

TARGET INDUSTRY PROFILE

Windmill Turbine and Blade Manufacturing

Prepared for:

DEVELOPMENT CORPORATION OF ABILENE INC.

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INTRODUCTION

This target industry profile is the product of a contract between the Wadley-Donovan Group (WDG) and the Development Corporation of Abilene, Inc. (DCOA). WDG was retained by DCOA to profile six target industries for the West Central Texas region.

The West Central Texas study area is a 19-county region consisting of Taylor, Brown, Comanche, Coleman, Mitchell, Nolan, Runnels, Fisher, Kent, Scurry, Stonewall, Haskell, Jones, Knox, Shackelford, Stephens, Throckmorton, Callahan, and Eastland counties. See Figure 1.

For purposes of WDG's target industries analysis, the 19-county region was divided into seven sub-regions chosen by DCOA. The seven sub-regions and the counties in those sub-regions are:

- **Abilene sub-region:** Taylor County
- **Brownwood sub-region:** Brown County, Comanche County, Coleman County
- **Sweetwater sub-region:** Mitchell County, Nolan County, Runnels County
- **Snyder sub-region:** Fisher County, Kent County, Scurry County, Stonewall County
- **Haskell sub-region:** Haskell County, Jones County, Knox County
- **Breckenridge sub-region:** Shackelford County, Stephens County, Throckmorton County
- **Eastland sub-region:** Callahan County, Eastland County

This document identifies and profiles the target industry *Windmill Turbine and Blade Manufacturing* for the Abilene, Brownwood, and Eastland sub-regions.

The windmill product manufacturing industry target comprises establishments primarily engaged in manufacturing turbines (NAICS 333611), which are the mechanical devices used to harness the energy from the wind, and turbine blades, which are one component of the wind turbine (NAICS 326199). While this report focuses on manufacturing the equipment involved in generating wind power, it is important to note that the West Texas region is also ideally suited for locating "wind farms" due to the flat terrain and abundant wind resources. West Texas is already home to a number of windmill farms that can provide large amounts of electricity without the use of fossil fuels.

This industry was selected for recruitment and attraction efforts, in part, because it meets the following goals:

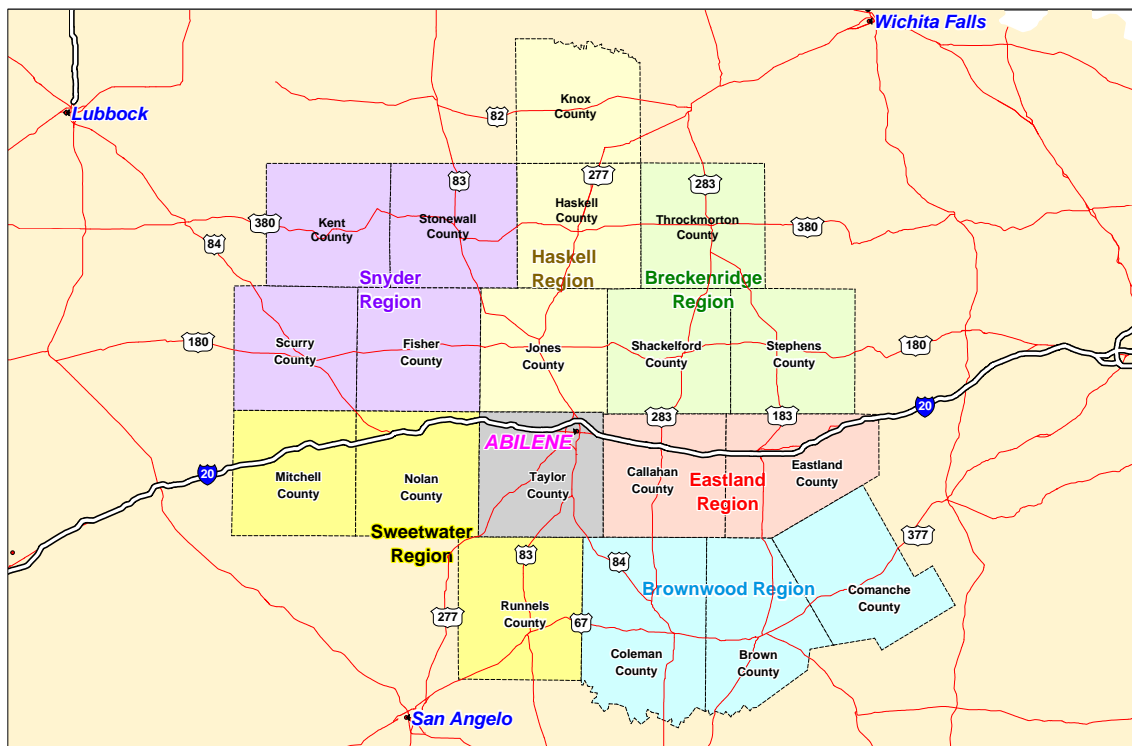
- It offers the best match among the competitive opportunities of the area, industry needs, and industry location trends.
- It builds off the West Central Texas region's blend of assets and challenges.
- It offers the area greater economic diversity and the chance to expand existing industry activities into more advanced operations.
- It offers the best and most realistic recruiting opportunities.
- It offers diversified employment opportunities for the area's residents and labor market, including Dyess AFB spouses.
- It offers opportunities for economic advancement through growing industries, technology-intensive industries, or industries that are showing continued capital and human resource investment.
- It offers a balance between environmentally sustainable development and the need for "living wage" opportunities.
- It does not burden the area's infrastructure and resources.
- It offers a broad diversity of job opportunities, including executive, managerial, professional, technical, administrative and clerical, and production.

This report is being submitted in conjunction with a full labor market, education, and infrastructure assessment and action plan of the 19-county region. That assessment provides additional detail to the findings outlined in this report.

These studies utilize the results of employer and educator interviews, data gathered from secondary sources, and the findings from the labor and infrastructure analysis completed by WDG and Science Applications International (SAIC).

WDG is a Grubb & Ellis Company that specializes in location consulting. Its clients include many of the world's leading companies. As an outgrowth of this corporate consulting, WDG is frequently asked by economic development agencies and utilities to assist them with their economic development programs. Assistance is typically provided in sales and marketing, strategic planning, and overall product development. Clients have included Hillsborough County, FL, New Orleans; Tulsa; Buffalo; Cincinnati; Orange County and Orlando, FL; Joplin, MO; Phoenix; Asheville, NC; Eastern Idaho; Memphis; Raleigh; Richmond; Jackson, TN; Mobile; Collier, Charlotte, and Lee Counties, FL; and the states of Delaware, Iowa, Maryland, Arkansas, Kentucky, Kansas, Wisconsin, and Washington.

**FIGURE 1
SUB-REGIONS IN THE WEST CENTRAL TEXAS STUDY AREA**



OVERVIEW OF WEST CENTRAL TEXAS REGION'S ASSETS FOR WINDMILL TURBINE AND BLADE MANUFACTURING

The Abilene, Brownwood, and Eastland sub-regions offer excellent locations for windmill turbine and blade manufacturing. Key assets include the following:

