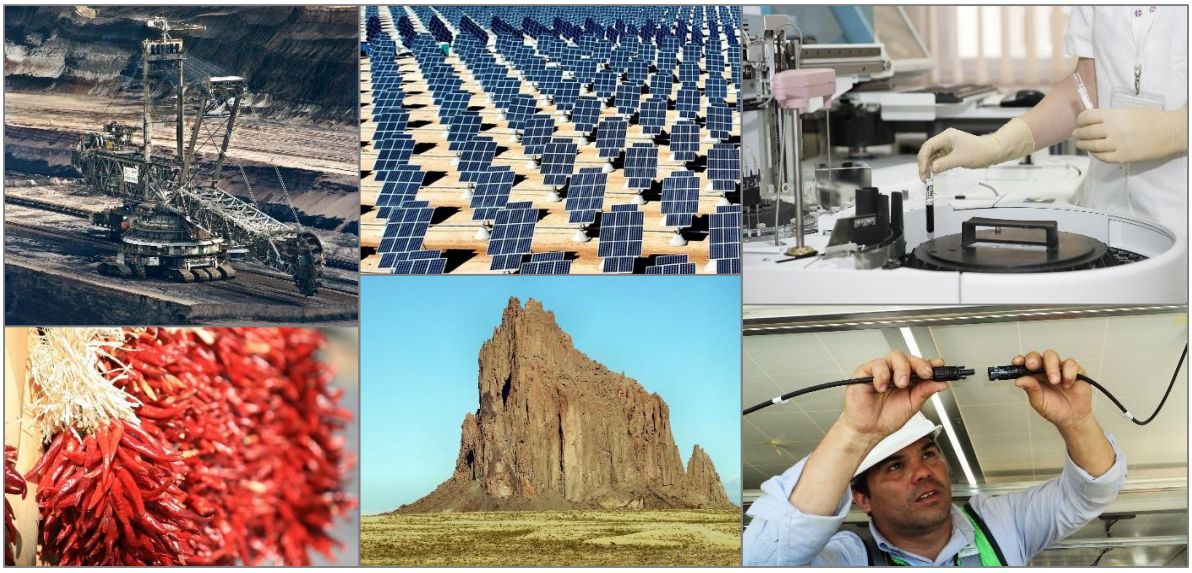
Regional Economic Assessment & Strategy for the Coal-Impacted Four Corners Region

Appendix A

February 8, 2017



Prepared for

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APPENDIX A: DIVERSIFICATION ANALYSIS DETAILS

A.1. DIMENSION STONE

For each industry identified as a potential target industry for diversification, this section presents bulleted, detailed information on product market (current demand, trends, characteristics), competition, inputs (requirements and availability), siting considerations (as applicable), legal/regulatory considerations (as applicable), and economic impacts.

Market

Current Market Demand

- Approximately 2.51 million tons of dimension stone, valued at $474 million, was sold or used by U.S. producers in 2015. Dimension stone was produced by 216 companies, operating 293 quarries, in 34 States. Leading producer States were, in descending order by tonnage, Texas, Indiana, Wisconsin, Massachusetts, and Georgia. These five States accounted for about 66% of the production and contributed about 63% of the value of domestic production. Approximately 42%, by tonnage, of dimension stone sold or used was limestone, followed by granite (21%), sandstone (17%), miscellaneous stone (16%), and marble and slate (2% each). By value, the leading sales or uses were for limestone (38%), followed by granite (25%), miscellaneous stone (18%), sandstone (11%), and marble and slate (4% each). Rough stone represented 59% of the tonnage and 49% of the value of all the dimension stone sold or used by domestic producers, including exports. The leading uses and distribution of rough stone, by tonnage, were in building and construction (58%), and in irregular-shaped stone (27%). Dressed stone mainly was sold for ashlars and partially squared pieces (44%), curbing (20%), and flagging (11%), by tonnage. (U.S. Geological Survey, 2016)

Salient Statistics—United States:[2]	2011	2012	2013	2014	2015[e]
Sold or used by producers: [3]					
Tonnage	1,850	2,150	2,280	2,470	2,510
Value, million dollars	395	452	459	470	474
Imports for consumption, value, million dollars	1,590	1,740	2,100	2,230	2,370
Exports, value, million dollars	66	65	61	70	80
Consumption, apparent, value, million dollars	1,910	2,130	2,500	2,630	2,760
Price	Variable, depending on type of product				
Employment, quarry and mill, number[4]	3,600	3,200	4,000	4,000	4,000
Net import reliance[5] as a percentage of apparent consumption (based on value)	80	79	82	82	83
Granite only:					
Production	462	499	496	519	530
Imports, value, million dollars	1,010	1,080	1,290	1,320	1,340
Exports (rough and finished)	80	77	85	88	88
Price	Variable, depending on type of product				
Employment, quarry and mill, number[4]	1,300	700	880	880	880

(U.S. Geological Survey, 2016)

- The average 2014 value as reported by domestic producers for dimension stone was $190 per metric ton, a 6% decrease from that of 2013 based on the USGS canvass data. The average unit values for various types of dimension stone were granite, $225 per ton; limestone, $173 per ton; marble, $380 per ton; sandstone, $129 per ton; and slate, $392 per ton. Available price data show considerable variation. Prices are substantially different not only for the type of stone but also for the appearance of the same type of stone. Color, grain structure, and finish contribute significantly to price and marketability. (Dolley, 2016)

TABLE 11
DIMENSION SANDSTONE SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY USE[1]

Use	2013 Quantity (metric tons)	2013 Value (thousands)	2014 Quantity (metric tons)	2014 Value (thousands)
Rough stone:				
Rough blocks for building and construction	158,000	$21,000	174,000	$22,700
Irregular-shaped stone	26,300	2,560	33,600	3,630
Other[2]	52,800	8,860	22,200	2,210
Dressed stone:				
Ashlars and partially squared pieces	45,500	7,500	58,900	10,700
Flagging	53,300	5,280	65,900	6,480
Panels and veneer	9,090	3,120	9,870	2,760
Slabs and blocks for building and construction	6,930	1,400	15,800	1,540
Other[3]	8,840	3,200	35,400	3,370
Total	360,000	52,900	416,000	53,400

[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes monumental and uses not specified.
[3]Includes tile, curbing, exports, uses not specified, and uses not listed.

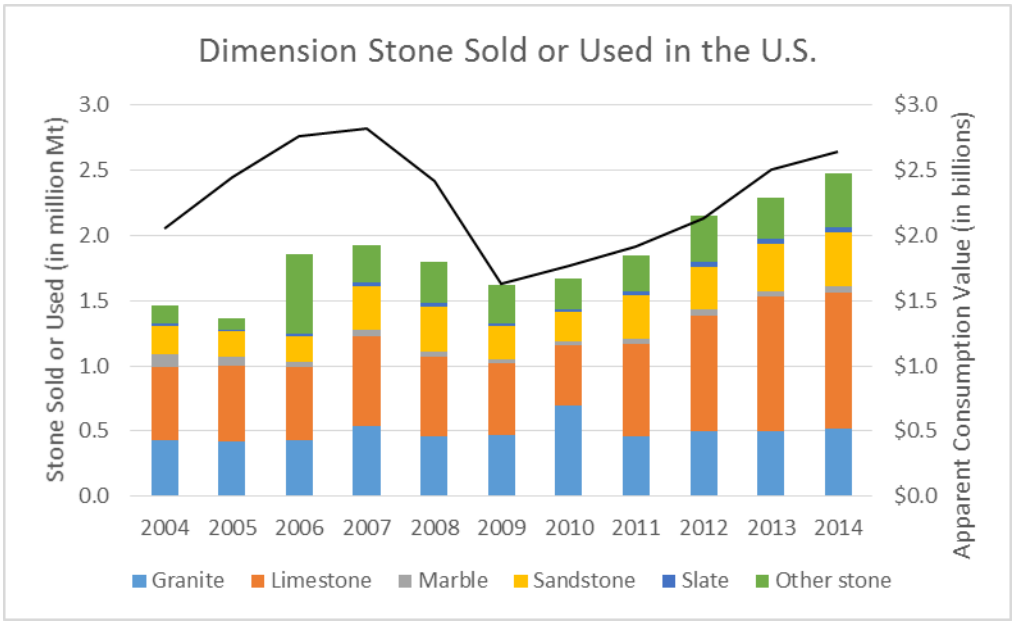
- (Dolley, 2016)

TABLE 6
DIMENSION SANDSTONE SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY STATE[1]

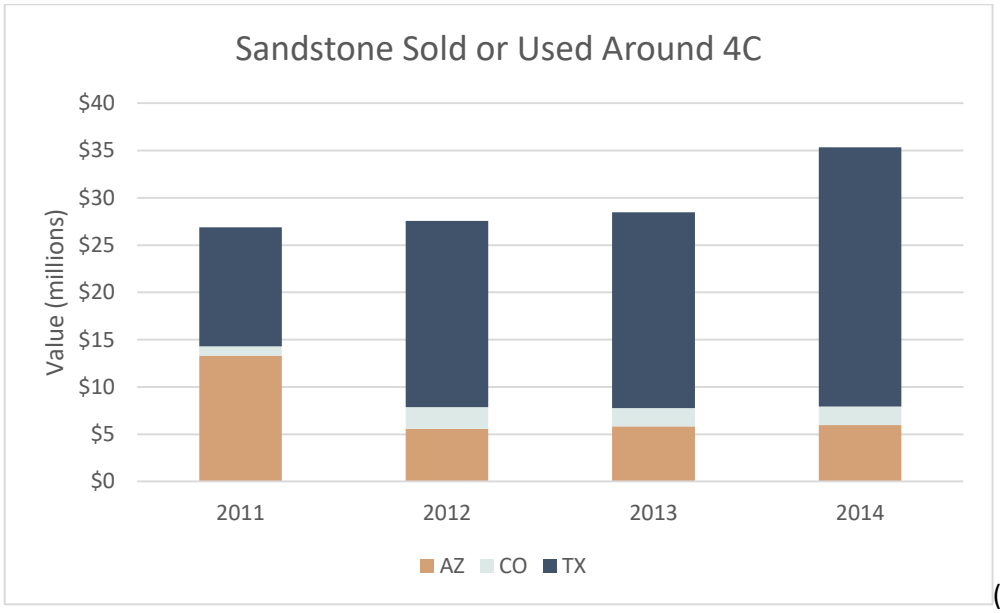
State	2013 Quantity (metric tons)	2013 Value (thousands)	2014 Quantity (metric tons)	2014 Value (thousands)
Arizona	52,300	$5,820	53,800	$5,970
Arkansas	9,530	1,230	9,700	1,240
Colorado	8,870	1,940	10,100	1,960
New York	36,500	1,580	41,200	1,880
Ohio	21,200	5,730	18,300	4,760
Oklahoma	43,400	7,880	35,400	3,200
Pennsylvania	18,900	4,100	40,700	3,600
Tennessee	16,300	1,290	22,700	2,020
Texas	135,000	20,700	169,000	27,400
Other[2]	18,200	2,600	14,500	1,380
Total	360,000	52,900	416,000	53,400

[1]Data are rounded to no more than three significant digits; may not add to totals shown.
[2]Includes Alabama, California, Kansas, Maryland, Michigan, and Wisconsin.

- (Dolley, 2016)
- US trends (IBIS World, 2016)
  - Recent industry-wide revenue was $15 billion
  - Annual growth from 2011-2016 averaged 3.9% per year
  - 42,019 people were employed in 1,359 businesses
- Travertine market
  - Two or three small travertine producers operate in the western United States. **U.S. demand for travertine is about 0.85 million tons, almost all of it imported.** Most of the imports come from Italy, Iran, Mexico, Turkey, and Peru. A decade ago, Italy had a near-monopoly on the world travertine market. (California Marble and Stone, n.d.)

- 

(U.S. Geological Survey, 2016)

- 

(U.S. Geological Survey, 2016)

Market Trends

- Housing starts (U.S. Census Bureau, 2016)
  - Permits for new units in NM have been fairly flat over the last 5 years
  - Permits for San Juan County have been declining over the last 5 years
  - There have been very few permits in McKinley County
  - No data was available for Cibola County
  - New housing unit permits for the states around 4C plus CA (NM, AZ, CO, UT, TX) more than doubled in the last 5 years, mostly due to **growth in TX and CA**.
  - Unit permits in the 4C counties, as well as the counties immediately surrounding them, have increase by 155% in last 5 years, primarily due to **growth in Albuquerque**.

- The United States is one of the world's leading markets for dimension stone. Total imports of dimension stone increased in value to about $2.37 billion compared with $2.23 billion in 2014. Slow growth in the U.S. economy in 2015, coupled with flat to slow growth in new residential construction, resulted in domestic production of dimension stone that was essentially level with the previous year. Dimension stone for construction and refurbishment was used in commercial and residential markets; in 2015, refurbishment and remodeling activity of existing homes remained steady compared with those of 2014. These factors contributed to a steady rise in dimension stone imports. Dimension stone exports increased to about $80 million. Apparent consumption, by value, was estimated to be $2.76 billion in 2015—a 5% increase from that of 2014. (U.S. Geological Survey, 2016)
- According to Italy's Internazionale Marmi e Macchine Carrara S.p.A., world dimension granite and marble production, including the United States, was estimated to be approximately 142 Mt in 2013, the last year for which data were available. Although some small-scale production was likely in many nations, dimension granite and marble was produced and officially reported in 29 countries. The top five producing countries in 2013 were, in descending order by tonnage, China, Turkey, India, Iran, and Italy, and these countries accounted for about 72% of the world's dimension granite and marble production. Global production of dimension granite and marble increased by 14% in 2013 compared with that of 2012. The United States ranked 18th in world production of dimension granite and marble in 2013. (U.S. Geological Survey, 2016)
- Recovery in downstream markets (i.e. commercial and residential construction) is expected to **increase demand for stone mining in the U.S.** (IBIS World, 2016)

Product Characteristics

- General description--Dimension stone is any natural, consolidated rock that is quarried and shaped to specified dimensions for structural or decorative purposes. Dimension stone can include rough stone, blocks, panels, and polished material (Allison, 1984). The terms building stone and decorative stone are used synonymously with dimension stone. Flagstone, often used as a decorative stone, is any naturz.1, fissile stone that readily splits into thin slabs roughly 7 - 10 cm thick (Allison, 1984). (McLemore, et al., 1986)
- Dimension stone is an attractive construction material because of its widespread occurrence, strength, durability, and pleasing appearance. Allison (1984) notes that the aesthetic appeal and popularity of natural stone is largely determined by its color, grain size, and texture, as well as by architectural and designer fashion trends. The aesthetic appeal generally controls the price and marketability of the stone. Of the total domestic production 1985, 42% of the stone was used for building construction and 27% for monuments. The remainder was principally used for flagging, curbing, paving, roofing slate, laboratory furniture, and refractory brick (Power, 1983; U.S. Bureau of Mines, 1986). (McLemore, et al., 1986)
- Sandstone provides another material appropriate for use as dimension stone. Dimension sandstone is used for exterior facing and trim on large buildings, for ashlar in residential construction, as flagstones and curbstones, and in retaining walls and bridge abutments. Dimension sandstone ranges in texture from very fine to coarse, and in deposit depth from a few inches to 200 feet. Some of the most desired sandstone colors are shades of gray and tan. Uniformity of color in dimension stone is typically favored, but some producers market

dimension sandstone that oxidized during weathering to produce aesthetically appealing spotted and streaked patterns. (Highbeam Business)

- Granite and sandstone quarrying usually involved "broaching," wire sawing, or jet piercing mining methods after the covering rock and silt were removed by scrapers or steam shovels. Broaching consisted of drilling a row of closely aligned holes in the rock face with tungsten carbide drill bits, then removing the blocks between the holes with broaching tools. Wire sawing involved the application of tensioned single- or triple-strand wire cables up to 16,000 feet long, which were drawn through pulleys. The cables formed a "saw" that was held against the rock and fed with a mixture of water and sand, with the ability to cut hard granite by abrasion at a rate of about two inches per hour. When cutting was completed, the mill blocks could be extracted from channels about a quarter of an inch wide and 50 to 70 feet deep. (Highbeam Business)
- Commercial travertine in New Mexico (Austin & Barker, 1990)

TABLE 3
DIMENSION STONE SOLD OR USED BY PRODUCERS IN THE UNITED STATES, BY STATE[1]

State	2013 Quantity (metric tons)	2013 Value (thousands)	2014 Quantity (metric tons)	2014 Value (thousands)
Alabama	W	W	W	W
Arizona	57,500	$6,420	54,600	$6,080
Arkansas	10,300	1,320	10,300	1,290
California	23,600	9,210	23,500	9,170
Colorado	17,700	7,270	17,300	6,230
Connecticut	W	W	W	W
Georgia	145,000	17,200	152,000	15,500
Idaho	32,800	5,840	63,700	8,640
Illinois	W	W	W	W
Indiana	150,000	26,200	200,000	34,400
Kansas	43,100	5,610	13,700	1,330
Maine	4,970	2,770	5,210	2,820
Maryland	2,400	687	3,230	723
Massachusetts	148,000	43,500	165,000	43,100
Michigan	W	W	W	W
Minnesota	59,500	24,300	51,000	21,000
Missouri	W	W	W	W
Montana	31,400	1,590	27,500	1,970
Nevada	W	W	W	W
New Hampshire	33,600	4,510	27,500	3,460
New Mexico	W	W	W	W
New York	120,000	17,300	126,000	17,600
North Carolina	46,900	19,600	43,800	20,700
Ohio	26,700	6,610	20,800	5,150
Oklahoma	43,400	7,880	62,200	5,240
Pennsylvania	25,400	5,890	50,900	5,720
South Carolina	W	W	W	W
South Dakota	W	W	W	W
Tennessee	32,300	6,140	51,100	11,000
Texas	905,000	151,000	922,000	159,000
Utah	W	W	W	W
Vermont	79,700	25,200	91,800	24,100
Virginia	12,400	7,590	12,800	7,730
Wisconsin	156,000	37,200	190,000	40,200
Other	70,200 r	18,000 r	84,900	17,900
Total	2,280,000 r	459,000 r	2,470,000	470,000

rRevised. W Withheld to avoid disclosing company proprietary data; included in "Other."
[1]Data are rounded to no more than three significant digits; may not add to totals shown.

- (Dolley, 2016)
- County Business Patterns Data, 2014 (U.S. Census Bureau, 2016)
    - NAICS Code 212311 (Dimension Stone Mining and Quarry)
        - No employment, payroll, or establishment data for the larger 4C-area counties
        - There are only 12 counties in 9 states with more than three establishments: PA, VT, TX, OK, NY, IN, ID, GA, AZ

        - The only nearby county with a significant industry is Williamson County, TX in the central part of the state, just north of Austin
            - Total employees: 345
            - Total annual payroll: $14.8 million
            - Total establishments: 10
        - Four counties in NM each have one establishment in this industry: Dona Ana, Lincoln, Rio Arriba, San Miguel
            - Payroll and employment were not available
- This is a natural economic adjustment to high transportation costs and high levels of product lost in further processing. Trimming an uncut rock to form a uniform block can easily reduce the weight by 20 percent or more. Cutting a block into slabs can remove 40 percent of the block depending on the thickness of the slabs. With transportation costs being on the order of twice as much as processing costs, **it makes economic sense to do as much processing as close to the quarry as possible and not pay to transport material that will be lost in processing**.

Competition

Major Players

- By market share (IBIS World, 2016)
    - LafargeHolcim
    - MMM
    - Vulcan
- This industry has a "moderate" level of concentration, with the three largest companies accounting for just over half of industry revenue. The last decade has seen a trend toward consolidation. (IBIS World, 2016)
- The top five producing companies were Buechel Stone Corp. in Wisconsin; Champlain Stone, Ltd. in New York; Espinoza Stone, Inc. in Texas; Fletcher Granite Co. in Massachusetts; and Mezger Enterprises Inc. in Texas. These companies accounted for about 18% of domestic production tonnage and about 17% of production value. The leading 15 companies accounted for 40% of total domestically produced tonnage and 42% of production value. (Dolley, 2016)
- **Dimension sandstone was produced by 64 companies that operated 71 quarries in 15 States**. Production increased by 15% to 416,000 t in 2014 from 360,000 t in 2013. The value increased slightly to $53.4 million in 2014 from $52.9 million in 2013. Gordon Stone Co. LLC; Harley Gray Stone Co.; MBK Associates LLC; Schaefer Enterprises of Deposit, Inc.; and TBK Materials LLC, which were the leading producers, accounted for about 30% of the tonnage and 13% of the value of domestic production. (Dolley, 2016)
- In 2016Q2, the companies with the greatest reported employee hours who were mining dimension stone were: Continental Cement Company, Cobra Stone Inc, Dos Rios Stone Products Operations LLC, Rock-it Natural Stone Inc, and Champion Stone Co
- In 2016Q2, the companies with the greatest reported employee hours who were mining sandstone were (with state of mine in parentheses): Rock-it Natural Stone Inc (AR), Quality Stone Quarries (OK), Kirby Stone Company LLC (WY), Arkins Park Stone (CO), and Coyle Stone LLC (OK). (Mine Safety and Health Administration, 2016)
- Travertine

- There is strong international competition from Turkey and India, who can supply travertine at a much lower cost than NM producers. (Vunjerovic, 2016)

Inputs

Required Inputs

- Average cost for equipment to begin a quarry operation will run between $300,000 and $500,000. This is $433,000 - $721,000 in 2016 dollars. (H. James Bourque and Associates, 1999)

Availability in 4C Region

- EMNRD Mine Tracking (New Mexico Energy, Minerals and Natural Resource Department, 2014)
  - 4C active stone mines in 2014

Commodities	County: Cibola	McKinley	San Juan	Total
Aggregate	1	0	14	15
Aggregate, Dimensio..	0	0	1	1
Aggregate, Limestone	0	2	0	2
Aggregate, Other	0	0	1	1
Limestone	1	0	0	1
Travertine	2	0	0	2
Total	4	2	16	22

    - Dimension & flagstone
      - Neff Trust Quarry in San Juan County
        - Mines aggregate, dimension, & flagstone
        - One source claims the mine is abandoned as of July 2011 (Graphiq, n.d.)
        - They mined dimension sandstone
        - Operated by KW Enterprises based in Durango, CO
    - Travertine
      - Ray Claims No. 4 & No. 6 Mines
        - Mine Travertine
        - Operated by International Stone Company based in Scottsdale, AZ
        - Was not operating in 2016 (Mine Safety and Health Administration, 2016)
  - All NM Mines

Commodities	Freq.	Percent
Aggregate	216	79.70
Aggregate, Caliche	1	0.37
Aggregate, Clay & Shale	10	3.69
Aggregate, Dimension & Flagstone	3	1.11
Aggregate, Dimension & Flagstone, Tra..	1	0.37
Aggregate, Limestone	5	1.85
Aggregate, Limestone, Other	1	0.37
Aggregate, Other	16	5.90
Dimension & Flagstone	6	2.21
Limestone	10	3.69
Travertine	2	0.74
Total	271	100.00

    - Active dimension stone mines in NM

Name	County	Commodities
Blue Mountain Stone Inc.	San Miguel	Dimension & Flagstone
Chavez Quarry	Guadalupe	Dimension & Flagstone
La Luz Quarry	Otero	Aggregate, Dimension & Flagstone
La Luz Quarry	Otero	Aggregate, Dimension & Flagstone
Lucero Quarry Mine	Valencia	Aggregate, Dimension & Flagstone, Travertine
Milagro Quarry	Guadalupe	Dimension & Flagstone
Neff Trust Quarry	San Juan	Aggregate, Dimension & Flagstone
New Mexico Travertine Belen Plant	Valencia	Dimension & Flagstone
Pohl Quarry	Torrance	Dimension & Flagstone
Pohl Quarry	Torrance	Dimension & Flagstone

- NM Bureau of Mines and Mineral Resources Reports
  - Mineral Resource Potential of NW NM (McLemore, A Preliminary Minerla-Resource Potential of Northwestern New Mexico; Introduction, 1986)
    - Cibola
      - Various units throughout the county have a high resource potential locally for clays, crushed and dimension stone, gemstones (small quantities), limestone, and travertine.
    - McKinley
      - Various units throughout the county have a high resource potential locally for clays, crushed and dimension stone, silica sand, gemstones (small quantities), limestone, and humate.
    - San Juan
      - Much of the county has a high resource potential for crushed and dimension stone.
  - Mineral Resource Potential of **Cibola County** (McLemore, et al., 1986)
    - In New Mexico, dimension stone quarrying has historically been a small industry. Small quantities of nearby stone have been used by local markets; The widespread use of adobe, concrete, brick, steel, and glass in modern construction has limited the use of stone to times when it is the most economical material available or when its decorative appeal makes it desirable for a particular project. (p. 161)
    - Cibola County has an abundance of potential sources of dimension stone. (p. 161)
    - There is considerable commercial interest in four travertine deposits in the eastern fifth of Cibola County that are part of the same regional trend. These include the Malpais Steptoe, Salado Spring, Mesa del Oro, and Lucero uplift deposits (Barker, this volume: fig. 32). A Quaternary travertine deposit just south of Ojo Caliente on the Zuni Reservation in extreme western Cibola County may also be useful for dimension stone (C. H. Maxwell and L. G. Nonini, written communication, 1977). These five travertine deposits are assigned high resource and moderate to high development potentials for dimension stone (Fig. 28: Maps 6, 35, 36, 37, 38). (p. 162)
    - Extensions of the Gallup and Wingate Sandstones into Cibola County have a high resource potential for dimension stone. (p. 163)

Table 21 - Potential sources of dimension stone in Cibola County.

Age	Rock Units	Resource potential for dimension stone
Quaternary	basalt, scoria	moderate to high
	travertine	high
Tertiary	basalt	moderate
	travertine	high
Cretaceous	Mesaverde Group	moderate
	Gallup Sandstone	high
	Mancos Shale	moderate
	Dakota Sandstone	moderate
Jurassic	Morrison Formation	moderate
	Zuni Sandstone	moderate
	Bluff Sandstone	moderate
	Todilto Limestone	moderate
	Summerville Formation	moderate
	Entrada Sandstone	moderate
Triassic	Wingate Sandstone	high
	Chinle Formation	moderate
Permian	Glorieta Sandstone	moderate
	San Andres Limestone	moderate
	Yeso Formation	moderate
	Abo Formation	moderate
Precambrian	granitoids	moderate
	quartzite	moderate

- (p. 163)
- Maps 35 – 38 detail the locations of dimension stone and their potential

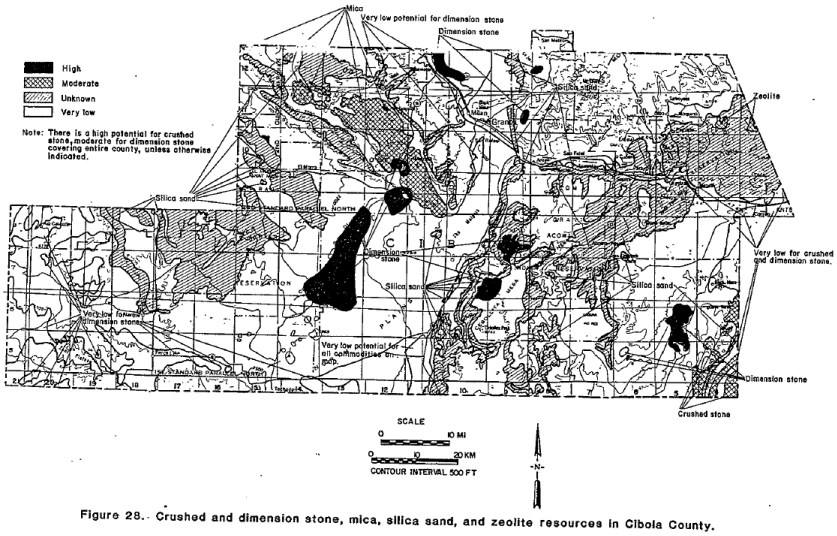


Figure 28. Crushed and dimension stone, mica, silica sand, and zeolite resources in Cibola County.

- (p. 159)

- Mineral Resource Potential of **McKinley County** (McLemore, et al., 1986)
  - McKinley County has an abundance of potential dimension stone resources (Fig. 31, Maps 36, 37, 38, 39, 60; Table 25). (p. 204)
  - Several sandstones on the Zuni Reservation can be readily cut for dimension stone. Some have been quarried and used in local construction. A quarry in the Wingate sandstone, in sec. 20, T. 10 N., R. 18 W., furnished material for several government buildings at Black Rock (Sears, 1925). (p. 207)
  - Several sandstones have commercial dimension stone potential on the Navajo Reservation. (p. 207)
  - **Sandstones of tan, orange, brick-red, and darker shades** are abundant within the Fort Defiance and Tohatchi quadrangles in McKinley County (Allen and Balk

1954). Rock suitable for future small, local stone operations appears to be plentiful in the area.

- The Chinle Formation, Entrada Sandstone, Summerville Formation, and the Morrison Formation are potential dimension stone resources within the Fort Defiance and Tohatchi quadrangles (Allen and Balk,1 954). The lower part of the Chinle Formation consists of several **gray to brick-red, fine-grained sandstone** lenses which break easily into large slabs 2 to 5 inches thick. Allen and Balk (1954) suggest that the sandstone could be sold as flagstone for use in garden facing, sidewalk plates, or other decorative materials, in communities such as Gallup. These sandstones are exposed at numerous localities along the road from Fort Defiance (Arizona) to Red Lake. A pale-green, very fine-grained, mildly silicified pellet-conglomerate, about 3 inches thick, occurs near the top of the sequence. It is a well indurated rock which could be used in heavy masonry, bridge abutments, and dams (Allen and Balk 1954).
- Maps 36 – 38, 60 show locations with potential for dimension stone.

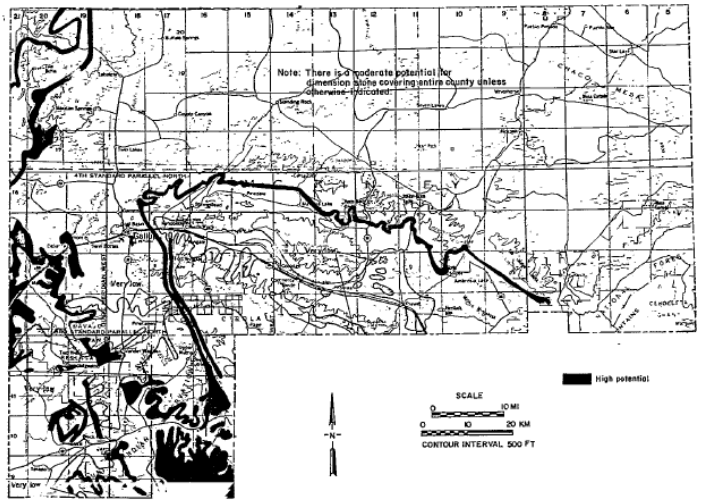


Figure 31. Resource potential for dimension stone.

- (p. 205)

Table 25 - Potential sources of dimension stone in McKinley County.

Age	Rock Unit	Resource Potential for dimensicn stone
Tertiary	basalt of Mt. Taylor	moderate
Cretaceous	Mesaverde Group	moderate
	Gallup Sandstone	high
	Mancos Shale	moderate
	Dakota Sandstone	moderate
Jurassic	Morrison Formation	moderate
	Zuni Sandstone	moderate
	Bluff Sandstone	moderate
	Todilto Limestone	moderate
	Summerville Formation	moderate
	Entrada Sandstone	moderate tc high
Triassic	Wingate Formation	high
	Chinle Formation	moderate tc high
Permian	Glorieta Sandstone	moderate
	San Andres Limestone	moderate
	Yeso Formation	moderate
Precambrian	gneissic granite	moderate

- (p. 206)

- Mineral Resource Potential of **San Juan County** (McLemore, et al., 1986)
  - San Juan County has an abundance of potential dimension stone resources (Fig. 32, Maps 90-93; Table 28). (p. 170)
  - Several **sandstones** targeted as potentially marketable dimension stone in McKinley County (McLemore et al., 1986), crop out in San Juan County. These include abundant tan, orange, brick-red, and darker colored sands exposed within the Fort Defiance and Tohatchi quadrangles (Allen and Balk, 1954) and the Navajo Indian Reservation (Allen, 1955). (p. 170)
  - The lower part of the Chinle Formation consists of several **gray to brick-red, fine-grained sandstone** lenses which break easily into large slabs 2 to 5 inches thick. The material is suitable for flagstone and decorative products, such as garden facing or sidewalk plates. A pale-green, very fine-grained, mildly silicified pellet-conglomerate, about 3 inches thick, occurs near the top of the formation. This well indurated rock may furnish durable construction material, possibly for use in heavy masonry, bridge abutments, and dams (Allen and Balk, 1954). (p. 173)
  - The Entrada Sandstone has been suggested as a possible source of building material and may be targeted for large-scale commercial operations. The unit is a well-exposed, massive, fine-grained sandstone of uniform and pleasing color which crops out near several fair-weather roads. (p. 173)
  - Extensions of the Gallup Sandstone into San Juan County have high resource potential for dimension stone.
  - Maps 90-93 show the locations of areas with potential for dimension stone. (saved in a separate document)

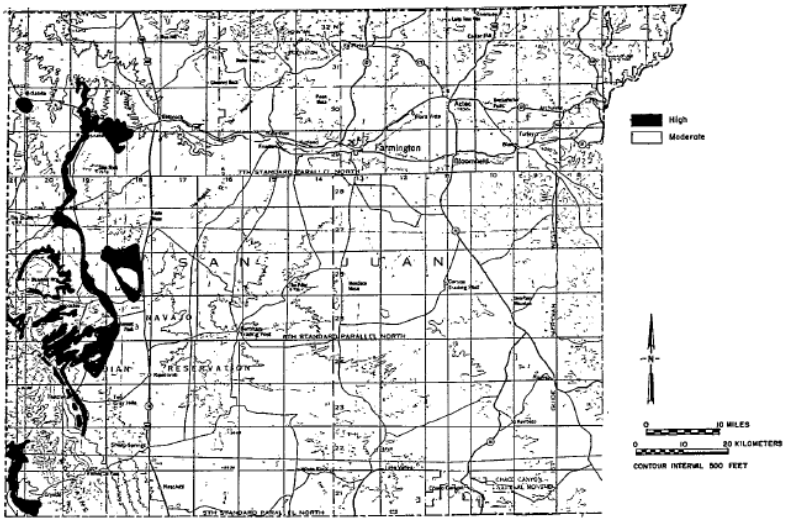


Figure 32. Resource potential for dimension stone in San Juan County, New Mexico.

