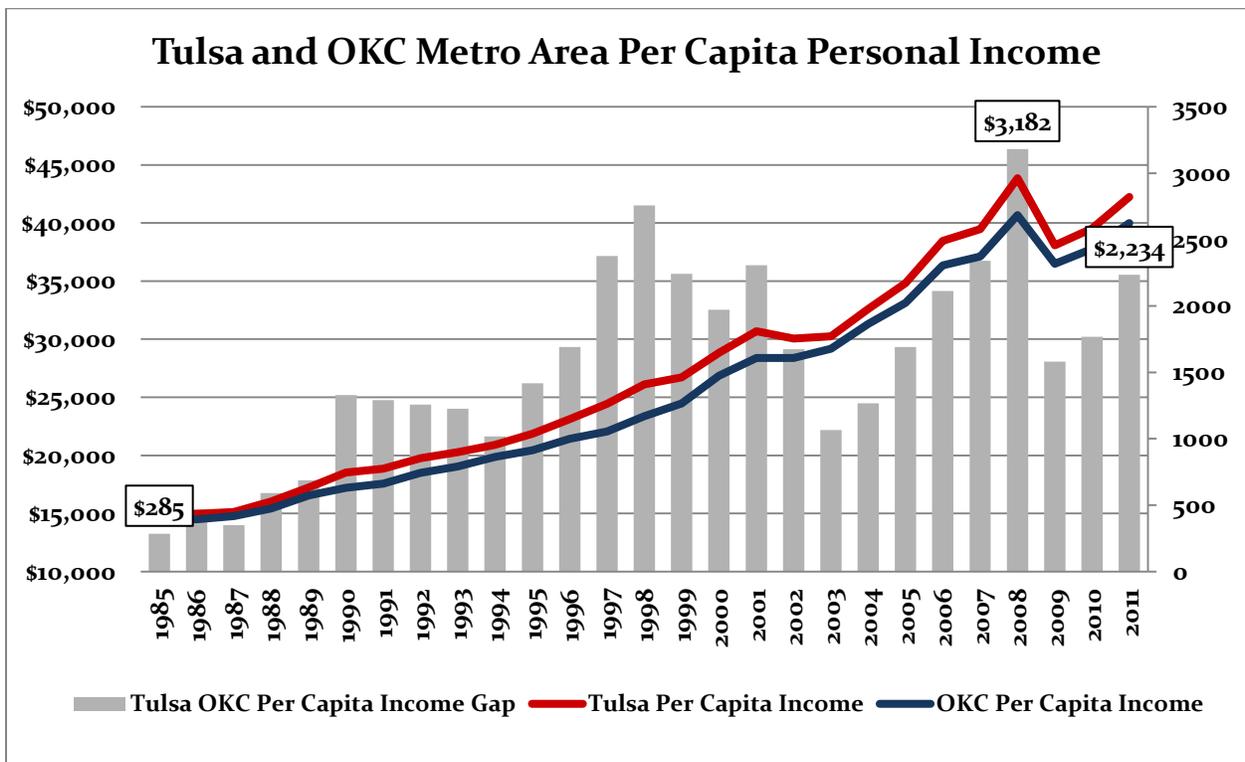


The figure above displays the size of the private sector economy in Tulsa and Oklahoma City over the 2002-2007 period. In 2002 the Tulsa economy created just over \$33 billion in final goods and services compared to just over \$35 billion in production from the Oklahoma City economy. The difference is represented by the gray bar (and measured on the right axis) and stood at \$2.4 billion. The economy grew at a much faster rate in Oklahoma City over the period and the GDP gap widened. The gap was exaggerated by the recession that, initial estimates suggest, exhibited a more adverse effect on the Tulsa economy. In 2010, Tulsa private production was valued at just over \$37 billion and Oklahoma City production at over \$44 billion, for a difference of \$7.16 billion.

The growth of the Oklahoma City economy is driven in part by population and labor force changes consistent with a widening population gap between the two cities. A better measure of the economic well-being of a region and its citizens is captured by “per capita” metrics.