- The three sub-regions have a strong base of manufacturing as well as traditional service-sector industry employment. The proportion of residents in the Brownwood sub-region (24.2%) and Eastland sub-region (14.9%) employed in manufacturing exceeds the West Central Texas regional average of 12.8%, as well as the Texas state average of 12.0%. The Abilene sub-region manufacturing sector employment is 7.5%. The national average is 14.4%. Additionally, 50.5% of the Abilene sub-region's workforce, 38.7% of the Brownwood sub-region's workforce, and 28.6% of the Eastland sub-region's workforce are employed in the service sector. Prospective employers often view a sizeable service sector presence as an asset. Persons employed in this sector often possess the aptitude and basic skills transferable to many production and administrative support occupations found in manufacturing facilities. The West Central Texas regional average for service sector employment is 43.6%, while the state and national averages are 37.6% and 37.4%, respectively.
- The Abilene, Brownwood, and Eastland sub-regions offer labor cost savings compared to state and national averages in all industry sectors. Total average industry earnings in the Eastland sub-region are 63% of the national norm, while the Abilene sub-region and Brownwood sub-region are 66% of the norm. Manufacturing wages in the Eastland sub-region are 69% of the national norm. The Abilene sub-region is 71% and the Brownwood sub-region is 82% of the national norm.
- Wind farms offer the potential for new income for ranchers. Wind power can be added to farm and ranch fields without interfering with their operations, and the equipment provides farmers and ranchers an added source of income through leasing and royalty arrangements.
- The terrain in West Central Texas is well suited for the establishment of wind generating facilities.
- California is the state in which the most wind power development has occurred up to now. However, Texas was a close second, installing more new capacity in 2001 than had ever been installed in the entire U.S. during a single year.
- All three sub-regions offer moderately-sized and growing populations. Applied Geographic Solutions, a leading national demographic data vendor, reported the Abilene sub-region had a 2002 population of 127,449, and is projected to increase 2.1% by 2007. The Brownwood sub-region had a population of 61,401 and is projected to increase by 2.2%, while the Eastland sub-region had a population of 31,253 and was projected to increase by 0.8%. With civilian labor forces of 56,267, 27,362 and 16,880 respectively, the Abilene, Brownwood, and Eastland sub-regions represent strong labor market potentials for companies requiring moderately-sized workforces.
- Dyess Air Force Base represents an additional resource of high quality labor for the area. There are approximately 2,000 to 2,500 spouses of active military personnel. These spouses represent potential employment candidates for target industry employers, as they are well-educated and seek quality employment.
- The sub-region labor force can conservatively sustain a manufacturing operation requiring a first-year staffing of up to 200 qualified employees, depending on geographic labor draw area and selectivity ratio. Assuming a hiring ratio of one hire for every five applicants, an operation could hire a minimum of 160 employees from the Abilene sub-region proper. A hiring ratio of one hire for every four applicants results in an increased staffing potential of 200 employees. This recruiting ability assumes an operation offering competitive wages, benefits and working conditions.
- The sub-regions offer a strong resident base of managerial, professional specialty, technical, production, and administrative support occupations. The presence of these skill-set concentrations is indicative of a

base of seasoned and technically-skilled workers attuned to manufacturing operations and management in general, and to the industry in particular.

- The Abilene, Brownwood, and Eastland sub-regions are home to a well-educated workforce. The proportion of residents in the Abilene and Brownwood sub-regions with one to three years of post-secondary training, which includes an Associate Degree, exceeds the regional (27.5%), state (27.6%), and national (27.3%) averages. Approximately 30% of the Abilene sub-regions and 28% of the Brownwood sub-region's residents have this level of training. The Eastland sub-region's average is 27.4%. The proportion of residents with a four-year college degree or higher in the Abilene sub-region (23.8%) and the Brownwood sub-region (19.5%) exceeds the West Central Texas regional average of 17.9%. The Eastland sub-region's average is 12.5%. The statewide average is 23.2%, while the national average is 24.4%.
- Post-secondary institutions in the West Central Texas region graduate more than 3,000 students per year. Many of these students graduate with technical skills in high demand by target industry employers, including industrial manufacturing technology, machine technology, drafting and design technology, and computer aided design (CAD), as well as business-related skills such as accounting, business administration, computer and information sciences, and administrative and secretarial services.
- The Abilene, Brownwood, and Eastland sub-regions have adequate water, sewer, electric, and natural gas reserves and capacity to meet the needs of manufacturing operations.
- Water supply planning on a broad geographic basis and through regional initiatives such as districts or by investing in municipal-owned reservoir systems has long been practiced, and has provided communities with a hedge on drought to ensure a dependable water supply. The Abilene, Brownwood, and Eastland regions have the largest available water supply capacities to support increases in industrial demand.
- Assessment of the availability of electric power to support population and economic growth in a region is determined through knowledge of peak electric demand (peak load) and available supply (generation capacity) and the ability to distribute the electricity generated. In the West Central Texas region, peak load occurs in late summer (summer peaking), coinciding with the peak of the cooling season. The difference between demand and capacity is the reserve capacity. While the electric utility industry has not established a firm benchmark percentage for a capacity margin that is considered adequate to guarantee electricity at all times and under varying conditions, the capacity margin of the Texas Grid (23.4), which includes the West Central Texas region, is the highest in the country.
- Air service to the three sub-regions is available through the Abilene Regional Airport. American Eagle services the airport and provides direct non-stop service to Dallas/Ft. Worth seven times a day.

KEY FINDINGS

Labor Market Orientation

The Abilene sub-region consists of Taylor County, and it is the only metropolitan statistical area (MSA) in the region. It is the regional center for services, shopping, and employment, and accounts for approximately 40% of the region's population, with an estimated 2002 population of 127,449. Like the region, the population is projected to remain relatively stable between 2002 and 2007, growing by approximately 2.1%. Relative to the region, Taylor County residents, on average, are younger, and have higher education levels and higher income levels. The Brownwood sub-region consists of Brown County, Comanche County, and Coleman County, and is located in the southeast area of the study region. It is the second-largest sub-region after the Abilene sub-region, with an estimated 2002 population of 61,401. The sub-region is projected to grow 2.2% between 2002 and 2007, roughly the same rate as the Abilene sub-region. The sub-region has several well-known manufacturing establishments that provide a strong base of experienced manufacturing skills.

The Eastland sub-region consists of Eastland and Callahan Counties. This sub-region is located in the east-central region of the West Central Texas study area. The Eastland sub-region is growing at a slower rate (0.8% by year 2007) than the region as a whole and has an estimated 2002 population of 31,253. Eastland has the highest median age among the sub-regions and the lowest median household income. There is also a higher proportion of residents with 12 to 15 years of education relative to the region (54.8% vs. 52.2%).

Primary access to the region is provided by Interstate 20 running east/west from Shreveport, LA through the Dallas/Ft. Worth metro area and into Abilene. I-20 continues southwest through Abilene to Midland and Odessa, where it connects with I-10. North/south routes include Highway 277 running north through Jones and Haskell Counties, and Highway 84 running south through Taylor and Coleman Counties.

Air service to the study area is available through the Abilene Regional Airport. American Eagle services the airport and provides direct non-stop service to Dallas/Ft. Worth seven times a day.

Table 1 presents highway mileage to key regional and national areas. Figures 2 and 3 show the West Central Texas region in the context of the south central region of the United States and the West Central Texas region in the context of the State of Texas.

TABLE 1
DISTANCE FROM ABILENE TO SELECT REGIONAL
AND NATIONAL CENTERS
Source: Microsoft Automap

Destination City	From Abilene, TX	
	Highway Miles	Driving Time
Albany, TX	50	58 mins.
Albuquerque, NM	488	9 hrs, 10 mins.
Amarillo, TX	288	5 hrs, 2 mins.
Anson, TX	24	32 mins.
Aspermont, TX	60	1 hr, 14 mins.
Austin, TX	270	5 hrs, 2 mins.
Baird, TX	25	28 mins.
Ballinger, TX	60	1 hr, 15 mins.
Benjamin, TX	95	2 hrs, 3 mins.
Breckenridge, TX	78	1 hr, 24 mins.
Brownwood, TX	97	1 hr, 49 mins.
Coleman, TX	57	1 hr, 13 mins.
Colorado City, TX	73	1 hr, 13 mins.
Colorado Springs, CO	654	11 hrs, 49 mins.
Comanche, TX	96	2 hrs, 1 min.
Corpus Christie, TX	409	7 hrs, 13 mins.
Dallas/Fort Worth, TX	185	3 hrs, 6 mins.

TABLE 1, *continued*
**DISTANCE FROM ABILENE TO SELECT REGIONAL
AND NATIONAL CENTERS**

Source: Microsoft Automap

Destination City	From Abilene, TX	
	Highway Miles	Driving Time
Eastland, TX	60	1 hr, 2 mins.
El Paso, TX	455	7 hrs, 5 mins.
Galveston, TX	469	7 hrs, 32 mins.
Haskell, TX	54	1 hr, 6 mins.
Houston, TX	421	6 hrs, 46 mins.
Jackson, MS	589	9 hrs, 21 mins.
Jayton, TX	83	1 hrs, 42 mins.
Las Vegas, NV	1,061	18 hrs, 27 mins.
Little Rock, AR	504	8 hrs, 3 mins.
New Orleans, LA	707	11 hrs, 13 mins.
Phoenix, AZ	886	13 hrs, 51 mins.
Roby, TX	52	1 hrs, 4 mins.
Salt Lake City, UT	1,107	20 hrs, 42 mins.
Shreveport, LA	370	5 hrs, 56 mins.
Snyder, TX	82	1 hr, 29 mins.
Sweetwater, TX	43	46 mins.
Throckmorton, TX	84	1 hr, 41 mins.
Tulsa, OK	396	6 hrs, 59 mins.
Wichita, KS	447	7 hrs, 44 mins.