(p. 171)

TABLE 28 - Current and potential sources of dimension stone in San Juan County.

Age	Rock Unit	Resource potential for dimension stone
Tertiary	Chuska Sandstone	moderate
	San Jose Formation	moderate
	Nacimiento Formation	moderate
	Ojo Alamo Sandstone	moderate
Cretaceous	Mesaverde Group	moderate
	Gallup Sandstone	high
	Mancos Shale	moderate
	Dakota Sandstone	moderate
Jurassic	Morrison Formation	moderate
	Zuni Sandstone	moderate
	Bluff Sandstone	moderate
	Todilto Limestone	moderate
	Summerville Formation	moderate
	Entrada Sandstone	moderate to high
Triassic	Wingate Formation	high
	Chinle Formation	moderate

(p. 172)

Economic Impacts

- Nationwide, the average earnings of all employees in stone mining and quarrying (NAICS 21231) was $24.24/hr or $1,100/wk in July 2016. (U.S. Bureau of Labor Statistics, 2016)
- 2014 County Business Patterns data for NAICS code 212311: Dimension stone mining and quarrying (U.S. Census Bureau, 2016)
    - Total annual payroll in the US: $124,977,000
    - Total employees in the US: 2,778
    - Total establishments in the US: 280
    - Average annual pay/employee: $44,988
    - Average employees/establishment: 9.92
    - Average annual payroll/establishment: $446,346

A.2. Crop Production

Crop production is defined here as activities involving either horticulture or row crop production; as well as indoor high tunnel and greenhouse activities.

Market

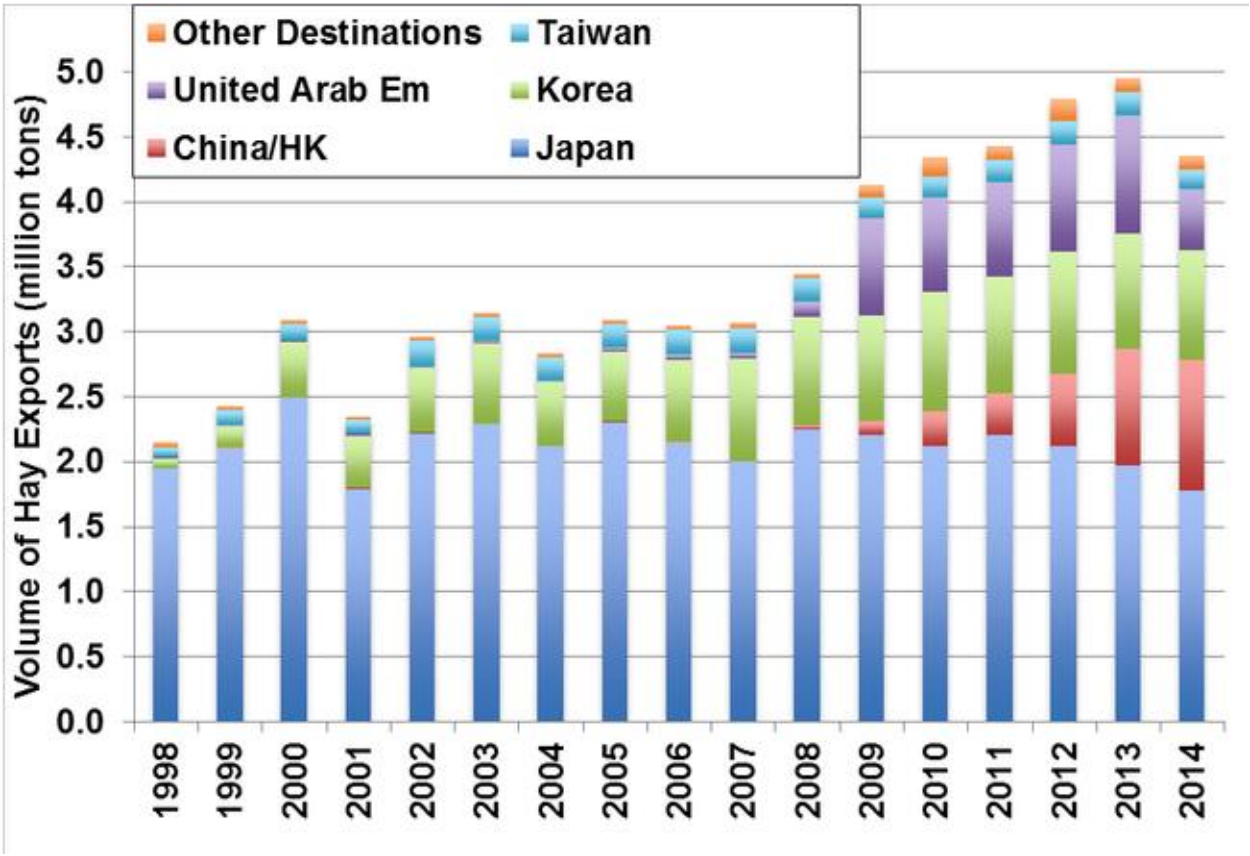
Current Market Demand

- The combination of agriculture and food processing is an important part of New Mexico's economy. Together, the two broad industries accounted for $10.6 billion, roughly 12.3 percent of New Mexico's $85 billion gross state product in 2012. (College Planning & Management, 2015)

- Forage crops
    - Two main things are driving large commercial forage production in the southwest:
        - One is the increasing trend of dairies increasing in size and moving to New Mexico. New Mexico has around 150 dairies averaging over 2,000 cows per dairy (which is the largest average herd size in the country). Daries require high

quality alfalfa feed, generally first or second cutting. (New Mexico Dairy Association, 2016)

- Two is the increasing trend of increased exports of hay from western ports to Asian countries



(Putnam, 2013)

- The southern port of Long Beach and Los Angeles tends to be favored due to the high volume of trade there, and the resulting large volume of 'empties' sent back to Asia from that port, resulting in less expensive shipping costs (Putnam, 2015)

Market Trends

- Production Trends:
  - The recent introduction of the Food Modernization Act will likely lead to future requirement of traceability to the farm level.
  - Good Agricultural Practices (GAP) requirements are beginning to be a requirement for many institutions.
  - Consumers are also demanding more certified organic products, especially in direct market sales. Currently COG represents approximately 3 to 5 percent of total production for the key crops considered.
- Hemp
  - Hemp is not legal to grow in most places in the United States, however, the Navajo Tribe amended their constitution in 2000 to allow for hemp production. It was recently

announced that NAPI will work with CannaNative to negotiate an MOU for hemp production on the Navajo Nation. (Borchardt, 2016)

Competition

Major Players

- Greenhouses:
  - Bright Green Group of Companies (Acoma Pueblo land)
  - Colorado Nursery and Greenhouse Association (New Mexico Chapter)
- Forage:
  - Anderson Hay: offers hay services and products to international buyers via shipping containers. Currently has operations in California, Washington and Oregon. Also has a contractual relationship with NAPI.
  - New Mexico Hay Association
- Vegetables and Fruits (direct market) distributors include:
  - **Duke City Produce**: A family owned business with approximately $1 million in annual revenue, headquartered in Albuquerque, offering daily fresh cut fruits and vegetables including seasonal produce available for grocery stores, restaurants and schools.
  - **Farmer's Market**: An Albuquerque, NM family owned business for over 50 years with the largest selection of locally grown New Mexico produce with a selection of fruits and vegetables from other areas available to the retail market
  - **GDI:** Servicing New Mexico, Arizona, Southwest Texas, Southern Colorado and Southern Utah, grocery and mini mart stores with dairy, frozen foods, tobacco, bakery and deli products and .
  - **Hacienda Packing LLC**: Serving the Albuquerque NM area since 2008 with fresh fruits and vegetables with an annual revenue between $20 and $50 million.
  - **Just the Best Produce**: Serving restaurants and hotels in Santa Fe, Albuquerque and Northern New Mexico with a wide variety of fruits and vegetables, specialty fruits and vegetables (including micro greens and baby vegetables), dairy, paper and frozen items.
  - **Kodiak Produce**: Serving restaurants, institutions, grocers, markets, co-ops and retail throughout the Southwest.
  - **La Montanita Co-Op**: With five locations in New Mexico: three in Albuquerque, one in Santa Fe and one in Gallup, serving small community grocers, commercial kitchens and restaurnts with fresh organic produce, local organic beef, lamb and other meats/cheeses, fair trade products and bulk foods.
  - **Labatt Food Service**: With five distribution centers in the Southwest: San Antonio, Dallas, Houston, Lubbock and Albuquerque, serving quick service, schools, healthcare and military institutions at the independent, chain and national account level with $50 million in annual sales.
  - **Legend Distributing**: Since 2004, importing organic and conventionally grown fruits and vegetables from Mexico, California and Florida to serve food service and retail customers in Arizona, Nevada, New Mexico, Texas, Colorado and Utah.
  - **PBA Produce**: Providing produce, storage and cross dock needs for customers in the Central Phoenix area.

- **Quality Fruits and Vegetables Co**.: A family owned distributor since 1986 with facilities in El Paso, Texas and Albuquerque, NM, providing fruits and vegetables to customers in Texas, New Mexico, and Mexico. Facilities are equipped with seven cold and low temperature rooms to maintain proper temperature requirements for storage of specific fruits and vegetables and seven air ripening rooms with a forced-air system to maintain specific temperatures for ripening of bananas and other fruits/vegetables on a two-rack system.
- **Ralph Basila Produce Company Inc**: Providing wholesale fruits and vegetables to the Albuquerque, NM market since 1947. After starting Ralph Basila Produce Co., Ralph started Farmer's Market to serve the retail market in 1962.
- **Sysco New Mexico**: Serving New Mexico, El Paso, Southern Colorado and Eastern Arizona with complete food service products for the foodservice industry.
- **US Foods**: National distributors with 250 thousand customers including restaurants, healthcare, hospitality, government and educational intuitions and $20 billion in annual revenue. Distribution center in Albuquerque provides complete product needs.

Expanding/Contracting

- From 2001 – 2012, McKinley, Cibola, and San Juan Counties experienced higher growth in farm employment than any other county in NM, showing increases of 86%, 98%, and 1091%, respectively. (Part of this growth is attributable to changed data collection methods) (Leach & Flaherty, 2014)

Inputs

- Access to equipment and infrastructure
  - There are several equipment dealers in the region as well as amendment suppliers including Wilbur Ellis.
- Workforce skills necessary for these industries would include heavy machinery; trucking; harvest labor; packing; sorting; bagging; and other manual labor tasks.

Availability in 4C Region

- Home to six of the seven life zones in the world. Long growing seasons and mild winters allow crops to be produced year round. The abundant sunshine and dry weather also produce less mud and fewer diseases for farm animals. Number one in the nation for chile production and number two in pecan production; the state also produces pistachios and peanuts. New Mexico ranks #9 (2013) for milk production in the nation and currently has 156 dairies that ship milk across state lines. There are 15 processing plants in the state that produce a wide range of products from packaged fluid milk to cheese to whey protein concentrate. The state is home to several cheese plants. Two of the largest are Southwest Cheese (Glanbia and DFA), in Clovis, and Leprino Foods, in Roswell. There are over 1.5 million head of cattle in the state. New Mexico is also known for its organic produce, herbal and homeopathic products, and wineries. (NMpartnership, n.d.)

- San Juan, McKinley, and Doña Ana counties had the largest number of farms as of 2012. As Exhibit 9 shows, just over 7,000 farms were located in the three counties alone, representing nearly 29 percent of all farms in the state. McKinley and San Juan also had the greatest acreage of farm land, with 3.02 and 2.58 million acres, respectively. Based on the number of farms and farm land, both counties were ranked in the top 10 for smallest average farm size. (Leach & Flaherty, 2014)
- 4C region cattle inventory (incl calves) in Jan 2016 (National Agricultural Statistics Service, 2016)
    - Cibola: 12,200 (1%)
    - McKinley:27,500 (2%)
    - San Juan:21,000 (1.5%)
    - La Plata:21,500
    - Montezuma:23,000
    - Apache:32,500
    - San Juan, UT:15,300
    - Sandoval:16,000
    - Rio Arriba:26,500
    - Regional Total:195,000
- Pecan bearing acres in 2012 (National Agricultural Statistics Service, 2016)
    - Cibola:Data suppressed
    - McKinley:No records
    - San Juan:Data suppressed
- Chile acres harvested (National Agricultural Statistics Service, 2016)
    - Cibola:No records
    - McKinley:Data suppressed
    - San Juan:68
- 2014 NM Ag Stats (Bustillos & Hoel, 2015)
    - Ag products for which 4C counties were principal NM producers in 2012
        - Cibola – none
        - McKinley – Squash, horses, mules (burros, donkeys)
        - San Juan – Cantaloupe, cucumbers, squash, sweet corn, horses, mules (burros, donkeys)
    - Cash Receipts in 2014
        - All livestock
            - Cibola: $10.2 mil
            - McKinley: $22.8 mil
            - San Juan:$16.9 mil
        - All crops
            - Cibola:$172,000
            - McKinley:$303,000
            - San Juan:$63.5 mil
    - County profiles
        - Cibola

Census 2012		Cibola County		Livestock – Jan 1, 2015	Head	Rank
Number of Farms	522			Cattle and Calves	11,800	29
Land in Farms (Acres)	1,558,974			Beef Cows	7,700	21
Avg. Size of Farm	2,987			Sheep and Lambs	2,700	9
Value of Products Sold	1/					
Avg. Farm Value Sold	1/					
Avg. Farm Expenses	$13,937					
Avg. Net Farm Income	-$2,675	Crops 2014	Acres	Yield	Production	Unit	Rank

- McKinley

Census 2012		McKinley County		Livestock – Jan 1, 2015	Head	Rank
Number of Farms	2,297			Cattle and Calves	26,500	14
Land in Farms (Acres)	3,022,704			Beef Cows	17,600	4
Avg. Size of Farm	1,316			Sheep and Lambs	26,500	1
Value of Products Sold	$8,389,000					
Avg. Farm Value Sold	$3,652					
Avg. Farm Expenses	$8,386					
Avg. Net Farm Income	-$4,269	Crops 2014	Acres	Yield	Production	Unit	Rank
		Hay, Alfalfa	500	2.00	1,000	Tons	14

- San Juan

Census 2012		San Juan County		Livestock – Jan 1, 2015	Head	Rank
Number of Farms	2,628			Cattle and Calves	20,000	21
Land in Farms (Acres)	2,580,319			Beef Cows	12,200	14
Avg. Size of Farm	982			Sheep and Lambs	14,400	2
Value of Products Sold	$71,311,000					
Avg. Farm Value Sold	$27,135					
Avg. Farm Expenses	$28,802					
Avg. Net Farm Income	$247	Crops 2014	Acres	Yield	Production	Unit	Rank

- Currently production in the region is concentrated in San Juan county, near Farmington at the Navajo Agricultural Products Industry (NAPI) headquarters. The crop mix at NAPI consists of a variety of crops including alfalfa, wheat, dry beans, popcorn, pumpkin, hybrid poplar, dent corn, and chipping potatoes.
- Nearly all of the crop production elsewhere in the region is composed of forage crops for livestock, mainly for personal use.

2012 Census of Agriculture	Cibola	McKinley	San Juan
Harvest Cropland (ac)	510	1,009	80,286
Forage (hay, grass silage, greenchop) (ac)	381	719	35,950
Corn for silage (ac)	0	0	201
Cattle and calves (number)	11,969	27,034	20,733
Hogs and pigs (number)	20	(D)	98
Sheep and lambs inventory (number)	1,862	23,496	19,333
Poultry, layers (number)	224	875	2,607
Vegetables harvested for sale (ac)	25	125	8,224
Peppers (no bell, incl chile) (ac)	0	(D)	68

Squash (all) (ac)	(D)	70	206
Sweet corn (ac)	(D)	20	135
Watermelon (ac)	(D)	21	(D)
Land in orchards	61	6	240
Fruit and nuts, noncitrus, all (ac)	(D)	6	232

(D) - value withheld to avoid disclosing individual farm data
(USDA, 2012)

- Most fruit crops in Northwest New Mexico has unreliable production due to the spring frost; when the plant breaks dormancy and then a killing frost will kill the buds on the tree. This is particularly true on apples and most stone fruits. Two fruit crops that hold promise for the region include grapes (table and wine) as well as Jujube. In addition, berries (such as blackberries and raspberries) are also prolific producers, especially when produced inside a high tunnel system. (Yao, 2016)
- Vegetable production affords another high valued crop that is suitable for the region. However, many of the soils in the region are extremely sandy which can be problematic (depending on coarseness and loam content) in that they do not have the water holding capacity. To mitigate this commercial vegetable producers like NAPI use center pivot technology so water can be applied uniformly and often. Cover crops are used to retain soils from wind erosion. (Stout, 2016)
- High tunnels are unheated structures with a plastic film that provide plants additional heat units during the days in the winter season. In the study area this is ideal for winter production of greens (e.g. spinach, lettuce, chard, etc.) (Guldan, 2016)
- Greenhouses are heated structures, usually more permanent in nature. The study area has plentiful resources of natural gas that could be used in heating controlled environments for a wide variety of fruit, vegetable, and nursery plant structures. Recently there was a large (160 acre) greenhouse development project announced with Acoma Pueblo and Bright Green Group (former greenhouse in Grants). The facility will focus on medicinal uses of plants. (Bright Green Group of Companies, 2016)

Siting

- Primary siting factors for crop production include availability of water; land availability; soil productivity and development costs (e.g. clearing, roads, etc if new irrigation); access to necessary equipment and infrastructure; and markets.
    - Soil productivity and development costs
        - NRCS soils classification identifies soil characteristics that would be of interest to a crop producer
    - Irrigation Districts in the region / access to water:
        - Cibola County: total (8) from Rio Grande drainage basin with most under 500 acres; the largest being Bluewater-Toltec Irrigation District at 3,000 acres
        - McKinley: total (1) from Little Colorado River; Ramah Valley at 1,190 acres
        - San Juan: Animas (18), La Plata (10), San Juan (6); a small handful in the 1,000 to 3,000 acre range; Also NAPI (80,000 acres currently) is in San Juan county as well. (Saavedra, 1987)

- NAPI has plans to extend irrigation to 110,000 acres with development of block 9 (uncertain as to when that development would occur)

Legal and Regulatory

- Due to the potential public health risks, a slaughter facility is subject to a great deal of regulation both on the state and federal level. This includes meat inspection on either the state or federal level, or both, as well as strict enforcement of the Hazard Analysis and Critical Control. Points (HACCP) program, designed as a prevention program rather than end inspection program, that is required by the FDA and USDA for food production facilities. These federal inspections and safety programs, in addition to any required licenses and state requirements, can add significant costs to the initial setup of a slaughter facility and yearly operational costs as well. While no slaughter facility can avoid regulation, their effects must be taken into account when determining whether or not a plant is viable. (Crawford, Hawkes, Rupasingha, & McConnaughey, 2008)

Economic Impacts

- McKinley and San Juan Counties ranked 2nd and 3rd in highest farm employment in NM with 2,834 (10%) and 2,124 (8%), respectively. Cibola was in the lowest 10 counties, with only 369 people employed. (Leach & Flaherty, 2014)
- **18 Occupations & Wages of Agricultural Workers New Mexico, May 2013** (Leach & Flaherty, 2014)

	Average	Median
Farmers, Ranchers & Other Agricultural Managers	$50,810	$51,120
Supervisors of Farming, Fishing & Forestry Workers	$35,540	$33,110
Agricultural Inspectors	$38,000	$37,010
Animal Breeders	**	**
Graders & Sorters-Agricultural Products	$18,850	$18,200
Agricultural Equipment Operators	$20,020	$19,210
Farmworkers & Laborers-Crop, Nursery & Greenhouse	$19,100	$18,340
Farmworkers-Farm, Ranch & Aquacultural Animals	$29,000	$30,070
All Other Agricultural Workers	**	**

- Average net cash income per NM farm in 2012: $9,501 (National Agricultural Statistics Service, 2016)

1. NORTHWEST	DIR. EMPL. IMPACT	TOT. EMPL. IMPACT	OUTPUT DIRECT $ IMPACT	OUTPUT TOTAL $ IMPACT	$ RANK
Petroleum Refineries	213	227	1,514,066,040	1,618,193,104	1
Oil & Natual Gas Extraction	3,292	4,396	672,063,782	897,328,597	2
State & Local Govt. Education	12,579	18,746	665,946,899	992,491,552	3
Electricity Generation, Transmission & Distribution	1,270	1,500	653,704,346	772,166,034	4
Support for Oil & Gas Ops.	2,436	3,438	458,677,429	647,379,687	6
Wholesale Businesses	4,450	5,824	456,078,583	597,035,083	7
Food & Drinking Places	7,195	9,810	373,729,706	509,566,019	8
Construction – New Non-residential	2,882	4,052	357,830,597	503,059,684	9
Hospitals – Private	2,633	3,860	352,323,730	516,595,684	10
AG PRODUCTION	**4,523**	**6,671**	**270,370,665**	**396,766,874**	**13**
FOOD PROCESSING	**91**	**116**	**32,309,966**	**40,725,693**	**63**

- (The Northwest Region includes San Juan, McKinley, and Rio Arriba Counties) (Diemer, Crawford, & Patrick, 2014)
- Profit potential is strong right now for many agricultural crops
- The types of jobs created are similar in skill level to the coal mining sector, however pay is generally much lower and many of the jobs are seasonal in nature
- Advances in technology in agricultural production has reduced the labor requirement, and increased the size of farm in the US over the past 100 years
- Direct marketing is continuing to increase; and have seen significant growth starting in the late nineties. This is likely because the market is willing to absorb premium prices for local foods. Farmers market sales in New Mexico more than doubled between 1998 and 2001. (Clayton Puckett, 2003)
    - While direct sales provide potential for smallholder farms, these are generally very small operations.

A.3. Food Processing

Market

Current demand

- The combination of agriculture and food processing is an important part of New Mexico's economy. Together, the two broad industries accounted for $10.6 billion, roughly 12.3 percent of New Mexico's $85 billion gross state product in 2012. (College Planning & Management, 2015)
- Food processing alone accounted for $2.9 billion in products and an additional $1.7 billion in value-adding processing/distribution, marketing, financing, and supporting services. Food processing was responsible for 8,924 jobs in New Mexico in 2012, including 5,654 jobs in

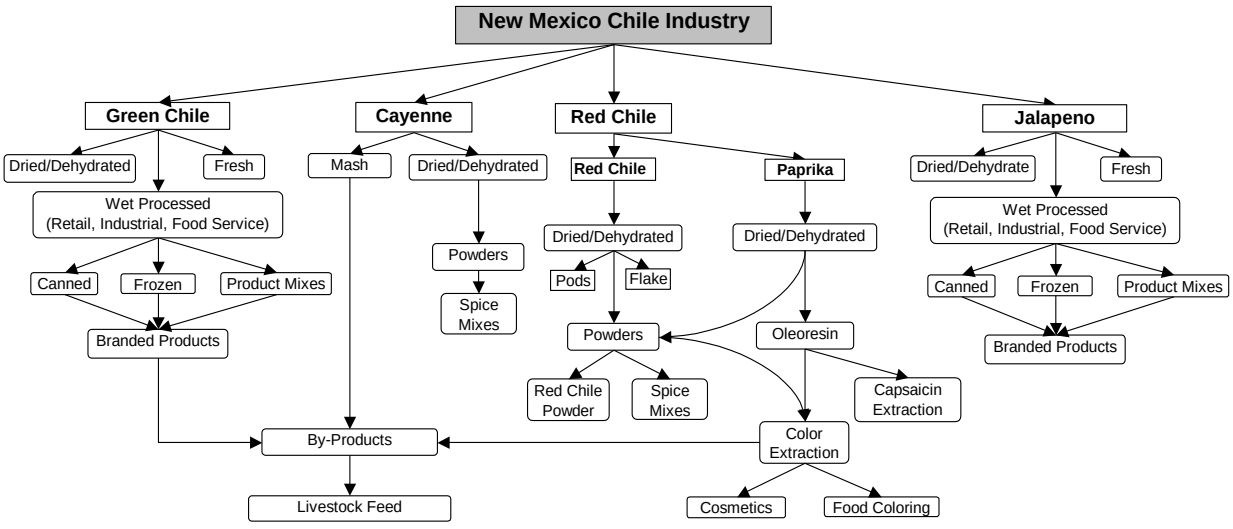
production-related activities and an additional 3,270 jobs in processing/distribution, marketing, financing, and supporting activities. (Diemer, Crawford, & Patrick, 2014)

Trends

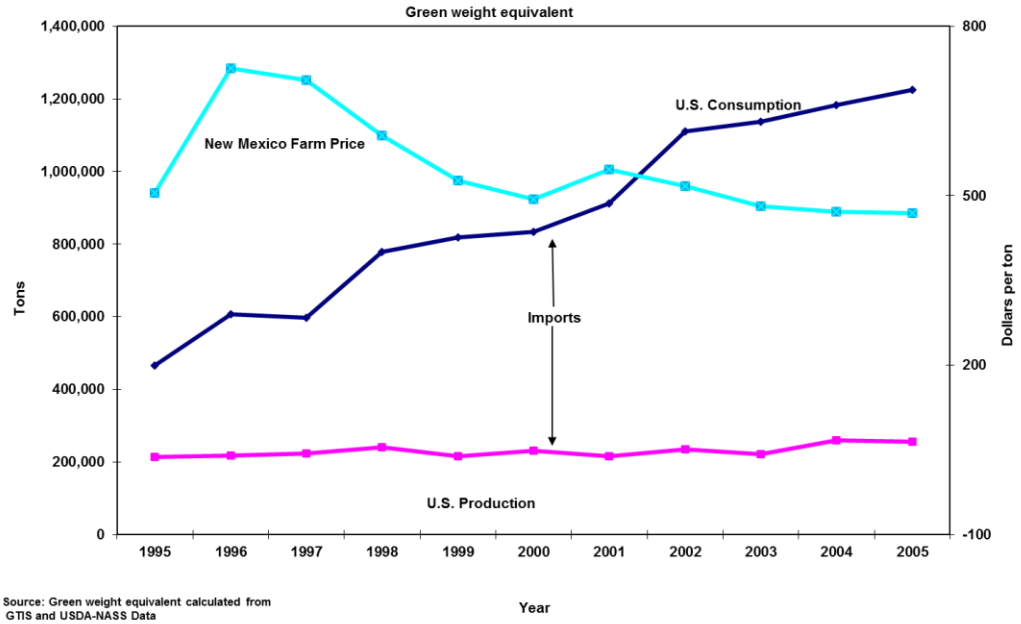
- There is an ongoing study to assess the potential for expanding food processing and value-added agriculture in NM being conducted by NMSU. (U.S. Department of Agriculture, 2015)

Characteristics

- The Metro region, which includes Bernalillo County, is the biggest food processing region in the state. (Diemer, Crawford, & Patrick, 2014)
- When compared to national statistics, New Mexico is below average in processing and utilizing its agricultural output (Ramirez and Crawford, 2005). An overwhelming majority of New Mexico's agricultural and processed food products find their way to markets outside the state. According to NMDA (2010), **99% of New Mexico's cattle are sent out of state for processing**. Ninety-seven percent of New Mexico's agricultural products leave the state, but the state in turn imports more than $4 billion in food products annually (NMDA, 2010). (Diemer, Crawford, & Patrick, 2014)
- Agricultural production's total impact is about 7.4% of New Mexico gross domestic product (GDP). Food processing's total impact adds another 5.7% to New Mexico's GDP. According to our IMPLAN analysis, agricultural production ranked 3rd in total statewide impact and food processing ranked 11th in total statewide impact. (Diemer, Crawford, & Patrick, 2014)
- Chile



U.S. Consumption, Supply, and Price, 1995 -2005



- As shown in the figure above, NM chiles were having a difficult time competing internationally. However, the recent New Mexico Chile Advertising Act has been passed, protecting specific use of "New Mexico Chile" (Frosch, 2011)
- Pueblos have their own seed stock, with slight variations in the traditional chile varieties between pueblos. Most pueblo's current use is for personal use and feast days. With additional production and marketing of specific varieties these chilis could provide another small scale agro-tourism type industry in the region. (Mendina, 2016)
- Potato
    - Chipping potatoes are currently grown at NAPI, and potato storage is also located on Navajo Nation. Frito Lay is the main destination for the chips (just outside of Tucson), along with a small amount to specialty chip companies like Poore Brothers (Arizona based, owned by Inventure Foods). The small scale kettle chip (like Poore Brothers) is a modular approach to food processing that is scalable and relatively inexpensive to start. Given the bulk of the regions' raw product is within the study area this is a reasonable perspective for a new enterprise to add value to an existing feedstock.
- Fruit
    - NMSU extension specialist Dr. Yao has led the effort in evaluating the agronomic potential of Jujube in New Mexico. There are an increasing number of Juju be plants established in the state. The main markets for this crop are cities with large Asian populations (e.g. San Francisco, Seattle, and New York). (Yao, Past, Present and Future of Jujubes - Chinese Dates in the United States, 2013)

Competition

Major Players

- Major food employers in NM (NMpartnership, n.d.)

MAJOR EMPLOYERS	
Stahmann Farms	Aqua Ranch
Glanbia	Franco Whole Foods
Hatch Chile Express	Southwest Cheese
DFA	La Chiripada Winery
Gruet Winery	Creamland Dairies
Young Pecan	General Mills
Leprino Foods	Baker Produce
Vivác Winery	Prepared Foods
Albuquerque Tortilla	St. Clair Winery
Fatman's Beef Jerky	

(Crawford, Hawkes, Rupasingha, & McConnaughey, 2008)

- Results of the study show that the **feasibility of slaughter facility is unlikely due to a lack of sufficient slaughter animals in the state as well as the competition the facility would face from larger, more efficient facilities located in Texas**. A grass fed program is feasible, however it would require significant changes in either the number of mother cows produced or the level of supplemental feeding producers employ in their management practices. The **option with the most potential seems to be a cooperative branding program which would market NM beef based on characteristics such as being locally grown and fresh**, as well as consumers' willingness to support local producers. (Crawford, Hawkes, Rupasingha, & McConnaughey, 2008)

- Verified processors of New Mexico chiles can be found in the NMSU Extension publication "Verified Processed Chile Companies and Products" accessed online at http://www.nmda.nmsu.edu/scs/licenseregistration/new-mexico-chile-labeling-registration/registered-processed-chile-companies-and-products/
    - None of the chile processors identified in the above source are located in the study area.

Inputs

Required

- There are 5 food business incubators in NM: One in Los Ojos, Espanola, Questa, Albuquerque, and Taos. (New Mexico State University, n.d.)
- According to the Energy Information Administration, New Mexico's energy cost was 7% below the national average in 2013 – one of the lowest in the southwest. (New Mexico Economic Development Department, 2015)

- New Mexico is strategically located in the middle of the southwest and the nation's fastest growing states. An excellent highway and rail infrastructure provides direct access to the east and west coasts, Texas, the Midwest, and the international borders of Canada and Mexico. Interstates 10 and 40 connect New Mexico to both the east and west coasts. Interstate 25 connects the state to international borders at Mexico and Canada. From New Mexico goods can be delivered to Texas, Arizona, Colorado, Kansas, and Utah within one day, and California markets in two days. The volume of truck traffic into the state translates into low backhaul rates for goods leaving the state. (New Mexico Economic Development Department, 2015)
- To support a facility in an area that contains both cattle-feeding and cow-calf production the regions should have a beef-animal inventory that is approximately four times the plants proposed annual kill volume (Crawford, Hawkes, Rupasingha, & McConnaughey, 2008). Applying this rule (and using the average number of kills and operating days from the report), the greater 4C region (which has an inventory of 200,000 head) would support approximately 28 kills/day, which would necessitate one fairly small slaughterhouse for the region. According to County Business Pattern data, there are already three existing slaughterhouses in the region.

Availability in 4C Region

- San Juan County hosts 5 feedlots, two in Aztec, one in Bloomfield, one in Bard, and one in La Plata. Cibola and McKinley don't have any. (Dreaming New Mexico, n.d.)
- There are three meat firms in the 4C counties (one that's listed closed). All seem like very small operations; local meat markets. There are four meat processing establishments in the 4C counties. All appear to be either meat shops, beef jerky producers, or Hispanic restaurant suppliers. There are 10 meat processing facilities in Albuquerque, with much the same profile. (Dreaming New Mexico, n.d.)
- By far, the biggest job-creating opportunity [in NM] is to create new grocery stores in food deserts in the state and build an in-state distribution infrastructure to service them. Other major opportunities are: raising more chickens and pigs, and **processing meat in state**; growing fruit and other produce; expanding the state's nursery industry; increasing the number of bakeries; and expanding food manufacturing industries (particularly for soybean products, healthy snack foods, and pet foods). (Shuman, 2010)
- The benefits of expanded consumer-oriented agriculture and food processing are readily apparent. However, such expansions face a number of substantial hurdles. Not least of these are government policy and private sector investments that will improve the state's agricultural infrastructure and services. These include financing to implement new technologies to lengthen production seasons and food storage facilities to ensure reliable supplies to wholesale and retail customers. Also needed are improved collaboration, networking, and distribution mechanisms that currently limit opportunities for connecting local producers and consumers to wholesale and retail outlets. (Diemer, Crawford, & Patrick, 2014)
- 2014 County Business Patterns data (U.S. Census Bureau, 2016)
    - NAICS code 311: Food manufacturing
    - Employment
        - McKinley: 0
        - Cibola: No records
        - San Juan, NM: 0

        - La Plata, CO: 8 (in Other Food Manufacturing)
        - Montezuma, CO: 0
        - Apache, AZ: No records
        - San Juan, UT: No records
    - Annual payroll
        - McKinley: 0
        - Cibola: No records
        - San Juan, NM: 0
        - La Plata, CO: $338,000 (in Other Food Manufacturing, which would include the establishments involved in Roasted Nuts and Peanut Butter Manufacturing, Other Snack Food Manufacturing, Coffee and Tea Manufacturing, and All Other Miscellaneous Food Manufacturing)
        - Montezuma, CO: 0
        - Apache, AZ: No records
        - San Juan, UT: No records
    - Number of Establishments
        - McKinley: 2
            - 2 in Retail Bakeries
        - Cibola: No records
        - San Juan, NM: 6
            - 1 in Animal (except Poultry) Slaughtering
            - 1 in Retail Bakeries
            - 1 in Commercial Bakeries
            - 2 in Tortilla Manufacturing
            - 1 in Roasted Nuts and Peanut Butter Manufacturing
        - La Plata, CO: 8
            - 2 in Confectionery Manufacturing from Purchased Chocolate
            - 1 in Fruit and Vegetable Canning
            - 1 in Animal (except Poultry) Slaughtering
            - 1 in Roasted Nuts and Peanut Butter Manufacturing
            - 1 in Other Snack Food Manufacturing
            - 1 in Coffee and Tea Manufacturing
            - 1 in All Other Miscellaneous Food Manufacturing
        - Montezuma, CO: 5
            - 1 in Other Animal Food Manufacturing
            - 1 in Flour Milling
            - 1 in Dried and Dehydrated Food Manufacturing
            - 2 in Animal (except Poultry) Slaughtering
        - Apache, AZ: No records
        - San Juan, UT: No records

- Currently food processing in the study area is concentrated at NAPI and activities there include cleaning and packaging processes for dry beans and popcorn; wheat milling (flour); and food distribution (Navajo Pride).