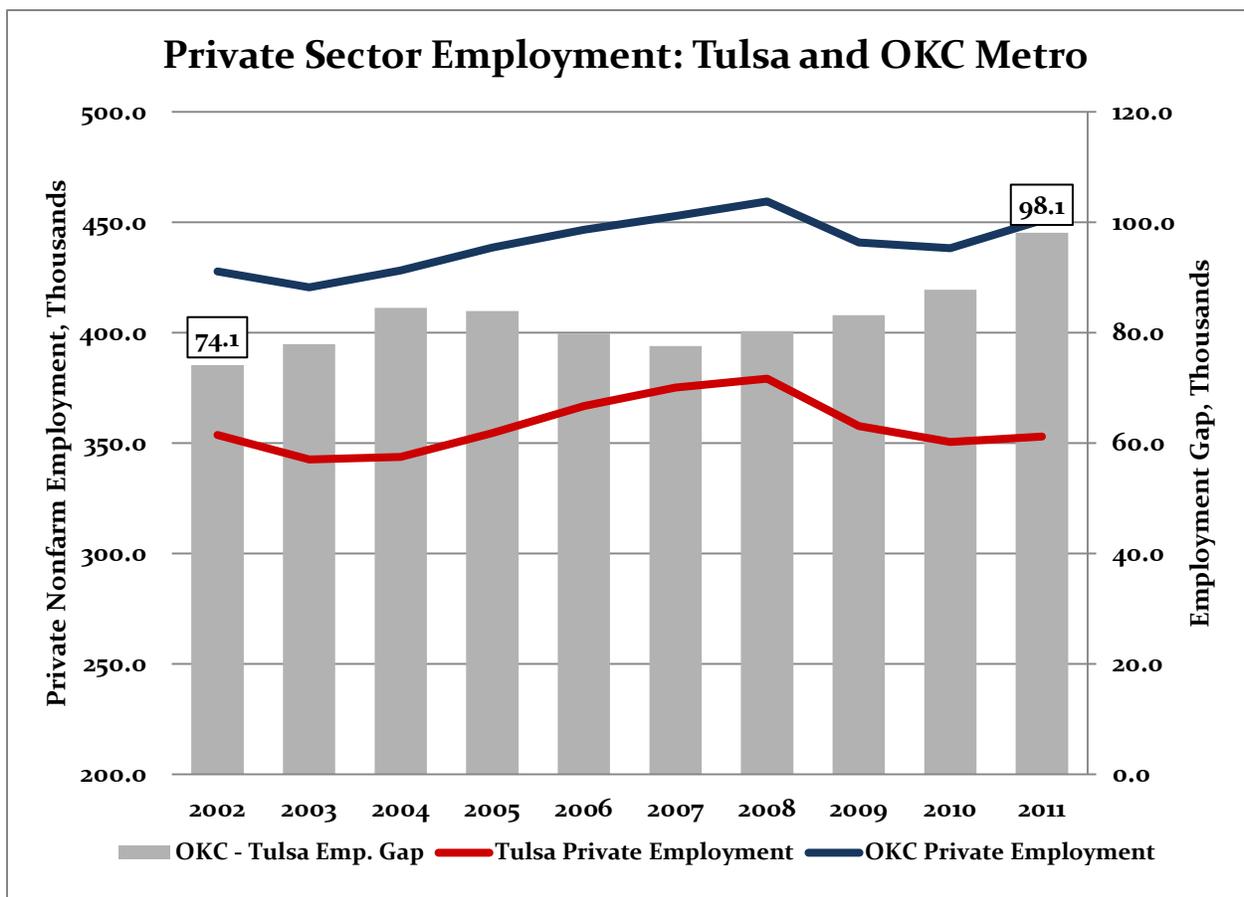


The figure above captures the value of production per person, or per capita, within the two economies. In 2002, the Tulsa economy produced final goods valued at \$41,666 per person compared to \$39,531 of production per person in Oklahoma City. Again, the height of the gray bars reflects the gap between Tulsa GDP per capita and Oklahoma City GDP per capita. This gap peaked during the economic expansion leading into the recession at \$2,953 of GDP per capita in 2008. The recession has since contributed to a tightening of the spread to its lowest level of \$574 of GDP per capita. It remains to be seen how the economic expansion and recession recovery have impacted this measure. Some indication may be seen in the related measure of per capita personal income.