FIGURE 2
WEST CENTRAL TEXAS IN THE CONTEXT OF THE SOUTH CENTRAL UNITED STATES

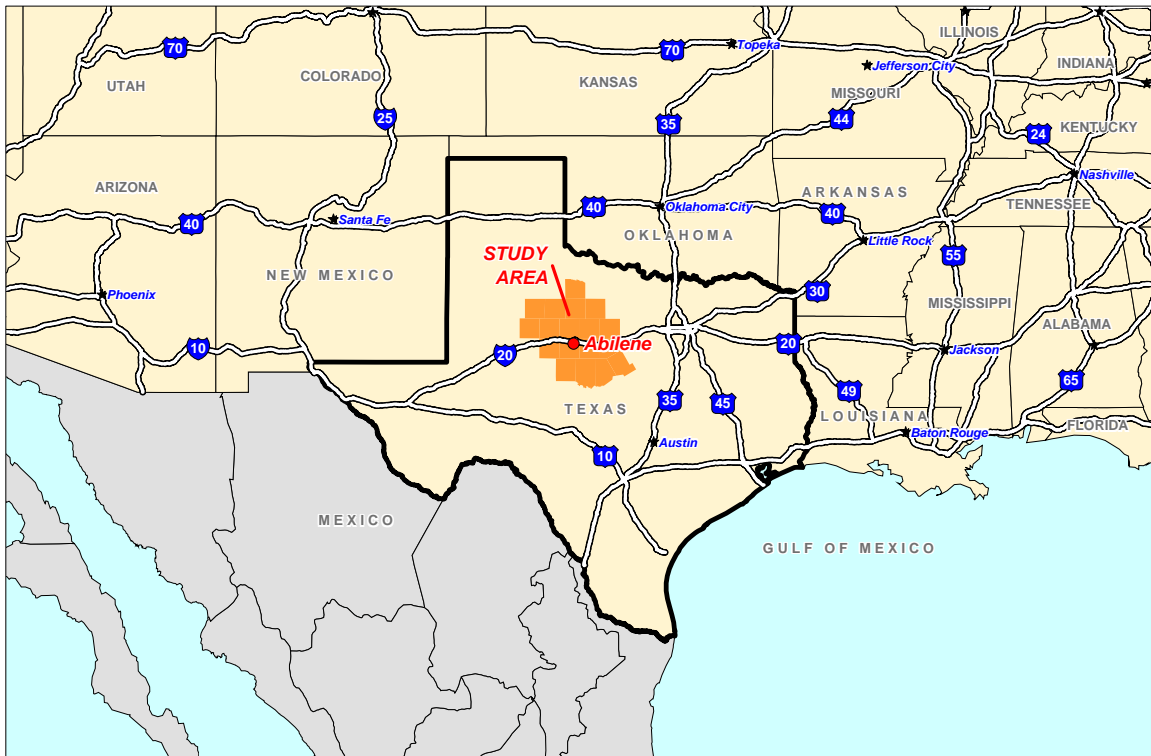
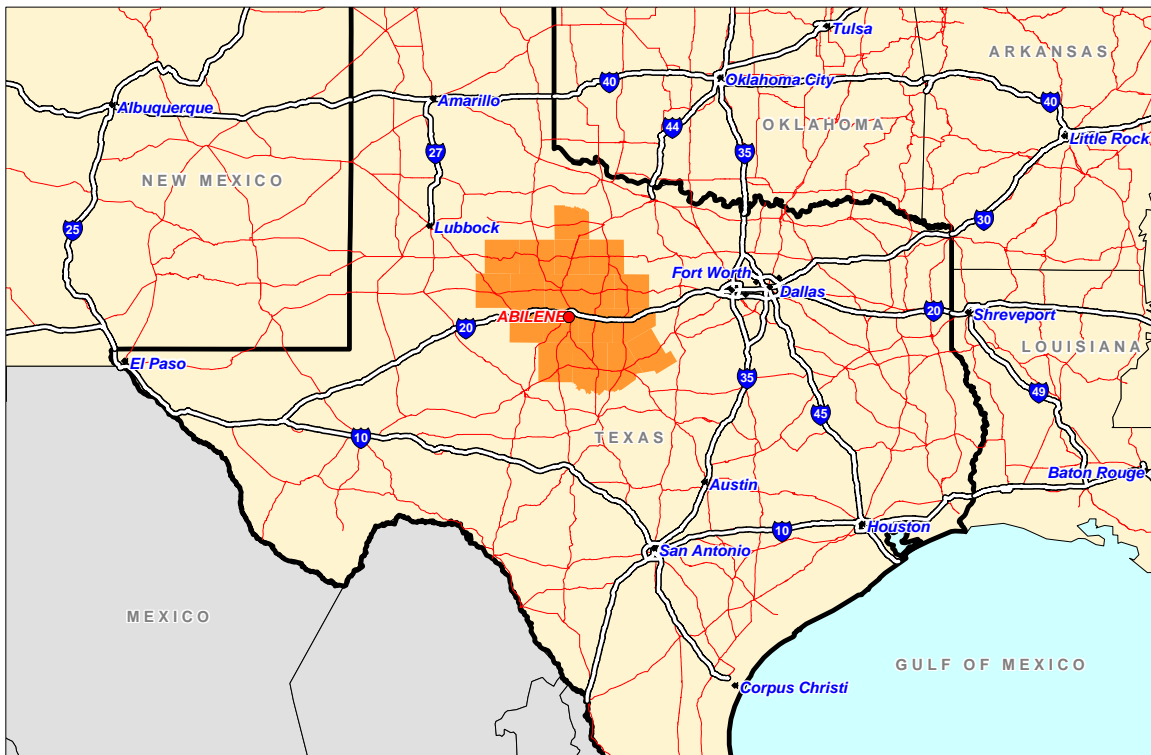


FIGURE 3
WEST CENTRAL TEXAS IN THE CONTEXT OF THE STATE OF TEXAS



Labor Availability

Overall

1. **The Abilene, Brownwood, and Eastland sub-regions are moderately sized with growing populations.** The Abilene sub-region had a population of 127,449 in 2002, and is projected to grow by 2.1% by 2007. The Brownwood sub-region had a population of 61,401 and is projected to increase by 2.2%, while the Eastland sub-region had a population of 31,253 and was projected to increase by 0.8%. The population base of these sub-regions represents a strong labor market potential for firms requiring moderately-sized workforces. The Abilene sub-region offers a civilian labor pool of 56,267. The Brownwood sub-region offers access to an estimated 27,362 workers, while the Eastland sub-region civilian labor force is 16,880.
2. **This target provides an opportunity to build on the three sub-regions' existing base of manufacturing operations.** As seen in Table 2, the sub-regions have a strong base of manufacturing as well as traditional service sector industry employment. Combined, the number of persons employed in the manufacturing industry sector in the three sub-regions is 8,528 workers. Major manufacturing sector employers in the sub-regions include Kohler Co., EBAA Iron Inc., 3M Co., ABCO Industries, Bandag Inc., Brownwood Manufacturing Co., CMI Johnson-Ross Inc., Gore's Inc., Tige Boats Inc., and Victor Equipment Co.
 - Workers employed in the service and retail trade sectors can be viewed as an attribute, and could prove to be beneficial in the growth and development of the manufacturing target. Employees in these industry sectors often possess the aptitude and basic skills that are transferable to many of the entry-level production and administrative support functions embedded in the target. Furthermore, many employees in the retail trade and service sectors would be attracted to positions at manufacturing facilities, as they could potentially offer more challenging work, higher wages, and an opportunity for job and career advancement. The service industry sector is well represented in the three regions, employing 46.0% of the combined labor force (32,830 workers). This also holds true for the retail trade sector. Over fifteen percent (15.3%) of the combined sub-region's workforce (10,944 workers) is employed in retail trade.