- Santa Ana pueblo (adjacent Cibola county) operates a corn mill. The main supply for the Santa Ana mill is Sunny State Products out of San Jon in Quay County New Mexico. (Leon, 2016)
- There are also three wineries in the study area; including Saint Clair, Interior Route and Wines of the San Juan (all in San Juan County) (New Mexico Wine & Grape Growers Association, 2016)
- As indicated in the crop production screening analysis there are several crops beyond those listed in the bullets above that are suited (agronomic) to the region, such as: jujube, berries, and other vegetables

Legal and Regulatory

- What's really needed to facilitate more in-state processing, however, is regulatory reform. Many interviewees complained bitterly about the USDA inspection systems for slaughtering facilities because it favors larger producers. Greater exemptions for intrastate meat producers, whether they are running processing plants and small mobile units, could be key. Lorentz Meats in Minnesota is an example of a successful small processing facility that has secured a USDA license for multispecies processing and developed a successful labor-intensive business that matches local producers and local consumers for quick, just-in-time processing. (Diemer, Crawford, & Patrick, 2014)

Economic Impacts

- We calculate, using the IMPLAN input-output model, that were Dreaming New Mexico's goal of 25% food localization realized by 2020, it could generate $1.4 billion in additional output, $346 million in additional earnings, $44 million in additional business taxes, and more than 10,000 additional jobs. Of these benefits, roughly 17% come from increased farming, 18% from the increased raising of fish, game, and meat, and the rest from value-added food manufacturing, distribution, retail, and restaurants. To put the jobs number in perspective, it's worth noting that 100% food localization would provide a job to more than half of all New Mexicans unemployed today. (Shuman, 2010)
- The proximity of many producers to New Mexico's population centers provides a significant opportunity to increase sales to meet the growing consumer demand for locally produced agricultural products. In 2010, over $13 million in New Mexico agricultural products were sold directly to consumers (via farmers' markets and other venues). According to NMDA (2010), if New Mexico consumers increased their purchases of food from local farmers and ranchers by 15%, over $375 million in direct farm income would be generated). The total income (direct, indirect, and induced) associated with these added purchases would contribute $725 million per year in outputs and wealth for New Mexico communities (NMDA, 2010). (Diemer, Crawford, & Patrick, 2014)

1. NORTHWEST	DIR. EMPL. IMPACT	TOT. EMPL. IMPACT	OUTPUT DIRECT $ IMPACT	OUTPUT TOTAL $ IMPACT	$ RANK
Petroleum Refineries	213	227	1,514,066,040	1,618,193,104	1
Oil & Natual Gas Extraction	3,292	4,396	672,063,782	897,328,597	2
State & Local Govt. Education	12,579	18,746	665,946,899	992,491,552	3
Electricity Generation, Transmission & Distribution	1,270	1,500	653,704,346	772,166,034	4
Support for Oil & Gas Ops.	2,436	3,438	458,677,429	647,379,687	6
Wholesale Businesses	4,450	5,824	456,078,583	597,035,083	7
Food & Drinking Places	7,195	9,810	373,729,706	509,566,019	8
Construction – New Non-residential	2,882	4,052	357,830,597	503,059,684	9
Hospitals – Private	2,633	3,860	352,323,730	516,595,684	10
AG PRODUCTION	**4,523**	**6,671**	**270,370,665**	**396,766,874**	**13**
FOOD PROCESSING	**91**	**116**	**32,309,966**	**40,725,693**	**63**

- (The Northwest Region includes San Juan, McKinley, and Rio Arriba Counties) (Diemer, Crawford, & Patrick, 2014)

MEDIAN HOURLY WAGE COMPARISON OF FOOD PRODUCTION WORKERS

	New Mexico	Arizona	California	Colorado	Oklahoma	Texas	Utah
First-Line Supervisors of Production & Operating Workers	$25.90	$24.78	$26.40	$28.70	$25.47	$28.69	$25.62
Food Batchmakers	$10.63	$10.96	$11.79	$12.33	$11.70	$10.26	$12.75
Food Cooking Machine Operators & Tenders	$10.87	$11.27	$12.81	$11.56	$11.84	$11.42	$13.51
Separating, Filtering, Clarifying, Precipitating, & Still Machine Setters, Operators, & Tenders	$16.36	$21.81	$18.18	$22.50	$11.81	$19.08	$18.25
Packaging & Filling Machine Operators & Tenders	$10.12	$11.71	$12.00	$11.60	$11.37	$10.87	$12.99
Industrial Machinery Mechanics	$22.45	$23.74	$26.89	$25.34	$23.64	$23.01	$24.80
Drivers/Sales Workers	$11.31	$9.60	$12.68	$10.13	$11.57	$10.34	$10.48
Heavy & Tractor-Trailer Truck Drivers	$18.45	$18.58	$19.90	$20.73	$18.24	$17.97	$20.12
Industrial Truck & Tractor Operators	$13.66	$14.82	$16.66	$15.96	$14.79	$13.38	$16.33
Packers & Packagers, Hand	$9.00	$9.16	$9.57	$9.37	$9.73	$9.17	$9.94

Source: U.S. Bureau of Labor Statistics, Occupational Employment Statistics, May 2014 estimates released March 25, 2015

- (New Mexico Economic Development Department, 2015)
- 2014 County Business Patterns data for NAICS code 311: Food manufacturing (U.S. Census Bureau, 2016)
    - Total annual payroll in the US: $59 billion
    - Total employees in the US: 1.4 million
    - Total establishments in the US: 26,947
    - Average annual pay/employee: $41,000

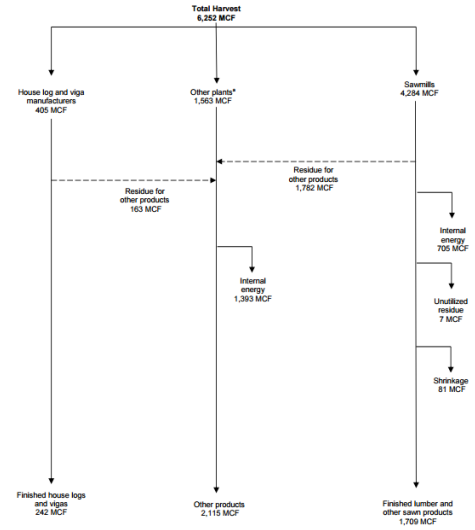
- Average employees/establishment: 53
- Average annual payroll/establishment: $2.2 million

A.4. Forest Restoration & Forest Products

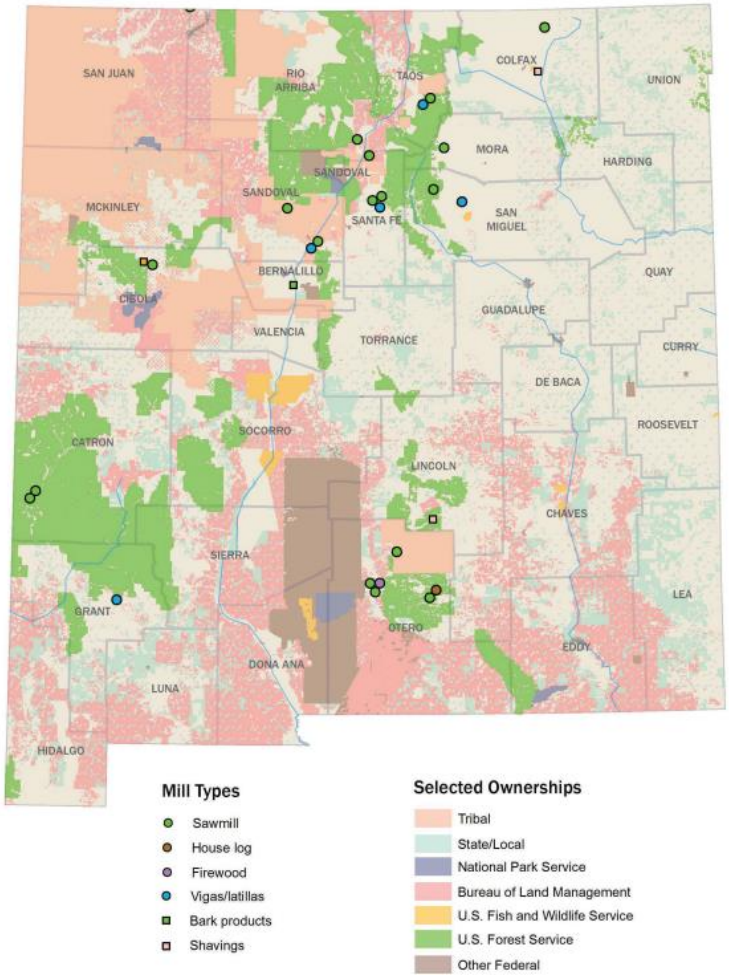
Market

Current demand

- 2014 County Business Patterns data on NAICS 3219: Other Wood Product Manufacturing (WPM) (U.S. Census Bureau, 2016)
  - Bernalillo County
    - 428 employees, $17 million in payroll, 21 establishments
      - Millwork: 210 employees, $8.5 million, 11 establishments
      - All Other WPM: 122 employees, $5.9 million, 6 establishments
      - All Other Misc WPM: 56 employees, $1.4 million, 7 establishments
  - All other counties in NM have less than 5 establishments and do not list payroll or employment
  - The 4C counties showed no data
  - Montezuma County, CO had 3 establishments with no data on payroll or employees. La Plata, CO had 2 establishments with no data on payroll or employees.
  - Apache County, AZ had 3 establishments with no data on payroll or employees.
  - San Juan County, UT had 1 establishment with no data on payroll or employees.
- NM timber industry, 2012 (U.S. Forest Service, 2016)
  - Distribution of timber products: Sawlogs 78%, vigas 5.4%, house logs 0.2%, and **other products 16.3%**. Other products include posts, poles, furniture logs, fiber logs, and industrial fuelwood.
  - The majority (78 percent) of New Mexico's 2012 timber harvest was processed in-State. About 3.8 MMBF of New Mexico timber was processed in Colorado, and 2.5 MMBF in Texas, while a small amount of timber from Colorado and Montana was processed in New Mexico.
  - Timber processors in New Mexico received 22,934 MBF of timber in 2012, including 418 MBF that was harvested outside the State (which were all "other products"). Log flow in NM consisted of mostly sawlogs but also "other products".



- igure N1—New Mexico timber harvest and flow, 2012.
- In Cibola County, there is **one sawmill and one shavings facility**. There are no facilities in McKinley or San Juan County.



- Sawmill – Mt. Taylor Manufacturing (Boyett, 2011)

- Located in Milan, Cibola County
- **Manufactures wood pellets from downed trees for energy** as part of a federal program. Allen said the BCAP program will run from August through September and during that time he expects to remove **50 semi-trailer loads, or 1,200 tons of wood**, from the Cibola National Forest. (Domrzalski, 2014)
- Our main division performs selective forest restoration. This process removes overgrown, drought ridden timber from the Cibola National Forest. The harvested material is made into boards and beams. The residue is made into compost, garden mulch, animal bedding and alternative energy in the form of wood pellets. Our secondary division is located in the South Valley of Albuquerque. Here we recycle clean wood waste. Approximately ten to twelve million pounds of clean wood is also converted into wood pellets rather than being needlessly land filled. (New Mexico Manufacturing Extension Partnership, n.d.)

- New Mexico's annual lumber production capacity was 63,020 MBF lumber tally in 2012. Sawmills produced 24,450 MBF of lumber and **utilized about 39 percent of their production capacity.**
- Decreases in capacity in the sawmill sector have resulted from the permanent closing of large sawmills since 2002, which were operating well below capacity. With the relatively low timber harvest levels of the past 10 to 15 years, many mills were unable to procure enough timber to operate profitably. With capacity utilization levels below 50 percent, **additional mills can be expected to close unless timber harvest levels increase and markets for wood products continue to improve.**
- **Sales from New Mexico's primary wood products industry in 2012 totaled slightly over $40 million**, including finished products and mill residue (table N17). **Other products and mill residues accounted for 64 percent** ($25.8 million) of total sales. Lumber, timbers, and other sawn products accounted for 27 percent of sales ($10.7 million); vigas and latillas accounted for 9 percent ($3.7 million). **New Mexico was the leading market area for each of the product categories**, accounting for 44 percent of lumber sales, 53 percent of viga and latilla sales, and **73 percent of other products and mill residue sales. Other areas outside the United States (mostly Mexico) accounted for 26 percent of lumber sales**. The other Four Corners States (Arizona, Colorado, and Utah) were the second leading market area for vigas and latillas, and **the South was the second leading destination for the other products category**.
- **About 2,300 workers were directly employed** in the primary and secondary forest products industry in New Mexico during 2012. This marked a **29 percent decline from the employment in the industry in 2007**. **Most of the decline came from wood products manufacturing, which fell from over 2,000 jobs to just over 1,300 in 2012.** Approximately 700 workers were employed in harvesting and processing timber or in private sector land management (i.e., the primary sector) in 2012, a decline of about 70 jobs from the 2007 level.

Trends

- Cellulose nanomaterials (U.S. Forest Service, 2014)
  - Lightweight, strong, and stiff
  - Low materials cost compared to other competing materials
  - Derived from renewable and broadly available resources
  - Great potential for use in many areas, including aerogels, oil drilling additives, paints, coatings, adhesives, cement, food additives, lightweight packaging materials, paper, health care products, tissue scaffolding, lightweight vehicle armor, space technology, and automotive parts.
  - Great potential for post-consumer disposability and recyclability
  - Still need to be transitioned to commercial application
  - There has been a great deal of federal funding but focused only on R&D
- US Forest Industry Outlook (Goergen et al., 2013)
  - Cellulose nanomaterials – strong, light, cheap, and renewable
  - Based upon available economic and production data, the **logging workforce may be the weakest link in the supply chain** today. Logging capacity has been reduced by 25 percent just since 2009. 71 percent of U.S. logging companies report difficulty in attracting new employees. Considerable evidence suggests that, over the last decade, this link has been economically squeezed between forest owners and manufacturers, jeopardizing the entire chain.
  - **Manufacturers will find it difficult to find new workers** for highly and moderately skilled positions due to the aging nature of the forest products manufacturing work force, as well as competition from other industries and employers who are offering more attractive career opportunities, and/or richer compensation packages.
- Global Forest Products Industry (Prestemon, Wear, & Foster, 2015)
  - The U.S. share of global wood products output peaked in 1998 at about 28 percent, declined to about 24 percent in 2006, and then fell with the 2007–2009 recession to an unprecedented low of about 17 percent, where it remained through 2013.
  - U.S. construction, heavily reliant on wood products, was affected [by the Recession] more than most other countries' construction sectors, and this largely explains the record low U.S. market share in forest products.
  - Long-term trends in paper use, trade, and U.S. manufacturing activity indicate that market share in the foreseeable future is unlikely to return to the peak levels (28 percent) observed in the late 1990s.
  - While domestic economic activity dominates U.S. forest product output, global markets are increasing in importance. Most notably, growth in manufacturing output in China has shifted paper and paperboard production toward Asia.

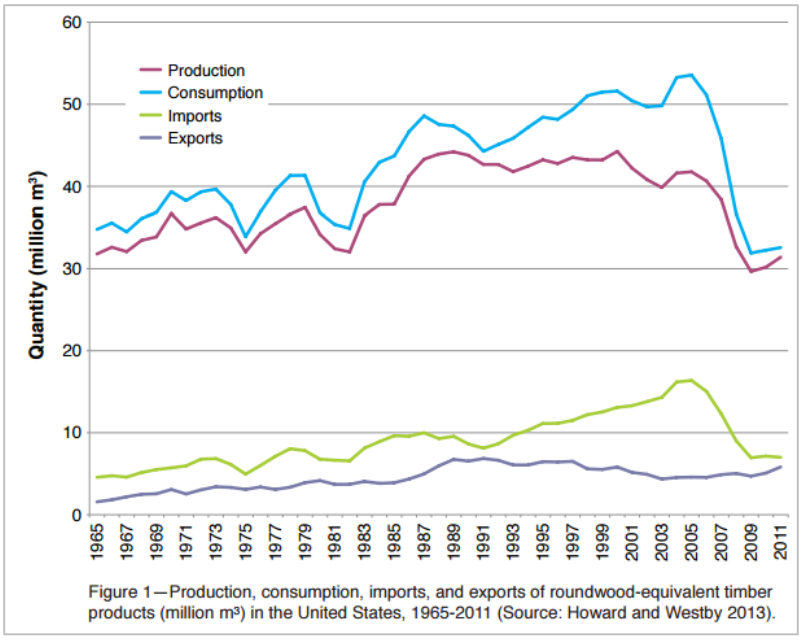


Figure 1—Production, consumption, imports, and exports of roundwood-equivalent timber products (million m³) in the United States, 1965-2011 (Source: Howard and Westby 2013).

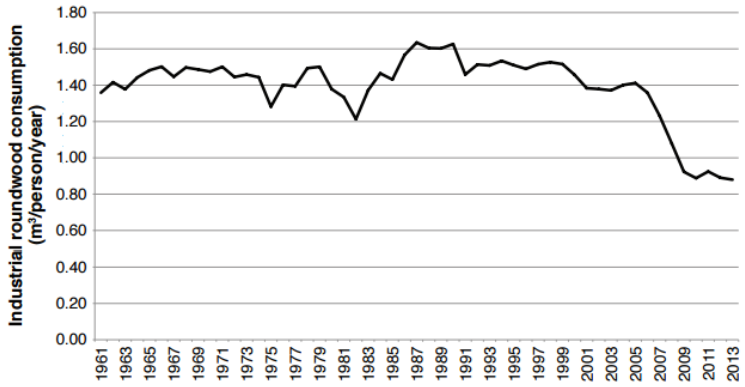


Figure 5—Annual consumption per capita of industrial roundwood in the United States, 1961-2013 (Sources: Food and Agricultural Organization of the United Nations 2014a, U.S. Census Bureau 2014a, 2014b, 2014c).

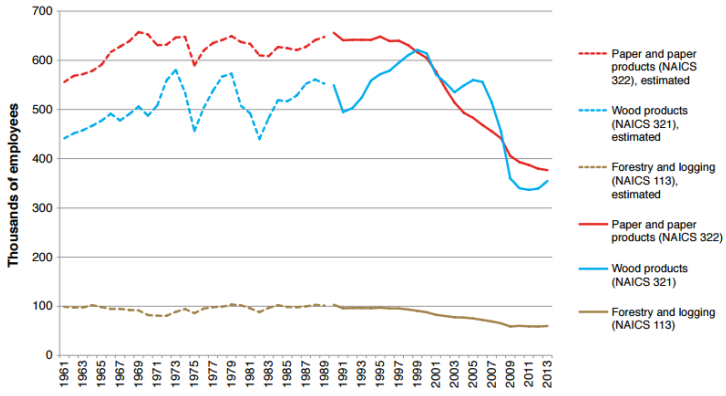
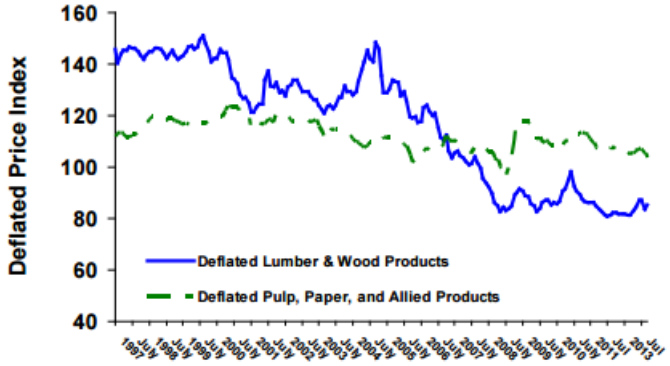


Figure 18—Employment in the forest products sector in the United States, 1961-2013 (Source: U.S. Bureau of Labor Statistics 2014a, 2014b, 2014c).

- **Growing products** for timber industry: other paper and paperboard, fiberboard, OSB, glulam, I-joist, laminated veneer lumber (LVL)
- **Declining products** for timber industry: printing and writing paper, newsprint, wood pulp

- US Forest Products 2011-2015 (Howard & McKeever, 2014)
    - Housing starts slowed in 2014 nationwide
    - Table 2 - Prospects and statistics for wood and wood products, 2013-2015

Figure 2 - Wholesale Prices of Forest Products, 1997-2013.



- 2002 – 2012 Timber trends in the Four Corners states (UT, CO, AZ & NM) (Sorenson, et al., University of Montana, 2014)
    - Harvest volume on tribal and private land has been decreasing while **harvests on national forest land have been increasing**
    - Timber processing capacity has remained the same while timber use has declined somewhat
    - Overall decline in forest industry employment since 1998, from around 34,000 to 21,000
    - The sales value of most wood products have declined significantly, including:
        - Lumber, timbers, and other sawn products ($1.4M to $73M)
        - House logs and log homes ($60M to $21M)
        - Posts, poles, vigas, latillas, and log furniture ($30M to $18M)
    - **Sales value of "Other" wood products increased from $45M to $120M.** These include shavings, electricity, fuel pellets, erosion control products, firewood, mulch, clean chips, animal bedding, utility poles, and mill residues.
    - Nearly $156 million (65 percent) of sales were within the Four Corners States.
    - Lumber production in Arizona was 50 MMBF, Colorado was 98 MMBF, **New Mexico was about 25 MMBF**, and Utah's lumber production was 12 MMBF.
    - During 2012, there was a net out-flow of timber from the Four Corners to mills in other states. Mills in the Four Corners received 0.4 MMBF of timber from outside the region, while **8.9 MMBF went to mills outside the region**.
    - Timber-processing capacity (i.e., the volume of timber that could be used by existing timber processors if demand for products were firm and sufficient raw material were available) in the Four Corners during 2012 was approximately 455 MMBF, Scribner, representing a 30% increase from the 2007 capacity. **The increase in processing capacity in the region is primarily due to new or reconfigured mills designed to generate electricity or produce energy products like fuel pellets**.
- NM timber industry trends 1986 – 1997 (Keegan III, et al., 2001)
- NM timber industry trends, 2012 (Sorenson, et al., 2016)

  - New Mexico's 2012 commercial timber harvest was 28,839 MBF Scribner, 73 percent of the 2007 harvest (Hayes et al. 2012), 39 percent of the 2002 harvest (Morgan et al. 2006), and 30 percent of the 1997 harvest (Keegan et al. 2001b).
  - National Forest System (national forests) accounted for nearly 50 percent of harvested volume in 2012.
  - **McKinley and San Juan Counties had no timber harvested in 2012. Cibola County had only 1,523 Mbf harvested** (5.3% of all timber harvested in NM that year).
-

Characteristics

- *How to Restore Forests on Surface-Mined Land* (Burger & Zipper, How to Restore Forests on Surface-Mined Land, 2011)
  - Target audience is Appalachian mines
  - Follows the "Forestry Reclamation Approach"
  - Advocates for accelerated forest succession approach: Grasses -> Legumes -> Nurse and crop trees -> **Crop trees**
  - Nurse trees are planted to assist the crop trees by enhancing the organic matter and nitrogen status of the soil and improving soil physical properties, and by attracting seed-carrying wildlife such as birds onto the site. Nurse trees will die or can be cut out after 15 to 20 years when crop trees need additional growing space. Nurse trees help achieve the minimum number of stems and groundcover required for bond release, and they provide food and cover for wildlife.
  - The cost of reclaiming mined land with trees using the methods recommended in this publication (Forestry Reclamation Approach) can be comparable to or less expensive than reclamation for hayland/pasture and less expensive than reforestation using conventional reclamation methods.
- *Restoring the Value of Forests on Reclaimed Mined Land* (Burger & Zipper, 2009)
- Surface Mining Control and Reclamation Act of 1977 (SMCRA)
  - History of the law's evolution (Office of Surface Mining Reclamation and Enforcement, 2015)
- Ecological/Environmental benefits of thinning
  - Forest thinning offers several benefits, according to Scott Lerich, NWTF senior regional biologist. Among them are: **increased biodiversity, watershed quality and amounts of forbs and grasses available for wildlife. It also increases employment opportunities, conservation of wildlife and prevents large-scale forest fires**. (Baird, n.d.)
- Rio Grande Water Fund calculates $700 per acre thinning costs; and with sale of small diameter trees the net cost of thinning could be in the $450 per acre range. (Logan, 2016)
  - Taos Valley Watershed Coalition - In other areas the Payment for Ecosystem Service (PES) model has been used where downstream watershed users, nonprofit public / private partnerships, businesses and agencies work together to prioritize forest treatments on a massive scale. (Logan, 2016)

Competition

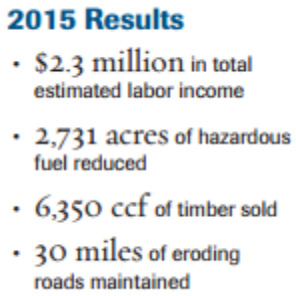
Major Players

- Essentially, one hundred percent of the logging workforce is employed by small, independent logging companies. These companies are family owned, with the median age of employees having risen to 54 years of age. Considerable evidence suggests that, over the last decade, this link has been economically squeezed between forest owners and manufacturers, jeopardizing the entire chain. (Goergen, Harding, Owen, Rey, & Scarlett, 2013)
    - FS annual budget for environmental restoration (in millions): $14.4 in 2013, $14.1 in 2014, and $14.1 in 2015, and $18.4 in 2016 (proposed). (U.S. Forest Service, 2015)
- Appalachia
    - NFWF and USFS grant funding totaling $678,000 for forest reclamation of mine lands in KY, MD, OH, TN, VA, and WV in 2014 (NFWF, 2014) (National Fish and Wildlife Foundation, 2014)

Inputs

Required

- **Funding**
    - Collaborative Forest Restoration Program (CFRP) (U.S. Forest Service, n.d.)
        - Since 2001 the Collaborative Forest Restoration Program (CFRP) has funded 175 projects including close to 500 partners in planning and implementing collaborative forest restoration and small diameter utilization projects in 20 counties across New Mexico. These projects have restored over 30,000 acres and created over 700 jobs.
        - Grant awards in 2013 averaged about $350,000 per project.
        - From 2001-201 there were approximately 10 CFRP-funded projects in Cibola County and three in McKinley County.
        - Zuni Mountain Collaborative Landscape Restoration Project (The Nature Conservancy, 2016)
            - Thanks to CFLR funding, there are now over 5,500 acres treated on USFS lands and plans in place to implement large prescribed burns. Leveraged state, private, and other federal funds have helped treat other jurisdictions and make communities more fire-adapted. This effort culminated with a 101 acre private land burn in 2015 bordering the Cibola National Forest that trained local firefighters.
            - In the community, the National Forest established a forester training program with Zuni Pueblo. The National Wild Turkey Federation Stewardship Agreement with **Mt. Taylor Manufacturing has grown to 45 full time harvesting and processing jobs** – jobs Eytan says wouldn't exist without CFLR.



- The Bluewater project is in New Mexico's Zuni Mountains. "This project grows in scope each year," Lerich said. The NWTF and the Forest Service have been thinning mostly ponderosa pine and Douglas fir for the past five years. Squirrel, elk, mule deer and Merriam's turkey are among the many animals benefitting from the project. Last year, the Forest Service added $2.2 million to the project. Lerich said they thinned 1,300 acres in the past 12 months. **Mt. Taylor Manufacturing, a sawmill in Milan, New Mexico, supports about 37 employees under the project**. Although the project is in the eastern Zuni Mountains, project managers hope it spreads to the western side, too. (Baird, n.d.)

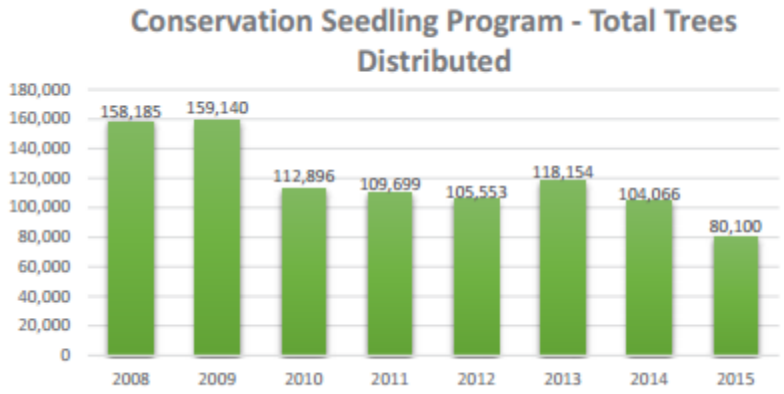
Availability in 4C Region

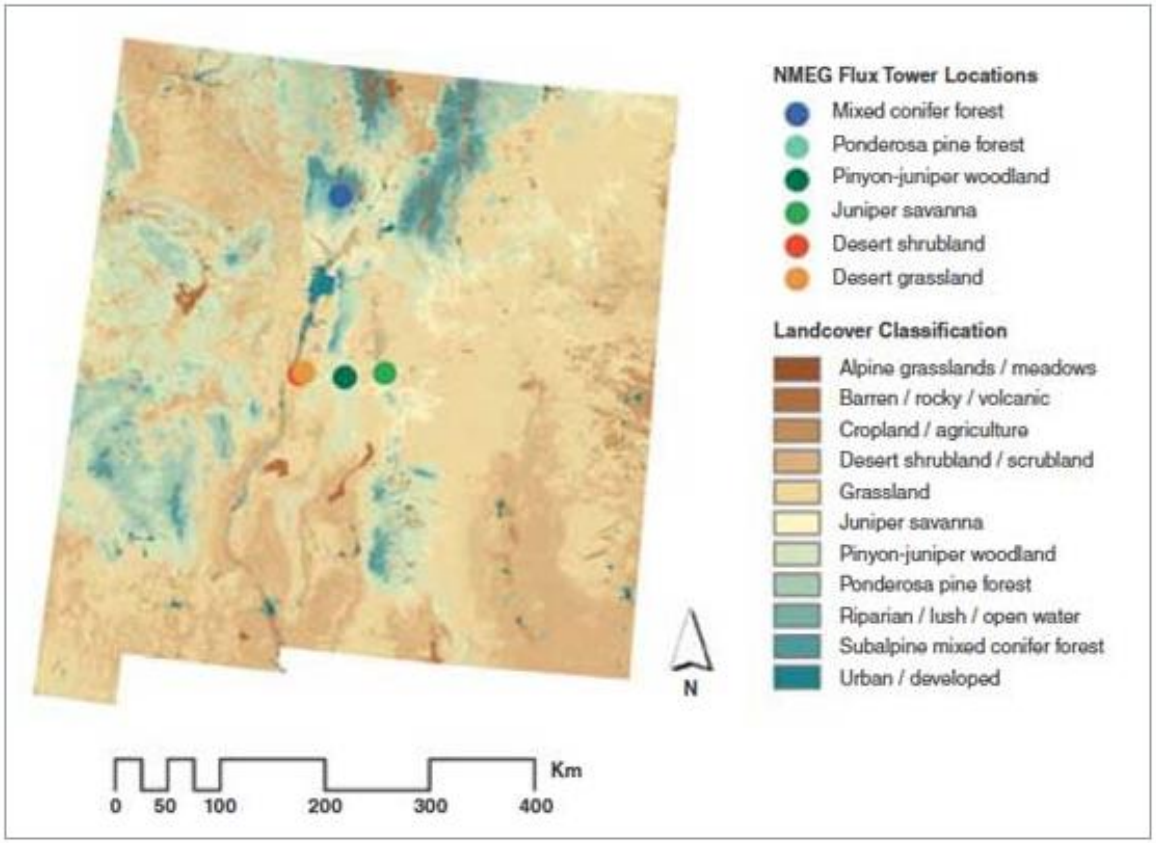
- Cibola National Forest Plan
  - Has not been updated since 1985
  - Currently being revised
  - Draft released in July 2016 (U.S. Forest Service, 2016)
    - On the Cibola, forest products include, but are not limited to, posts, poles, latillas, vigas, fuelwood, pellets, and rough-cut dimensional lumber (typically used for pallet production). **This material primarily provides local subsistence and livelihood to rural communities**, with small quantities sold across State lines and a portion of the dimensional lumber sold to Mexico for pallet production. A **sustainable supply of wood is available to support a wood harvesting and utilization industry of a size and diversity that can effectively and efficiently restore and maintain the desired conditions for forest and woodland communities**. Where appropriate, forest products are available: (1) to the public, including Tribal and land grant communities, for traditional and culturally important activities, (2) through either personal-use permits or commercial sales, and (3) as plant communities successfully adapt to a changing and variable climate.
    - Removal of special forest products for commercial purposes and personal use (including firewood) shall not be allowed in a research natural area unless it helps meet its desired conditions. Gathering of forest products for sale should not be permitted in areas recommended for wilderness designation.
    - A mutual concern about high fire risks, the need to restore a culturally important landscape and watershed, and the desire to support local forest-based industries, led to the development of the Zuni Mountain Collaborative

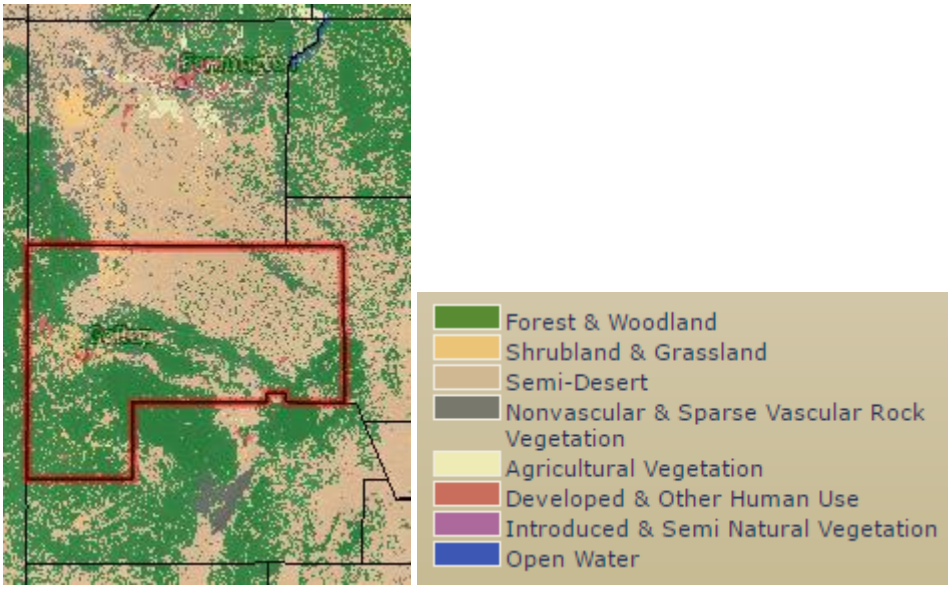
Forest Landscape Restoration Program. This program has received grants to restore the Zuni Mountain landscape to historic vegetation conditions using thinning and prescribed fire. Materials from the thinning will provide firewood for personal use and commercial contracts. When completed, the landscape will have fewer, but larger, trees; and more open areas to allow grass and herbs to recover. This will increase resilience to climate change and may increase water availability.