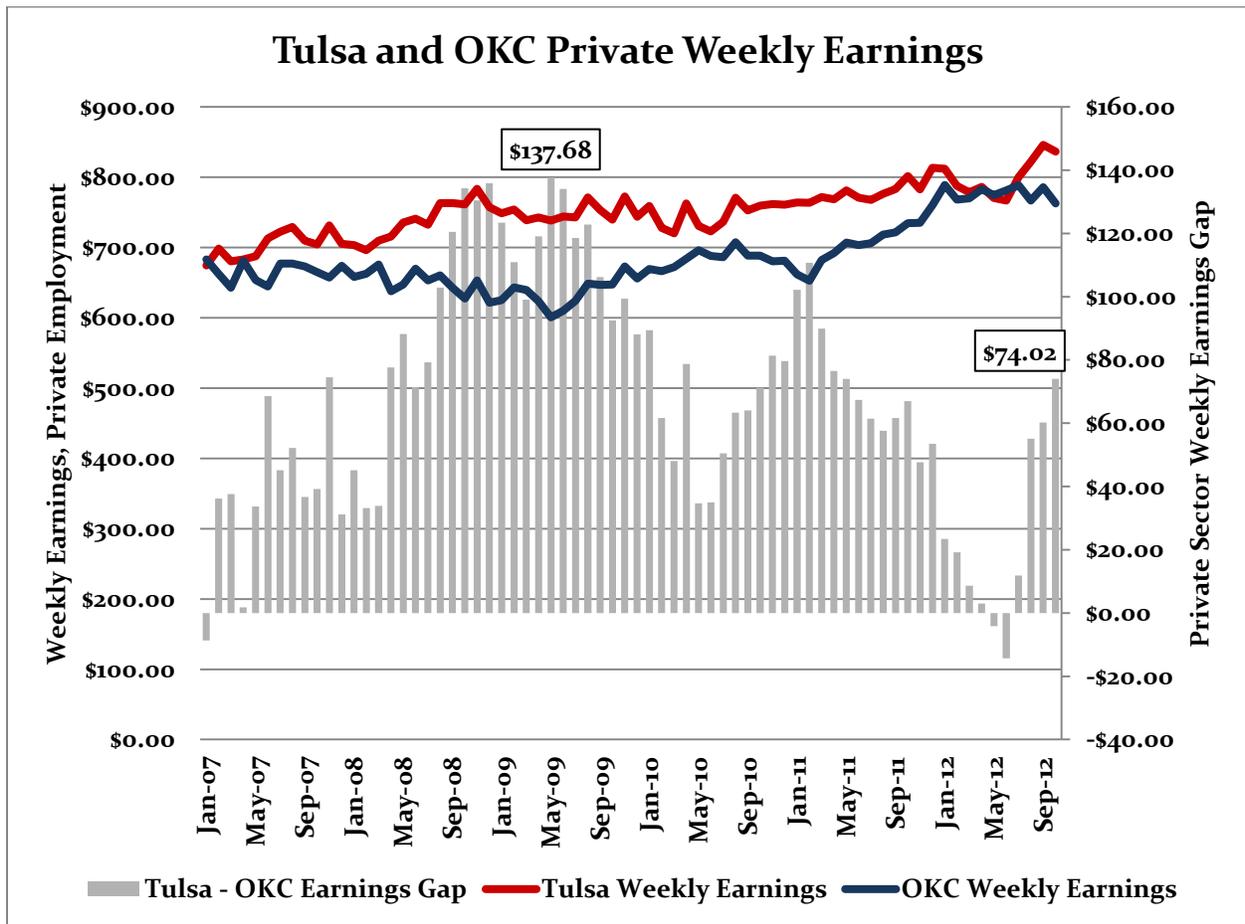
In 1985, per capita personal incomes were nearly identical at just under \$15,000 per person and the gap measured at only \$285 in Tulsa’s favor. The economic expansion of the 1990’s widened the income gap considerably before narrowing following the 2001-2002 recession. A similar pattern is

observed in the previous decade, with the economic expansion driving the gap in per capita personal income to a high of \$3,182 in 2008 before contracting with the recession. The per capita income gap has widened again with the recovery, estimated at \$2,234 in 2011. Tulsa County remains the highest per capita income county in the state and continues to enjoy the positive economic momentum of the last 25 years.



Positive economic momentum notwithstanding, broad measures of economic activity indicate an Oklahoma City economy that is larger and faster growing than its Tulsa counterpart. This reality is highlighted again by the measure of total private sector employment. In 2002, Tulsa was home to nearly 354,000 private sector jobs, or 74,100 fewer jobs than the 428,000 jobs reported in the

Oklahoma City economy. That gap has widened over the last ten years. From 2002 through the pre-recession peak, Tulsa added 25,500 jobs compared to growth of 31,700 jobs in Oklahoma City. However, during the recession and initial recovery, the Oklahoma City economy managed to hold on to nearly 75% of those job gains while Tulsa gave back all of its jobs gains, leaving the Tulsa private sector job numbers in 2011 exactly where they stood in 2002. The result is an estimated 2011 private sector jobs gap of 98,100 in Oklahoma City's favor.



As before, broad measures of economic activity fail to tell the entire story. At the beginning of the available data series in January 2007, average weekly earnings of private sector employment stood at nearly identical levels: \$683 per week in Oklahoma City and \$674 in Tulsa. As the national economy continued through the pre-recession expansion, average weekly earnings of private

sector jobs grew more rapidly in Tulsa. The result was a significant earnings gap that emerged in Tulsa. At its peak, the average weekly wage of a private sector job was \$137 higher in Tulsa. The recession hit the Tulsa labor market harder and erased the earnings gap. However, as the recovery progresses and the Tulsa economy gains steam, the earnings gap has re-emerged, with a typical private sector job in Tulsa offering \$74 per week more than private sector employment in Oklahoma City.