TABLE 2
INDUSTRY EMPLOYMENT BY SECTOR, 2000 (*indicates service sector)

Source: U.S. Department of Commerce, County Business Patterns

NAICS	Industry Description	Abilene sub-Region	Eastland sub-Region	Brownwood Sub-region	West Texas Region	TX	U.S.
11----	Forestry, fishing, hunting, and agriculture support	10	0	35	198	---	---
21----	Mining	635	139	90	2,739	---	---
22----	Utilities	461	106	203	1,301	---	---
23----	Construction	2,506	1,106	740	5,658	---	---
31----	Manufacturing	3,706	893	3,929	11,970	---	---
42----	Wholesale trade	2,031	515	961	4,354	---	---
44----	Retail trade	7,230	976	2,738	14,460	---	---
48----	Transportation & warehousing	1,246	136	240	2,388	---	---
51----	Information	1,337	140	275	2,163	---	---
52----	Finance & insurance	2,436	224	581	4,317	---	---
53----	Real estate & rental & leasing	811	20	115	1,127	---	---
54----	Professional, scientific & technical services	1,378	123	250	2,249	---	---
55----	Management of companies & enterprises	447	10	95	592	---	---
56----	Admin, support, waste mgt, remediation services*	2,955	85	331	3,493	---	---
61----	Educational services*	2,373	10	385	3,678	---	---
62----	Health care and social assistance*	10,176	797	3,229	18,115	---	---
71----	Arts, entertainment & recreation*	597	20	141	893	---	---
72----	Accommodation & food services*	5,695	504	1,289	9,139	---	---
81----	Other services (except public administration)*	3,027	300	916	5,634	---	---
95----	Auxiliaries (ex. corporate, subsidiary & regional mgt)	66	10	10	246	---	---
99----	Unclassified establishments	75	17	34	238	---	---

TABLE 2, continued
INDUSTRY EMPLOYMENT BY SECTOR, 2000 (*indicates service sector)
 Source: U.S. Department of Commerce, County Business Patterns

NAICS	Industry Description	Abilene sub-Region	Eastland sub-Region	Brownwood Sub-region	West Texas Region	TX	U.S.
Percentage of Employment							
11----	Forestry, fishing, hunting, and agriculture support	0.0%	0.0%	0.2%	0.2%	0.1%	0.2%
21----	Mining	1.3%	2.3%	0.6%	2.9%	1.3%	0.4%
22----	Utilities	0.9%	1.8%	1.2%	1.4%	0.6%	0.6%
23----	Construction	5.1%	18.5%	4.6%	6.0%	6.5%	5.8%
31----	Manufacturing	7.5%	14.9%	24.2%	12.8%	12.0%	14.4%
42----	Wholesale trade	4.1%	8.6%	5.9%	4.6%	5.7%	5.4%
44----	Retail trade	14.7%	16.3%	16.8%	15.4%	12.7%	13.0%
48----	Transportation & warehousing	2.5%	2.3%	1.5%	2.5%	3.9%	3.3%
51----	Information	2.7%	2.3%	1.7%	2.3%	3.1%	3.1%
52----	Finance & insurance	5.0%	3.7%	3.6%	4.6%	4.8%	5.2%
53----	Real estate & rental & leasing	1.6%	0.3%	0.7%	1.2%	1.8%	1.7%
54----	Professional, scientific & technical services	2.8%	2.1%	1.5%	2.4%	5.5%	6.0%
55----	Management of companies & enterprises	0.9%	0.2%	0.6%	0.6%	3.2%	2.5%
56----	Admin, support, waste mgt, remediation services*	6.0%	1.4%	2.0%	3.7%	9.9%	8.0%
61----	Educational services*	4.8%	0.2%	2.4%	3.9%	1.4%	2.2%
62----	Health care and social assistance*	20.7%	13.3%	19.9%	19.3%	11.5%	12.4%
71----	Arts, entertainment & recreation*	1.2%	0.3%	0.9%	1.0%	1.1%	1.5%
72----	Accommodation & food services*	11.6%	8.4%	7.9%	9.7%	8.8%	8.7%
81----	Other services (except public administration)*	6.2%	5.0%	5.6%	6.0%	4.9%	4.6%
95----	Auxiliaries (ex. corporate, subsidiary & regional mgt)	0.1%	0.2%	0.1%	0.3%	1.0%	0.9%
99----	Unclassified establishments	0.2%	0.3%	0.2%	0.3%	0.1%	0.1%

3. **The existing industry base of the Abilene, Brownwood, and Eastland sub-regions offer an excellent opportunity for a manufacturing facility needing to hire between 55 and 200 employees.** Table 3 shows a conservative estimate of qualified manufacturing workers over one year for a facility locating in each of the three sub-regions, assuming the new operation offers competitive wages and benefits. This staffing potential varies by geographic labor draw area and selectivity ratio. Assuming a hiring ratio of one hire for every five applicants, an operation could hire at least 160 employees from the Abilene sub-region, 115 employees from the Brownwood sub-region, or 55 employees from the Eastland sub-region proper. A hiring ratio of one hire for every four applicants results in an increased annual staffing potential of at least 200 employees from the Abilene sub-region, 140 employees from the Brownwood sub-region, or 70 employees from the Eastland sub-region. While this model quantifies staffing potentials exclusive to each respective sub-region, the more likely scenario would be an applicant flow emanating from all three sub-regions. It should be noted that this model assumes no other similar operations offering competitive wages and benefits enter the market at the same time. As more competitors enter the market, the number of successful hires likely will decline.

TABLE 3
ESTIMATED LABOR SUPPLY YIELD FOR A COMPETITIVE
MANUFACTURING OPERATION

Source: WDG estimate based on employment figures and projections by AGS, Inc.

	Factor	30-Minute Commute Zone of Abilene Sub-region	30-Minute Commute Zone of Brownwood Sub-region	30-Minute Commute Zone of Eastland Sub-region
1	Currently employed supply	690	280	130
2	Potential underemployment yield	1,855	500	255
3	Increased participation yield	295	720	385
4	New labor force entrants	110	45	5
5	Total expected applicants- 1 year	2,945	1,550	775
6	Applicant commute propensity (85%)	2,505	1,390	700
7	Initial Employer Intercept (80%)	2,005	1,255	630
8	Qualified Applicants (50%)	1,000	625	315
9	Employee Acceptance (85%)	800	565	285
10	Staffing potential with one-in-five selectivity	200	115	55
11	Staffing potential with one-in-four selectivity	160	140	70

Explanatory Notes:

1. Estimate of currently employed workers unhappy enough with their current job to apply.
2. Individuals currently working in low-level sales, service, and farming, forestry or fishing occupations who will apply.
3. Women currently not participating in the workforce who will participate
4. Growth component to account for new entrants into the labor force
5. Total eligible population.
6. Percentage of workers willing to commute for employment from various labor sheds – percentage varies depending on location.
7. Percentage of workers who will work at initial operation despite similar positions available between their residence and the original employers. In this case, it is assumed that a manufacturing facility coming into the area would be the employer of choice and a high percentage of workers would commute to the employer's original location. As more competitors enter the market, the percentage of workers accepting work at the original location is assumed to decline.
8. Number of applicants passing initial screening and offered an interview. The actual percentage will vary according to the skills required by the operation, and the skill level of the available workforce.
9. The percentage of workers accepting a new position. Again, it is assumed that initially, a high percentage would accept a position. However, as additional companies enter the market, the percentage is likely to decline because of increased competition for workers.
10. For a company desiring to hire one individual for every five interviews, the maximum estimated staffing potential for their operation in year one.
11. For a company desiring to hire one individual for every four interviews, the maximum estimated staffing potential for their operation in year one.

4. **The Abilene, Brownwood, and Eastland sub-region's labor force has a strong resident base of production, transportation, material-moving, and laborer occupations.** Table 4 compares the employment distribution by occupational category of these and other occupations relevant to the turbine and blade manufacturing industry in the three sub-regions to regional, state, and national norms. In most instances, sub-region employment in these sectors mirrors or exceeds regional, state, and national norms. When viewed against regional, state, and national averages, there is a higher proportion of residents employed as precision production workers, machine operators, transportation and material movers, and equipment cleaners, helpers, and laborers in the Brownwood and Eastland sub-regions. The Abilene sub-region averages are somewhat lower. Persons employed in the sales and service occupational categories in all three sub-regions exceed both state and national averages. These skill-set concentrations are indicative of a base of seasoned and technically-skilled workers in the sub-region's workforce. Importantly, workers in the sales and service sectors often have skills that are immediately transferable to many target industry occupations.