- The Mount Taylor Ranger District has four rivers that have strong potential for "wild and scenic" classification.

- Conservation Seedling Program - Each year, tens of thousands of tree and shrub seedlings are planted on private and public lands across New Mexico through Forestry's Conservation Seedling Program. The program provides economically priced tree and shrub species to New Mexico landowners for the establishment of windbreaks, erosion control, reforestation, crop and livestock protection, Christmas tree farm establishment, energy cost savings and to improve wildlife habitat. In 2015, the Conservation Seedling Program distributed 80,100 seedlings through sales during the New Mexico State Fair, educational donations, and for the spring and fall sales and distribution cycles. (New Mexico Energy, Minerals & Natural Resources Department, 2015)



- 

(LeFevre, 2012)
- 

(U.S. Geological Survey, n.d.)

Siting

- AZ's 4FI - Delivery advantage in producing OSB lumber in the SW. Problems with Pioneer Forest Products. Potential for Arizona Forest Restoration Products. (LoMonaco, 2013)
- Wildfire impacts

- The Whitewater-Baldy Complex Fire was a wildfire that started on May 9, 2012 in Catron County, New Mexico, USA. As of July 23, the fire had burned more than 297,845 acres (465.383 sq mi; 120,534 ha) in Gila National Forest at 95% containment. This well surpassed the Las Conchas Fire of 2011, thus making Whitewater-Bald the largest wildfire in New Mexico state history. The fire burned mostly within the Gila Wilderness, which includes the fire's namesake, Whitewater Baldy Mountain. (Wikipedia, 2016)
- The Cibola National Forest's current species composition and fuel densities greatly differ from historical conditions. Changes in species composition and fuel densities are a result of wildfire suppression, livestock grazing, regeneration, and encroachment of early and/or late successional species. **These conditions, especially when combined with drought and climate change, create a more continuous canopy cover, ladder fuels, and accumulations of live and dead woody material. As a result, the probability of large, uncharacteristic, stand-replacing fires continues to increase. These fires burn with more intensity and severity; cause higher tree mortality; degrade watersheds; sterilize soils; and threaten adjacent communities, forest infrastructure, and wildlife habitat.** Examples of uncharacteristic wildfires on the forest include Ojo Peak, Trigo, and Big Springs, all of which occurred within 6 months of each other on the Mountainair Ranger District in 2007 and 2008. These fires burned a total of 26,156 acres. (U.S. Forest Service, 2016)
- NM has had four major fires (>100,000 acres) since 1997: Whitewater-Baldy in 2012 (297,845 ac in Gila NF), Las Conchas in 2011 (156,593 ac in Santa Fe NF), Silver in 2013 (138,546 ac in Gila NF), and Donaldson in 2011 (101,563 ac near Lincoln). (National Interagency Fire Center, n.d.)
- One analysis estimated that the suppression costs of NM wildfires from 2009 – 2012 was $117 million. The total costs (including evacuation and damage costs) may have been between $223 million and $3.4 billion. (Impact DataSource, 2013)

Economic Impacts

- Commercial timber value of reclaimed mine sites by quality (Burger & Zipper, Restoring the Value of Forests on Reclaimed Mined Land, 2009)
  - 30 years: $100/acre for low quality, $2,800/acre for high quality
  - 60 years: $900/ac for low quality; $6,800/ac for high quality
- Environmental cleanups of abandoned mines vary in size from hundreds of thousands to many millions of dollars. In almost all cases, the site investigation, planning and actual cleanup work is performed by private environmental, engineering and construction firms under contract with the Forest Service. Private contractors also perform much of the abandoned mine safety closure work in states such as Colorado, Arizona, New Mexico and California that have the largest abandoned mine safety hazard mitigation workload. (Holtrop, 2011)
- 2014 County Business Patterns data for NAICS code 1132: Forest Nurseries and Gathering of Forest Products (U.S. Census Bureau, 2016)
  - Total annual payroll in the US: $53 million
  - Total employees in the US: 1,510
  - Total establishments in the US: 176
  - Average annual pay/employee: $35,000
  - Average employees/establishment: 8.6

    - Average annual payroll/establishment: $304,000
- 2014 County Business Patterns data for NAICS code 321: Wood product manufacturing (U.S. Census Bureau, 2016)
    - Total annual payroll in the US: $14.4 billion
    - Total employees in the US: 365,402
    - Total establishments in the US: 13,719
    - Average annual pay/employee: $39,000
    - Average employees/establishment: 26.6
    - Average annual payroll/establishment: $1 million
- Mt. Taylor production and employment
    - The site sits on 15 acres and **employs 11**. (Valenta, 2011)
    - The project also had a measurable economic effect in Cibola County. The economic benefits of the project also precipitated positive social changes in both counties project, McKinley and Cibola. Mt. Taylor Manufacturing, the wood processing and implementation partner invested heavily in FY13 in their wood processing and waste capturing capacity. They directly invested $595,165 of their own cash to build this capacity. These investments increased their efficiency by 400% so that **they went from being able to process 2 cut-to-length loads per week of wood to now being able to process 12 loads of wood per week**. This capacity investment now **directly supports 15 wood processing jobs**. Many of the positions are filled with skilled members of the Navajo Nation that commute from McKinley County. There are also **8 full time secondary wood processing jobs** that manufacture residential wood pellets from the waste (mixed with recycled clean wood waste) of the primary tree processing. The pictures below depict the redesigned mill operations which now have many automated features and sorting and sawing stations. In addition, all milling waste is captured and processed for landscaping or pellets. (U.S. Forest Service, 2013)

A.5. Mine Reclamation

Market

Current demand

Trends

Characteristics

- Major reclamation programs
    - Abandoned Mine Land (AML) Program
        - In 2015, the AML Program completed ten construction projects at abandoned mine sites in New Mexico. (New Mexico Energy, Minerals & Natural Resources Department, 2015)
    - Coal Mine Reclamation Program
        - The Coal Program regulates, inspects and enforces on all coal mines on federal, state and private lands within New Mexico, with the exception of Tribal lands.

The program oversees more than 85,000 acres of permitted mine lands and nearly $500 million in financial assurance. (New Mexico Energy, Minerals & Natural Resources Department, 2015)

- Mine Registration, Reporting & Safeguarding Program
  - This program provides comprehensive information on mineral resources, mine registration, reclamation and safeguarding efforts, legislation, and other MMD activities related to New Mexico's mineral extraction industry and mineral resources. (New Mexico Energy, Minerals & Natural Resources Department, 2015)
- Mining Act Reclamation Program (MARP)
  - MARP regulates, inspects and enforces on all hard rock or mineral mines on federal, state and private lands within New Mexico. MARP oversees the reclamation of all exploration and extraction activities conducted at all mines and mills, excluding coal, potash and aggregate mines. MARP has permitted approximately 563 mining and exploration projects encompassing over $693.6 million in financial assurance. **The overall disturbed acreage under permit with MARP is 26,130 acres as of the end of 2014**. The total number of acres reclaimed since 1994, when the program was started, is 6,961 acres as of the end of 2014. (New Mexico Energy, Minerals & Natural Resources Department, 2015)

Competition

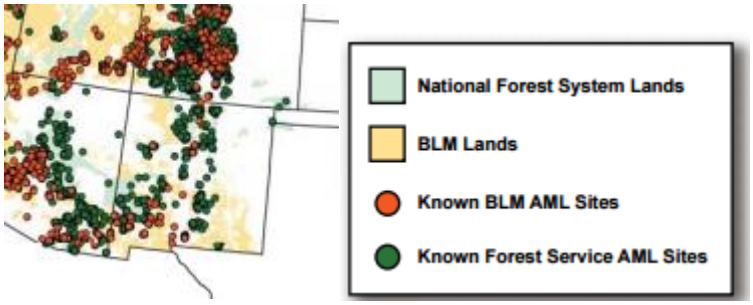
Major Players

- Federal agencies
  - Forest Service AML Program
    - Key elements of these programs include **mitigating abandoned mine hazards; restoring land and water contaminated or disturbed by abandoned mines; and enhancing fish and wildlife habitat through reclamation of abandoned mines**. (Holtrop, 2011)
    - Because many AML sites involve a combination of federal, state, and private lands, the Forest Service actively seeks partnerships with other agencies, private groups or persons, and companies or owners potentially responsible for the site. This allows the Forest Service to "leverage" its funds to maximize accomplishments and achieve reclamation of all sites in an entire watershed regardless of ownership. (U.S. Forest Service, 2004)
    - The nine Forest Service Regions submit proposals to the Washington Office of specific Regional priority cleanup projects, including the estimated costs and benefits of each project, for competitive consideration against other Regions' AML projects. A team consisting of 6 Forest Service representatives (1 each from the Minerals and Geology, Engineering, and Watershed Staffs and 3 Regional Office AML program leaders) rate each of the submitted projects through a formal "Choosing by Advantages" methodology. Projects are ranked by the team based on how well they meet criteria for human health and safety, environment protection, public/private partnerships and public interest. The Forest Service Washington Office then makes final allocation decisions to

specific cleanup projects. The USDA prioritizes projects for its funds using a similar approach. (U.S. Forest Service, 2004)

- The abandoned mine cleanup and restoration work that is funded by the Forest Service AML Program falls into 3 general categories: (U.S. Forest Service, 2004)
    - Large & Complex Mine and Mill Sites in Heavily Impacted Watersheds
        - Frequently work on these sites is done by companies or individuals potentially responsible for the site, under the direction and oversight of the Forest Service and other state or federal agencies. Although relatively few in number, work on these projects has the potential to restore many miles of aquatic resources, often in sensitive or critical habitat, and tens to hundreds of acres of soil and vegetative resources.
    - Drainages Affected By Historic Placer Mining
        - Restoration of these areas typically involves design and construction of a natural stream channel and associated floodplain, removal or reshaping and revegetation of placer tailings (rocks and boulders), and reestablishment of wetlands or riparian habitat.
    - Small Mine Cleanups and Safety Hazards
        - Cleanup may involve reshaping the site; closing mine adits and shafts; containing mine wastes in on-site capped and lined repositories; water source control and simple treatment systems (e.g. passive lime); removing mine chemicals and trash; removing or stabilizing old mine buildings for historic interpretation; and preserving habitat where possible for AML-dependent wildlife species such as bats.
- Environmental Compliance and Protection/Abandoned Mine Land Program (ECAP/AML), which consists of three major activities:
    - Cleanup and reclamation of National Forest System (NFS) lands impacted by hazardous materials and/or mining activities;
    - Mitigation of safety hazards associated with inactive/abandoned mine lands; and
    - Environmental compliance audits of Forest Service operations, facilities, and permitted activities. (Holtrop, 2011)
- Approximately 75 to 85 percent of the total ECAP/AML budget is expended on the cleanup and safety hazard mitigation at abandoned mine sites. The scope AML cleanup on land managed by the Forest Service is large and could consume an estimated $4 to $6 billion, or even more considering potential long term treatment needs, to complete response actions at these sites. . (Holtrop, 2011)
- **Funding Prioritization:** Descriptions of proposed CERCLA and non-CERCLA cleanup projects, including abandoned mines along with the costs and benefits of each, are submitted by the Forest Service Regional Offices two years prior to the fiscal year that funding would be received. Because the number of projects always exceeds the available budget, they are prioritized based on potential

benefits to human health and safety; environmental factors such as water quality; and economic and social factors including the potential for state or federal partnerships, public interest and overall cost. The projects are then ranked and funded as money becomes available through the budget process. In FY 2011, we received approximately $16 million to fund CERCLA cleanup of 75 contaminated sites. We anticipate contributions to this effort from individual PRP's along with some State and local contributions. In FY 2012, we have requested $15 million to fund the mitigation of 50 sites. (Holtrop, 2011)

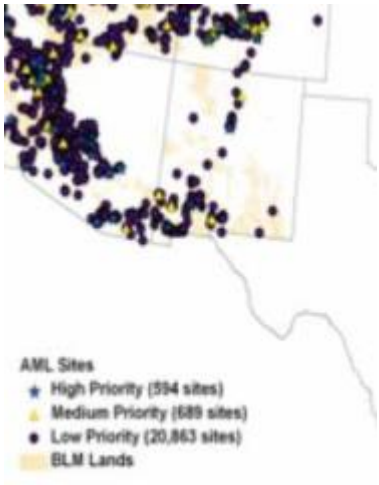
- Currently no single source of funding, whether it be Federal, State, tribal, or private, is adequate on its own to address the magnitude of the problem that exists. To remediate a particular site, **the BLM and Forest Service may work with Federal, State, and private partners who are able to apply funding from a variety of programs and authorities, including SMCRA; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); and the Clean Water Act Grant Program.** (Bureau of Land Management and U.S. Forest Service, 2007)
- 

(Bureau of Land Management and U.S. Forest Service, 2007)
- In other work completed in 2007, the Cibola National Forest finished filling mining shafts and deep cuts over a mile in length in the Bonita Canyon Watershed, approximately 20 miles southwest of the town of Grants, New Mexico and north of El Malpais National Monument. The mine cuts and shafts part of the Zuni Mine, an historic mine and mining camp which was very active from 1940 on through the 1960's. Because the mine area was well-roaded and visible from a State Highway, weekend campers, off-road vehicles and rock hounders are very active in the area. Because of the risk to visitors exploring the mine area, the Forest Service completed the work of filling in the shafts and cut in 2007, at a cost of approximately $250,000. (Ferguson, 2008)

- Office of Surface Mining Reclamation and Enforcement (OSM)
  - The Office of Surface Mining Reclamation and Enforcement (OSMRE), within the Department of the Interior, is the primary Federal agency responsible for abandoned coal mine reclamation. A national program, established by 1977 law, is in place that includes an inventory of high priority sites, a reclamation fee paid by the coal mining industry, and a funding mechanism comprised largely of grants to States and Indian tribes with approved programs. **Priority focus is on sites posing health and safety hazards**. There is an inventory of high priority

abandoned coal mines maintained jointly by OSM and program States and Tribes. (New Mexico Energy, Minerals & Natural Resources Department, 2015)

- Grant matching - The level of match required for a specific assistance program is set by legislation or agency regulations or directives. For example, the Surface Mining Control and Reclamation Act (SMCRA) require states to provide 50% match for regulatory program administration and enforcement (A&E) grants for work on non-Federal lands. (Office of Surface Mining Reclamation and Enforcement, 2015)
- In 2016, OSMRE granted $224 million for mine reclamation under the AML program. **New Mexico received $2.79 million of this.** (Office of Surface Mining Reclamation and Enforcement, 2016)

- BLM
  - Costs to validate and remediate BLM AML sites in New Mexico Texas: $1.1 million (Bureau of Land Management, 2013)
    - Not many in the 4C region
    - 

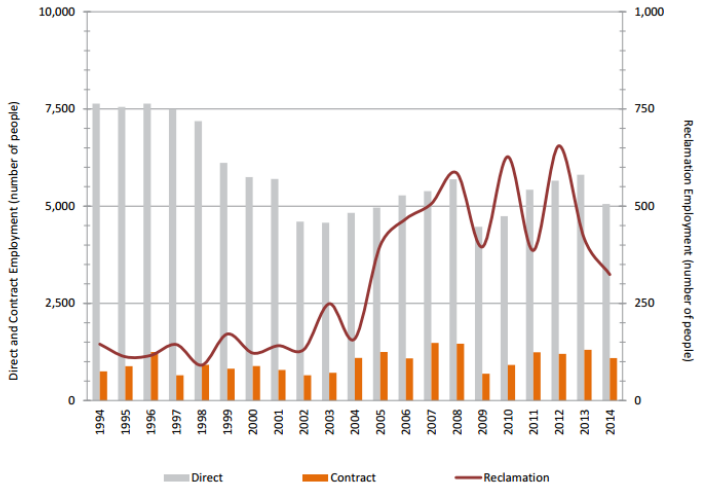
- EPA
  - 2015 Superfund budget for Remedial uses (ongoing fund-financed projects, maximize the preparation of “shovel ready” projects, and fund new construction projects.): $501 M; $539.6 M proposed for FY 2016 (Environmental Protection Agency, 2015)
  - The Superfund Remedial program is (proposed to be) funded at $521 million in FY 2017. (It was $501M in 2016). The agency will continue to give priority to completing projects at various stages in the response process, such as investigation, remedial design, and remedy construction. This will help support community revitalization and economic redevelopment and will provide funding to initiate cleanup construction work at several construction projects. In FY 2017, the annual targets will be the same as FY 2016, 675 remedial site assessment completions, 105 remedial action project completions, 13 construction completions, and 45 site-wide ready for anticipated use. (Environmental Protection Agency, 2016)

- New Mexico
  - Chevron Mining Inc

- Peabody Energy
- BLM
- Freeport McMoran

Expanding/Contracting

- In June 2014, Chevron Mining Inc. made the decision to permanently close the Questa Mine in Taos County, a Superfund site. Chevron Mining Inc. initiated reclamation of the Questa Mine in late 2014 with the partial demolition of the mill area and closure of the underground mine. Reclamation and remediation continue in 2015 with further demolition of the mill area, construction of a water treatment plant, removal and disposal of old tailings, and remediation of Eagle Rock Lake. Reclamation will continue for a number of years as plans are approved and then implemented to reclaim the tailings area and the mine/mill area. Three agencies (MMD, New Mexico Environment Department and the Environmental Protection Agency) are working with Chevron to develop reclamation plans and agreements following the federal CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) process. (National Fish and Wildlife Foundation, 2014)
- Total mining sector direct and contract employment decreased by 13 percent from 2013 (7,112) to 2014 (6,145): direct employment decreased from 5,806 to 5,055 employees; contract employment decreased from 1,306 workers to 1,090; **reclamation employment decreased from 416 workers to 324** (Figure 4). (New Mexico Energy, Minerals & Natural Resources Department, 2015)



- (New Mexico Energy, Minerals & Natural Resources Department, 2015)
- Peabody Energy received Phase I bond release on a portion of the Lee Ranch Mine upon successful completion of backfilling and grading of 730 acres of pit reclamation. Applications for partial bond release for 1,056 acres at La Plata Mine, and for full bond release for portions of San Juan Mine totaling 1,193 acres, are also being processed. (New Mexico Energy, Minerals & Natural Resources Department, 2015)
- Chevron Mining Inc. is requesting a completeness review of an application for partial bond release on 1,504 acres at McKinley Mine; inspection of the reclamation will occur in the spring of 2016. (New Mexico Energy, Minerals & Natural Resources Department, 2015)

Availability in 4C Region

- The U.S. Department of Energy expects to spend nearly $100 million in long-term monitoring and maintenance costs at these sites until 2070 and $50 million in groundwater remediation costs at only three of the 24 sites: Shiprock, New Mexico, and Tuba City and Monument Valley Arizona. (Power, 2008)
- New Mexico still faces major legacy costs associated with remediating the public health problems created by past uranium mining. There remain hundreds of millions of dollars' worth of damage that still has to be coped with. Nearly 600 abandoned uranium mines have been identified in McKinley, Cibola and Sandoval Counties. The majority of inventoried abandoned uranium mines have no record of any reclamation done or even being required. (Power, 2008)
- As of 2014, here are 13 mines in the 3-County area that are actively involved in reclamation (New Mexico Energy, Minerals and Natural Resource Department, 2014)
- As of 2014, there are 29 mines in the 3-County area that are actively being mined (New Mexico Energy, Minerals and Natural Resource Department, 2014)
- As of 2014, there were 960 acres "disturbed" in the 4C counties and 314 acres "reclaimed". (Martinez & Sheperd, 2014)
- As of 2014, there were only two active coal mines mining 5,300 acres (New Mexico Energy, Minerals and Natural Resource Department, 2014)
- MMD estimates that more than 15,000 hazardous mine openings remain un-reclaimed throughout New Mexico. (New Mexico Energy, Minerals & Natural Resources Department, 2015)
- Bond release applications to NM EMNRD (New Mexico Energy, Minerals and Natural Resources Department, 2016)
    - Lee Ranch Mine Phase I – July 2016
        - Backfillling, grading, and top soiling have been completed on 2,743 acres
        - 7,622 acres are disturbed (which includes those above)
    - Lee Ranch Mine Phase II – Aug 2016
        - Backfilling, grading, top soiling, and revegetation activities have been completed on 1,130.5 acres
        - 7,622 acres are disturbed (which includes those above)
    - El Segundo Mine Phase I – June 2016
        - Backfillling, grading, and top soiling have been completed on 1,411.8 acres
        - 5,330 acres are disturbed (which includes those above)
    - McKinley Mine – Aug 2016
        - Backfilling, grading, and topsoil placement has been completed on 1,504.3 acres
    - San Juan Mine – Aug 2016
        - Backfilling, grading and final surface configuration has been completed on 329 acres
- NM EMNRD Coal Mines Query (New Mexico Energy, Minerals and Natural Resources Department, 2015)
    - Provides a timeline of acres disturbed, backfilled/graded, seeded/topsoiled
- MMD Online (New Mexico Mining and Minerals Department, n.d.)

  - Provides information on mine registration and permits in NM
  - Excel file is saved
- There are six sites in NM that are classified as Abandoned Mine Lands (Environmental Protection Agency, 2016)
- There are sixteen sites in NM that are currently on the National Priorities List (Superfund). Six are in the 4C counties. (Environmental Protection Agency, 2016)
- EPA National Priorities List (Superfund) Sites within 4C region
  - Jackpile-Paguate Uranium Mine (Environmental Protection Agency, 2016)
    - Paguate, Cibola County
    - 2,656 acres were disturbed by mining
    - Mining operations **detrimentally affected surface water** with hazardous chemicals in quantities sufficient to support listing onto the EPA National Priorities List (NPL) for CERCLA cleanup.
    - Site listed in 2012
  - United Nuclear Corp (Environmental Protection Agency, 2016)
    - located near Gallup, New Mexico
    - The site includes a former uranium ore processing mill and tailings disposal area
    - Facility operations **contaminated soil and groundwater**. Cleanup activities and monitoring are ongoing.
    - The selected remedy included: containment and removal of contaminated ground water in three shallow ground-water zones utilizing existing and additional wells, evaporation of ground water removed from aquifers, and implementation of performance monitoring and evaluation programs. The tailings cells have been capped with an interim radon barrier cover as part of the reclamation activities directed by the Nuclear Regulatory Commission. Two evaporation ponds have been constructed on top of the cells as part of the EPA's ground-water remedy.
    - EPA divided the site into two areas, or operable units (OUs), for cleanup: groundwater (OU-1) and surface soil (OU-2). The long-term remedy for OU-2 includes transportation of mine waste from the Northeast Church Rock mine and the receipt, consolidation and disposal of this mine waste at the mill site within the tailings disposal area. A remedial design for the construction of the tailings repository is ongoing.
  - Homestake Mining Company (Environmental Protection Agency, 2016)
    - located in Cibola County about 5.5 miles north of the village of Milan
    - The site includes a former uranium mill and the impacted portions of the underlying groundwater aquifers
    - Site operations and seepage from two tailings impoundments **contaminated soil and groundwater** with hazardous chemicals. Cleanup at the site is ongoing.
    - The NRC is requiring that the Corrective Action Plan include cleanup of off-site contamination and that the license be amended accordingly. Reverse gradient injection has ensured that contaminants in the groundwater will not expand into the shallow aquifer, thus making the shallow water potentially usable in the

downgradient areas. Once the tailings piles have been closed, the site will be transferred to the Department of Energy (DOE) under general license.

- Grants Chlorinated Solvents (Environmental Protection Agency, 2016)
  - located in Grants, Cibola County, New Mexico
  - The site consists of a 20-acre, 100-foot-deep groundwater plume that extends about 1,000 feet from the source. An operating dry cleaning facility, no longer a source is the primary source of contamination. The primary chemicals contaminating groundwater include tetrachloroethylene (PCE) and its degradation products. Following remedy construction, operation and maintenance activities and groundwater monitoring are ongoing.
  - The site's long-term remedy, selected in 2006, included vapor intrusion mitigation, thermal and chemical dechlorination technologies to address **shallow and deep groundwater contamination**, and institutional controls. EPA updated the remedy in 2011 to eliminate thermal treatment at the secondary source area due to low contaminant levels and to expand thermal treatment downgradient of the primary source into the shallow plume core. Enhanced reductive dechlorination also replaced the deep thermal treatment (from 40 to 80 feet below ground surface) in the primary source area. Remedy construction finished in September 2012. The thermal remedy treated about 33,000 cubic yards of contaminated soil. Operation and maintenance activities and groundwater monitoring are ongoing.
- Lee Arches Landfill (Environmental Protection Agency, 2016)
  - The 60-acre Lee Acres Landfill (USDOI) site is a closed landfill near Farmington, New Mexico.
  - The Bureau of Land Management (BLM) manages the site, which consists of solid waste trenches and unlined waste lagoons. At least three of the lagoons may have received a mixture of liquid wastes, including produced waters from oil and gas fields, waste oil, spent acids, chlorinated organic solvents and septic tank wastes. Following construction of the site's remedy, groundwater monitoring is ongoing.
  - The site's long-term remedy included a **cover over the existing landfill and groundwater monitoring**. Construction of the landfill cover finished in 2005. BLM continues to monitor the site regularly.
- Prewitt Abandoned Refinery (Environmental Protection Agency, 2016)
  - The 70-acre Prewitt Abandoned Refinery site is located near Prewitt in McKinley County
  - The refinery operated between 1938 and 1957. The refinery and other site structures came down; however, scattered demolished structures, foundations and exposed fill remained on the site. Refinery operations **contaminated soil and groundwater** with hazardous chemicals. The remedy for surface media is complete. Subsurface media may require additional cleanup.
  - The site's long-term remedy for surface media included excavation and off-site disposal of asbestos-containing materials, lead-contaminated soil and separator contents, and removal and disposal of the separator structure. The site's long-

term remedy for the subsurface media included soil vapor extraction, contaminated groundwater migration control, groundwater remediation by extraction, treatment and re-injection, and use of a nutrient injection system to enhance in-place biodegradation. The remedy for the surface media is complete. Subsurface media may require additional cleanup.

Economic Impacts

- Report on the Abandoned Mine Land (AML) program, including the economic impacts to the nation (Dixon & Bilbrey, 2015)
    - New Mexico has over $21.6 million worth of AML reclamation outstanding

TABLE 1 New Mexico Summary of Commodity Production, Production Value, Employment, Payroll, Revenue and Ranking: 2014

Mineral	Production [1]	Production Rank [2]	Production Value $	Employment [3]	Reclamation Employment	Payroll $ [4]	Revenue Generated $ [5]	
							State	Federal
Coal	21,730,572	12	$ 757,312,996	1,436	148	$ 84,557,320	$ 19,400,137	$ 8,033,183
Copper	343,292,033	3	$ 1,071,057,411	1,842	36	$ 110,877,438	$ 8,785,019	$ -
Gold [6]	8,580	-	$ 10,858,944	-	-	$ -	$ 62,924	$ -
Industrial Minerals [7]	1,199,137	-	$ 77,800,389	472	14	$ 17,609,605	$ 1,030,231	$ 316,161
Aggregates [8]	11,339,585	-	$ 93,439,942	830	55	$ 15,851,577	$ 3,529,457	$ -
Other Metals	71,352	-	$ 982,217	26	-	$ 1,308,156	$ 4,429,933	$ -
Molybdenum	13,183	-	$ 150,194	431	30	$ 13,017,482	$ -	$ -
Potash	2,130,352	1	$ 1,093,208,523	1,078	33	$ 97,754,429	$ 7,067,326	$ 10,843,943
Silver	22,617	-	$ 431,333	-	-	$ -	$ 2,912	$ -
Uranium [9]	-	-	$ -	30	8	$ 597,941	$ -	$ -
TOTAL			$ 3,105,241,950	6,145	324	$ 341,573,947	$ 44,307,940	$19,193,287

- (New Mexico Energy, Minerals & Natural Resources Department, 2015)
- 2014 County Business Patterns data for NAICS code 562211: Hazardous Waste Treatment and Disposal (U.S. Census Bureau, 2016)
    - Total annual payroll in the US: $1.9 billion
    - Total employees in the US: 28,319
    - Total establishments in the US: 886
    - Average annual pay/employee: $69,000
    - Average employees/establishment: 32
    - Average annual payroll/establishment: $2.2 million

A.6. Renewable Energy Component Manufacturing

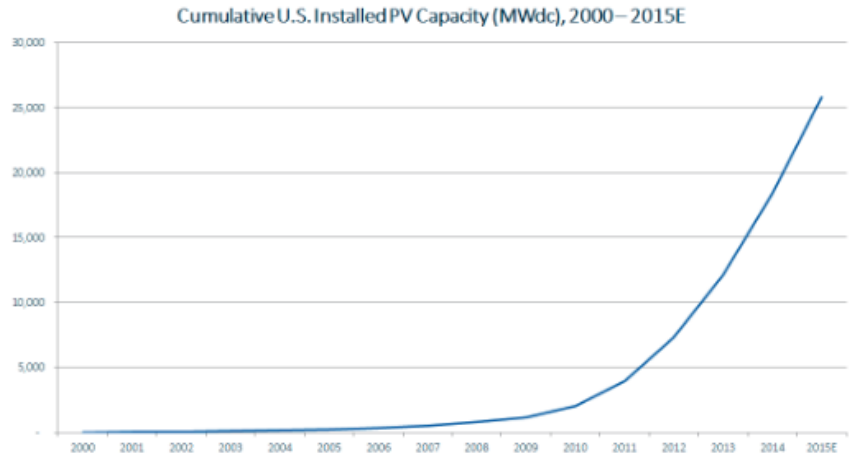
Market

Current demand

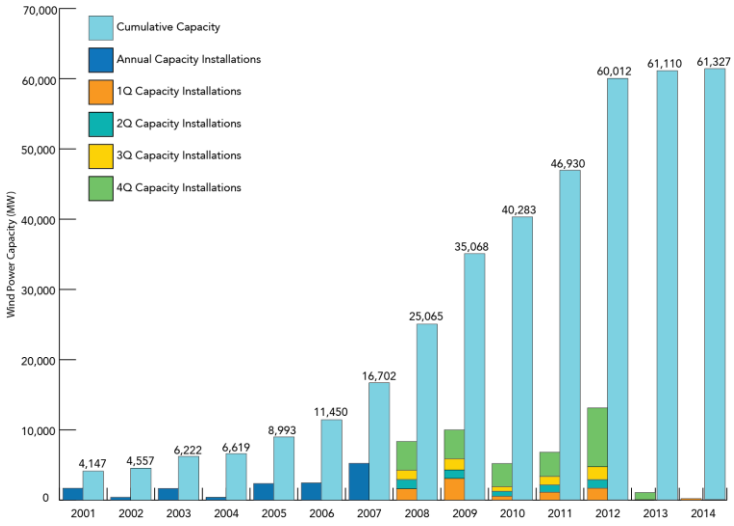
- Current and short-term projections of US renewable energy demand (U.S. Energy Information Administration, 2016)
- China is expected to dramatically decrease solar PV installations for the rest of the year. As a result, solar PV prices are expected to plummet as production capacity also increases. Demand in the US is decreasing and prices continue to be low due to high inventories. These trends are expected to strain PV module suppliers, resulting in consolidation. (Pothecary, 2016)
- 2016 is on track to be a milestone year for U.S. solar, with more than 10 GW added on annual basis for the first time ever and the number of homeowners with solar installed eclipsing the 1 million mark. And with the ITC extension, 10 gigawatts is not a one-time peak, but more likely a floor, with U.S. solar installations reaching 20 gigawatts per year by 2020. (Munsell, 2016)

- The U.S. now has nearly 75 gigawatts (GW) of installed wind power capacity. Last year, wind installed 8.6 GW of new electric generating capacity, making it the largest source of new capacity ahead of solar (7.3 GW) and natural gas (6 GW). An additional 9.4 GW of wind power was under construction at the start of 2016, with another 4.9 GW in advanced stages of development. (American Wind Energy Association, 2016)