Conclusion

Several interesting trends emerge from the previous economic discussion. The first is anecdotal evidence that the Tulsa economy is more reliant on national economic activity. The pre-recession expansion highlighted and exaggerated Tulsa's economic strengths. Tulsa's per capita private industry GDP, per capita personal income, and private sector weekly earnings all peaked at levels significantly higher than the corresponding metrics of the Oklahoma City economy. As the nation progresses through the persistently disappointing economic recovery, the impacts of improving national conditions on Tulsa's economy are only recently appearing. Gaps in per capita personal income and weekly earnings are widening again, with per capita private industry GDP expected to do likewise as updated data is released. The major question is one of timing and magnitude: when will national conditions improve markedly and as they do, what will be the magnitude of the economic response in Tulsa?

The second trend is sustained strength in the Tulsa economy. Tulsa continues to support jobs with higher levels of value added to local production than any other metro area in the state. This reality is supported by the finding that Tulsa continues to enjoy higher levels of per capita personal income and higher average weekly earnings of private sector jobs than any other area of the state. Tulsa's economic strengths are the residual effects of its history as an energy center.

The current economic strength in Tulsa reflects its energy history. The economic contributions of today's energy industry indicate that the economic linkages developed over decades as an energy center remain intact. Together, these findings suggest an opportunity for Tulsa to develop around its core strength as an energy city, keeping local much of the spillover economic activity, and maximizing local job and wealth creation. Tulsa's best days as a center of energy-related economic activity may well lie ahead.

Appendix A: Commentary on Input-Output Methodology

Economic impact analysis typically occurs in an input-output (IO) framework. IO models begin with a snapshot of the local economy that freezes in place all local spending patterns. From this frozen in time perspective, the extent to which output in one sector (construction, for example) is reliant on inputs from another local sector (wholesale lumber distribution, for example) is revealed. The result is an estimated share of the output from the wholesale lumber distribution sector that is required to support every dollar of output from the construction sector - or the extent to which the local construction sector is *linked* to the local wholesale lumber distribution sector. Similar linkages are estimated between all industries as well as between households and government institutions. These linkages reveal the extent to which local production of goods and services and local institutional (household and government) expenditures are linked to the local economy.

The frozen expenditure patterns are combined with two significant simplifying assumptions. The first is that production occurs in fixed proportions. This assumption implies that new economic activity will require proportional increases in economic activity from all supporting, or linked, sectors. The second assumption is that input prices are fixed. This assumption implies that new economic activity can generate increases only in the level of production in supporting, or linked, sectors, leaving all prices unaffected. With expenditure patterns observed at a given point in time and the simplifying assumptions of fixed proportions production and fixed prices in place, a regional IO model is constructed and used for two basic types of analysis.

The first use of a regional IO model is to estimate the economic impact resulting from some new economic activity. Given a proposed change in final production within (or demand from) a sector, the model estimates the secondary, or spillover economic activity required to

accommodate the new activity. Further, the model estimates the new activity generated as households and institutions adjust their levels of local spending consistent with the new income and tax streams generated from the new economic activity in the region. This first use of the model is economic impact analysis in the traditional sense. The second use of a regional IO model is to estimate the contribution of an existing industry to the local economy. From this perspective, the model estimates the total economic activity in the region that can be attributed to the existing industry. This is commonly referred to as a contributions analysis as it estimates the total economic contributions to a region of some existing economic activity.

Contributions analysis can be performed in several ways. The first involves restricting the model in a way that reveals only the backward linked employment, or the number of jobs by sector that exist in support of the already existent economic activity. The alternative is to treat the levels of existing activity as "new" and observe the resulting impacts. From this perspective, the model reveals the potential creation of jobs, labor income, and final production that could be expected from a doubling of the industry. The first approach tends to offer a more conservative estimate of employment linkages while the alternative tends to offer an upper-bound perspective on potential impacts from expansion of an existing industry.

Because the custom definition of the energy industry and the data sources employed are certain to understate the true size of the energy industry in Tulsa, we employ the second approach to contributions analysis in this report. That is, the appropriate interpretation of the economic impacts to be presented is that the energy industry in the Tulsa MSA is *at least* as large as the estimated 56,023 jobs and the economic impacts from doubling employment in each sector of the energy industry could be *as much as* those reported here.