- The proportion of metro area residents employed in precision production and machine operator occupations in the Brownwood sub-region, 18.2% (4,778 workers), and the Eastland sub-region, 18.2% (2,415 workers), exceeds the West Central Texas regional average (16.3%), the state average (15.8%), and the national average (16.7%). The Abilene sub-region average is 13.8% (8,093 workers).
- The proportion of residents employed in transportation and material-moving occupations in the Brownwood sub-region, 9.0% (2,348 workers), and the Eastland sub-region, 10.7% (1,413 workers), also exceeds the West Central Texas regional average (8.5%), the state average (7.4%), and the national average (7.3%). The Abilene sub-region average is 6.7% (3,974 workers).
- The proportion of residents employed in sales and service occupations in all three sub-regions, Abilene–31.6% (18,611 workers), Brownwood–30.2% (7,926 workers), and Eastland–28.3% (3,753 workers), exceeds the state average (27.9%) and the national average (27.0%). The West Central Texas regional average is 29.8%.
- The proportion of residents employed in executive and professional specialty occupations in the Abilene sub-region, 25.0% (14,736 workers), exceeds the regional average (20.4%) and state average (24.6%), while mirroring the national average (25.0%). The Brownwood sub-region average is 17.3% (4,540 workers), and the Eastland sub-region average is 18.0% (2,381 workers).
- The proportion of residents employed in technical occupations in the Abilene sub-region, 3.8% (2,226 workers), exceeds the regional average (2.8%) and the national average (3.6%). The state average is 3.8%. The Brownwood sub-region average, 2.4% (628 workers), and Eastland sub-region average, 2.2% (289 workers), are somewhat lower.
- The proportion of residents employed in clerical and administrative support occupations in the Abilene sub-region, 16.5% (9,703 workers), and the Eastland sub-region, 15.4% (2,033 workers), exceeds the regional average of 15.1%. The Brownwood sub-region average is 13.7% (3,586 workers). The state average is 17.1%, while the national average is 17.2%.

TABLE 4
EMPLOYMENT BY SELECTED OCCUPATION 2001
 Source: Applied Geographic Solutions

Occupation	Abilene Region	Brownwood Region	Eastland Region	West TX Region	Texas	U.S.
Actual Employment						
Executive	5,464	1,766	867	10,942	--	--
Professional	9,272	2,774	1,514	18,619	--	--
Technician	2,226	628	289	4,121	--	--
Sales	7,126	2,697	1,409	15,066	--	--
Clerical	9,703	3,586	2,033	21,851	--	--
Services	11,485	5,229	2,344	28,009	--	--
Farming	1,603	2,417	948	10,381	--	--
Precision Production	6,048	2,818	1,789	16,732	--	--
Machine Operators	2,045	1,960	626	6,750	--	--
Transportation	2,335	1,359	848	7,348	--	--
Laborers / Handlers	1,639	989	565	4,928	--	--
Percentage of Labor Force						
Executive	9.3%	6.7%	6.6%	7.6%	10.5%	10.6%
Professional	15.7%	10.6%	11.4%	12.9%	14.1%	14.4%
Technician	3.8%	2.4%	2.2%	2.8%	3.8%	3.6%
Sales	12.1%	10.3%	10.6%	10.4%	11.5%	10.9%
Clerical	16.5%	13.7%	15.4%	15.1%	17.1%	17.2%
Services	19.5%	19.9%	17.7%	19.4%	16.4%	16.1%
Farming	2.7%	9.2%	7.2%	7.2%	3.2%	3.1%
Precision Production	10.3%	10.7%	13.5%	11.6%	11.3%	11.0%
Machine Operators	3.5%	7.5%	4.7%	4.7%	4.5%	5.7%
Transportation	4.0%	5.2%	6.4%	5.1%	3.8%	3.7%
Laborers / Handlers	2.8%	3.8%	4.3%	3.4%	3.6%	3.6%

Abilene Sub-region

1. **Among the sub-regions, the Abilene sub-region has the largest labor pool.** The sub-region had an average civilian labor force of 57,335 in 2001.
 - Among all of the sub-regions, the largest labor pool is within a 30-minute commute zone from 6450 Five Points Parkway in the City of Abilene. Typically, most non-exempt and hourly employees will commute up to 30 minutes for a competitively-paying job. Within a 30-minute drive time from the Abilene commute node, there is a population base of 137,275 offering a labor force of 61,755.
2. **Surveyed area employers report satisfactory-to-good availability of employment candidates for a range of skills, and, for the most part, are pleased with the overall quality of the workforce.** Basic computer skills among job applicants, including basic keyboarding skills, using word processing software, and accessing and using the Internet, were rated as good by local employers. Work ethic and productivity were rated as above-average.
3. **There is a potentially hidden labor force in the Abilene sub-region of approximately 45,854 residents.** This pool of workers consists of currently-not-employed residents interested in employment, employed residents interested in training for career advancement, and recent college graduates.
 - Approximately 59.3% of residents currently not employed (i.e., unemployed and not participating in the labor force) in the Abilene sub-region are interested in working. This equates to 19,100 residents that potentially could enter the labor market, of which 66.7% report that they have no limitations to working. The most frequently-mentioned work limitation is the lack of jobs matching the surveyed respondents' level of education/training.
 - An additional 47.2% of employed residents would be interested in training to acquire new job skills, which amounts to 25,400 residents.
 - The Abilene sub-region is home to many of the region's post-secondary institutions, namely: Abilene Christian College, Hardin-Simmons University, McMurray University, Cisco Junior College, and Texas State Technical College. These institutions graduate more than 1,350 students annually.
4. **Dyess Air Force Base is another important source of labor for Taylor County employers.** There are approximately 5,437 enlisted military at the base and over 6,000 family members. Spouses of military personnel and exiting military comprise an important component of Taylor County's workforce, according to interviewed employers.

Brownwood Sub-region

1. **The Brownwood sub-region has the second-largest labor force after the Abilene sub-region, with a civilian labor force of 26,744.**
 - Within a 30-minute drive time of 2800 Morris Sheppard Drive in Brownwood, there is an estimated labor pool of 14,665.
 - The Brownwood sub-region's labor force participation rate (58.2%) is slightly lower than the region (61.9%).
2. **Based on the demographic profile of the sub-region and residential survey results, it is estimated that there is a hidden labor supply of 20,500 residents.**
 - Approximately 57.6% of currently-non-employed residents indicate that they would be interested in working, amounting to 8,000 individuals. 51.5% of these residents report no limitations to working. The second most frequently-mentioned work limitation is dependent care obligations.
 - Roughly 46% of currently employed residents would be interested in training to upgrade their job skills for career development. This amounts to 12,000 residents interested in enhancing their skills.

- Graduates from local post-secondary institutions such as Texas State Technical College-Brownwood, Central Texas Commercial College, and Howard Payne University graduate just under 500 students per year.

Eastland Sub-region

1. **The Eastland sub-region has a small civilian labor pool; however, it is the only sub-region to experience an increase in its workforce.** In 2001, the Eastland sub-region had an annual civilian labor force of 15,621 residents, which was a 4.2% increase since 1996.
 - The sub-region has the lowest labor participation rate among all of the sub-regions. Only 56.6% of working-age residents are actively participating in the workforce.
 - The commute zone node for the Eastland sub-region is located at 100 West Main in Eastland. Within a 30-minute drive time of this site, there is a population of 15,539 providing a labor force of 7,689.
2. **There is a labor reserve of 11,300 in the Eastland sub-region.**
 - There are 3,000 residents currently not employed that would be interested in employment. This amounts to 66.7% of all non-employed residents.
 - There are a large number of currently employed residents that would be interested in training for career development. Approximately 51.1% of employed residents—the highest percentage among all of the sub-regions—would be interested in upgrading their skills. This amounts to 8,300 residents.

Training Resources

1. **The West Central Texas region's two- and four-year post-secondary institutions graduate more than 3,000 students per year in a variety of disciplines.** Post-secondary institutions in the West Central Texas region include Abilene Christian University, American Commercial College, Central Texas Commercial College, Cisco Junior College, Hardin-Simmons University, Howard Payne University, McMurray University, Ranger College, Texas State Technical College, and Western Texas College. Many of these students graduate with technical skills in high demand by manufacturing industry employers, including industrial manufacturing technology and industrial maintenance technology, as well as business-related skills such as accounting, business administration, computer and information sciences, and administrative and secretarial services. Table 5 shows enrollment and graduation figures for regional post-secondary institutions. Combined, these institutions have an enrollment of more than 11,000 students.