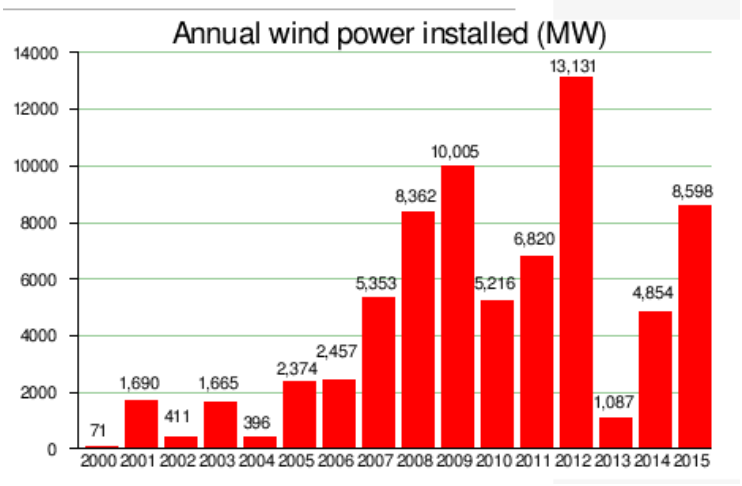
Trends



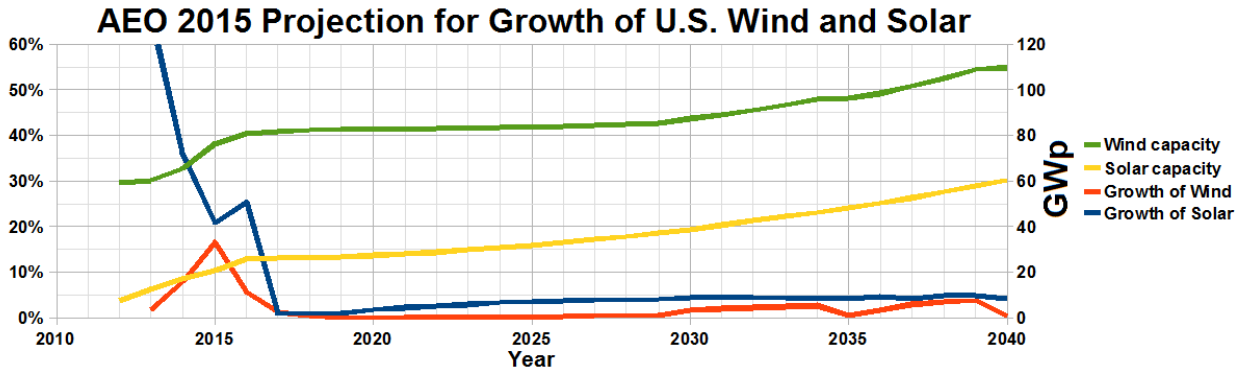
- (Munsell, 2016)



- (American Wind Energy Association, 2016)



- (Wikipedia, 2016)



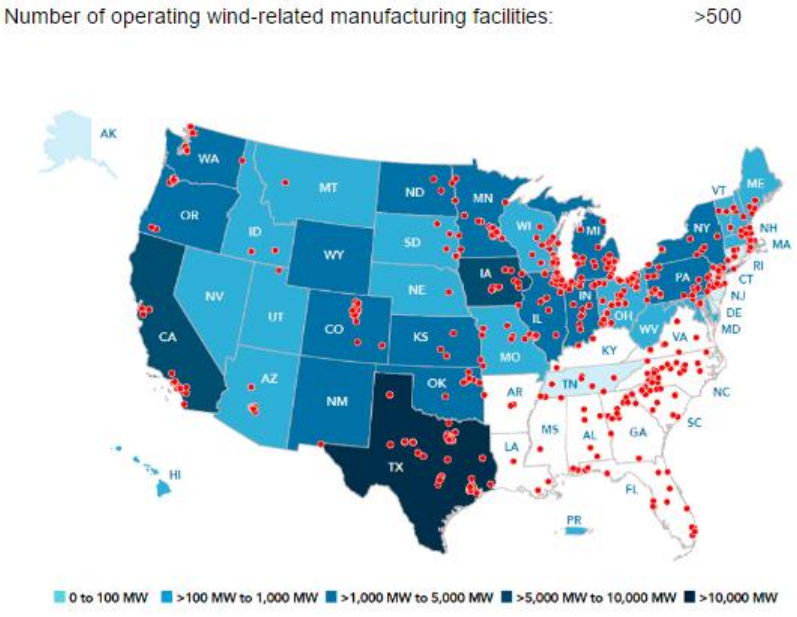
(Wikipedia, 2016)

- Global prices of solar PV modules are expected to fall in the next few years, reaching 44 cents per watt by 2020. (Pickerel, 2016)
- Solar PV module prices have fallen as much as 10% since the first half of 2016. (Osbourne, 2016)
- Global PV demand is expected to increase over the next few years, leading to a 135 GW market in 2020. Even when accounting for already-planned module capacity additions, this could lead to a supply crunch toward the end of the decade, suggesting an opportunity for module suppliers to further expand production. (Anand, 2015)
- By year-end 2013, the total number of grid-connected PV systems nationwide reached more than 445,000. Domestic demand is met both by imports and by about 75 U.S. manufacturing facilities employing upwards of 30,000 U.S. workers in 2014. Production is clustered in a few states including California, Ohio, Oregon, Texas, and Washington. Overcapacity has led to a precipitous decline in module prices, which have fallen 65%-70% since 2009, causing significant hardship for many American manufacturers. Some PV manufacturers have closed their U.S. operations, some have entered bankruptcy, and others are reassessing their business models. Although hundreds of small companies are engaged in PV-related manufacturing around the world, profitability concerns appear to be driving consolidation, with fewer than a dozen firms now controlling half of global module production. (Platzer, 2015)
- U.S. solar manufacturing makes up a small part of the U.S. manufacturing base. In 2014, the nation's solar manufacturing industry directly employed about 32,000 workers, according to the Solar Energy Industries Association (SEIA), a trade group. The U.S. cell and module market,

measured by domestic shipment revenues, has grown in size from $3.3 billion in 2008 to $7.1 billion in 2012, reports the U.S. Energy Information Administration (EIA). Following an unprecedented period of growth, the number of PV systems in the United States reached more than 445,000 by the end of 2013, more than twice the total at the end of 2011. (Platzer, 2015)

- Projected wind capacity growth to 2050 by state (U.S. Department of Energy, 2015)
- U.S. domestic assembly and manufacturing for the renewable industry has expanded significantly over the past decade. In the Southwest, wind energy-related plants are heavily concentrated in California, Texas, and Arizona; with a small number in New Mexico. (JBA & Assoc., 2015)
- Furthermore, as discussed above, there were [solar] **plant downsizings, closures, new facilities and consolidations**. Losses seen in polysilicon manufacturing likely offset gains in less labor intensive inverter manufacturing. The consolidations allowed companies to prune lower skilled workers and gain efficiencies in automation that required higher skilled workers. (Solar Foundation, 2015)

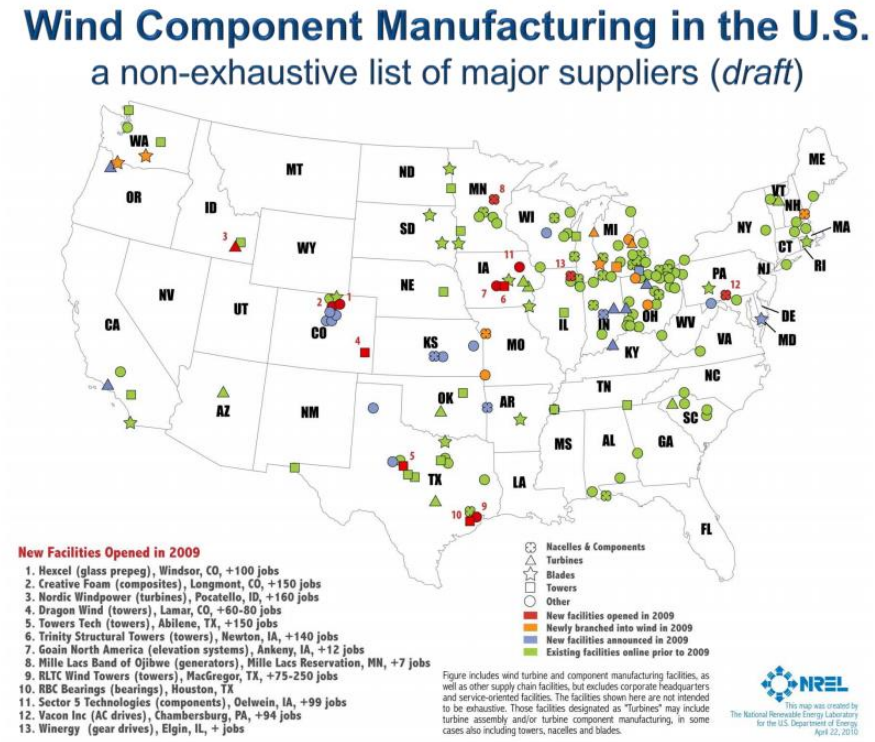
Characteristics



- (American Wind Energy Association, 2016)
- Investment in new wind will create a demand for all of the components that make up a wind generator. As a rule of thumb, every 1000 MW requires a $1 Billion investment in rotors, generators, towers and other related investments. (Sterzinger & Svrcek, 2005)
- The U.S. Department of Energy (DOE) estimated in 2011 that a [solar PV] manufacturing plant to produce 120 megawatts (MW) of cells per year would require an investment of around $40 million. (Platzer, 2015)
- PV systems do not require complex machinery and thousands of parts. In fact, most PV systems have no moving parts at all. They also have long service lifetimes, typically ranging from 10 to 30 years, with some minor performance degradation over time. In addition, PV systems are modular; to build a system to generate large amounts of power, the manufacturer essentially joins together more components than required for a smaller system. These characteristics make

PV manufacturing quite different from production of most other types of generating equipment. In particular, PV systems offer little opportunity for manufacturers to make customized, higher-value products to meet unique needs. Manufacturers offer competing technological approaches to turning sunlight into electricity, but many customers have no reason to care about the technology so long as the system generates the promised amount of electricity. Economies of scale are significant, as increasing output tends to lower a factory's unit costs. (Platzer, 2015)

- Examples of manufacturing facilities and associated jobs (National Renewable Energy Laboratory, 2010)



- (National Renewable Energy Laboratory, 2010)

Competition

Major Players

- **GE Wind** led the U.S. market with more than 5 GW of wind turbines newly installed in 2012, for a 38% market share. Following GE Wind were **Siemens** (with a 20% market share), Vestas (14%), and Gamesa (10%). There has been a notable increase in the number of wind turbine manufacturers serving the U.S. market; the number installing more than 1 MW increased from just five in 2005 to 25 in 2012. The "big three" turbine suppliers—GE Wind, **Vestas**, and Siemens—have, however, actually gained market share since 2008/2009. Globally, U.S.-owned GE ascended to an effective tie with Vestas as the top supplier of turbines worldwide in 2012. Chinese turbine manufacturers also continue to occupy positions of prominence in the global ratings, although none of these suppliers made the top five in 2012. To date, their growth has been based almost entirely on sales to the Chinese market. However, 2012 U.S. installations by Chinese and South Korean manufacturers included those from **Goldwind, China Creative Wind Energy, Guodian United Power, Sinovel, Hyundai, HZ Windpower, and Sany Electric**. (U.S. Department of Energy, 2013)

- Trina Solar, JinkoSolar, Canadian Solar and JA Solar and the top 10 producers are expected to account for nearly 50% of the global module market in 2016. Global market reach for these producers is expected to continue to increase with overall end-market demand and capacity expansion plans that match demand. (Osbourne, 2016)
- A handful of manufacturers dominate polysilicon production (for solar PV). In 2013, the largest polysilicon manufacturer was **GLC Poly from China, followed by Wacker-Chemie** from Germany, **Hemlock** from the United States, and **OCI** from South Korea. In 2013, nearly half of the world's polysilicon was produced by Chinese and South Korean companies. (Platzer, 2015)
- SEIA reports the U.S. solar manufacturing sector in 2014 was made up of about 75 production sites that manufacture primary PV components (polysilicon, wafers, cells, modules, and inverters) and more than 450 additional domestic facilities that manufacture other PV-related products such as racking hardware and manufacturing equipment. SolarWorld's Oregon facility is the largest solar cell and module plant in the United States, with the capacity to produce 500 MW of solar cells per year at full production. Other foreign-based firms, such as **Sanyo Solar and SMA Solar,** also operate PV primary component plants in the United States. (Platzer, 2015)

Expanding/Contracting

- Wind turbine and component manufacturers met the challenge of supplying a 13-GW market in 2012. Seven of the 10 2012 Wind Technologies Market Report turbine suppliers with the largest share of the U.S. market in 2012 had one or more operational manufacturing facility in the United States in 2012. In contrast, only 8 years earlier, there was only one active utility-scale turbine manufacturer assembling nacelles in the United States (GE). Despite this significant growth in the domestic supply chain, reduced near-term demand expectations led to a difficult business environment in 2012. Not only did a smaller number of new turbine and component manufacturing facilities open in 2012 than in 2011, but also a number of facilities closed (including the manufacturing facilities of Clipper and Nordic). Even with these adjustments, near-term forecasts for wind power additions in the United States suggest that the market will have an over-capacity of nacelle assembly capability in the short term. The American Wind Energy Association estimates that the entire wind energy sector directly and indirectly employed 80,700 full-time workers in the United States at the end of 2012. Although this is 5,700 more jobs than reported in 2011, wind industry manufacturing jobs saw an overall decrease from 30,000 jobs in 2011 to 25,500 in 2012 due to the severe decline in new orders towards the end of 2012. Manufacturers have now begun receiving orders for 2013 and 2014 delivery, but it is not yet clear to what degree these orders will lead to a recovery of the manufacturing sector in 2013. (U.S. Department of Energy, 2013)
- **Challenging market conditions have led to numerous bankruptcies and manufacturing consolidations among solar firms. Consequently, several manufacturers have recently reduced, idled, or closed their U.S. operations, including Suntech, Kyocera, and Schott Solar. Other manufacturers such as Hemlock Semiconductor and GE Energy have abandoned their plans to build new solar factories in the United States. Generally, PV production facilities appear to have relatively short life spans, at least in the United States. A large share of the facilities that have closed operated for less than five years**. (Platzer, 2015)
- A considerably **smaller number of manufacturers have opened or announced plans to open new U.S. manufacturing plants or expand existing ones**. 1366 Technologies in Massachusetts and Mission Solar in Texas are among the solar factories that have opened since 2012. Stion, a

CIGS thin-film manufacturer in Mississippi, announced that it expects to increase its solar panel manufacturing capacity in 2015. In 2014, Suniva began construction of a second solar PV facility in Michigan. (Platzer, 2015)

- The **number of solar manufacturing jobs has been relatively flat since 2012**, even as total employment in the solar energy industry increased, according to figures from SEIA. This is not surprising, as the majority of PV cells and modules are made overseas, including many that are manufactured by U.S. companies at offshore facilities. Domestic producers or assemblers of PV cells and modules do not employ a large number of workers. For example, SolarWorld had fewer than 1,000 production workers in 2013, and Suniva expects to employ a few hundred production workers when its newest factory in Michigan becomes fully operational. First Solar reportedly has more than 1,000 workers at its factory in Ohio. These estimates, combined with the number of solar cell and module manufactures that have shuttered their operations in recent years, suggest that the near-term prospects for increased employment in solar manufacturing seem limited. (Platzer, 2015)
- SolarWorld Americas this year plans to expand the crystalline silicon module manufacturing capacity at its factory in Hillsboro from 380 MW to 530 MW, while also boosting its capacity for producing monocrystalline cells by 100 MW to 435 MW. The U.S. subsidiary of Germany's SolarWorld AG plans to invest $10 million into the expansion, creating about 200 new full-time jobs by summer and expanding SolarWorld's workforce in Hillsboro to 900. In the Rust Belt, for instance, monocrystalline PV cell and module producer Suniva is building a 200 MW factory in Michigan, while leading thin film module manufacturer First Solar is adding two new production lines at its existing plant in Ohio. In Mississippi, thin film competitor Stion says it is expanding its factory this year, while thin film startup Siva Power has an eye on 2016 to build its first production facility. In upstate New York, SolarCity, the nation's largest solar installer, has broken ground on a massive factory that company executives say has "a targeted capacity greater than 1 GW within the next two years." The factory will feature crystalline technology acquired last year through SolarCity's purchase of startup company Sivelo. (Hering, 2015)
- In San Antonio, Texas, Mission Solar Energy, a subsidiary of Korean polysilicon producer OCI, is this year doubling the size of its crystalline module plant to 200 MW, creating 400 new jobs. The company is contracted to supply domestically sourced solar systems to local utility CPS Energy. In Georgia, Suniva is considering expanding the 160 MW manufacturing footprint at its existing factory. Further up the PV manufacturing value chain, Massachusetts-based 1366 Technologies is currently evaluating several sites in the U.S. for a planned 250 MW wafer production facility. In the state of Washington, REC Silicon recently announced plans to add 3,000 metric tons of polysilicon production capacity in Moses Lake in 2016. Germany's Wacker Chemie, meanwhile, is building a $2.4 billion polysilicon plant in Charleston, Tennessee, that is expected to begin operations in mid-2015 and create 650 new jobs. (Hering, 2015)
- The census finds U.S. [solar] manufacturers added 2,639 new positions in 2014 – which was good enough for nearly 9% annual growth, boosting the solar manufacturing workforce to 32,490. Based in large part on expansions at cell and module factories in Oregon, Michigan, Ohio, New York and Texas, the census forecasts 14.5% employment growth this year, with an additional 4,700 jobs. The resulting 37,194 solar manufacturing jobs at the end of 2015 would represent the most since 2011. (Hering, 2015)

Inputs

Required

Solar PV

- Polysilicon, based on sand, is the feedstock for the PV and semiconductor industries. It is the material used to make the semiconductors that convert sunlight into electricity. Polysilicon accounts for about a quarter of the cost of a finished solar panel. Production requires large processing plants that may cost of up to $1 billion to build. Historically, polysilicon prices have been volatile because the construction of a new plant can add a large amount of supply to the market. A handful of manufacturers dominate polysilicon production. In 2013, the largest polysilicon manufacturer was GLC Poly from China, followed by Wacker-Chemie from Germany, Hemlock from the United States, and OCI from South Korea. In 2013, nearly half of the world's polysilicon was produced by Chinese and South Korean companies. (Platzer, 2015)
- Production of solar glass is highly capital intensive, and approximately 60% of the global market is controlled by four manufacturers. The glass is expensive to ship, so glass producers tend to locate near module manufacturers. In some countries, module manufacturing is highly automated; in others, more labor-intensive processes are used. (Platzer, 2015)

Wind

- Towers are made mostly of steel coated with a zinc alloy for protection. The nacelle is usually made of fiberglass with the generator and electronic components comprised of steel and copper. Blades are made of fiberglass, wood, and/or aluminum, often filled with a lightweight core of plastic foam, honeycomb, or balsa wood. Constructing the components requires large factory areas. (How Products are Made, n.d.)

Availability in 4C region

- One study measures potential for component manufacturing by the number of existing jobs in NAICS codes relevant to component manufacturing. The study suggests that NM is not among the top 20 states with the potential for growth in this industry. (Sterzinger & Svrcek, 2005)
- There are already three facilities in NM that manufacture components for solar pv systems; one that produces raw materials, one that produces modules, and one that produces both cells and modules. (Platzer, 2015)
- Existing facilities in the 4C region
    - EMCORE - solar cell manufacturing for space and defense. Sold to Veritas Capital. Unclear if they still hold operations in ABQ.
    - Csol Corp – Manufactures solar panels out of Albuquerque. Employs 5-10 people. Website does now work; maybe out of business.
    - Bergen Solar – thermovoltaics manufacturing. Still in ABQ?
    - eQsolaris – experimental photovoltaics

Siting

- As the demand for renewable energy increases and wind turbines are "scaled-up" to ever larger sizes, American manufacturers must find ways to overcome infrastructure and logistics constraints to lower the cost of wind energy. These constraints include **highway underpass heights** limiting the size of wind towers, **availability of cranes** able to lift and install nacelles, and

the **trucking fleet's difficulty in transporting longer wind blades**. A study released by the Energy Department, *Enabling Wind Power Nationwide*, concluded that the technological innovations enabling development of very large wind turbines have significant potential to reduce the cost of wind energy. However, transportation and logistics challenges are limiting the size and height of towers and turbines that can be deployed throughout the country. Addressing these challenges head-on, in January 2014, DOE announced $2 million for two organizations that will advance technologies that avoid these logistical barriers. (U.S. Department of Energy, n.d.)

- Maps showing potential wind capacity indicate good opportunities for wind power development in eastern NM and west TX, CO, and OK. Wind power component manufacturing in the 4C region could supply these areas. (U.S. Department of Energy, 2016)
- An updated map showing new potential for wind power resulting from taller turbines shows improved capability in western NM and new accessibility in the 4C region. (U.S. Department of Energy, 2015)
- Increased rotor diameter and hub heights also drive higher expenses related to transportation and installation. **Larger turbine components require special transportation and support vehicles and can only be transported on certain U.S. highways**. The relationship between tower transportation cost and turbine nameplate rating and tower height is depicted in Figure 5-2. The tower mass and cost grow rapidly as a result of the transportation constraint on the base diameter of the tower. **Installation of increasingly heavier components on taller towers requires costly special-purpose cranes.** While there are still LCOE benefits possible with increases in turbine size and operating height, other constraints such as transportation limitations and lack of crane availability are already limiting technology growth. (U.S. Department of Energy, 2015)
- An industry research company placed the US as the fifth most attractive country for PV manufacturing behind China, Singapore, Taiwan, and Malaysia. The index focuses on a shortlist of 50 countries selected on the basis of demand availability and experience with high-tech manufacturing. These 50 countries have been assessed for PV manufacturing attractiveness based on their business environment, access to demand, PV manufacturing, and all-in costs. (Anand, 2015)

Legal and Regulatory

- Federal renewable energy tax credits extended for another five years. (Brady, 2015)
- A new section of the Gross Receipts and Compensating Tax Act was enacted to read: "Receipts from selling wind generation nacelles, rotors or related equipment to the United States or New Mexico or any governmental unit or subdivision, agency, department or instrumentality thereof, if such equipment is installed on a supporting structure, may be deducted from gross receipts." (Putnam, 2002)
- NM Renewable Energy Portfolio Standard

Eligible Renewable/Other Technologies:	Geothermal Electric, Solar Thermal Electric, Solar Photovoltaics, Wind (All), Biomass, Hydroelectric, Landfill Gas, Wind (Small), Anaerobic Digestion, Fuel Cells using Renewable Fuels Zero Emission Technology
Applicable Sectors:	Investor-Owned Utility, Cooperative Utilities
Standard:	Investor-owned utilities: 20% by 2020 Rural electric cooperatives: 10% by 2020
Technology Minimum:	For IOUs in 2020: Solar: 20% of RPS requirement (4% of sales) Wind: 30% of RPS requirement (6% of sales) Other renewables: 5% of RPS requirement (1% of sales) Distributed Renewables: 3% of RPS requirement (0.6% of sales)
Compliance Multipliers:	3.0 for solar developed and operational before January 1, 2012, by a distribution cooperative or through the wholesale contract obligation of the wholesale supplier
REC Lifetime:	4 years
Credit Trading/Tracking System:	Yes (WREGIS)

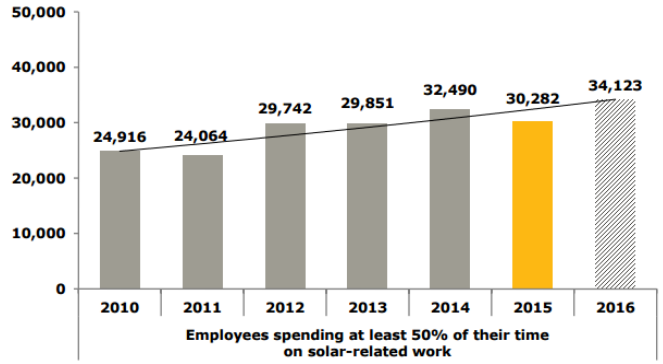
- (DSIRE, 2015)

Economic Impacts

- Median solar assembly worker wages increased by 30% from $**15 to $18 per hour**. Surveyed establishments also hired more educated workers in 2015: 35% required a bachelor's degree and 10% an associate's degree, up from 21% and 6% respectively in 2014. (Solar Foundation, 2015)
- A study of wind development in Iowa showed the following economic impacts per MW:
  - 2.3 FTE job during construction
  - 0.27 permanent jobs
  - $290,000 in total economic activity during construction (2010$)
  - $38,000 total economic activity per year of operation
  - Over $6,000 per year in property taxes
  - Almost $4,000 per year in lease income to land owners
  - (Figures represent gross labor force, not net jobs, and impacts only to Iowa, which only installed the wind turbines but did not manufacture the components) (U.S. Department of Energy, 2015)
- Jobs from wind component manufacturing facilities (National Renewable Energy Laboratory, 2010)
  - LM Wind Power in AR
    - Produces blades
    - Employs 300 workers
    - Wages ranges $12.15 – 15.50/hr
  - Brevini Wind in IN
    - Produces gear boxes
    - 455 workers
    - Average salaries of $46,000/yr
    - Total annual payroll anticipated to be $20.9 million
  - Alstom Power Inc in TX
    - Nacelle
    - 275 jobs
  - Ingeteam in WI
    - Generators
    - 275 jobs
  - Ingersoll Machine

        - Various components
        - 87 jobs
    - Schuff Steel
        - Towers
        - 275-300 jobs
    - Aluwind
        - Various components
        - 80-105 jobs
    - WindStream Technologies Inc
        - Small scale turbines
        - 260 jobs

Figure 7: Solar Manufacturing Employment Growth, 2010-2016 (Projected)



- (Solar Foundation, 2015)
- By year-end 2013, the total number of grid-connected PV systems nationwide reached more than 445,000. Domestic demand is met both by imports and by about 75 U.S. manufacturing facilities employing upwards of 30,000 U.S. workers in 2014. Production is clustered in a few states including California, Ohio, Oregon, Texas, and Washington. (Platzer, 2015)
- The U.S. Department of Energy (DOE) estimated in 2011 that a manufacturing plant to produce 120 megawatts (MW) of cells per year would require an investment of around $40 million. (Platzer, 2015)
- U.S. PV manufacturing capacity was about 1.6 GW/year (Hering, 2015). With 30,000 manufacturing workers employed, this **averages 18.75 workers per MW** of annual manufacturing capacity.
- 2014 County Business Patterns data for NAICS code 333611: Turbine and Turbine Generator Set Units Manufacturing (U.S. Census Bureau, 2016)
    - Total annual payroll in the US: $2.5 billion
    - Total employees in the US: 34,367
    - Total establishments in the US: 265
    - Average annual pay/employee: $73,000
    - Average employees/establishment: 130
    - Average annual payroll/establishment: $9.4 million

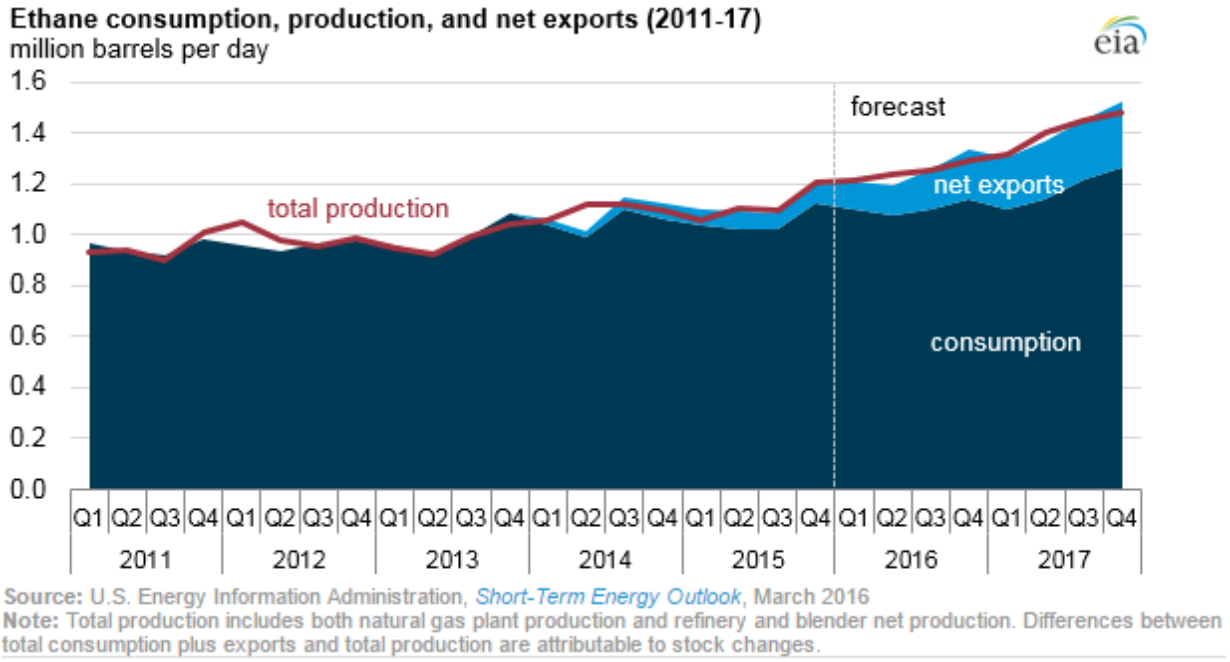
A.7. Petrochemical Manufacturing

Market

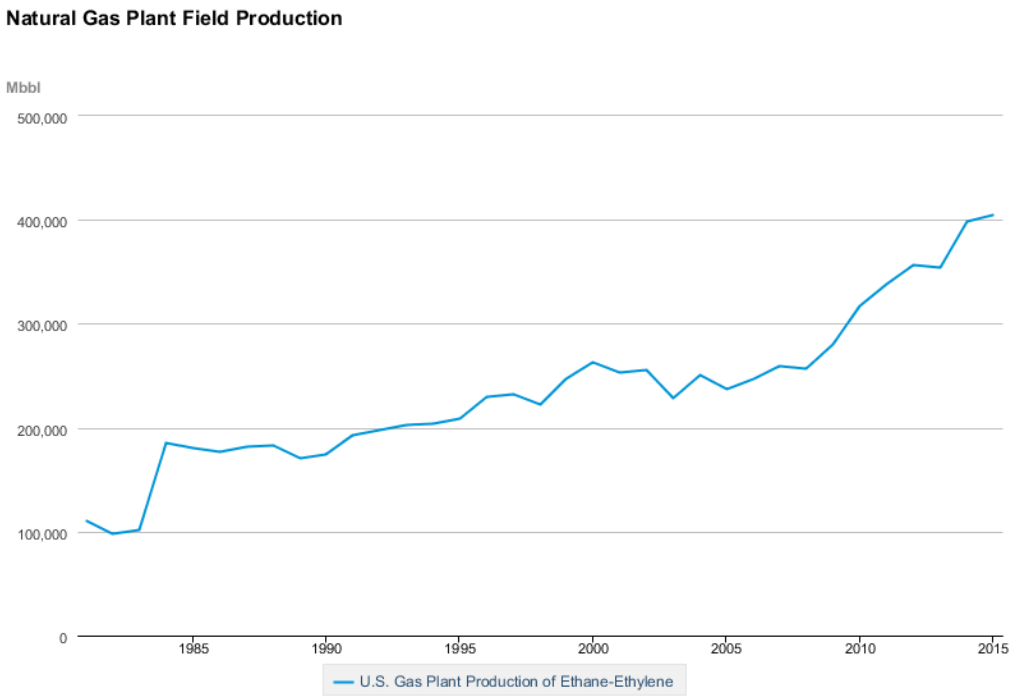
Current demand

- Refined petroleum products supply 35 percent of our nation's energy needs and 92 percent of U.S. transportation fuels, and EIA projects U.S. reliance on petroleum will remain high for decades to come. (American Fuel & Petroleum Manufacturers, 2016)
- The petrochemical sector was buoyed last week on news that global demand for its products could remain strong over the next five years. The International Energy Agency said oil demand for petrochemicals would rise roughly 2 million barrels a day from 2015 to 2021, a nearly 3 percent annual growth rate. (Gallucci, 2016)

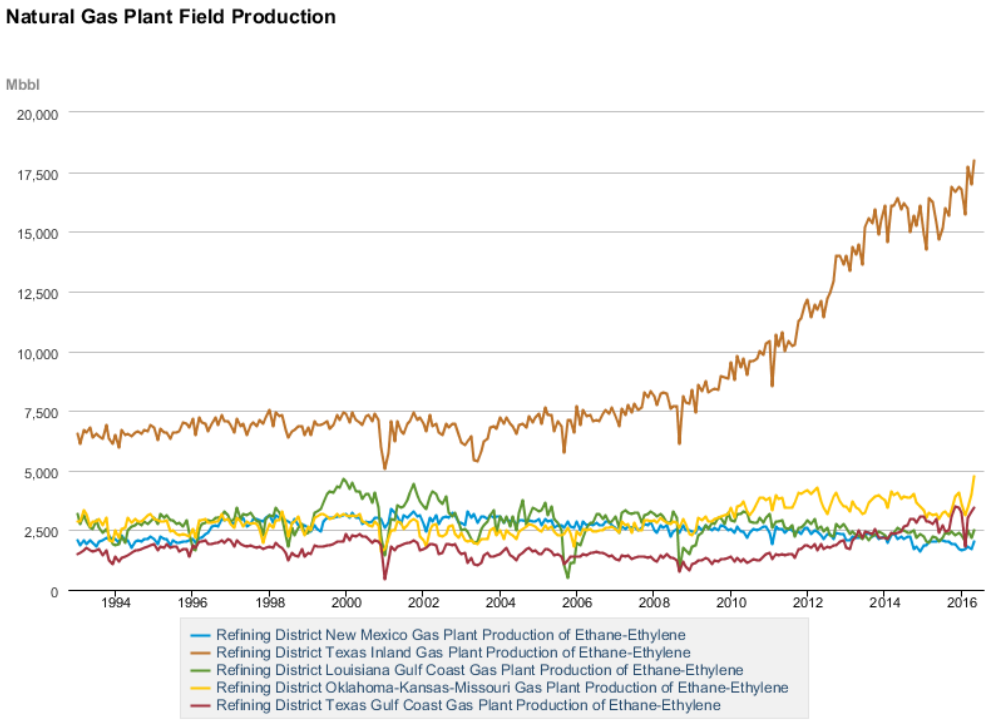
Trends



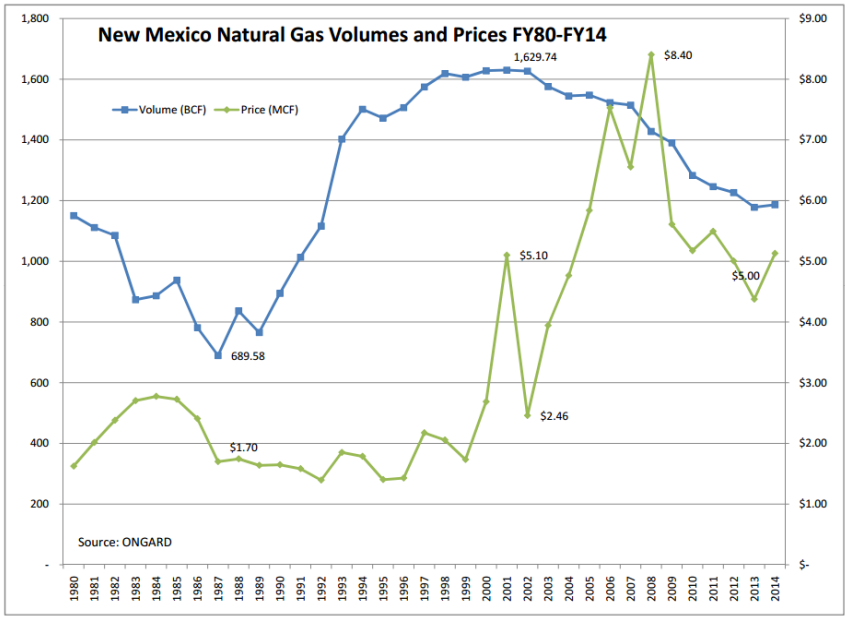
- (U.S. Energy Information Administration, 2016)



