COMMUNITIES LEAP
U.S. DEPARTMENT OF ENERGY

Is Clean Hydrogen Production a Good Fit for Questa?

Final Economic Impact Results

July 2024

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National Renewable Energy Laboratory (NREL)

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Foreword (1 of 2)

From 2022 to 2024 a coalition of stakeholders in the Village of Questa, NM partnered with the U.S. Department of Energy's Communities Local Energy Action Program (LEAP) to explore options to develop electrolytic hydrogen production facilities to create jobs, provide clean energy, and utilize former mine resources. In the project's first phase, the National Renewable Energy Laboratory (NREL) provided technical assistance to assess the economic feasibility of constructing solar PV-powered hydrogen facilities at Chevron's former molybdenum mine site and tailing facility, including a grid-tied hydrogen energy storage facility (Topolski et al. 2023). This economic impact assessment report extends the grid-tied energy storage application findings of the original feasibility study to estimate potential impacts on jobs, earnings, and tax revenues. The findings of the previous study and this report are intended to inform the Village of Questa and broader Taos County communities of possible scope, costs, benefits, risks, and next steps of electrolytic hydrogen development, recognizing that the assessment is necessarily incomplete and uncertain given the commercial novelty of clean hydrogen technologies.

This economic impact assessment report relies on the technoeconomic financial analysis conducted in the first phase of the project (Topolski et al. 2023), and on an input-output model applied to the economy of Questa and the surrounding area, the rest of Taos County and the state of New Mexico. Key assumptions used in the first phase financial analysis include estimates of 2027 electrolyzer and fuel cell costs based on global deployment projections; Kit Carson Electric Cooperative (KCEC) service territory projected net load, PV capacity, and storage capacity for 2027; 2021 solar PV generation profiles; a heuristic dispatch strategy for local solar, battery energy storage, and hydrogen energy storage; and ability to claim the full value of Inflation Reduction Act incentives. The economic impact assessment relies on data describing economy-wide linkages and spending patterns in New Mexico in 2019 as well as input data sourced from Questa Communities LEAP coalition members and average national workforce characteristics. This study does not address, e.g., a full range of possible costs for early-stage commercial polymer electrolyte membrane (PEM) electrolyzers, PEM fuel cells, and hydrogen storage; implications of multiple weather years for system sizing and operations; quantification of resiliency benefits; a full accounting of water use; water sourcing; project financing and incentives; cost recovery and ratepayer impacts; changes in economic structure post-COVID-19; potential increased demand on public services (safety, roads, water treatment, housing, schools, etc.); environmental impacts; cultural impacts; asset ownership; distribution of benefits; or workforce training needs.

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Foreword (2 of 2)

Given the uncertainty of some study inputs, as well as the many aspects of procuring, constructing, and operating a hydrogen energy storage facility not addressed in this study, this report is intended for discussion purposes only and should not be the sole basis of future design or investment decisions. It should not be used to estimate or extrapolate the impact of hydrogen projects of different scales and use cases. The purpose of this report and the overall study is to provide information to the Questa Community Coalition and surrounding community members. The authors, NREL, U.S. Department of Energy, and Communities Local Energy Action Program (LEAP) are not recommending any specific course of action.

Development of any kind comes with tradeoffs that must be considered by community leaders and residents. Choosing a specific economic development path can impact or present tradeoffs between land use, water use, allocation of public services, and the job functions of community members. For the community to determine if hydrogen is a good fit for Questa, they could pursue additional activities such as: assessment of other technology options to provide clean electricity; assessment of other economic development opportunities; hydrogen workforce gap analysis; third-party validation, cost-benefit analysis, and safety design of hydrogen facilities described in this study or otherwise under consideration; ensure leaders are providing continuous, transparent and meaningful outreach and engagement; develop community benefit agreements and workforce development programs.