TABLE 5
REGIONAL POST-SECONDARY INSTITUTIONS' ENROLLMENT AND GRADUATES, 2000
Source: U.S. Department of Education

Institutions	County	City	Total Fall Enrollment	Total Graduates
<i>Less-than-four-year institutions</i>				
Cisco Junior College	Eastland	Cisco	1,143	272
Western Texas College	Scurry	Snyder	554	185
Central Texas Commercial College	Brown	Brownwood	60	39
American Commercial College	Taylor	Abilene	114	188
Texas State Technical College-Sweetwater	Nolan	Sweetwater	800	354
<i>More-than-four-year institutions</i>				
Abilene Christian University	Taylor	Abilene	3,565	894
Hardin-Simmons University	Taylor	Abilene	1,752	456
Howard Payne University	Brown	Brownwood	1,189	262
McMurry University	Taylor	Abilene	965	195
Ranger College	Eastland	Ranger	588	131
Hendrick Medical Center School of Radiography	Taylor	Abilene	20	19
Stenograph Institute of Texas	Taylor	Abilene	117	34

2. **Several institutions in the West Texas region offer degrees and programs offerings relevant to target industry employers.**

- **Texas State Technical College** has four campuses within the west Texas study area: Abilene, Breckenridge, Brownwood, and Sweetwater. All of the campuses offer a range of programs providing business and technical skills applicable to positions in the manufacturing industry.
 - Texas State Technical College-Abilene offers degree programs and coursework in Computer Technology such as computer network technology, computer science technology, computer information technology, and digital imaging and design technology. Manufacturing Technology course offerings include drafting and design technology.
 - Texas State Technical College-Breckenridge offers a Computer Information Technology (CIT) program. The CIT program offers two separate program options, including computer business systems and digital multimedia systems. Students who choose the Computer Business Systems option receive training in software applications such as word processing, electronic spreadsheets, and database management systems, with particular attention given to accounting and automated accounting systems.
 - Texas State Technical College-Brownwood offers degree and certificate programs in Computer Information Technology and Computer Networking, as well Manufacturing Technology programs in industrial maintenance technician and machine technology. A degree program in drafting design technology and certificate program in computer-aided design (CAD) are also available.
 - Texas State Technical College-Sweetwater has a Computer Technology division offering degree programs in computer information technology, computer network technology, computer science technology and digital imaging and design technology. Manufacturing Technology degree programs include automation robotics and drafting design technology and a certificate program in computer-aided design (CAD).
- **Cisco Junior College** offers degree programs in accounting, business, and computer science. Technical certificate programs are in maintenance mechanics and office systems technology.
- **The Hardin-Simmons Kelley College of Business** offers undergraduate majors in accounting, computer science, economics, finance, general business, international business, management, and marketing. The Master of Business Administration (M.B.A.) degree is also offered.
- **Howard Payne University** offers more than 50 majors, minors, and pre-professional programs within six schools. Some of the degree programs offered include business administration, communication, computer information systems, and general studies. Within the business administration programs, concentrations are available in business education, finance, management, and marketing.
- **Abilene Christian College** offers degree programs through three colleges and a graduate school. The College of Business Administration offers degrees in accounting and finance and management sciences, as well as a Master of Accountancy degree. The College of Arts and Sciences offers degrees in communications, journalism and mass communication, and mathematics and computer science.

Labor Quality

1. **Demographics for the Abilene, Brownwood and Eastland sub-regions indicate a well-educated workforce.** As shown in Table 6, the education levels of sub-region residents, specifically those with post-secondary education, are high relative to regional and state figures.
 - According to 2000 data from the U.S. Bureau of the Census, the percentage of residents with at least a high school diploma in the Abilene sub-region (81.2%) and the Brownwood sub-region (78.4%), exceeds the West Central Texas regional average (76.8%) and the state average (75.6%). The Eastland sub-region (75.4%) mirrors the state average. The national average is 80.3%.

- The percentage of residents in the Abilene sub-region with one to three years of post-secondary training, which includes an Associate degree (30.3%), and the Brownwood sub-region (28.0%), surpasses the regional average (27.5%), the state average (27.6%), and the national average (27.3%). The Eastland sub-region (27.4%) mirrors these averages. This is significant, since many employers prefer to hire employees with some post-secondary.
- The proportion of residents with a four-year college degree in the Abilene sub-region (22.5%) and the Brownwood sub-region (19.5%) exceeds the West Central Texas regional average (17.9%). The Eastland sub-region's average is 12.5%. The Texas statewide average is 23.2%, while the national average is 24.4%.

TABLE 6
EDUCATIONAL ATTAINMENT 2000

Source: U.S. Bureau of the Census

	Abilene Sub-region	Brownwood Sub-region	Eastland Sub-region	West Central TX	Texas	United States
No High School Diploma	18.8%	21.6%	24.6%	23.2%	24.4%	19.6%
High School Diploma Only	28.4%	30.8%	35.4%	31.4%	24.8%	28.6%
1-3 Years College	24.8%	23.3%	22.4%	22.7%	22.4%	21.0%
Associate Degree	5.5%	4.7%	5.1%	4.8%	5.2%	6.3%
1 to 3 Years College Incl. Associate Degree	30.3%	28.0%	27.4%	27.5%	27.6%	27.3%
Bachelors Degree	14.9%	13.1%	9.0%	12.1%	15.6%	15.5%
Graduate Degree	7.6%	6.5%	3.6%	5.8%	7.6%	8.9%
16 Or More Years Of Education	22.5%	19.5%	12.5%	17.9%	23.2%	24.4%

2. **Surveyed employers in the West Central Texas region are generally satisfied with the quality of the workforce.**
 - Overall basic skills and verbal communication skills across the region were given satisfactory scores (a median and average score of 3.0 on a scale where 1=poor and 5=excellent).
 - Team and cooperative skills received a slightly higher rating
3. **Employers also rated the work ethic and productivity of the regional workforce as satisfactory to above-satisfactory.**
 - Work ethic and productivity received median scores of 3.0 and average scores of 3.2, on a scale where 1=poor and 5=excellent.
 - Employers rated the productivity higher in the region compared to other company locations. Employers gave satisfactory-to-good scores on employee willingness to work overtime.
4. **Area employers indicated that, while employee turnover is somewhat high across the region, absenteeism is not a problem.**
 - Average annual turnover was reported to be approximately 10% by area employers. Average daily absenteeism was under 5% and not perceived as a problem among employers.

Labor Costs

1. **Published wage data shows the Abilene MSA (Abilene sub-region) has average-to-below-average labor costs relative to the nation in almost all representative occupations.** Wage data for each specific sub-region is not available, but Abilene MSA data can be considered as representative of the region. Table 7 shows median earnings for some representative target-industry-related occupational groups in the Abilene MSA and the U.S. (recently published by the U.S. Bureau of Labor Statistics). Among those occupations listed within each target industry occupational group, average earnings in Abilene are substantially lower than national averages.

- Production occupations such as cutting, punching, and press machine setters, operators, and tenders, averaging \$18,845, offer an 18% savings over national averages, while production worker's helpers, averaging \$16,266, are 9% less expensive in the Abilene market. First-line supervisors/managers of production and operating workers earn 17% below the national average, or roughly \$33,280.
- Transportation and material-moving occupations can also offer cost savings. Laborers and freight, stock, and material-moving workers, averaging \$14,456, represent a 23% savings, while hand packers and packagers, averaging \$13,291, are 15% less expensive. Truck drivers, averaging \$21,486, are 4% below national averages.
- Management occupational salaries average 24%-41% less than national norms in the Abilene market. Positions such as computer and information systems managers, averaging \$46,238, and purchasing managers, averaging \$33,966, are 36%-41% below national averages. General and operations managers, averaging \$42,827, industrial production managers, averaging \$43,493, and human resources managers, averaging \$42,536, constitute a 28%-30% savings. Administrative service managers are 24% less costly, earning an average of \$35,526.
- Business and Financial Operations occupational salaries for positions such as purchasing agents and accountants and auditors are 13%-23% less costly than national averages in the Abilene market. Salaries range from \$33,176 for purchasing agents to \$37,627 for accountants and auditors.
- Office and Administrative Support occupations in Abilene represent considerable savings for all occupational titles listed when compared to the nation. Average salaries for office-related occupations such as executive secretaries and administrative assistants, customer service representatives, bookkeeping, accounting and auditing clerks, and general office clerks represent savings ranging from 19%-28%. Salaries for these positions average in the high 'teens to mid-twenties, ranging from \$17,098 for a general office clerk to \$24,066 for an executive secretary or administrative assistant. First-line supervisors/managers of office and administrative support workers, averaging \$27,331, are 25% below the national average.
- Computer and Mathematical occupations also offer savings. Computer programmers represent the most significant savings when compared to national averages. Average salaries in Abilene for this position, \$43,888, are 24% less expensive while network and computer systems administrators, averaging \$42,848, are 16% below the national average.