- U.S. ethane consumption, which was 1.05 million b/d in 2015, is forecast to increase 50,000 b/d in 2016 as expansion projects at ethylene-producing petrochemical plants increase feedstock demand for ethane. In 2017, ethane consumption is projected to increase another 80,000 b/d as capacity begins to ramp up at five new petrochemical plants and at a previously deactivated plant. (U.S. Energy Information Administration, 2016)



- (U.S. Energy Information Administration, 2016)



- (Moorsel, 2015)

Characteristics

- Natural gas is processed to produce methane and natural gas liquids (NGLs) that are contained in the natural gas. These natural gas liquids include ethane, propane, and butane, and are produced mostly via natural gas processing. That is, stripping the NGLs out of the natural gas (which is mostly methane) that is shipped to consumers via pipelines. This largely occurs in the Gulf Coast region and is the major reason the US petrochemicals industry developed in that

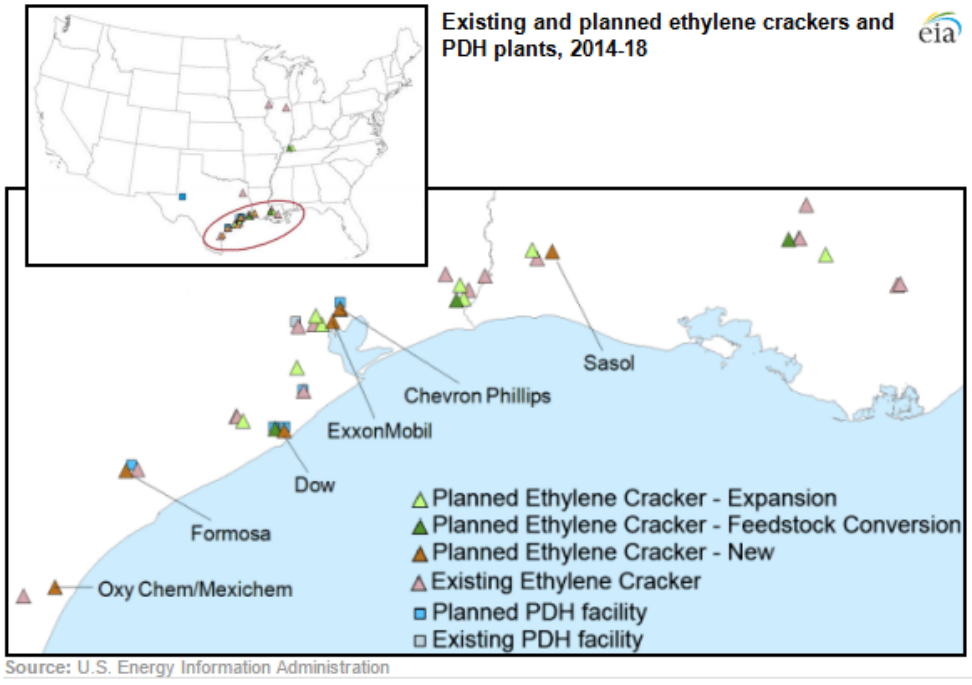
region. Ethane is a saturated C2 light hydrocarbon; a colorless and odorless gas. It is the primary raw material used as a feedstock in the production of ethylene and competes with other steam cracker feedstocks. Propane is also used as a feedstock but it is more widely used as a fuel. Butane is another NGL feedstock. (American Chemistry Council, 2011)

- Petroleum is refined to produce a variety of petroleum products, including naphtha and gas oil, which are the primary heavy liquid feedstocks. Naphtha is a generic term for hydrocarbon mixtures that distill at a boiling range between 70°C and 190°C. Naphtha, gas oil, ethane, propane and butane are processed in large vessels or "crackers", which are heated and pressurized to crack the hydrocarbon chains into smaller ones. These smaller hydrocarbons are the gaseous petrochemical feedstocks used to make the products of chemistry. In the US petrochemical industry, the organic chemicals with the largest production volumes are methanol, ethylene, propylene, butadiene, benzene, toluene and xylenes. (American Chemistry Council, 2011)
- Ethane is difficult to transport, so it is unlikely that the majority of excess ethane supply would be exported out of the United States. As a result, it is also reasonable to assume that the additional ethane supply will be consumed domestically by the petrochemical sector to produce ethylene. (American Chemistry Council, 2011)
- This industry manufactures petrochemicals, which are chemicals derived from refined petroleum or liquid hydrocarbons. Key products include ethylene, propylene, butylene, benzene, toluene, styrene, xylene, ethyl benzene and cumene. These products are used in the production of consumer products, automotive components and various durable and non-durable goods. Organic compounds like ethyl alcohol and inorganic chemicals like carbon black are excluded from the industry. (IBIS World, 2016)
- In 2015 in the US this industry had 40 businesses and 8,632 employees. (IBIS World, 2016)
- Most major petrochemical companies are integrated (forward to downstream derivatives and/or backward to raw materials) to improve margins and to secure raw material source. This has resulted in a number of petrochemical companies either divesting nonintegrated plants, forming a partnership with another company to improve operating efficiency (including sales, marketing, and distribution), or ceasing operations. (IHS Markit, 2015)

Competition

Major Players and location

- Dow Chemical
- Sasol
- Royal Dutch Shell PLC
- Chevron Philips Chemical
- ExxonMobil (Maverick, 2014)

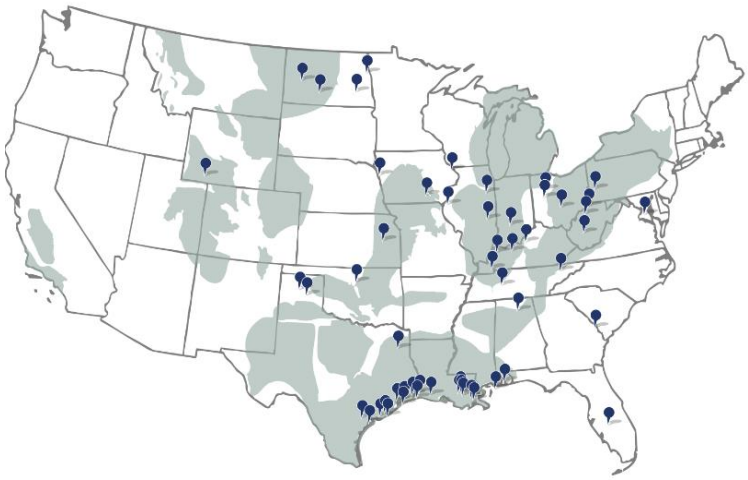


- (U.S. Energy Information Administration, 2015)
- Map of related sites (The Center for Land Use Interpretation, n.d.)
- Top 10 Gas Producers in NM (Cardno Entrix, 2013)
    - ConocoPhillips
    - Oxy USA
    - Energen Resource Corp
    - BP America
    - Devon Energy Corp, LP
    - COG Operating LLC
    - WPX Energy Production, LLC
    - Chevron USA, Inc
    - Apache Corp
    - Yates Petroleum Co
- Top 10 Oil Producers in NM
    - COG Operating
    - Oxy USA
    - Apache Corp
    - Chevron USA
    - ConocoPhillips
    - Cimarex Energy
    - Devon Energy
    - BOPCO, LP
    - Yates Petroleum Corp
    - ExxonMobil (incl. XTO)
- Trade associations and events
    - American Fuel & Petrochemical Manufacturers

        - Annual Meeting – Mar 2017 in San Antonio, TX
        - International Petrochemical Conference – Mar 2017 in San Antonio, TX
    - American Chemistry Council
    - American Petroleum Institute
    - World Petrochemical Conference – Mar 2017 in Houston, TX

Expanding/Contracting

- Shell's PA cracker facility
    - In June 2016, Shell Chemical Appalachia announced it plans to build a massive, multi-billion dollar petrochemical plant (known as an ethane cracker) in Potter Township, Beaver County, about 30 miles northwest of Pittsburgh. **The location was chosen because of its proximity to gas supplies**, creating shorter and more reliable supply chains than those for comparable facilities on the U.S. Gulf Coast, and because **it will be within 700 miles of North American polyethylene customers**, the company said. **Pennsylvania attracted Shell by granting the company a fifteen-year tax amnesty window**. Former Governor Tom Corbett successfully pushed for an additional tax break that will grant Shell a $2.10 credit for every gallon of ethane it purchases from Pennsylvania-based natural gas drillers. Over a 25-year window, the credit has been valued at $1.65 billion, making it the largest tax break in state history. (StateImpact, 2016)
    - Main construction will start in approximately 18 months, with commercial production expected to begin early in the next decade. The complex will use low-cost ethane from shale gas producers in the Marcellus and Utica basins to produce 1.6 million tonnes of polyethylene per year. Polyethylene is used in many products, from food packaging and containers to automotive components. As a result of its close **proximity to gas feedstock**, the complex, and its customers, **will benefit from shorter and more dependable supply chains**, compared to supply from the Gulf Coast. The **location is also ideal because more than 70% of North American polyethylene customers are within a 700-mile radius** of Pittsburgh. (Yao, Assistant professor and Extension Fruit Specialist, NMSU, 2016)
- During 2014 and 2015, on a percentage basis, **all regions of the United States experienced faster growth in chemical production than the Gulf Coast region**. (DeRosa, Downes, Lentz, & Allen, 2016)
- Shale-Advantaged Chemical Investments

-  (Swift, Economic, Energy and Chemical Industry Trends, 2016)
- **Capital spending for basic chemicals is expected to rise steadily through 2021, mainly through plant structures and major process equipment**. (Swift, Economic, Energy and Chemical Industry Trends, 2016)
- Seven new ethane crackers are currently under construction in the U.S., with several more in various stages of engineering and planning. Over $76 billion in new projects have been completed or are currently under construction. ACC analysis from March 2015, based on a then-current total of 225 projects representing $138 billion in investment, found that when these projects come online after 2023, the new investments could generate $93.0 billion in incremental output. (Swift, Economic, Energy and Chemical Industry Trends, 2016)
- ACC's running tab of 274 announced projects represents a cumulative investment of $171 billion. Fully 60% of this is foreign direct investment. (Swift, Moore, Rose-Glowacki, & Sanchez, 2016)
- Energy companies proposed or received approval to build 140 petrochemical projects in the last five years as falling oil and natural gas prices made it cheaper to refine and process the raw materials, the Environmental Integrity Project, a nonprofit advocacy group, said Monday. Nearly one-third of those projects, or 44 facilities, were proposed or permitted in 2015 alone. (Gallucci, 2016)
- Investments that will spur additional economic growth are on the rise. American refining companies are planning to spend $48 billion dollars in the next five years (2016-2020), or almost $10 billion per year on capital expenditures. In addition, more than 250 U.S. petrochemical projects have been announced with investments averaging about $11 billion per year. Nearly 65 percent of this funding comes from foreign investment, demonstrating that overseas companies are recognizing that the U.S. offers a highly attractive and competitive manufacturing environment. (American Fuel & Petroleum Manufacturers, 2016)
- The U.S. petrochemical industry is expected to keep expanding in 2015 amid the upstream oil and gas sector woes. The industry has been investing billions to grow and build new plants to leverage the inexpensive domestic crude oil. Industry experts are optimistic that any surges in oil prices won't diminish growth around Houston and the Gulf Coast region, according to a Houston Chronicle article that ran In Dec. 2014. The article reports that the industry has planned

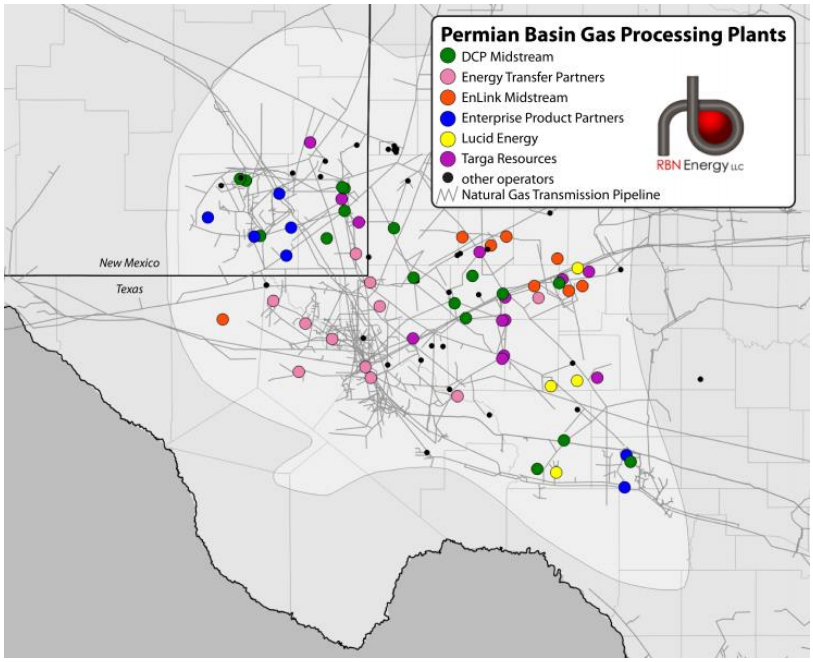
215 projects valued at $133 billon. Those projects include building new plants, re-opening shuttered facilities, and expand existing facilities. (Texas Gulf Coast Community Colleges, 2015)

- Between 2014 and 2018, U.S. petrochemical capacity expansion projects are projected to increase domestic demand for ethane by nearly 600,000 barrels per day (bbl/d) and propane by nearly 200,000 bbl/d. This growing demand is in response to growing domestic hydrocarbon gas liquids (HGL) supply and favorable petrochemical feedstock prices in the United States relative to the international market. (U.S. Energy Information Administration, 2015)
- Four projects (from Dow, ExxonMobil, Chevron Philips, and OxyChem/Mexichem) are already under construction, and two projects (from Formosa and Sasol) have received permitting approval and commitments from investors. Together with capacity expansions at existing facilities, these six new facilities are expected to increase U.S. ethylene production by 40%, to a total of more than 37 million metric tons (mt), more than one-fifth of current global ethylene production capacity (approximately 150 million mt). Currently, only one PDH plant is in operation in the United States: the PetroLogistics plant in Houston, Texas. This plant is estimated to consume 30,000 bbl/d of propane. However, there are six new PDH projects at various stages of development that, if completed, could increase U.S. petrochemical sector propane demand by an additional 190,000 bbl/d by the end of 2018. (U.S. Energy Information Administration, 2015)

Inputs

Required

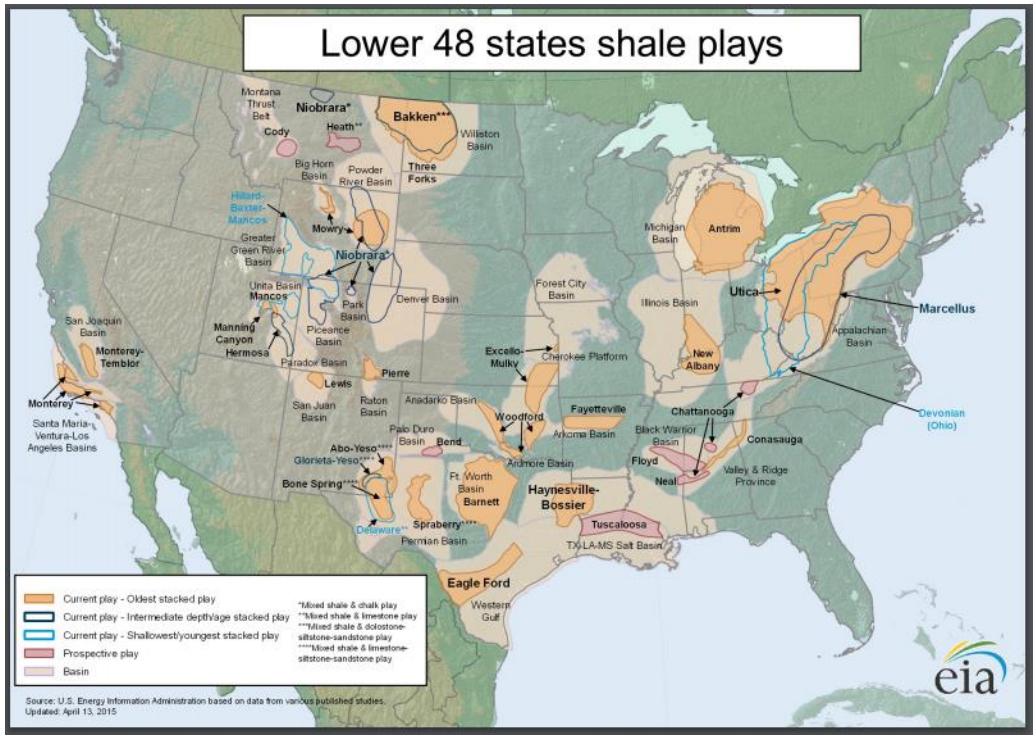
- There are five natural gas processing plants in the San Juan Basin, all located near the Blanco Hub. (DeRosa, Downes, Lentz, & Allen, 2016)
- On average during the first 10 months of 2015, the Blanco Hub natural gas spot price was 16 ¢/MMBtu (6%) below the Henry Hub price. (DeRosa, Downes, Lentz, & Allen, 2016)
- Propylene is only used as an intermediate and only sold to chemical plants, so the potential customer base will be smaller. However, propylene production from methane in the Four Corners would provide a feedstock cost advantage not shared with any other current producers in the United States. Polypropylene, from methane-derived propylene, would offer a feedstock advantage compared to other domestic manufacturers and offer a wider potential customer base because of sales to fabricators and processors throughout the country. (DeRosa, Downes, Lentz, & Allen, 2016)
- The petrochemical industry uses hydrocarbon feedstocks such as ethane and propane to create plastics, fibers, resins, and a wide range of other consumer and industrial materials. Ethylene-cracking plants most commonly process either ethane or naphtha to produce ethylene, an important compound used in the manufacture of plastics and other industrial materials. Although naphtha, a hydrocarbon that contains mostly molecules with 5–12 carbon atoms, is one of the lighter components produced by refining crude oil, it is a much heavier feedstock than ethane or propane, which respectively consist of hydrocarbon molecules with 2 or 3 carbon atoms. All ethylene projects currently planned for the United States are designed to consume light feed, predominantly ethane, for the production of ethylene. (U.S. Energy Information Administration, 2015)



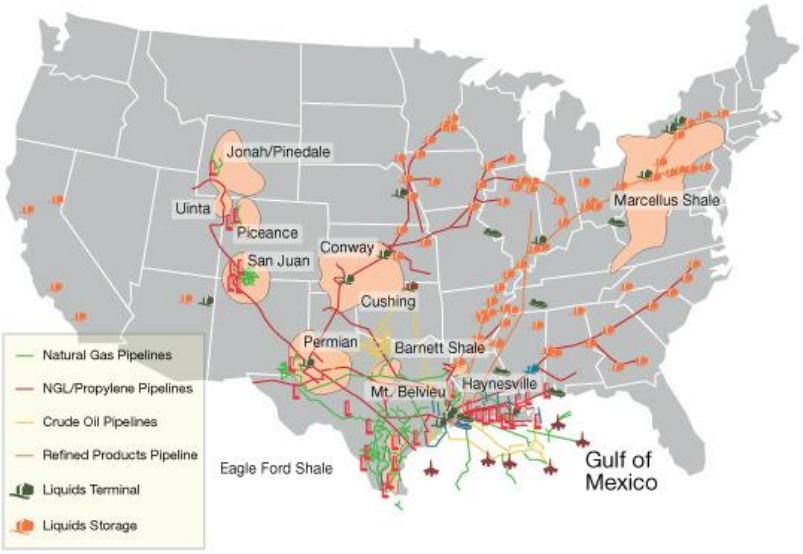
(Carr, 2016)

- Chemical plants need vast amounts of water for cooling and cleaning. (Galbraith, 2012)

Availability in 4C region

- 

(U.S. Energy Information Administration, 2011)



- (Petroleum Online, n.d.)
- As with crude oil, New Mexico natural gas production is typically in the top 10. The San Juan Basin is the largest field of a proven natural gas reserve in the United States and the leading coalbed-methane-producing region. New Mexico production of coalbed methane, about one-fifth of the national total, rivals production in Colorado and is responsible for around a quarter of all coalbed methane produced in the United States. Less than one-tenth of New Mexico's natural gas is used in the state. The majority of New Mexico's supply is delivered to the West Coast and to market centers in West Texas that supply the Midwest. New Mexico's Blanco Hub, in the San Juan basin, is a major gathering point for Rocky Mountain natural gas supplies heading to West Coast markets. Production information suggests natural gas from the Permian Basin, the second most productive natural gas region in the state, is richer in NGL than that from the San Juan Basin. While 64 percent of the natural gas produced in New Mexico is from the San Juan Basin, compared with 34 percent from the Permian Basin, the basins are nearly equal in NGL production volume. (New Mexico Legislative Finance Committee, 2016)
- There are 5 natural gas production plants in the San Juan Basin all near the Blanco Hub east of Farmington. (DeRosa, Downes, Lentz, & Allen, 2016)

Siting

- Transporting petrochemical products out of the 4C region would require trucking it, which increases transportation costs. (Byrom, 2016)
- A study testing the market feasibility of a 4C petrochemical facility found no apparent barriers to its development. **In the last decade, the structure of the petrochemical industry has begun to change from clustered in the Gulf Region to more dispersed manufacturing**. One consulting company, PRISM analytics, has put forward a proposal to research how such a facility would work and what financial incentives would help spur its development. (DeRosa, 2016)
- Nevertheless, exactly the same range of factors that influenced locations in the nineteenth century are active today, for example: **access to raw materials, plentiful water supplies, good communications (road, rail and port facilities), closeness to the customer for the products, reliable energy supplies, and the availability of skilled labor**. One thing that changed during the

twentieth century was the importance of oil and natural gas feedstocks in supporting the growing petrochemical/polymer industry which developed principally after 1945. This explains why some installations are sited adjacent to oil fields. For example, there is a cluster of companies adjacent to the oil fields in Texas, and the **discoveries and development of gas shale** (still a controversial process in many countries) in places like Texas, Colorado and Pennsylvania are leading to new investment in chemical plants nearby. **Access to the sea for transport** remains a huge influence. Refineries and chemical companies have been built on the coast of many countries, whether they have their own indigenous oil and gas or whether they import it. (University of York, 2013)

- As it is cheaper to transport crude oil than to distribute many of its end products around the globe, there is now a trend for oil-producing countries to invest in more distant refineries and plants, **closer to the consumer market**. Another major factor determining location has always been a profitable market for the end products. Since the chemical industry is its own biggest customer, it makes good sense to **group together companies that use chemical products** as intermediates in their own manufacturing process. This has led to clusters of plants (Figure 3) which successively use the output of one process as the input to another. For example, the manufacture of fertilizers, such as ammonium nitrate and carbamide (urea), can be found adjacent to ammonia plants which are themselves close to plants with a ready source of raw materials, either methane or naphtha, used to make ammonia. More recently, close proximity to other high technology industries, as well as easy airport access, have been influential factors particularly for plants producing specialty chemicals. (University of York, 2013)
- A study simulating a hypothetical petrochemical plant in the 4C area indicated strong market potential for urea. A urea plant could have markets in most of the western U.S. (617,000 MT/yr) and internationally (13,200 MT/yr). A propylene plant showed weak potential to be competitive. The analysis indicated that a 4C propylene plant could not compete well with Gulf Coast producers, but could grab market shares on the West Coast and across the Pacific Ocean. A polypropylene plant could supply 413,000 MT/yr domestically and 86,000 MT/yr of exports. Overall, the analysis indicated strong potential for a urea and/or propylene plant in the 4C area. The lack of railroad connectivity in Farmington did not significantly impact sales in the simulation. (DeRosa, Downes, Lentz, & Allen, 2016)

Legal and Regulatory

- The Environmental Integrity Project said it compiled its list of proposed and permitted facilities by searching state and federal records for projects with special greenhouse gas permits. The U.S. Environmental Protection Agency requires operators to get permits for new facilities or significant expansions that would boost carbon dioxide emissions by at least 100,000 tons a year. The 140 facilities, if constructed as planned, would together produce around 179 million tons of greenhouse gases per year – equal to running 39 coal-fired power plants, the group found in its report. The list doesn't include dozens of smaller projects, including ones just below the 100,000-ton trigger for EPA permits. He said policymakers, energy industry leaders and environmental groups often overlook the petrochemical sector in broader discussion of U.S. climate change policies. Industrial plants accounted for about 21 percent of total U.S. greenhouse gas emissions in 2013, making it the third-largest source behind electricity and transportation, which accounted for 31 percent and 29 percent of emissions, respectively, the EPA reported. (Gallucci, 2016)

- Increasing concerns over fossil fuel supply and consumption, with respect to their impact on health and the environment, have led to the passage of legislation globally that will affect chemical and energy production and processing for the foreseeable future. (IHS Markit, 2015)
- The report, published last week by the Environmental Integrity Project, found that over the last year, U.S. companies were granted draft or final permits for the construction or expansion of at least 46 petrochemical facilities. Once these facilities are completed, they'll collectively emit 55 million tons of greenhouse gases a year — an emissions equivalent of twelve 500-megawatt coal-fired power plants. (ThinkProgress, 2014)
- "New projects and modifications at major pollution sources are already required to employ the best available technologies to eliminate greenhouse gases as well as 'conventional' pollutants like nitrogen oxide, volatile organic compounds, or toxic chemicals like formaldehyde or hexane," the report's authors write. (ThinkProgress, 2014)

Economic Impacts

- 2014 County Business Patterns data for NAICS code 32511: Petrochemical manufacturing (U.S. Census Bureau, 2016)
    - Total annual payroll in the US: $1.1 billion
    - Total employees in the US: 9,304
    - Total establishments in the US: 58
    - Average annual pay/employee: $116,000
    - Average employees/establishment: 160
    - Average annual payroll/establishment: $19 million
- Shell's PA cracker facility
    - Construction is expected to begin in 2017, creating some **6,000 construction jobs**, the company says. Commercial operation is due to begin "early in the next decade" and will **employ about 600 people permanently**. The operation is due to make **1.6 million tonnes a year** of ethylene which is used in products ranging from food packaging to automotive parts. (StateImpact, 2016)
    - The project will bring new growth and jobs to the region, with up to 6,000 construction workers involved in building the new facility, and an expected 600 permanent employees when completed. (Yao, Assistant professor and Extension Fruit Specialist, NMSU, 2016)
- Plastics manufacturing employees on average earn a wage 73 percent higher than the average American, according to a 2015 American Chemistry Council report. (Spegelmyer & Taylor, 2016)

A.8. Industrial Gas Manufacturing

Market

Current demand

- According to the US Energy Information Administration's most recent Short-Term Energy Outlook, growth in US industrial demand will continue through 2015, with consumption averaging 21.3 bcfd in 2014 and 22.1 bcfd in 2015, a 4% increase, boosted by newly proposed chemical plants. (Oil & Gas Journal, 2014)

Trends

- We expect merchant gas prices to remain mostly stable for the next several years. Two main reasons for our view: The first is the depressing effect of new production capacity on industry operating rates. The second is the growing industry trend toward geographic density, where companies pursue rising regional market shares at the expense of higher selling prices. (Silver, Morningstar, 2015)

Characteristics

- Industrial gases are gaseous materials that are manufactured for use in Industry. The principal gases provided are nitrogen, oxygen, carbon dioxide, argon, hydrogen, helium and acetylene; although a huge variety of gases and mixtures are available in gas cylinders. Industrial gases are used in a wide range of industries, which include oil and gas, petrochemicals, chemicals, power, mining, steelmaking, metals, environmental protection, medicine, pharmaceuticals, biotechnology, food, water, fertilizers, nuclear power, electronics and aerospace. (Wikipedia, 2016)
- The major industrial gases can be produced in bulk and delivered to customers by pipeline, but can also be packaged and transported. (Wikipedia, 2016)
- Overview of industry (Engineering 360, n.d.)
- Given the highly concentrated nature of the industry, barriers to entry are high. It is difficult for new entrants to gain revenue as many of the established operators have strong relationships with key buyers and have established multi-year contracts with many of their customers. Moreover, the major industry operators have a strong influence over the pricing of key products including nitrogen, oxygen and hydrogen. Many of these large companies can lower the price of their goods because of their bulk production. Lower prices can crowd out smaller producers who are unable to lower their prices without enduring a financial loss. (IBIS World, 2016)
- The industry includes 77 businesses, employs 9,884 people, produces $8 billion in annual revenue, and experienced growth of 0.1% from 2011 – 2016. (IBIS World, 2016)
- The industrial gases industry produced approximately $12.2 billion worth of products in 2014 and directly employed about 60,000 American workers. It also supplies products to industries that account for 25% of U.S. GDP. (American Chemistry Council)
- Uses for nitrogen gas in oil and gas extraction (Rigzone)

Competition

Major Players

- Air Liquide
- Air Products
- Praxair Inc
- The Linde Group
- Praxair (PX), Air Products (APD), Air Liquide (AI), and Linde (LIN)--account for 80% of industry revenues (Silver, 4 Industrial-Gas Suppliers With Potential, 2015)
- Praxair, Inc., a Fortune 250 company with 2013 sales of $12 billion, is the largest industrial gases company in North and South America and one of the largest worldwide. (Praxair, 2014)

Expanding/Contracting

- We expect revenue and earnings growth to accelerate beginning later this year, in step with an accelerating pace of new project startups. (Silver, Morningstar, 2015)
- Praxair, Inc. (NYSE: PX) today announced it will further expand liquid and gaseous nitrogen supply and storage at the company's Kirtland, New Mexico, industrial gases facilities over the next two years. The expansion will more than triple its current capacity of liquid nitrogen to over 800 tons per day, including gaseous nitrogen that is being supplied to local pipeline customers under long-term contracts. "Our investments have enabled Praxair to continue to grow and serve the oil service segment, as well as other liquid customers in the region," said Gerald Miller, vice president of the West Region for Praxair's U.S. industrial gases business. "We are committed to investing in areas that show significant and growing demand for industrial gases, such as the San Juan Basin." **Demand for pipeline and liquid nitrogen continues to grow as oil and gas operators develop new resources in the San Juan Basin**, a low cost producing region, which includes southwestern Colorado, northwestern New Mexico and adjacent areas in Arizona and Utah. "It's important that we continue to make New Mexico a place where Fortune 250 companies like Praxair can expand and be successful," said Governor Susana Martinez. "We welcome Praxair's continued investment and the jobs that result from **improving the state's tax and regulatory climate**." (Praxair, 2014)
- The announcement Friday of Praxair's new nitrogen facility in New Mexico is one of several projects announced by the Danbury-based Fortune 250 company in the past month that increases its production capabilities. Officials with the company, the largest supplier of industrial gases in North and South America, said Friday they've expanded their New Mexico facility to include a new nitrogen producing plant that will increase the company's capacity for the industrial gas to meet increasing demands. The demand, company officials said, comes from continued oil and gas operators who are developing new resources in the San Juan Basin. The news comes weeks after the company announced several other investments in their infrastructure, including a packaged gas filling plant in North Dakota and an air separation unit in Tennessee, which will allow the company to expand its supply of oxygen, nitrogen and argon, company officials said. The production expansion of the company makes sense, considering recent reports by analysts that call for continued growth in demand for the company's products. (Perrefort, 2014)

Inputs

Required

- Cryogenic technologies also allow the liquefaction of natural gas, hydrogen and helium. In natural-gas processing, cryogenic technologies are used to remove nitrogen from natural gas in a Nitrogen Rejection Unit; a process that can also be used to produce helium from natural gas - if the natural gas fields contain sufficient helium to make this economic. The larger industrial gas companies have often invested in extensive patent libraries in all fields of their business, but particularly in cryogenics. (Wikipedia, 2016)
- The other principal production technology in the industry is Reforming. Steam reforming is a chemical process used to convert natural gas and steam into a syngas containing hydrogen and carbon monoxide with carbon dioxide as a byproduct. Synthesis gas is often a precursor to the chemical synthesis of ammonia or methanol. (Wikipedia, 2016)

- Industrial-gas suppliers possess sturdy economic moats, based on the long-term relationships they forge with their main customers. This, in turn, leads to meaningful barriers to entry, high switching costs, and valuable intangible assets. (Silver, Morningstar, 2015)
- Nitrogen gas is an industrial gas produced by fractional distillation of liquid air, so the only feedstock is air.