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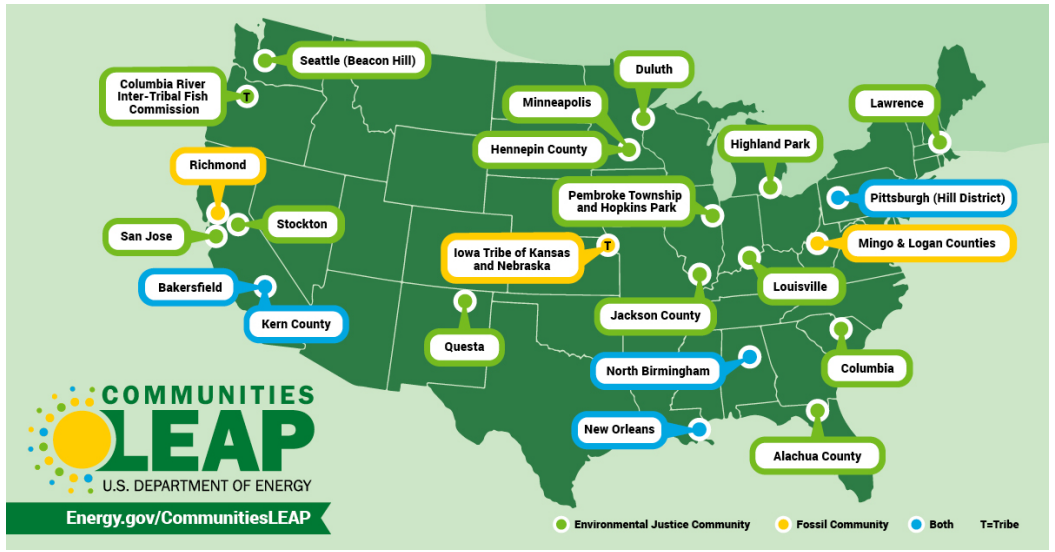
Project Background

Overview and Introduction: Why Hydrogen? And How Did We Get Here?

Kit Carson Electric Cooperative (KCEC) has been exploring alternatives to meet its membership-driven 100% renewable energy goals in advance of the New Mexico legal mandate for rural co-ops to transition to carbon-free electricity by 2050. Questa Community Coalition members see potential economic development and brownfield reuse benefits of clean hydrogen production in Questa.

- The Communities Local Energy Action Program (LEAP) facilitates community-wide economic empowerment, local environmental improvements, and other benefits through clean energy deployment in communities that are low-income, energy-burdened, experiencing environmental justice impacts, or experiencing a shift away from economic reliance on fossil fuels.
- This coalition applied for a Communities LEAP technical assistance grant to study the feasibility and potential impacts of clean hydrogen development in Questa.
- Questa is one of the 24 communities selected for the Communities LEAP Pilot.

Questa LEAP Coalition members and NREL team visit the hydrogen test bed facility at the Flatirons campus in Boulder County on December 9, 2022. *Photo by Ryan Weeks, NREL*



Map of communities participating in the LEAP Pilot. *Illustration by DOE*

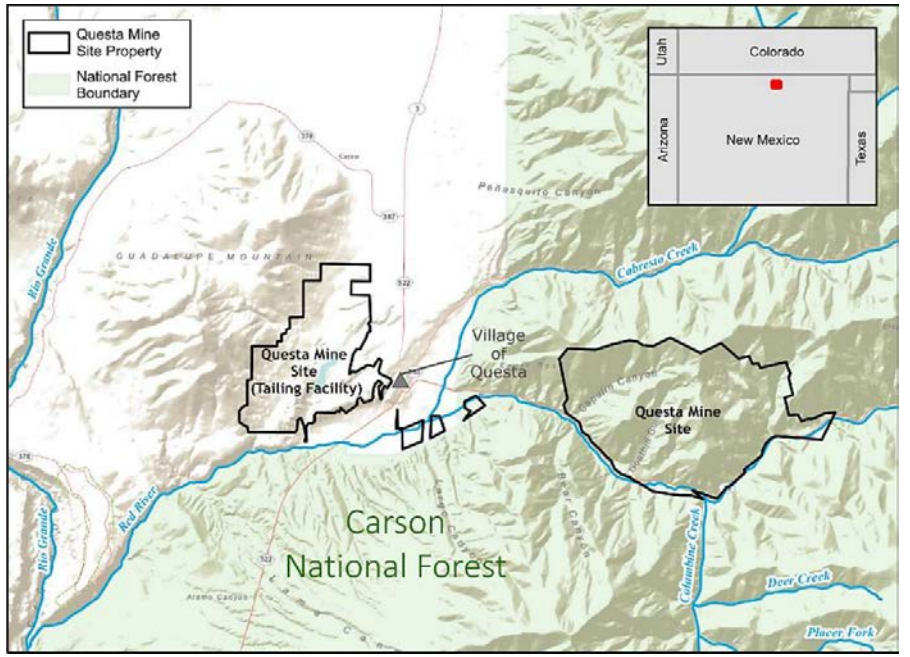
Questa's Communities LEAP Application

What?