TABLE 7
MEDIAN ANNUAL EARNINGS IN THE ABILENE MSA
AND THE U.S. IN SELECT OCCUPATIONS 2000

Source: U.S. Bureau of Labor Statistics, Area Occupational Employment & Wage Estimates

	Abilene MSA	U.S.	% Difference Abilene vs. U.S.
Management Occupations			
General and Operations Managers	\$42,827	\$61,173	-30.0%
Administrative Services Managers	\$35,526	\$47,070	-24.5%
Computer and Information Systems Managers	\$46,238	\$78,832	-41.3%
Human Resources Managers	\$42,536	\$58,989	-27.9%
Industrial Production Managers	\$43,493	\$61,651	-29.5%
Purchasing Managers	\$33,966	\$53,040	-36.0%
Business and Financial Operations Occupations			
Purchasing Agents	\$33,176	\$43,222	-23.2%
Accountants and Auditors	\$37,627	\$43,493	-13.5%

TABLE 7, continued
MEDIAN ANNUAL EARNINGS IN THE ABILENE MSA
AND THE U.S. IN SELECT OCCUPATIONS 2000

Source: U.S. Bureau of Labor Statistics, Area Occupational Employment & Wage Estimates

	Abilene MSA	U.S.	% Difference Abilene vs. U.S.
Office and Administrative Support Occupations			
First-Line Supervisors/Managers of Office and Administrative Support Workers	\$27,331	\$36,421	-25.0%
Bookkeeping, Accounting, and Auditing Clerks	\$20,405	\$25,667	-20.5%
Customer Service Representatives	\$17,784	\$24,606	-27.7%
Executive Secretaries and Administrative Assistants	\$24,066	\$31,096	-22.6%
Office Clerks, General	\$17,098	\$21,133	-19.1%
Computer and Mathematical Occupations			
Computer Programmers	\$43,888	\$57,595	-23.8%
Network and Computer Systems Administrators	\$42,848	\$51,272	-16.4%
Production Occupations			
First-Line Supervisors/Managers of Production and Operating Workers	\$33,280	\$40,331	-17.5%
Cutting, Punching, and Press Machine Setters, Operators, and Tenders, Metal and Plastic	\$18,845	\$22,942	-17.9%
Helpers--Production Workers	\$16,266	\$18,013	-9.7%
Transportation and Material Moving Occupations			
Truck Drivers, Light Or Delivery Services	\$21,486	\$22,339	-3.8%
Laborers and Freight, Stock, and Material Movers, Hand	\$14,456	\$18,803	-23.1%
Packers and Packagers, Hand	\$13,291	\$15,662	-15.1%

Infrastructure and Operating Environment

1. **The West Texas region is ideally suited for locating "wind farms" due to the flat terrain and abundant wind resources.** West Texas is already home to a number of windmill farms that can provide large amounts of electricity without the use of fossil fuels. One windmill farm, located between Abilene and Sweetwater, consists of 100 wind turbines, each rated at 1.5 megawatts.
2. **The West Texas region is home to several major manufacturers.** Major manufacturing employers in the Abilene, Brownwood, and Eastland sub-regions include Kohler Co., EBAA Iron Inc., 3M Co., ABCO Industries, Bandag Inc., Brownwood Manufacturing Co., CMI Johnson-Ross Inc., Gore's Inc., Tige Boats Inc., and Victor Equipment Co. Table 8 provides a sampling of these employers and their approximate employment.

TABLE 8
MAJOR MANUFACTURING EMPLOYERS

Source: WDG from Development Corporation Of Abilene, Inc. (DCOA) Data

Company	Employment
Kohler Co	1,000-4,999
EBSS Iron Inc	250-499
3m Co	500-999
ABCO Industries	100-249
Bandag Inc	100-249
Brownwood Manufacturing Co	100-249
CMI Johnson-Ross Inc	100-249
Gore's Inc	100-249
Tige Boats Inc	100-249
Victor Equipment Co	100-249

3. **The urbanized areas in the West Central Texas region have been proactive in investing in the necessary water supply and distribution infrastructure to support future growth and development.** In particular, the cities of Abilene and Brownwood have taken significant steps to modernize their infrastructure. The Abilene, Brownwood, and Eastland sub-regions have adequate water supplies and the necessary delivery infrastructure to reliably meet current needs and to provide for some service expansion.
4. **Within the West Central Texas region, there is adequate wastewater collection and treatment infrastructure.** Several cities have recently made investments in their wastewater infrastructure and/or have ongoing wastewater upgrade projects.
5. **All of the West Central Texas region's urbanized areas have good highway access,** with particularly good access through Abilene, Eastland, and Sweetwater, which are optimally located along or near Interstate 20. Abilene, Brownwood, Snyder, and Sweetwater also have rail access. Abilene and Brownwood have commercial airline service from their regional airports to Dallas-Fort Worth.
6. **Texas Workers' Compensation and labor legislation are favorable to employers.** A review of existing Texas labor law, as seen in Table 9, reveals no current state legislation exceeding federal mandates. Texas is a right-to-work state. There are no statewide restrictions stronger than federal in terms of drug testing, right-to-know, ADA legislation, EEO hiring, sexual harassment, or mandated parental leave legislation. Texas has solid employment-at-will legislation, meaning that an employee is hired at will, and that employment can be terminated at the will of either the employer or the employee.

TABLE 9
TEXAS LABOR LEGISLATION
Source: State of Texas

Employment at will? (Yes or No)	Yes
If yes, significant restrictions (from employers standpoint)	No
Restrictions on employee drug testing	No
Telephone monitoring restrictions for regulation of productivity (or customer service)	Yes: One Party Consent
Plant Closing Law stricter than Federal?	No
ADA legislation stricter than Federal?	No
Ban on hiring replacement workers during a strike?	No
Striking workers entitled to unemployment insurance?	No
Relatively difficult for an employer to contest and win a workers' comp. claim?	No
Relatively difficult for an employer to contest and win an unemployment ins. claim?	No
Right-to-Work law in effect?	Yes
EEO hiring standards more restrictive than Federal?	No
Sexual harassment laws more restrictive than Federal?	No
Mandated parental leave legislation more generous than Federal?	No
Onerous provisions for wrongful discharge	No

Quality of Life

1. **Taylor County—specifically the City of Abilene—functions as a regional center for business, healthcare, transportation, and education, which has resulted in a wide variety of lodging, dining, cultural, and retail opportunities.** The Abilene Philharmonic Orchestra, the Abilene Community Theatre, the Abilene Repertoire, the Abilene Opera Association, multiple spectator and participatory sporting events, annual celebrations, and numerous historical attractions are just a few of the available opportunities that enhance the quality of life in Taylor County.
 - Abilene has witnessed a dramatic renewal and redevelopment of its downtown district. In addition to renovating numerous downtown properties, Abilene plans on capturing its West Texas heritage in a facility called "Frontier Texas!" that will include both a visitors center and a historical experience.
 - Abilene has 31 parks covering 2,481 acres, 2 public swimming pools, and 6 public or private golf courses.

- The climate and diverse environment of West Central Texas lends itself to year-round participation in most outdoor sports. There are at least six months of each year devoted to hunting seasons that focus on game birds and animals that are native to or abundant in this area.
- 2. **The cost of living is below the national average (where data was available).** In Abilene, the cost of living (COL) index is 96.2 where the U.S. is 100. The COL index in Brownwood is 85.2.
- 3. **The City of Abilene, on average, enjoys 350 days of sunshine per year.** The average annual temperature is 64.8 degrees Fahrenheit (F). In July, the average high temperature is 85°F, and the average low is 64°F. In January, the average high is 65°F, with the average low at 43°F.
- 4. **The City of Abilene serves as a regional medical center.** Abilene has two hospitals, with a total of 680 beds. 285 physicians practice in the City of Abilene, as well as 64 dentists.

INDUSTRY BACKGROUND

An industry definition, employment composition, and an overview of the target's sectors are presented below.

Definition

Wind power is an increasingly popular renewable energy source. The windmill product manufacturing industry target comprises establishments primarily engaged in manufacturing turbines (SIC 3511, NAICS 333611), which are the mechanical devices used to harness the energy from the wind, and turbine blades, which is one component of the wind turbine (SIC 3089, NAICS 326199). There are two basic designs of wind electric turbines: vertical-axis, or "egg-beater" style, and horizontal-axis machines. Horizontal-axis wind turbines are most common today, constituting nearly all of the "utility-scale" turbines in the global market.

There are four main parts to a wind turbine: the base, tower, nacelle, and blades. The blades capture the wind's energy, spinning a generator in the nacelle. The tower contains the electrical conduits, supports the nacelle, and provides access to the nacelle for maintenance. The base, made of concrete and steel, supports the whole structure.