Availability in 4C region

- Praxair, Inc. (NYSE: PX) announced it will further expand its industrial gases facilities located in Kirtland, New Mexico. The expansion will include a new nitrogen plant that will increase production capacity in 2014. Demand for nitrogen continues to grow as oil and gas operators develop new resources in the San Juan Basin, which includes southwestern Colorado, northwestern New Mexico and adjacent areas in Arizona and Utah. “Our new plant will increase our supply in the San Juan Basin helping us meet customer requirements for pipeline and liquid nitrogen,” said Gerald Miller, vice president of the West Region for Praxair’s U.S. industrial gases business. “Our continued investment in this area is possible, in part, because of the support we receive from local and state government.” (Praxair, 2014)
- Praxair, Inc. (NYSE: PX), announced today that it has started up a second nitrogen plant at its facility in Kirtland, New Mexico to support growing nitrogen demand in the San Juan basin, which includes southwestern Colorado and northwestern New Mexico. The new plant, along with an additional liquefier expansion to be completed later this year, will increase total capacity at the site to 300 TPD (tons per day) of liquid nitrogen, in addition to gaseous nitrogen that is being supplied to local pipeline customers under long-term contracts. Demand for nitrogen continues to grow as local oil and gas operators develop new oil resources in the area. Nitrogen is an inert gas that can effectively replace water that is typically used in hydraulic fracturing. (Praxair, 2013)
- Praxair, Inc. (PX: NYSE) announced today that it will expand its storage and industrial gas production capacities at its Kirtland, New Mexico facility. The expansion doubles the current storage capacity and increases production capacity by 100 to 150 tons per day over the next two years. "This phased-in expansion is in response to the growing demand by oil and gas production customers located in the San Juan basin in Colorado and New Mexico," said Scott Kaltrider, regional vice president, west region, North American Industrial Gases. Praxair supplies an array of products and services to the energy sector, including nitrogen and carbon dioxide injection and rejection, mobile nitrogen pumping services, foam-fracturing applications, portable coal-bed methane recovery systems and clean dry-air systems. (Praxair, 2007)
- The San Juan Basin contains one of the largest proved natural gas reserves in the United States. Although New Mexico's total proved natural gas reserves have declined over the past decade, the state's proved shale gas reserves have risen significantly. Shale gas reserves are a small portion of the state's total proved gas reserves, but several New Mexico basins have shale gas potential. New Mexico produces more natural gas than it uses and sends natural gas through interstate pipelines to Arizona and Texas and on to markets from the West Coast to the Midwest. The Blanco Hub, located in the San Juan Basin, is a major connection and trading point for interstate pipelines carrying Rocky Mountain natural gas. New Mexico has only two underground storage fields with a small amount of natural gas storage capacity. (U.S. Energy Information Administration, 2015)

- Praxair's plant in Kirtland produces approximately 300 tons of liquid nitrogen a day to support fracking in the San Juan Basin. (Schwartz, 2014)

Siting

- The cost of electricity is the largest single operating cost incurred in air separation plants. It is usually between one third and two thirds of the operating costs associated with producing gas and liquid products. Electric motors are used to drive the compression equipment, and power is required for process heaters, instrumentation systems and cooling systems. Electrical power is just as much a raw material as air when manufacturing atmospheric industrial gas products. Small gaseous product plants may use hundreds of kilowatts (kW). Large liquid plants may have power demands measured in thousands and tens of thousands of kilowatts (megawatts or MW). (Universal Industrial Gases, Inc., n.d.)

Legal and Regulatory

- Praxair has expanded their facilities in San Juan County three times. As an incentive, the County has given Praxair property tax breaks and special terms. (Schwartz, 2014)

Economic Impacts

- 2014 County Business Patterns data for NAICS code 32512: Industrial gas manufacturing (U.S. Census Bureau, 2016)
    - Total annual payroll in the US: $1 billion
    - Total employees in the US: 13,870
    - Total establishments in the US: 449
    - Average annual pay/employee: $73,000
    - Average employees/establishment: 31
    - Average annual payroll/establishment: $226,000

A.9. Electronic Assembly and Parts Manufacturing

Market

Current demand

- Computer and electronic product manufacturing shipments totaled $339.4 billion in 2012 and accounted for 5.9 percent of total U.S. manufacturing shipments. (Diagne, 2015)
- Printed circuit board (PCB) and electronics manufacturing services (EMS) industries in North America continued to report positive growth in June 2016, based on three-month rolling averages. Semiconductor shipments continued to show signs of recovery in June, although year-on-year sales growth remains negative, based on a three-month rolling average. The turnaround for semiconductor sales began in April 2016 after a steep decline that spanned 12 months. Two leading indicators, the U.S. Purchasing Managers' Index (PMI) and U.S. new orders for computer and electronic products, were mixed in June. The PMI strengthened and remained in positive territory, while U.S. new orders strengthened slightly in June but remained negative. The PMI typically leads sales by three to six months and U.S. new orders for electronic products tend to lead sales by one to two months. Another leading indicator, IPC's PCB book-to-bill ratio, is based on three-month rolling averages of orders and sales, and normally leads PCB sales by three to six months. The ratio was positive during the first five months of 2016, but slipped into negative territory to 0.98 in June due to declines in order in April and May. These indicators point to a

possible slowdown in electronics industry sales this summer, followed by slow growth in subsequent months. (IPC, 2016)

Trends

- The Circuit Board and Electronic Component Manufacturing industry produces inputs that are essential in the downstream production of consumer electronics. As a result, demand for industry products is often tied to production levels and demand from downstream industries. Although the economic recovery has improved demand for consumer electronics in the five years to 2016, revenue growth has been mild due to rising import competition and greater offshoring activity. Similar trends are expected in the five years to 2021, as manufacturers continue to relocate abroad and a strong dollar encourages greater import volumes. Although demand for industry products will remain strong, manufacturers are expected to lower their prices to remain competitive against foreign producers. (IBIS World, 2016)
- Key market trends: (Global Industry Analysts, Inc., 2015)
    - Proliferation of consumer electronics and mobile devices
    - Electromechanical applications of capacitors in the defense sector
    - Growing penetration of electronics in the healthcare sector
    - Increasing use of electronic components in automotive electronics
    - Trend towards automation of industrial processes
    - Global drive towards building and home automation
- **Automotive electronics** - Smart Cars" are quickly becoming the new rage among auto manufacturers. A few years ago, it was only the high-end "luxury" brands including hookups for smartphones and tablets. Now? We're likely only a few years from seeing those become "standard" options. In fact, they may even come to supplant more expensive audio setups in low-cost cars. After all, from a manufacturing perspective, it's a lot cheaper to include an iPod dock than it is to include a full radio/audio player. And in the meantime, electronics are expected to comprise forty percent of car component costs in 2015. Or, at the high-end, we're now seeing brands like Lexus talking about full "Heads Up Displays" integrated onto\into their front windshields, to create a driver's view that, in many ways, looks like the sorts of HUDs we see on military equipment. Research in this sector is undoubtedly going to cause a boom.
- **Medical electronics** - Rapidly-developing countries are buying up medical equipment about as fast as anyone can produce it. They're also looking into setting up their own shops, especially in India, which already has a thriving (if often unlicensed) biomed field. Parallel to this, of course, is the never-ending drive by the high-tech nations to keep developing better medical hardware. Either way, current estimates by Frost's are that the electronics manufacturing sector will be worth nearly $40 billion by the end of the decade. It's a wide-open field with room for practically any quality manufacturer.
- **Green tech** - As climate change statistics continue to mount, there's increasing pressure from *all* areas – consumers, businesses, and governments – to look into more eco-friendly manufacturing solutions. The various carbon cap or carbon trading plans being implemented are also helping to drive this push.

Characteristics

- This industry differs somewhat from other manufacturing industries in that production workers make up a relatively small proportion of the workforce. Technological innovation characterizes

this industry more than most others and, in fact, drives much of the industry's production. This unusually rapid pace of innovation and technological advancement requires a high proportion of engineers, engineering technicians, and other technical workers who carry out extensive research and development (R&D). Likewise, the importance of promoting and selling the products manufactured by the various segments of the industry requires knowledgeable marketing and sales workers. American companies in this industry manufacture and assemble many products abroad to take advantage of lower production costs and favorable regulatory environments. (CollegeGrad, 2008)

- The Circuit Board & Electronic Component Manufacturing industry in the U.S. is comprised of 2,758 businesses, employs 151,483 people, generates $39 billion in revenue, and had annual growth of -2.8% from 2011 to 2016. (IBIS World, 2016)
- NAICS 33441b

Competition

Major Players

- Fujitsu Component Limited
- KEMET Corporation
- Omron Corporation
- Microsemi Corporation
- ABB
- TE Connectivity Ltd
- API Technologies Corp
- Eaton Corp
- Largest defense contractors in NM in 2012: (Albuquerque Business First, 2012)
    - Applied Research Associates Inc
    - TRAX International
    - KL House Construction Co
    - Honeywell International Inc
    - Boeing
- Defense contractor trade shows

Expanding/Contracting

- Delta Group Electronics recently completed renovation of its new assembly facility in Albuquerque. The expanded footprint of nearly 50,000 square feet gives Delta the necessary space to develop products for its U.S. customers in the aerospace, defense and homeland security industries. (Sinovic, 2015)
- In the last year, Intel has reduced the number of employees at its chip manufacturing facility in Rio Rancho, NM. (Cardillo, 2016) This could cause an increase in the supply of skilled labor in the area for electronics manufacturing.
- Raytheon opened a new warehouse in fall 2014, expanding their facilities in Farmington, NM. The warehouse will span 30,000 square feet and be located adjacent to the main site. It is the result of three years of collaboration between the Navajo Nation, the State of New Mexico, San Juan County, and Raytheon. The Raytheon Diné Facility is staffed by approximately 200 employee and contractor associates. (Raytheon, 2015)

Inputs

Required

- A variety of metals, plastics, raw materials and chemicals are used by the electronics industry. Some of the more common metals include copper, lithium, tin, silver, gold, nickel and aluminum. The production of some of these materials is cost-intensive and often requires substantial energy use. (Investopedia, 2015)
- Water is a vital resource in the electronics industry, with the vast majority of the industry's water footprint connected to the manufacture of semiconductors – those miniature electronic circuits with transistors that make our cell phones, laptops and cars function. For perspective: It takes approximately 2,200 gallons of water, including 1,500 gallons of ultra-pure water, to create one integrated circuit on a 30-centimeter wafer – and one computer can contain a multitude of those little wafers, or chips. (Gonzalez, 2015)

Availability in 4C region

- The City of Albuquerque host a handle of electronics manufacturers, including Intel, and the local community college has programs focused on electronics and advanced manufacturing. (City of Albuquerque, n.d.)
- Advantages of locating manufacturing facilities in NM (New Mexico Partnership)
- Computer and electronic manufacturing is the largest manufacturing industry in NM (National Association of Manufacturers, 2015)
- Raytheon Missile System's Ktech division in Albuquerque has won a $4.8 million contract from the U.S. Air Force to finalize a new type of missile that uses directed energy like lasers or microwaves rather than explosives to destroy battlefield targets. Raytheon Ktech now employs 170 people in New Mexico. The new contract will lead to more hiring, but it's not clear how many employees will be added. (Robinson-Avila, 2016)
- New Mexico has three copper mines: Cobre, Chino and Tyrone. All three are currently owned by Freeport-McMoRan Copper & Gold Inc., the world's largest publicly traded copper company. (Paskus, 2013) Operating plans call for a 50 percent reduction in mining rates at the Tyrone mine, which produced 84 million pounds of copper in 2015. (Freeport-McMoRan, n.d.) The Cobre Mine is currently inactive but some future mining is intended. (New Mexico Copper Rules, n.d.)
- According to U.S.G.S., the principal copper mining states, in order of descending production, are Arizona, Utah, New Mexico, Nevada and Montana. The mines in these states together accounted for 99 percent of domestic production. (New Mexico Copper Rules, n.d.)
- Industrial electricity rates in New Mexico average 5.83¢/kWh, which ranks the state 38th in the nation. The average industrial electricity rate of 5.83¢/kWh in NM is 12.59% less than the national average industrial rate of 6.67¢/kWh. (Electricity Local, n.d.)
- Meanwhile, *TreeHugger* reports that researchers at the University of Wyoming have discovered an enormous supply of lithium at the Rock Springs Uplift, a geological feature in southwest Wyoming. Initial tests indicate the lithium-rich brine from a 25-square-mile area could contain 228,000 tons of the stuff. That's enough to meet annual U.S. demand and is twice the amount available at Silver Peak in Nevada, which is the biggest domestic lithium producer today. (Hanley, 2015)

Siting

- Most electronic products contain many intermediate components that are purchased from other manufacturers. Companies producing intermediate components and finished goods often choose to locate near each other so that companies can receive new products more quickly and lower their inventory costs. It also facilitates joint research and development projects that benefit both companies. As a result, several regions of the country have become centers of the electronic products industry. The most prominent of these centers is Silicon Valley, a concentration of integrated circuit, software, and computer firms in California's Santa Clara Valley, near San Jose. However, there are several other centers of the industry throughout the country. (CollegeGrad, n.d.)
- To produce circuit boards, a substantial amount of copper wiring is required. Copper mines use as much as 500 gallons of water per second of operation, so water is also a significant commodity consumed by the industry. Electronics production also involves a range of different chemicals. Solvents and various gases help control product quality, stripping away impurities, cleaning components and de-greasing materials. Electronics manufacturers have to purchase chemical supplies on an ongoing basis, and many of them benefit from locating their operations close to key producers. (Investopedia, 2015)

Legal and Regulatory

- The State of NM offers manufacturing companies a number of tax incentives. (New Mexico Parntership, n.d.)

Economic Impacts

- The Raytheon Diné Facility is staffed by approximately 200 employee and contractor associates. (Raytheon, 2015)
- Raytheon Ktech now employs 170 people in New Mexico. The new contract will lead to more hiring, but it's not clear how many employees will be added. (Robinson-Avila, 2016)
- 2014 County Business Patterns data for NAICS code 3344: Semiconductor and Other Electronic Component Manufacturing (U.S. Census Bureau, 2016)
    - Total annual payroll in the US: $20 billion
    - Total employees in the US: 271,390
    - Total establishments in the US: 4,043
    - Average annual pay/employee: $75,000
    - Average employees/establishment: 67
    - Average annual payroll/establishment: $5 million

A.10. Transloader / Warehousing and Distribution

Market

Current demand

- Mexico is the largest export market for New Mexico, followed by Canada (based on a review of FAF tonnage data). Major export sectors by tonnage volume are agricultural commodities and food stuffs, coal, and manufactured goods (e.g., plastics, electronics, and machinery). (JBA & Associates, 2015)

- The Commercial and Industrial Base is based upon health care, extraction industries and support services, distribution, general manufacturing and a growing tourism industry. Located in the major cities of San Juan County are three industrial parks (total of 343 acres) and another under development (138 acres). A Fed Ex Distribution Center, Pepsi Bottling, Wagner Equipment and Pyramid Corporation among others are located in the existing parks. (Four Corners Economic Development)

Trends

- As a result, our country's major ports are facing congestion as the inbound volume of goods manufactured abroad continues to rise. Projections for the next five years indicate that some ports will triple their containership capacity and freight throughput. To accommodate the rise in global imports, the industry is shifting more to an "inland port" model, where inbound goods are quickly off-loaded from ships and moved to inland distribution centers for subsequent handling and redistribution within the country. (JBA & Associates, 2015)
- The Southwest region (Arizona, New Mexico, Oklahoma and Texas) 4 has outperformed most other regions during the recovery from the Great Recession. Growth of this region is expected to remain healthy, apart from negative impacts from curtailment of oil production and investment. The Southwest region is the largest destination for New Mexico's outbound domestic freight, dominated by resource-based shipments. (JBA & Associates, 2015)
- New Mexico has underperformed compared with neighboring states. New Mexico's resource-based sectors have contributed positively to recent economic growth in the State; however, construction, manufacturing, and service sectors have been a drag on the State's economic growth. Lower oil prices may curtail production and development of shale oil production in New Mexico (including in the San Juan Basin, but see further discussion later in the report) and dampen the State's economic growth over the next few years. (JBA & Associates, 2015)
- A successful Alberta start-up is bringing the Internet of Things (IoT) to the rail industry through a new product called the TRIG XLOAD. The TRIG XLOAD is an industrial IoT platform that increases the visibility of products being transported inside a tanker rail car. Since it began operations in 2012, TRIG has been working towards the goal of developing and commercializing modern technology to solve fundamental rail issues related to transloading logistics and operations, along with the health, safety, and environmental issues that are prevalent in this industry. The TRIG XLOAD sensor is nearing completion of its safety certification and is positioned to be the first electronic sensor sanctioned by the American Association of Railroads to travel on moving cars. TRIG's patented sensor uses radio frequency technology to automatically monitor volumes, levels, and ambient temperatures of products inside of closed rail cars. Relevant product data is transmitted to 1) Operators working at the loading and unloading terminals, 2) Schedulers and logistics personnel at regional offices, and 3) Managers and directors at head offices. (Kliment, 2016)
- Industry trends in the (larger) 4C area: (JBA & Assoc., 2015)
    - **Warehouse/distribution (DC)** showed good growth between 2013 and 2014 (69%). Interstate access, rail service and large regional markets are critical here.
    - **Call/data centers/software/IT**, which includes many technology, IT, data center and office uses, showed excellent growth between 2013 and 2014 (147%).
    - **Food processing** showed outstanding growth between 2013 and 2014 (233%).

- **Oil/gas** industry growth showed outstanding growth between 2013 and 2014 (600%)
- **Other manufacturing sectors** that showed positive growth between 2013 and 2014 included metals; chemicals/pharmaceuticals/biotech; plastics; transportation equipment; computer/electronics, industrial machinery, and data centers.

Characteristics

- Since transfer requires handling of the goods, it causes expense and risk of damage. Therefore, transloading facilities are designed with the intent of minimizing handling. Due to differing capacities of the different modes, the facilities typically require some storage facility, such as warehouses or rail yards. For bulk goods, specialized material handling and storage are typically provided (as, for example, in grain elevators). Intermodal transport limits handling by using standardized containers, which are handled as units and which also serve for storage if needed. Transloading is often combined with classification and routing facilities, since the latter often require handling of goods. Transloading may occur at railway sidings and break-of-gauge stations. (Wikipedia, 2016)

Competition

Major Players

- Inland Empire; Phoenix; Albuquerque; Las Cruces (JBA & Associates, 2015)
- Regional intermodal container hub nearby (ABQ) (JBA & Associates, 2015)

Expanding/Contracting

- In July 2015 New Mexico Transloading's (NMT) new transloading center is set to be completed and 100 percent operational. NMT is providing a first-of its-kind service in the Albuquerque metro area and fills a much needed transportation link to get goods from truck to rail to export goods from Central New Mexico. New Mexico Transloading was incorporated in July 2014 in Albuquerque's South Valley and is New Mexico's first multi-modal, state-of-the-art art transloading facility with the capacity to move a variety of products such as palletized goods, steel, timber, agricultural products, propane and oil, bulk liquid, dry goods, construction materials and heavy equipment. (New Mexico Economic Development Department, 2015)
- The intermodal rail sector has expanded over the past decade driven by increasingly competitive rail costs versus trucking, driver shortages in the trucking industry investments by the railroads, shipper willingness to incorporate rail into supply chain strategies, penetration of shorter haul corridors, and the growth of intermodal-friendly international container volumes. (JBA & Associates, 2015)

Inputs

Required

- Important elements of a successful inland port/intermodal project include: 1) access to regional market commodities; 2) access to a railroad mainline or shortline connecting to a mainline; 3) physical ability/permission to spur off of the mainline with loop tracks; 4) good Interstate or 4-lane highway connections; 5) transloading equipment/infrastructure; and 6) fully improved industrial sites. (JBA & Associates, 2015)
- Ideal inland ports have efficient access to logistics services, transportation systems, and consumer markets; and may be in close proximity to a "traditional" port. Furthermore, the best

locations also support large, flexible buildings and have extensive parking for containers and trailers, as well as easy access to mature transportation infrastructures. (JBA & Associates, 2015)

Availability in 4C region

- Goods heading to and from Asia already pass through Albuquerque on rail lines that link the port of Long Beach, California, with Chicago. Another rail line provides a link to Mexico. (McKay, 2016)
- The BNSF Railway, a Class I railroad, runs through Gallup and Thoreau. A transloading facility in Thoreau could provide truck access to Farmington via Hwy 371. A facility near Gallup could provide access via Hwy 491. (Wikipedia, 2016)
- A 2015 study found that there were four sites near Gallup that could be suitable as inland ports. One just northwest of Mentmore received a score of "Excellent". The projected costs to construct these sites ranged from $18.7 million to $26.7 million. (JBA & Associates, 2015)
- Projected best markets for the 4C area: (JBA & Associates, 2015)
    - **Oil/Gas/Mining Related**
        - Fracking sand (two types)
        - Pipe
        - Mining/industrial equipment
        - Water recycling equipment
        - Imaging equipment
        - Chemicals
        - Coal
    - **Food Processing/Agricultural Products** (including "grain in a box" transload)
    - **Chemicals/Biofuels**
    - **Warehouse/Distribution** (rail related DCs)
    - **Industrial Machinery/Fab Metal Products/Transportation Equipment** (including rail car manufacturing and repair)
    - **Plastics Products**
    - **Renewable Energy Production** (solar and wind).
    -
- Navajo Industrial Parks in NM (Navajo Nation, 2007)
    - Church Rock near Gallup – furniture, camper manufacturing, food distribution
    - Shush Be Toh near Gallup
    - Shiprock – Hardware, fast food, metal manufacturing
    - NAPI near Farmington – defense, food processing, civil works
    - NFPI in Navajo

Siting

- Key Factors:
    - Space
    - Storage
    - Proximity to railroad tracks
    - Ease of access to the main roadways
    - Conducive topography
    - Cost of land
    - Conducive zoning
    - Access to site using existing "at-grade" rail crossings

- High frequency of intermodal rail service is offered between LA/LB, and to a lesser extent Houston, and intermodal terminals in Phoenix (282 miles from The Navajo Chapters) and Dallas-Fort Worth (750 miles from The Navajo Chapters). These are the two major intermodal hubs in the region for international seaborne containerized cargo. BNSF also operates an intermodal yard in Albuquerque (140 miles from The Navajo Chapters) mainly for domestic intermodal cargo; and UP has intermodal terminals at Santa Teresa, NM (376 miles from The Navajo Chapters) and Tucson, AZ (383 miles from The Navajo Chapters) for domestic and international cargo. (JBA & Associates, 2015)
- The Inland Port Area has a number of key strengths from a transportation/logistics standpoint:
    - I-40 Interstate highway access
    - BNSF Class 1 mainline rail with an existing spur loop near Site 1
    - Industrial sites with excellent access
    - Adequate air carrier service (i.e. UPS/FedEx), but no commercial air service nearby.

Legal and Regulatory

- With the assistance of the New Mexico Economic Development Department's Local Economic Development's Local Economic Development Act (LEDA) and Job Training Incentive program, NMT was able to offset cost of construction and on-the-job training for new employees. To date, NMT has been approved for $200,000 in LEDA funds for the creation of 200 jobs. Additionally, the New Mexico Economic Development Department allocated $251,772 to training 30 employees through the Job Training Incentive Program (JTIP). JTIP reimburses qualified economic-based companies for a portion of training costs associated with job creation. The program provides for classroom or on-the-job training, reimbursing an expanding or relocating business for up to 75 percent of a trainee's wages for as long as six months. The amount of the award depends on the number and complexity of jobs, the wages paid, and the business location. To qualify, new or expanding companies must either create a product in New Mexico, or provide a nonretail service with 50 percent of the company's costumer or revenue base outside of the state. The eligible jobs must be full-time and year-round. The trainee must be a new hire to the company and have been a New Mexico resident for at least one year at any time prior to being hired. (New Mexico Economic Development Department, 2015)
- Eighty percent of the [transloading] project [in Davenport, IA] is being paid for by federal and state grants, including a $7 million grant from the U.S. Economic Development Administration. (Wellner, 2015)
- A transloading facility would require environmental review and permitting studies, which would likely include: Environmental Site Assessment (ESA); Rare, Threatened, or Endangered species Analysis; Archeological/Historical Review; Topographic Analysis, Hydrologic/Wetland Delineation; Air Quality Analysis; Geotechnical Study; and Flood Control Planning and Analysis. (JBA & Associates, 2015)

Economic Impacts

- A study examining a potential inland port near Gallup estimated that two facilities would entail: (JBA & Associates, 2015)
    - Total site preparation and construction costs of $27.2 million
    - 140 direct new full- and part-time positions

    - An annual employee compensation of $3.5 million (including benefits; averages out to $25,000/yr per new position)
    - Per facility employment and compensation:
        - 15 laborers @ $20k/yr
        - 20 production @ $30k/yr
        - 30 warehouse @ $20k/yr
        - 5 management @ $50k/yr
    - 162 direct jobs from facility construction
    - These are the estimated benefits for McKinley County
- 2014 County Business Patterns data for NAICS code 493110: General Warehousing and Storage (U.S. Census Bureau, 2016)
    - Total annual payroll in the US: $27 billion
    - Total employees in the US: 650,533
    - Total establishments in the US: 10,377
    - Average annual pay/employee: $41,500
    - Average employees/establishment: 62.7
    - Average annual payroll/establishment: $2.6 million
- 2014 County Business Patterns data for NAICS code 4885: Freight Transportation Arrangement (U.S. Census Bureau, 2016)
    - Total annual payroll in the US: $13.3 billion
    - Total employees in the US: 238,310
    - Total establishments in the US: 20,008
    - Average annual pay/employee: $56,000
    - Average employees/establishment: 11.9
    - Average annual payroll/establishment: $665,192
- 2014 County Business Patterns data for NAICS code 488999: All Other Support Activities for Transportation (U.S. Census Bureau, 2016)
    - Total annual payroll in the US: $59 million
    - Total employees in the US: 1,545
    - Total establishments in the US: 326
    - Average annual pay/employee: $38,000
    - Average employees/establishment: 4.7
    - Average annual payroll/establishment: $181,000

A.11. CULTURAL CENTER

Market

Current Demand

Market for cultural centers, museums and related facilities:

- New Mexico and surrounding states have a thriving market for cultural related activities including museum and gallery visitation.
    - Nationwide, 21 percent of US Adults visited an art museum or gallery in the previous year, according to a 2012 study (National Endowment for the Arts, 2015).

  - New Mexico and surrounding states have a higher than average demand for museums and galleries with almost 26 percent of adults visiting an art museum or gallery in the previous year, according to a 2012 study. The New Mexico region had the second highest percentage of adults visiting museums nationwide, second only to the pacific region at just over 28 percent (National Endowment for the Arts, 2015).

- Nationwide, demand for visitor serving organizations is failing to keep pace with population growth (DILENSCHNEIDER, 2013). Americans are attending fewer arts activities including visiting museums and galleries than they did a decade ago.
  - The market is down from 10, 20, and 30 years ago, with 39 percent of the population attending arts activities in 1982, 41 percent in 1992, 39.4 percent in 2002, and 33.4 percent in 2012. This decrease is present across all demographic groups except those Americans 75 and over, which were actually more likely to visit museums than a decade ago (National Endowment for the Arts, 2015).
  - In a 2014 study, eighty-three percent of visitor serving-organizations indicated flat or declining attendance. (DILENSCHNEIDER, 2013).

- The majority of leisure travelers participate in cultural or heritage activities including visiting museums, with 78 percent of US leisure travelers participating in cultural or heritage activities. These travelers also spend 63 percent more than average US leisure travelers. (American Alliance of Museums)
- Museums are more popular than major league sporting events and theme parks combined! American museums see approximately 850 million visits each year, while major league sporting events and thee parks saw a combined 483 million visits in 2011. Additionally, American museums received 524 million online visits from adults by 2006. (American Alliance of Museums)

Service characteristics sought by target market:

Cultural centers/Museums

- Organizations with a reputation for effectively delivering their mission are more profitable/financially stable than those organizations that are perceived as primarily attractions, especially to the under represented millennials (Dilenschneider, 2015).
- Leisure group tour visitation to museums is in decline due to decreasing desire for such experiences. Only 52 percent of respondents thought group tours were fun in a 2014 survey, down from 57 percent in 2008. While those respondents 35 and over had a 54 percent agreement rate in 2014, those respondents under 35 had an agreement rate of only 48 percent. (Dilenschneider, Group Tour Indterest in Decline: Why Museums should Invest Elsewhere, 2015)
- Museums provide educational opportunities for school-aged children
  - Nationally, museums receive more than 55 million visits from children in school groups. (American Alliance of Museums) http://www.aam-us.org/about-museums/museum-facts
  - Educational based museum visits are tailored towards K-12 children with three quarters of museum spending on education tailored towards that age group (American Alliance of Museums).

- Many museums provide programs for veterans and military families, offering free admission to active duty and reserve personnel and their families. (American Alliance of Museums).

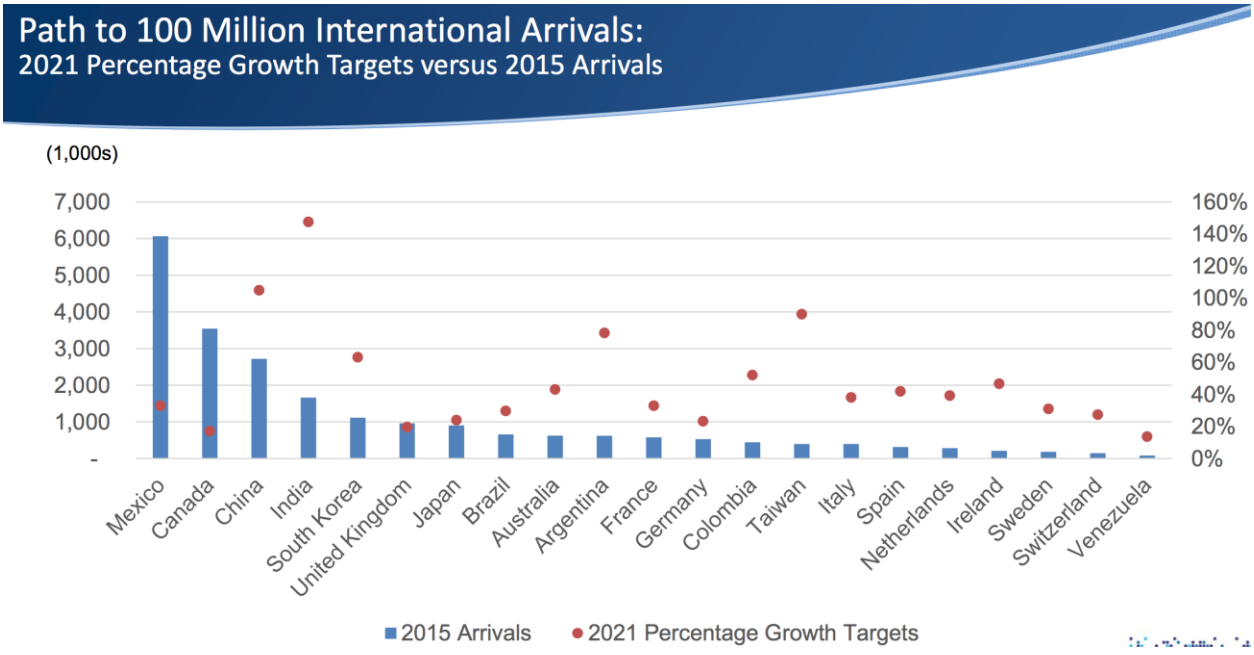
Market competition/Competitiveness of industry in location:

- Visitors to visitor serving organizations (such as museums) are primarily motivated to visit a site due to exterior factors to the organization. For example, the primary leisure activity motivation was to visit friends/family (70.4 percent) with the second most prevalent factor being to visit a major metropolitan area (65.8 percent) and with visit historic locations is 4th most popular at almost 30 percent. (Dilenschneider, Leisure Activity Motivation: How People Decide to Attend Your Museum or Visitor Serving Organization, 2013)http://colleendilen.com/2013/10/10/leisure-activity-motivation-how-people-decide-to-attend-your-museum-or-visitor-serving-organization-data/
- The market for galleries/museums/cultural centers is well supplied within the three county region (see museums listed below).
- Museums provide many economic benefits to the economy including, employing 400 thousand Americans and directly contributing $21 billion to the economy annually with additional indirect spending by visitors. For every 100 jobs created from new arts demand, 62 additional jobs are also created (American Alliance of Museums).
- The three county region has a plethora of existing cultural locations, making it an ideal location to create a unifying cultural trail for tourists.

Trends

- More than 66 percent of museums reported economic stress in 2012. (American Alliance of Museums)
- The study area of concern, the industry saw growth with the completion of the Western New Mexico Aviation Heritage Museum in Cibola County.
  - http://www.cibolahistory.org/aviation-heritage-museum.html
- The industry is facing a decline in attendance
  - In recent years, visitation to nonprofit visitor-serving organizations including museums has largely declined (http://colleendilen.com/2014/12/03/signs-of-trouble-for-the-museum-industry-data/)
  - In a 2014 study, eighty-three percent of visitor serving-organizations indicated flat or declining attendance. This occurrence was found across all regions, organization type and size. (http://colleendilen.com/2014/12/03/signs-of-trouble-for-the-museum-industry-data/)
  - Americans are visiting art museums and galleries as well as touring parks and monuments less than they did a decade ago. This decrease is present across all demographic groups except those Americans 75 and over, which were actually more likely to visit museums than a decade ago. https://www.arts.gov/sites/default/files/2012-sppa-feb2015.pdf Page 2
  - The percentage of Americans attending at art activities including visits to museums and galleries dropped from 39 percent 2002 to just 33.4 percent in 2012: https://www.arts.gov/sites/default/files/2012-sppa-feb2015.pdf page 3

- While millenials are the largest segment of visitors to cultural organizations, they are the only age demographic not visiting at US population representative rates (Dilenschneider, Millenial Data Round Up: What Your Cultural Organization Needs to Know, 2016).
- Social media is the primary information source for high-propensity visitors to cultural organizations followed by websites accessed by mobile devices, websites accessed by traditional methods, and word of mouth. Websites for cultural organizations include institutional websites, trip advisor, yelp, etc. (Dilenschneider, The Power of Social Media vs. Your Organizations Website (DATA), 2016)
- Millennial visitors to cultural organizations are most likely to come back within the year, most likely to recommend a visit to a friend, and are the ost connected to the web (Dilenschneider, The Hidden Value of Millennial Visitors to Cultural Organizations (DATA), 2016).
- International tourism to the southwest is changing rapidly. Currently, most visitors are from Mexico and Canada. However, in the near future China, India and other Asian countries are expected to account for future growth in tourist. This year Brand USA partnered with China to run a series of US – China Tourism Year events and educational resources, aimed at making it easier for potential Chinese travelers to get a visa and enter the US. Next year, Brand USA will partner with India for a similar project. (Sheivachman, 2016)



  - Average expenditures for overseas visitors average $3,500 per trip (Rupert, 2014)

Competition

Major Players

Key Players Cultural Centers – in and around 3-county region

- New Mexico and in particular the area in and around Cibola, San Juan and Mckinley counties is a hotbed of cultural interest. The following cultural centers and museums educate interested tourists and locals alike. Cultural centers frequently include museums, galleries/stores, cafés, education offerings and events.