- Study whether it would be beneficial to reuse mine and local resources (i.e., land, water) to produce electrolytic hydrogen.

Why?

- Deliver clean, reliable electricity during non-solar and other hard-to-serve times (KCEC)
- Create jobs in Questa (Village of Questa, Chevron)
- Attract more economic activity (Village of Questa, Chevron)
- Increase tax base (Village of Questa)
- Put existing assets to beneficial use (Chevron)
- Maintain affordable energy bills during the transition to clean electricity (KCEC, Village of Questa)
- Support corporate carbon-reduction goals (Chevron)
- Be a replicable model for other rural and Tribal communities (KCEC, Village of Questa).



Map of former molybdenum mine site and tailings facility located in Questa, New Mexico. *Map by EPA* https://onrt.env.nm.gov/wp-content/uploads/2018/05/Final-Questa_RPEA_5.21.18.pdf.

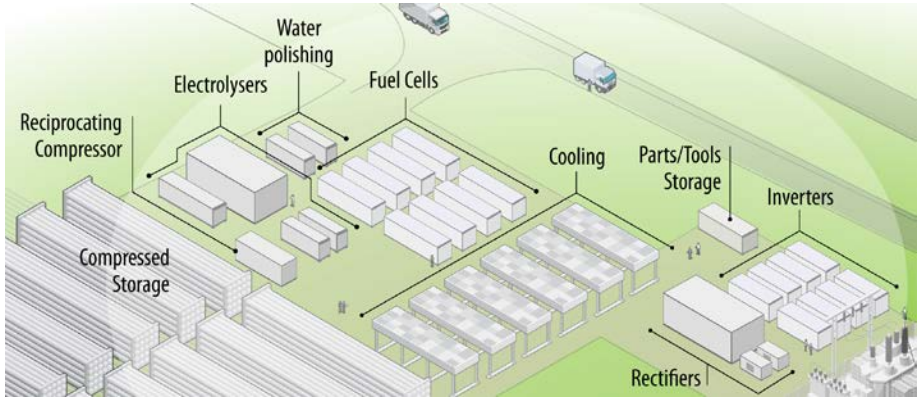
KCEC is looking beyond their 100% daytime solar goal.

KCEC solar panels generate daytime power. *Photo by KCEC* https://kitcarson.com/electric/100-daytime-solar-energy-by-2022/.

Previous Work: Economic Feasibility

Facility A: Grid-Connected Energy Storage*

- Facility A is to store and supply excess solar power for KCEC
- 7.5 MW discharge capacity and 36-hr storage duration
- Estimated levelized cost of electricity = $0.45/kWh of round-tripped electricity (with incentives).



Conceptual rendering

Illustration by Alfred Hicks, NREL

Facility B: Heavy-Duty Vehicle Fueling

- Facility B is to support Chevron heavy-duty fuel cell vehicle refueling.
- Annual capacity of 157 tons/yr of on-demand 700-bar hydrogen gas for heavy- duty fuel cell vehicle refueling.
- Levelized cost of hydrogen = $6.06/kg of 700 bar hydrogen ($4.86/gal diesel equiv., with incentives).