A turbine's blades are designed like airplane wings and use lift to capture the wind's energy. Because of the blade's special shape, the wind creates a pocket of pressure as it passes through the blade. This pressure pulls the blade, causing the turbine to rotate. This modern blade design captures the wind's energy much more efficiently than old farm windmills, which use the force of the wind pushing against the blades. The blades spin at a slow rate of about 20 revolutions per minute (RPM), although the speed of the blade tip can be over 150 miles per hour.

The output of a wind turbine depends on the turbine's size and the wind's speed through the rotor. The wind turns the blades, which spin a shaft, which connects to a generator and makes electricity. Wind turbines being manufactured now have power ratings ranging from 250 watts to 1.8 megawatts (MW). Utility scale turbines range in size from 50 kilowatts and up. Single small turbines, below 50 kilowatts, are used for homes, telecommunications dishes, or water pumping. The most economical application of wind electric turbines is in groups of large machines (660 kW and up), called "wind power plants" or "wind farms."

Employment Composition

The U.S. wind industry currently directly employs more than 2,000 people. The wind industry contributes directly to the economy of 46 states, with power plants and manufacturing facilities that produce wind turbines, blades, electronic components, gearboxes, generators, and a wide range of equipment. According to one estimate, wind and solar energy are likely to furnish one of the largest sources of new manufacturing jobs worldwide during the 21st century.

Occupations within the industry range from technicians up to professional engineers. New wind generating facilities require workers with business, meteorological, and engineering experience to plan and build projects. Meteorologists help engineers identify appropriate sites with suitable wind conditions. Engineers then design the wind plant, working with the utility companies and communities. Construction workers are needed to build the wind plant. In addition, mechanical and electrical technicians, called "windsmiths," are required to operate and maintain the wind turbines.

Both industry and research laboratories constantly try to improve the design and efficiency of wind turbines. These research and development (R&D) groups generally employ mechanical, electrical, and aeronautic engineers with advanced degrees, as well as experienced technicians.

Sector Overview and Trends

Wind energy is a rapidly-growing market segment of the energy industry. On average, the global wind energy market has been growing at an average of 24% annually within the last 10 years. The U.S. wind energy experienced unprecedented success in 2001, installing a record amount of new generating equipment across 16 states, with interest in installing more throughout the country. A setback occurred in U.S. government policy as

the federal wind energy production tax credit (PTC) was allowed to expire at the end of December 2001. After several months of uncertainty, the PTC was extended to December 31, 2003. Long-term growth of the industry, therefore, will largely be determined by the presence of a consistent energy policy in the form of the wind energy production tax credit. Central to the industry's agenda in 2003 will be a proposed multi-year extension of the existing federal wind energy production tax credit.

According to the American Wind Energy Association (www.awea.org), 2002 proved to be a strong year despite overall stagnating conditions in the broader energy industry. AWEA reports that total installed wind electric generating capacity expanded by nearly 10% during the year, with 410 megawatts (MW) of new equipment going into service (enough to meet the needs of approximately 120,000 average American homes). At the end of 2002, it was estimated that wind plants in 27 states across the country totaled 4,685 MW, enough to serve more than 1.3 million households. AWEA had previously projected a record year in 2003 with more than 2,000 MW total installed generating capacity. However, given the growing uncertainty in energy policy, it scaled its forecast back to a range of 1,500 to 1,800 MW.

Table 10 shows industry employment and establishment trends in two sectors in which wind-generating-equipment-manufacturing establishments are classified. Within the NAICS classification system, there is not a perfect classification for wind generating equipment; however, many turbine manufacturers will be classified under NAICS 333611—turbine and turbine generator set units manufacturing—while larger blade manufacturers are often classified under NAICS 326199—all other plastics product manufacturing. Between 1998 and 2000, the only years for which NAICS data are available, overall employment in the two sectors increased by 1.3% while the number of establishments declined. One reason for the decline in the number of establishments is the increased consolidation within the sector. Average earnings in both industry sectors saw increases during this period, and overall, average annual earnings increased by approximately 6%.

TABLE 10
TARGET INDUSTRY EMPLOYMENT AND ESTABLISHMENT TRENDS (1998 – 2000)
Source: U.S. Department of Commerce, County Business Patterns

	Turbine and Turbine Generator Set Unit Manufacturing	Miscellaneous Plastic Manufacturing	Total
Employment (1998)	18,063	521,707	539,770
Employment (2000)	17,156	529,507	546,663
% Change '98-'00	-5.0%	1.5%	1.3%
Establishments (1998)	98	8,599	8,697
Establishments (2000)	104	8,311	8,415
% Change '98-'00	6.1%	-3.3%	-3.2%
Average Establishment Size (1998)	184	61	62
Average Establishment Size (2000)	165	64	65
% Change '98-'00	11.7%	-4.8%	-4.5%
Average Employee Earnings (1998)	\$48,159	\$28,485	\$29,143
Average Employee Earnings (2000)	\$55,302	\$30,062	\$30,854
% Change '98-'00	14.8%	5.5%	5.9%

Table 11 shows representative companies within the industry. With a global market share of 24 percent, Vestas of Portland, OR is the biggest turbine maker in the world, followed by Spain's Gamesa Eolica, German privately-owned Enercon, Danish NEG Micon, Denmark's Bonus, and Germany's Nordex.

TABLE 11
REPRESENTATIVE WIND TURBINE AND BLADE MANUFACTURING EMPLOYERS
 Source: American Wind Energy Association

Firm	Location
Bergey Windpower Company Inc.	Norman, OK
BONUS Wind Turbines Texas	Denmark
GE Wind	Tehachapi, CA
Gamesa Eolica	Spain
Innovative Technologies Group	St. Mary's, WV
Mitsubishi Power Systems, Inc.	Newport Beach, CA
NEG Micon USA, Inc.	Rolling Meadows, IL
Nordex USA, Inc.	Grand Prairie, TX
Northern Power Systems, Inc.	Waitsfield, VT
Synergy Power Corporation	Hong Kong
Vestas-American Wind Technology, Inc.	Portland, OR
Wintec LLC	Lake Oswego, OR
WindTech International, LLC	Bedford, NY
The Wind Turbine Company	Katonah, NY
Wind Turbine Industries Corporation	Prior Lake, MN
Enercon	Germany

PRINCIPAL LOCATIONAL CRITERIA

1. There are specific criteria for the location of a wind farm.
 - The most important factor to consider in the construction of a wind energy facility is the site's wind resource. A site must have a minimum annual average wind speed of 11-13 miles per hour to be considered. The best locations for positioning a wind turbine include close proximity to a large body of water such as a lake or ocean, or on the top of hills or mountain ridges. Obstructions like trees, buildings, and uneven terrain all serve to reduce wind speed.
 - Close proximity to existing transmission lines. Extending or modifying existing transmission lines can be extremely costly and often must go through an extensive permitting and approval process.
 - Secure access to a site. The construction of a wind farm necessitates the use of heavy industrial equipment. Developers will need to invest in roads capable of accommodating significant weight.
2. For wind turbine and blade manufacturing operations, there must be favorable access to production and supervisory talent from the local labor market. Some representative occupations in this industry are listed below.
 - Engineers: electronic, electrical, mechanical, materials, industrial
 - Inspectors, testers, and graders: precision
 - Metal and plastic machine operators
 - General managers and top executives
 - Electrical and electronic drafters
 - Freight, stock, and material movers: hand
 - Industrial machinery mechanics
 - Mechanical drafters
 - Sales and related workers
 - Helpers, laborers
 - Electrical and electronic technicians
 - Maintenance repairers, general utility
 - Industrial truck and tractor operators
 - Industrial engineering technicians
 - Industrial production managers
 - Commercial and industrial designers
 - Technical writers
 - Computer-controlled machine tool operators, metal and plastic
 - General office clerks
3. A labor force with good basic and technical skills.
4. Wages that are below the national industry average.
5. Overall low or moderate operating costs, including real estate, personal property, inventory, sales, and payroll taxes; property costs; and construction costs.
6. Strong vocational/technical training programs.
7. Access to markets (preferably with delivery times by the second morning after the day of shipment—about 1½ days).
8. Positive labor/management relations.
9. Good support services and suppliers within a day's drive or less.

10. Favorable labor legislation, such as the ability to hire workers during a strike and a favorable environment to contest Workers' Compensation and unemployment claims.
11. Reliable and low-cost electric power.
12. Available sites or buildings with full utility service, proximity to the interstate system, and zoned for heavy and light manufacturing.
13. Fair and rapid environmental permitting and construction approvals.
14. Excellent sewer treatment capacities for treating waste by-products.
15. Abundant and well-priced natural gas.
16. Abundant clean water.
17. Rail service opportunities for very large facilities to accommodate inbound raw materials.