- **Indian Pueblo Cultural Center**: Albuquerque, New Mexico
    - The center is off I40 and includes a café, a native arts store (also online), a museum (with collections & murals, exhibitions, and a library/archive) and events (including native dances, a book club, and special group meetings/tours/exibits). The facility caters to summer camps, school trips, self-guided trips and guided trips. They have a weekly story time and creative Saturdays for children.
    - Admission is $8.40 for adults, $6.40 for Seniors/Military Personnel/NM Residents, $5.40 for children and groups, and children under 5 are free.
    - http://www.indianpueblo.org
    - Visitation communication: Messages with Joleen 9/13/16 @11am & Lindsey Lancaster 10/26/16 @ 11:15am
- **Sky City Cultural Center and Haak'u Museum**: Cibola County, New Mexico
    - The center is the reception center and museum for Pueblo of Acoma visitors. Sky City is the oldest continuously inhabited settlement in North America and is designated as a National Trust for Historic Preservation and a National Historical Landmark. The inhabitants of Sky City are the Acoma Pueblo, a federally recognized Indian Tribe with 432 thousand acres, 4,800 tribal members, and 250 primitive dwelling without electricity, water or sewer. The site includes the San Esteban del Ray Mission, a Catholic mission ibuilt in 1629, and is also listed as a National Historical Landmarks and are on the National Register of Historic Places.
    - The cultural center showcases the history, art and lifeway of the Acoma people; the museum focuses on the revitalization of lost art forms and preservation of Acoma history; and a gift shop, café and meeting/event facilities are also featured at the 40,000 SF center.
    - The Sky City Casino is the recommended lodging location, just off I40.
    - http://www.acomaskycity.org/home.html
    - Sky city attracts over 115 thousand visitors annually (the business of culture at acoma pueblo)
    - Visitation communication: Message 10/25/2016 at 11am
- **New Mexico Mining Museum** at the Chamber of Commerce: Grants, NM
    - The facility is a visitor center that hands out brochures and answers tourist questions but also includes a museum that is a self-guided simulated underground uranium mine.
    - Admission: adults $3, seniors and children $2, children under 6 are free.
    - Visitation: 6,790 visitors in 2015 and 4,504 Jan-Sept 2016. Visitation is heaviest in May, June and July, with approximately double the visitors in the six-month period March through August as September through February (Legler, 2016)
    - http://www.fourcornersgeotourism.com/content/new-mexico-mining-museum/fca9987D2808F46D9A7C
- **Western New Mexico Aviation Heritage Museum**, Cibola County
    - Located at the Grants-Milan NM Airport in Cibola County.
    - The facility is an air history and interpretive site honoring pioneering aviators who crossed West '1929-era LA to Amarillo segment of the Midcontential Airway, established by Charles Lindbergh. Two 1929 historic structures are featured at the site; a 51foot

airway beacon tower and a 1953 Flight Service Station, which is listed on the National Register of Historic Places.
    - http://www.cibolahistory.org/aviation-heritage-museum.html
- **Salmon Ruins Museum**, Bloomfield, NM.
    - The site includes a museum, guided and step-on tours, lectures, facilitiy rentals, and multiple historical sites of interest.
        - The museum offers artifacts from the excavation collections, unique cultural textiles and mining artifacts.
        - Pioneer Homestead was built by George Salmon in the 1890s. The original home, dugout, carriage house, well and bunk house are available to visitors.
        - A two-acre 11th century pueblo ruin of the Chaco Culture is available to visitors.
        - Heritage park offers tipi and Hogan replicas and picnic facilities to visitors as well as an Amphitheater.
    - Admission: adults $4, seniors $3, children $1 and children 5 and under are free.
    - Visitation: In 2015, the facilities received 5,707 visits (Brandy, 2016).
    - http://www.salmonruins.com
- **Farmington Museum and Visitor Center:** Farmington NM
    - The facility includes a museum, store, exhibits and visitor center with programs for children,
    - Admission: Suggested donation $3 for adult and $2 for children
    - http://www.fmtn.org/248/Farmington-Museum-at-Gateway-Park
- **E3 Children's Museum and Science Center**: Farmington, NM
    - The facility offers a gallery with science focused interactive activities and special programs throughout the year.
    - http://www.fmtn.org/254/E3-Childrens-Museum-Science-Center
- **Gallup Cultural Center**: Gallup, NM
    - Located in the Santa Fe Depot, the facility offers a museum, lectures, forums, and diverse heritage celebrations to the community, school children, and visitors.
    - https://www.southwestindian.com/foundation/cultural-center/
- **National Hispanic Cultural Center:** Albuquerque, NM
    - The expansive Hispanic cultural focused facility presents over 700 events annually in addition to the library, art museum, genealogy center, educational resources, restaurants and store.
    - Admission: $6 for adults, $5 for residents, free for youth 16 and under.
    - Visitation: For the 2016 fiscal year (July 1, 2015 through June 30, 2016), the site saw 242,795 visitors, 125,751 of those visits were education related visits for children. Albuquerque public school district students visit the site in their 4th grade year as part of an educational field trip. Visitation does not present large fluctuations seasonally. Offsite visitation, when the center puts on conferences, etc. is 39,619, and offsite educational visits is 18,744, which includes school performance and other educational offerings at local area schools. (Cuessy, 2016)
    - http://www.nhccnm.org

Key Players Cultural Monuments/Parks

- **El Malpais**: Cibola County, New Mexico
  - El Malpais is a National Monument featuring a volcanic landscape of cinder cones, sandstone bluffs, hiking trails and lava tube caves in Cibola County. The
  - There are three visitor centers for the Monument:
    - El Malpais Visitor Center in Grants
    - El Malpais Information Center (NPS) is opened seasonally and includes a bookstore, exhibits about different lava flows, access to the Continental Divide National Scenic Trail and a picnic area.
    - El Malpais Ranger Station (BLM) is located 9 miles south of I40 and serves at the gateway to the El Malpais National Conservation Area. The facility is currently closed.
  - Admission: Free.
  - Visitation: The Monument received 164 thousand visits in 2014 and 174 thousand visits in 2015. Over the past two decades, the Monument has received of average of 129 thousand annual visitors (NPS Stats).
  - https://www.nps.gov/elma/planyourvisit/visitorcenters.htm
- **Aztec Ruins National Monument**, Aztec, New Mexico
  - The ancient Pueblo ruins at 'Aztec Ruins National Monument' includes the ancient Pueblo 'Great House', a social, economic and political center for the ancient Pueblo people. The site includes a self-guided half-mile walk through the original well-preserved rooms and the ceremonial Great Kiva.
  - The site includes a heritage garden with native plants, special events and interpretive programs, a junior ranger program, and a visitor center—the historic home of pioneering archeologist Earl Morris.
  - A section of the 'Old Spanish Trail', a trade route from Santa Fe to Los Angeles, is available for visitors to walk from Aztec Ruins to the historic downtown Aztec.
  - Admission: $5 per adult and free for children under 16.
  - Visitation: In 2014, the site received 44,721 visitors. In 2015, the site received 53,165 visitors. (National Parks Service)
  - https://www.nps.gov/azru/index.htm
- **El Morro National Monument**: Ramah, NM
  - For hundreds of years, El Morro ('the headland') National Monument was a campsite and waterhole for Ancestral Puebloans, American and Spanish travelers who carved over 2 thousand petroglyphs, messages, dates and signatures into the stone.
  - The site includes hiking and walking trails, visitor center, and a junior ranger program.
  - Admission: No fee.
  - Visitation: In 2014, the site received 46,256 visitors. In 2015, the site received 49,390 visitors. (National Parks Service)
  - https://www.nps.gov/elmo/index.htm
- **Chaco Culture National Historic Park,** San Juan County
  - At Chaco Cultural NHP, ancient Pueblo built massive buildings with organizational and engineering abilities not seen elsewhere in the American Southwest. The site was active between 850 and 1250 AD.

  - The site offers hiding and biking trails, night sky programs at the observatory, camping and evening campfire talks and guided tours.
  - The center is such a good place to stargaze, with 99 percent of the site being natural dark zones without permanent outdoor lights, it was recently earned the distinction of becoming an International Dark Sky Park. The site has an observatory and offers associated programs for adults, students and children.
  - Admission: $16/vehicle, $12/motorcycle and $8/individual.
  - Visitation: In 2014, the site received 38,386 visitors. In 2015, the site received 38,914 visitors. (National Parks Service)
  - https://www.nps.gov/chcu/index.htm
- **Four Corners Monument/Four Corners Tribal Park,** San Juan County
  - The intersection of New Mexico, Arizona, Utah and Colorado is commemorated with a brass monument. Shopping and sightseeing are also available at the location with native American artisans making traditional handmade crafts, jewelry and foods for sale.
  - Admission: $3/person
  - http://www.newmexico.org/listing/?lid=19809

Key Players Cultural Trails:

Economic Impact

- 2014 County Business Patterns data (U.S. Census Bureau, 2016)
  - NAICS 712: Museums, Historical Sites, and Similar Institutions
    - Total employees: 143,298
    - Total annual payroll: $4.6 million
    - Total establishments: 7,498
    - Average annual payroll/employee: $32,000
    - Average employees/establishment: 19.1
    - Average payroll/establishment: $609,000
  - NAICS 71211: Museums
    - Total employees: 91,966
    - Total annual payroll: $3 billion
    - Total establishments: 5,051
    - Average annual payroll/employee: $32,000
    - Average employees/establishment: 18.2
    - Average payroll/establishment: $589,000
  - NAICS 71212: Historical sites
    - Total employees: 10,239
    - Total annual payroll: $2.6 million
    - Total establishments: 1,142
    - Average annual payroll/employee: $26,000
    - Average employees/establishment: 9
    - Average payroll/establishment: $233,000

A.12. Outdoor Education Adventure

The three county region has a large and varied array of outdoor recreational opportunities currently available. While the list includes many independent outdoor recreational operations and educational opportunities, this report will focus on two potential recreation based outdoor opportunities a Guest Ranch and a Cultural Experience Destination. Guest ranches cater to families, weddings, and conventions, and provide on-site lodging, dining, and outdoor focused recreational/educational opportunities for guests of all ages. Cultural experience destinations allow the visitor to become part of the cultural/historic experience by walking through historically/culturally styled facilities with actors playing the role of historically/culturally accurate residents. Sometimes these experiences are called "living history museums" with the best known and largest being Colonial Williamsburg in Vermont.

Market

Current Demand

- The US demand for outdoor recreation is large with almost half of the US population participated in an outdoor activity at least once in 2013 (49.2 percent) http://www.outdoorfoundation.org/pdf/ResearchParticipation2014.pdf page 1
- Almost half of the US population participated in an outdoor activity at least once in 2013 (49.2 percent).
- http://www.outdoorfoundation.org/pdf/ResearchParticipation2014.pdf page 17
- The percentage of Americans that participate in outdoor recreation has remained relatively steady over the past eight years, ranging from 48.6 percent in 2008 to 40 percent in 2007. http://www.outdoorfoundation.org/pdf/ResearchParticipation2014.pdf page 8
- Camping, as reported by KOA (the nation's largest private campground system), reported that 2015 was a very strong year with a 10.8 percent increase in occupancy in the American Southwest. (Outdoor Recreation Outlook 2016 by American Recreation Coalition)
- Federal land camping reservations increased 19 percent from 2014 to 2015. Federal lands recorded more than 22 million visits in 2015, an increase of 31 percent from 2014. (Outdoor Recreation Outlook 2016 by American Recreation Coalition) http://www.outdoorfoundation.org/pdf/ResearchParticipation2014.pdf page 1
- Approximately 278 thousand people fished, 69 thousand hunted and 566 thousand people participated in wildlife-watching in New Mexico in 2011 (the most recent survey year available). http://www.census.gov/prod/2013pubs/fhw11-nm.pdf pg4
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Characteristics

- Recreation and outdoor activities include a wide range of activities in the New Mexico region of concern including bird watching, hunting, fishing, camping, hot air ballooning, off road jeep trips, hiking, motocross, wilderness adventures, and art walks.
- The most frequent reason Americans participate in outdoor activities is to get exercise (72 percent). Being close to nature is the fourth most prevalent response at 48 percent.
- Within New Mexico, 783 thousand resident and non-residents participated in wildlife-related activities in 2011 (US Fish and Wildlife Service & US Census Bureau, 2014)

- Many highly ranked outdoor adventure opportunities exist in Albuquerque https://www.tripadvisor.com/Attractions-g28952-Activities-c61-t211-New_Mexico.html
- "Disappearing Dude Ranches", WSJ http://www.wsj.com/articles/SB115223994758800354

Competition

Major Players

Key Players Guest Ranches:

- **Geronimo Trail Guest Ranch**, Winston, NM
  - Small family ranch with old west experience.
  - $306 - $329/night, 3-night minimum. Ranch capacity: 16.
  - http://www.duderanch.org/new-mexico-dude-ranch
- **Burnt Well Guest Ranch**, Roswell, NM
  - Working cattle/sheep ranch where you can participate in actual ranch work and work on your riding skills.
  - $239-$301/night. Ranch capacity: 10
  - http://www.duderanch.org/new-mexico-dude-ranch
- **Concho Hills Guest Ranch**,
  - 6 guest suites, $300/night,
  - Recreation is done on national forest lands
  - http://conchohillsranch.com/rates/
- **Los Pinos Guest Ranch**
  - $145/night, two night minimum
  - Borders Santa Fe National Forest
  - http://www.lospinosranch.com
- **Z Lazy B Mountain Retreat,** Fort Wingate, NM *within 3-county region*
  - The retreat includes indoor/outdoor dining options with room for 50 guests indoors and up to 250 outdoors. You can hunt, camp, hike, mountain bike, snowmobile and cross country ski to just name a few. This serene area is only a 20 minute drive from Interstate 40.
  - $120/night/cabin (double occupancy).
  - Z Lazy B has a dining hall and five cabins that you may rent.
  - This ranch behaves more like a hotel, providing lodging without offering dining or recreational opportunities themselves, nor do they facilitate independently owned, nearby recreational opportunities for guests. From the reviews, it looks as if the office isn't staffed, but the ranch accommodates weddings, for which, staff would be hired.
  - http://www.zlazyb.com

Key Players Cultural Experience / Experiential Camp Destinations:

- **Genesee Experiential outdoor Center (GEOC),** outside of Denver; operated by Denver Parks & Recreation. Located at Genesee Mountain Park on 2,400 acre park. Attendees are exposed to adventures that instill elements of self-esteem, teamwork, effective leadership, creative problem solving and self-discipline. (Center, n.d.)

- **Missoula Outdoor Recreation & Education (MORE),** in Missoula. Goal of the program is to provide programs that fit the needs of people in Missoula. Associated with the community Parks and Recreation department. Offers walking tours of city parks, volunteer projects, white water rafting, rock climbing, and leadership camps at several different levels. The groups mission is to offer opportunities to experience, learn, enjoy and grow in the outdoors. (Missoula Outdoor Recreation & Education (MORE), 2016)
- **Outward Bound.** In various locations throughout the US Outward Bound expeditions offer 1,000 courses covering 35,000 students annually. The mission of Outward Bound is to change lives through Challenge and Discovery. (Outward Bound, 2016)
- **Irvine Ranch Outdoor Education Center** in Orange, CA. This is a 210 acre outdoor education center, owned and operated by Orange County Council and Boy Scouts of America. The center features half day through five day academic and recreational programs; geared to K-12 students and is consistent with Irvine Ranch Conservancy.
- **Colonial Williamsburg**, Williamsburg, Virginia The site is the largest living history museum in the world featuring a functioning colonial town in Virginia complete with restored historically furnished buildings and costumed interpreters. In addition to the town, there are two art museums and a 1700s farmhouse. The site includes hotels, restaurants, shops, performances, golf, spas, and tennis in addition to the colonial Williamsburg attractions. Williamsburg is part of the 'Historic Triangle of Virginia', which includes Yorktown and Jamestown.
    - https://www.colonialwilliamsburg.com
    - Online experience available – tour the town, learn about the residents, what life was like in the town, the revolution, trades, clothing, gardens, and more.
    - "We are the family fieldtrip"
    - ticket sales reached 574,300 in 2015, 5% lift in leisure visitation
- **Conner Prairie,** Fishers, Indiana:
    - The 200 acre site has five themed historic areas including 1836 Prairietown, Conner Homestead, 1859 Balloon Village, 1863 Civil War Journey and Lenape Indian Camp. Activities include role-playing as citizens of the town, trading, making crafts, enlisting in the Civil War, and ballooning.
    - www.connerprairie.org
- **Turtle Island Preserve**, Boone, North Carolina:
    - The site is "Turtle Island guides people through experiences with the natural world to enhance their appreciation and respect for life. We achieve this through a more comprehensive understanding of nature combined with the lessons of our elders and traditions."
    - Accommodations are primitive tents and log houses without bathrooms.
    - Camps for children and college-aged students are available as well as family visits.
    - http://turtleislandpreserve.org
- **Camp Hancock**, John Day, Oregon
    - Outdoor Science School at Hancock Field Station is an overnight camp for first to 12th graders lasting 5 days and costing $260/person April-June and $245/person Sept-Oct. The program is a science learning opportunity in the John Day Fossil Beds National Monument. Facilities are cabins with shared restrooms.

        - https://www.omsi.edu/program/outdoor-science-school-at-hancock-field-station-5-days
    - Family camp at Hancock Field Station, three-days over the summer includes hikes, wildlife and fossil exploration in the John Day Fossil Beds National Monument. $155-$205.
        - https://programs.omsi.edu/hancock-family-weekend
- **Polynesian Cultural Center**: Oahu, Hawaii
    - The facility has 42 acres with reproduction of 6 Polynesian villages. Guests can experience an authentic Polynesian luau, arts, history, games, and music of Pacific cultures.
    - http://www.polynesia.com
- **El Rancho de las Golondrinas**: Santa Fe, New Mexico
    - The 'Ranch of the Swallows' is a living history museum on 200 acres outside of Santa Fe, New Mexico. The museum opened in 1972 and is dedicated to the culture and heritage of Spanish Colonial New Mexico. The facilities include colonial buildings original to the site from the early 18th century and reconstruction of historical buildings from around the sate. Period appropriate celebrations, dance, and music are included in festivals and theme weekends.
    - https://golondrinas.org
    - 505-471-2261
- More living history museums: 10 best http://studenttravelplanningguide.com/a-dozen-top-living-history-museums/

Key Recreational Experiences:

- New Mexico has a thriving outdoor education and adventure market:
    - Riverside Nature Center: http://www.fmtn.org/252/Riverside-Nature-Center
    - Red Rock Park and Museum: http://www.gallupnm.gov/index.aspx?nid=207
    - Gallup Motocross Park: http://www.gallupnm.gov/index.aspx?nid=340
    - Gallup Hiking/Biking Trails: http://www.galluptrails.com/gallup-area-trail-info
    - Red Rock Balloon Rally: http://www.redrockballoonrally.com
- New Mexico has a thriving off road adventure market:
    - New Mexico Jeep Tours in Albuquerque, https://www.tripadvisor.com/Attraction_Review-g60933-d1771801-Reviews-New_Mexico_Jeep_Tours-Albuquerque_New_Mexico.html
    - New Mexico Adventure Company, Red River, http://www.bighornsports.us
    - Bobcat Pass Wilderness adventures, Red River, https://www.tripadvisor.com/Attractions-g28952-Activities-c61-t211-New_Mexico.html
    - Santa Fe Walkabouts, Santa Fe
    - Red River Off-road Day Tours, Red River
    - Santa Fe Jeep Tours, Santa Fe,
    - 4x4 By Fun, Santa Fe
    - Taos Jeep Tours day tours, Taos
- NM Outdoor: http://newmexicooutdoor.com
- NM Mountain Club: http://www.nmmountainclub.org

- Birdwatching: https://www.newmexico.org/birding/
- Albuquerque Biological Park, http://www.bioparksociety.org/main/
- Environmental Education Associates of New Mexico: http://eeanm.org
- Adventure Education, Prescott College http://www.prescott.edu/academics/study-areas/adventure-education

Expanding / Contracting

- Domestic marketable trips increased by 200,000 visitors to 32.2 million in 2013. (Orr, 2014)
- Camping, as reported by KOA (the nation's largest private campground system), reported that 2015 was a very strong year with a 10.8 percent increase in occupancy in the American Southwest. (Outdoor Recreation Outlook 2016 by American Recreation Coalition)
- Federal land camping reservations increased 19 percent from 2014 to 2015. Federal lands recorded more than 22 million visits in 2015, an increase of 31 percent from 2014. (Outdoor Recreation Outlook 2016 by American Recreation Coalition)
- New Mexico visitor spending increased by 7 percent from 2012 to 2013 (Orr, 2014)
- The New Mexico tourism industry jobs increased by 2 percent from 2012 to 2013 (Orr, 2014)
- Federal land camping reservations increased 19 percent from 2014 to 2015. Federal lands recorded more than 22 million visits in 2015, an increase of 31 percent from 2014. (Outdoor Recreation Outlook 2016 by American Recreation Coalition) http://www.outdoorfoundation.org/pdf/ResearchParticipation2014.pdf page 1
- National Parks within New Mexico generally indicate steady or increasing visitation for 2015. (National Parks Service)
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Economic Impacts

- 2014 County Business Patterns data (U.S. Census Bureau, 2016)
  - NAICS 721214: Recreational and Vacation Camps (except Campgrounds)
    - Total employees: 23,092
    - Total annual payroll: $831 million
    - Total establishments: 2,967
    - Average annual payroll/employee: $36,000
    - Average employees/establishment: 7.8
    - Average payroll/establishment: $280,000

A.13. Business Environment

State Rankings

- In a CNBC ranking of states by business-friendliness, **NM ranked 39th**. The categories where NM ranked below the median were: Workforce (42nd), Economy (38th), Quality of Live (36th),

Technology and Innovation (33rd), Education (34th), Business Friendliness (43rd), and Access to Capital (46th). In many of the categories, NM fell from their 2015 rank, including Workforce (from 16th to 42nd), Infrastructure (from 5th to 14th), Economy (from 24th to 38th), Quality of Life (from 24th to 36th), Business Friendliness (41st to 43rd), Cost of Living (13th to 25th), and Access to Capital (42nd to 46th). (CNBC, 2016)

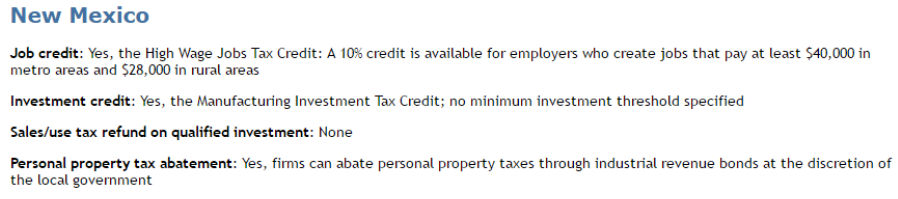
- **Forbes ranked NM 47th** in its "Best States for Business". Among the categories where it was ranked well below average were Labor Supply (45th), Regulatory Environment (33rd), Economic Climate (49th), Growth Prospects (34th), and Quality of Life (43rd). Poor quality of life ranking was attributed to comparatively low school test scores and high crime. (Forbes, 2015)
- The **Tax Foundation ranked NM 35th** on its Business Tax Climate Index. Two categories where NM ranked especially low were Individual Income Tax (35th) and Sales Tax (42nd). However, NM was ranked 1st in Property Tax. (Walczak, Drenkard, & Henchman, 2016)
- In 2015 **Chief Executive ranked NM 36th** in terms of its favorability to CEOs, down from 30th in 2014. This rankings are based on a survey of CEOs. (Chief Executive, 2015)
- In Chief Executive's 2016 survey, **NM edged up to 32nd**. In the three categories that were evaluated, NM ranked 34th in Taxation and Regulation, 47th in Workforce Quality, and 44th in Living Environment. Among the states included in the Southwest region (AZ, AR, OK, TX), NM ranked last in every category. (Chief Executive, 2016)
- A 2015 study compared effective tax rates between states for different kinds of businesses. Here's how NM fared: (Tax Foundation, 2015)

Type of Business	Existing		New	
	Rank	Effective Tax Rate	Rank	Effective Tax Rate
Corporate Headquarters	28th	13.8%	10th	8.8%
R&D Facility	24th	11.5%	5th	-0.2%
Retail Store	10th	13.1%	8th	22.2%
Capital-Intensive Manufacturing	27th	11.0%	37th	12.1%
Labor-Intensive Manufacturing	31st	10.2%	21st	8.5%
Call Center	24th	19.2%	22nd	23.6%
Distribution Center	12th	21.8%	19th	27.4%

- New Mexico's three-factor apportionment and sourcing rules which impose state taxes based on the location of the income-producing activity **work to the detriment of firms that sell out of state**. The state imposes a throwback rule, with an exemption for manufacturers. Although equipment is included in the state's property tax base, **overall property tax burdens in New Mexico are generally light**. However, **manufacturing machinery and research and development (R&D) equipment are also subject to sales tax**, driving up costs for those firms. New Mexico ranks 10th for the mature retail establishment, which, with an effective tax rate of 13.1 percent, has **low income and property tax burdens that help offset a high sales tax burden**. The state's **new manufacturing operations experience at best middle of-the-road tax burdens**. Although these operations enjoy **low income and property tax burdens thanks to generous tax incentives**, they experience **the highest sales tax burdens in the nation** for their firm types, along with **above-average unemployment insurance** tax burdens. **New R&D facilities actually experience a negative effective tax rate** of -0.2 percent in New Mexico, meaning that the firm is subsidized through the tax code. The firm experiences **low property tax burdens along with a negative income tax burden due to the state's R&D credit**. The mature firm, by contrast,

experiences an 11.5 percent tax burden. The state ranks 31st for mature labor-intensive manufacturing with an effective tax rate of 10.2 percent. While the firm enjoys the **fourth lowest property tax burden** of its firm type, it also bears the **second highest sales tax burden**. The firm's moderate income tax burden would be even higher if the state did not exempt manufacturers from its throwback rule. (Tax Foundation, 2015)

State Incentives

- 

(Government of Nebraska, 2012)
- Tax incentives listed by NM EDD (those listed below are not duplicated here) (New Mexico Wine & Grape Growers Association, 2016)
    - **Consumables Gross Receipts Tax Deduction for Manufacturers:** A seller may deduct receipts from sales to a manufacturer of tangible personal property that becomes an ingredient or component part of a manufactured product. The deduction will be 100% at the beginning of next year. This could apply to industrial gas or petrochemical manufacturers.
- Tax incentives listed on Business Facilities (Business Facilities, 2016)
    - **Agricultural Business Tax Deductions and Exemptions**:
        - Feed for livestock, including the baling wire or twine used to contain the feed, fish raised for human consumption, poultry or animals raised for hides or pelts and seeds, roots, bulbs, plants, soil conditioners, fertilizers, insecticides, germicides, insects, fungicides, weedicides and water for irrigation
        - Warehousing, threshing, cleaning, harvesting, growing, cultivating or processing agricultural products including ginning cotton and testing and transporting milk
        - Feeding, pasturing, penning, handling or training livestock and, for agribusinesses, selling livestock, live poultry and unprocessed agricultural products, hides and pelts
        - 50% of receipts from selling agricultural implements, farm tractors or vehicles
        - Receipts from sales of veterinary medical services, medicine or medical supplies used in the medical treatment of cattle if the sale is made to one of the following:
        - A person engaged in the business of ranching or farming, including dairy farmers
        - A veterinarian who is providing veterinary medical services, medicine or medical supplies in the treatment of cattle owned by a person engaged in the ranching or farming business
    - **Alternative Energy Product Manufacturer's** Tax Credit: Manufacturers of certain alternative energy products may receive a tax credit not to exceed 5% of qualified expenditures for purchase of manufacturing equipment used in the manufacturing operation. This credit is designed to stimulate the development of new alternative energy manufacturing facilities.

- **High Wage Jobs** Tax Credit: A taxpayer who is an eligible employer may apply for and receive a tax credit for each new high-wage economic-base job. The credit amount equals 10% of the wages and benefits paid for each new economic-base job created.
  - Qualified jobs:
    - Pays at least $40,000/year in a community with a population of less than 40,000 for jobs created after July 1, 2015
    - Pays at least $60,000/year in a community with a population of 40,000 or more for jobs created on or after July 1, 2015
    - Occupied for at least 48 weeks by the employee
  - Qualified employers:
    - Are growing with employment greater than the previous year; and
    - Made more than 50% of its sales to persons outside New Mexico during the most recent 12 months of the employer's modified combined tax liability reporting periods ending prior to claiming this credit; or
    - Are eligible for the Job Training Incentive Program
    - Qualified employers can take the credit for 4 years. The credit may only be claimed for up to one year after the end of the four qualifying periods. The credit can be applied to the state portion of the gross receipts tax, compensating tax, and withholding tax. Any excess credit will be refunded to the taxpayer. The credit shall not exceed $12,000 per year, per job.
  - Qualified employees:
    - Must be a resident of New Mexico
    - Cannot be a relative of the employer or own more than 50% of the company
- **Investment Tax Credit for Manufacturers**: Manufacturers may take a credit against gross receipts, compensating or withholding taxes equal to 5.125% of the value of qualified equipment when the following employment conditions are met:
  - For every $500,000 of equipment, 1 employee must be added up to $30 million; and
  - For amounts exceeding $30 million, 1 employee must be added for each $1 million of equipment
  - The credit may (also) be claimed for equipment acquired under an IRB. This is a double benefit because no gross receipts or compensating tax was paid on the purchase or importation of the equipment.
  - The manufacturer simply reduces its tax payment to the state (by as much as 85% per reporting period) until the amount of investment credit is exhausted. There also are provisions for issuing a refund when the credit balance falls under $500,000. The credit does not apply against local gross receipts taxes.
- **Rural Jobs Tax Credit**: This credit can be applied to taxes due on (state) gross receipts, corporate income, or personal income tax. Rural New Mexico is defined as any part of the state other than Los Alamos County; certain municipalities: Albuquerque, Rio Rancho, Farmington, Las Cruces, Roswell, and Santa Fe; and a 10-mile zone around those select municipalities.

- Company eligibility:
  - Companies that manufacture or produce a product in New Mexico
  - Non-retail service companies that export a substantial percentage of services out of state (50% or more revenues and/or customer base)
  - Certain green industries
- The rural area is divided into 2 tiers:
  - Tier 2 = Non-metro area municipalities that exceed 15,000 in population: Alamogordo, Carlsbad, Clovis, Gallup, and Hobbs
  - Tier 1 = Everywhere else in a rural area
- The maximum tax credit amount with respect to each qualifying job is equal to:
  - Tier 1: 25% of the first $16,000 in wages paid for the qualifying job (may be taken at $1,000 per year for four years)
  - Tier 2: 12.5% of the first $16,000 in wages paid for the qualifying job (may be taken at $1,000 per year for two years)
- A qualifying job is a job filled by an eligible employee for 48 weeks in a 12-month qualifying period. The credit may be carried forward for up to three years.

- **Wind Energy Equipment Gross Receipts Tax Deduction**: New Mexico provides a gross receipts tax deduction for receipts from selling wind turbines, nacelles, rotors, blades and related equipment to a state or federal government entity.
- **Job Training Incentive Program** (JTIP): Funds classroom and on-the-job training for newly created jobs in expanding or relocating businesses for up to six months. It reimburses 50% to 75% of employee wages. Custom training at a NM public educational institution may also be covered. Companies that manufacture or produce a product in New Mexico, non-retail service companies that export a substantial percentage of services out of state (50%+ of revenues and/or customer base) and certain green industries are eligible. The company must be financially sound and creating new jobs as a result of expansion or relocation to NM. Businesses in certain industries are not eligible (e.g., agriculture, construction, gambling, health care and retail). Jobs eligible for funding must be full time (min. 32 hours per week), year-round and directly related to the creation of the product or service. Trainees must be guaranteed full-time employment upon successful completion of the training program. To be eligible for funding, trainees must be new hires to the company, have been residents of the state for at least one year at any time prior to employment in an eligible position and not have left high school in the three months prior to employment, unless they have graduated or completed a GED.

Local Incentives

- **Property tax exemption:** The governing body of a county or a municipality may, by a majority vote of the elected members, adopt a resolution exempting commercial personal property of a new business facility located in the county or municipality from the imposition of any property tax on commercial personal property authorized to be imposed by the respective governing body. The exemption authorized by 3-64-3A NMSA of this section may be for up to 100% of the

value for property taxation purposes of the property exempted. The exemption may not exceed more than 20 years. (Greater Gallup Economic Development Corporation, n.d.)

- **Industrial Revenue Bonds:** Pursuant to the Industrial Revenue Bond Act, New Mexico municipalities and counties are authorized to issue IRBs to stimulate the expansion and relocation of commercial and industrial projects in the state. IRB financing for land, buildings and equipment is available for: Headquarter office buildings; Warehouses; Manufacturing facilities; Service-oriented facilities not primarily engaged in the sale of goods and commodities at retail; A 501(c)3 non-profit organization; and All expenses, attorneys', engineering and architects' fees, premiums and commissions deemed necessary. (Greater Gallup Economic Development Corporation, n.d.)
- **Local Economic Development Act:** Allows communities the option of offering local government aid to qualifying business entities for economic development projects. One of LEDA's advantages is that it allows municipalities and counties to enter into joint powers agreements to plan and support regional economic development projects. The source of public money used to fund economic development projects can come from up to 5% of the annual General Fund (GF) expenditures of the local government in that fiscal year. Economic development projects must create new job opportunities and result in facilities to support new or expanding businesses. Development plans or ordinances adopting plans must include safeguards including specific ways local government will recover costs, land, buildings, or other thing of value if the business quits, leaves area, or otherwise fails to live up to contractual or implied obligations.
- **Local Options Gross Receipts Tax**: Communities that have already passed the Local Economic Development Act (LEDA) are able to pass a LOGRT. The community votes to raise its LOGRT. The rate is set at 1/8 of 1%. Revenue must be used for economic development projects. The LEDA - LOGRT allows communities the option of designating two of its four increments of the MIGR for economic development plans, payment of bonds, and infrastructure improvement. In the event a community passes a LEDA and allocates 5% of the General Fund for economic development, LOGRT provides the community with a source of additional revenue to completely fund the economic development project.
- **New Mexico Community Capital:** New Mexico Community Capital's mission is "to improve the lives of New Mexicans, particularly those in rural and economically under-served areas, by investing in New Mexican businesses, helping those companies prosper, and contribute to their communities." The average investment of NMCC is $500,000 to $1m targeted at businesses with sales of at least $500,000, with a positive cash flow and sales growth, experienced management, and at least five full time employees. 40% of investment is targeted outside the Rio Grande corridor. NMCC looks for underserved businesses and communities with businesses in light **manufacturing**, consumer business & services, consumer products, **food processing**, artisan and tourism, and **sustainable energy** and **environmental remediation.**