Light-duty hydrogen fueling facility in La Cañada, CA

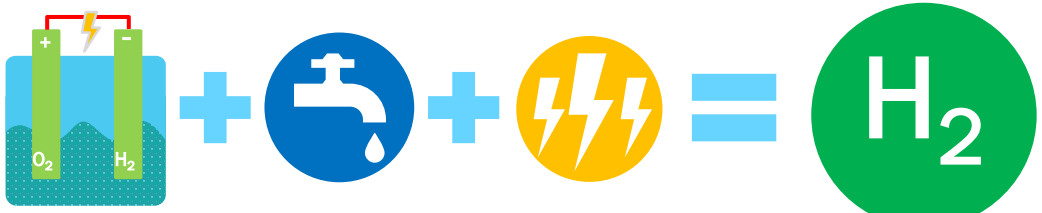
Photo by Dennis Schroeder, NREL

*This presentation focuses on the economic impacts of Facility A only.
Details for Facilities A and B are available in https://www.nrel.gov/docs/fy23osti/86665.pdf.

Previous Work: Facility A Techno-Economic Impact Summary*

- Equipment configuration and size:
  - 32-MW polymer electrolyte membrane (PEM) electrolyzer
  - 14 metric ton compressed hydrogen gas storage (36 hours of fuel cell operation)
  - 7.5-MW PEM fuel cell
  - 15-MW solar photovoltaic (PV) array.
- Results:
  - $44.5 MM overnight capital cost **without** incentives
  - $0.45/kWh of round-tripped electricity **with** incentives.
- Assumptions:
  - Projected 2027 technology costs
  - $3/kg Hydrogen Production Tax Credits from the Inflation Reduction Act for electrolyzer, rectifier
  - 40% Inflation Reduction Act Investment Tax Credit for hydrogen storage, fuel cell, inverter.
- Limitations:
  - Simple power dispatch strategy for KCEC's local PV, batteries, and hydrogen storage assets, assuming 2021 weather
  - Does not assess tax credit qualification given U.S. Department of Treasury proposed rulemaking (*Federal Register* 2023).

Grid-connected **electrolyzer** annual summary



32-MW electrolyzer | **5.34 acre-ft of water/year** | **25.9 GWh/yr of excess electricity** | **460 metric tons of hydrogen/year**

Grid-connected **fuel cell** annual summary

460 metric tons of hydrogen/year | **7.5-MW fuel cell** | **0.27 acre-ft of water/year** | **9 GWh/yr of round-tripped electricity**

*Results from https://www.nrel.gov/docs/fy23osti/86665.pdf

Economic Impact Assessment Results

Overview: Economic Impact Analysis

Temporary Effects

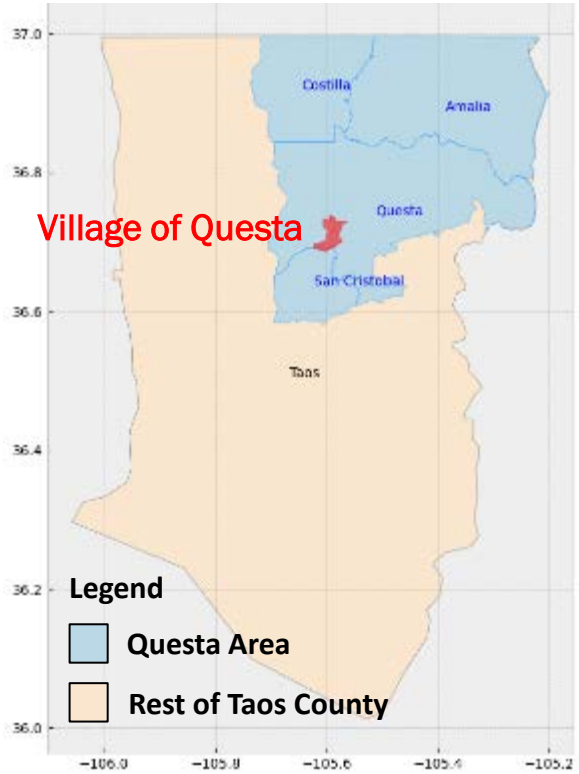
Hydrogen Facility Construction

Example electrolyzer.
Photo by John De La Rosa, NREL 34729

Solar Plant Construction

Solar PV construction jobs
Photo by Dennis Schroeder, NREL 40822

Impacts on Jobs, Earnings, Taxes



Taos County and Village of Questa area boundaries (in blue).
Image by Francisco-Solis and Atom. Data from U.S. Census Bureau

Permanent Effects

Hydrogen Facility Operation and Maintenance (O&M)

Example above-ground hydrogen storage
Photo by Werner Slocum, NREL 72174

Solar Plant O&M

Solar PV maintenance jobs
Photo by Dennis Schroeder, NREL 46281

Questa Economic Impact Assessment Approach

- **Goal:** Estimate potential local (Village of Questa), regional (Taos County), and state (New Mexico) economic effects of constructing and operating a new hydrogen facility and solar plant in Questa, NM.

- **Method:** Input-Output Analysis is a commonly used framework for estimating economic impacts from a change in demand in a region.

- **Main data sources:**
  - **Economic IMpact Analysis for PLANning (IMPLAN; IMPLAN 2023)**: 2019 input-output tables for New Mexico counties:
    - **NREL**: hydrogen facility construction and operation cost data, solar facility operation cost data.
    - **Kit Carson**: solar facility construction cost data (Topolski et al. 2023).

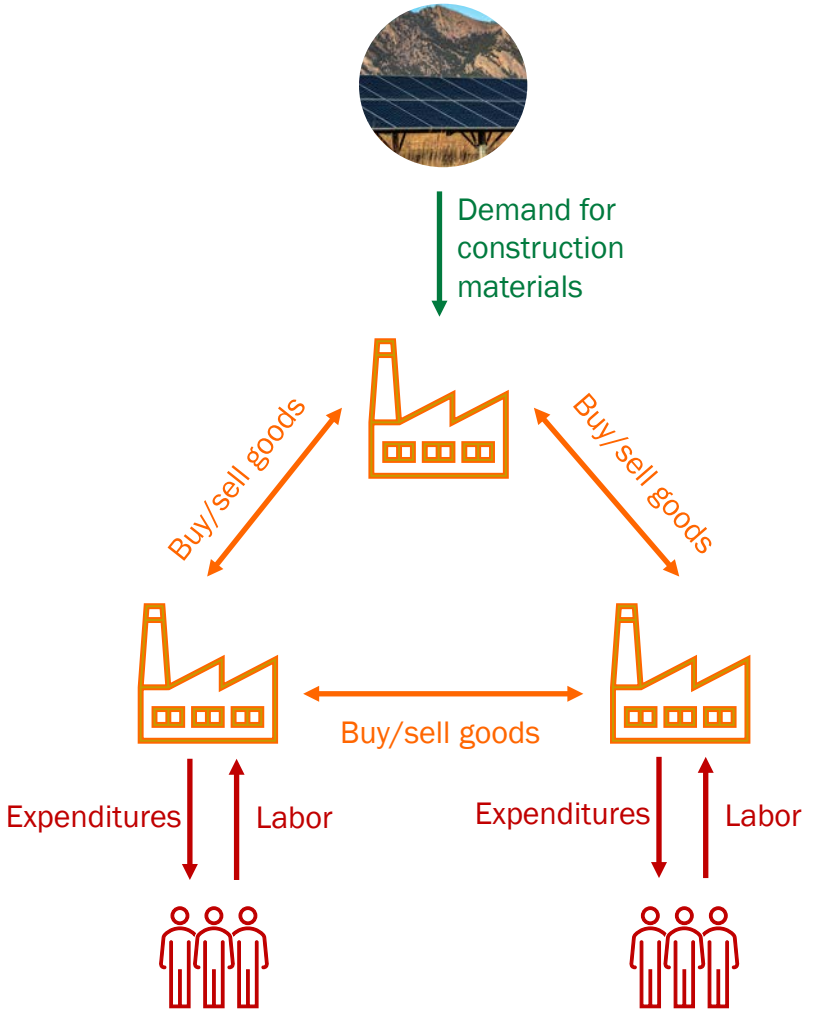
Methodology

Input-Output Analysis

The accounting system underlying input-output analyses describes the structure of the economy as a network of sectors that sell to one another, to local households and governments, and to external markets.

This analysis estimates impacts on all sectors in the region, as it considers all supply chains simultaneously.

IMPLAN* provides the input-output data used in this analysis.



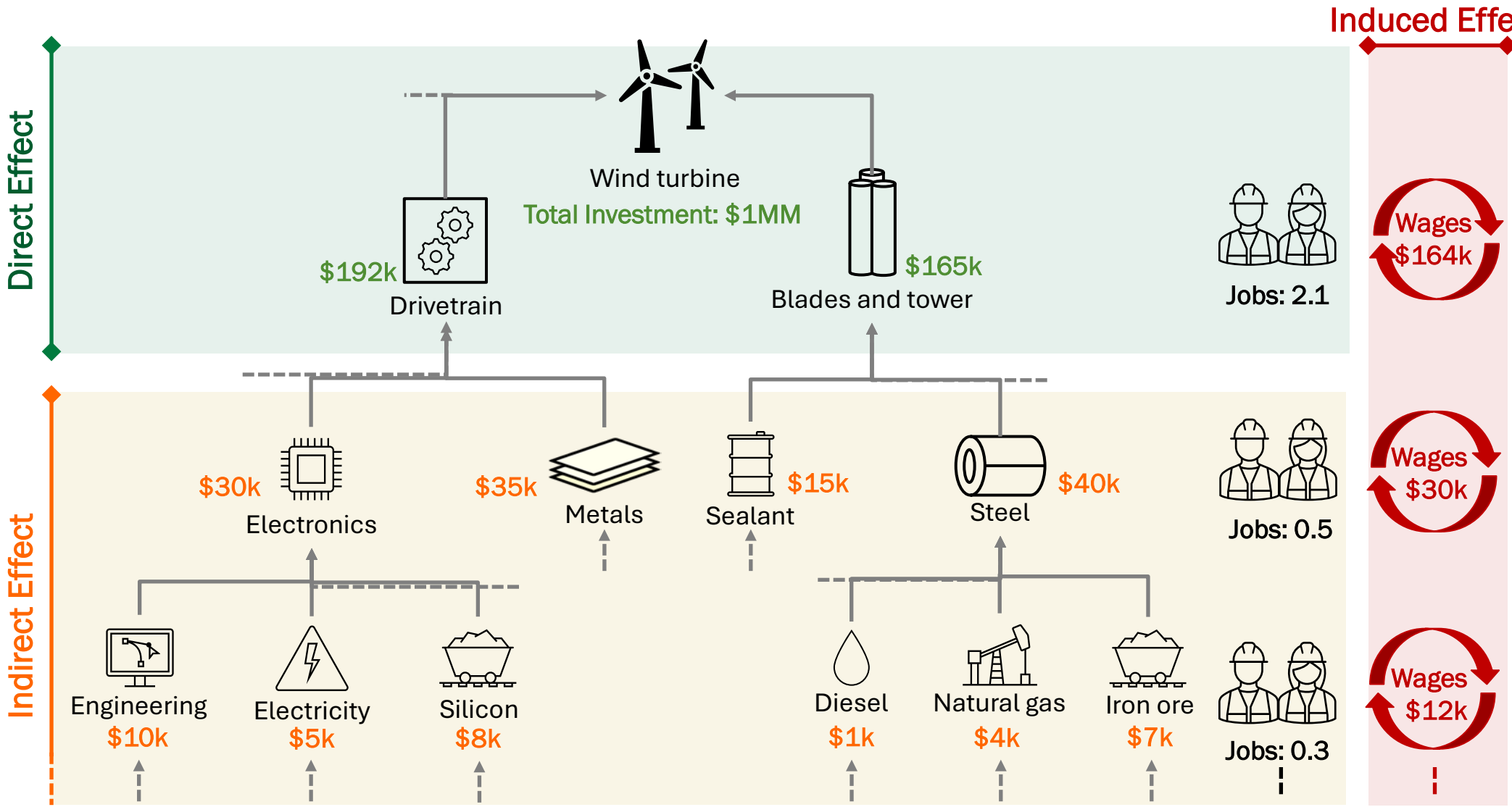
DIRECT Effect
Total investment

INDIRECT Effect
Supply chains

INDUCED Effect
Labor expenditures

*See https://implan.com/.

Example of Multiplier Effect



INDUSTRIAL OUTPUT

Direct	$1,000k
Indirect	$194k
Induced	$486k
Total	$1,680k

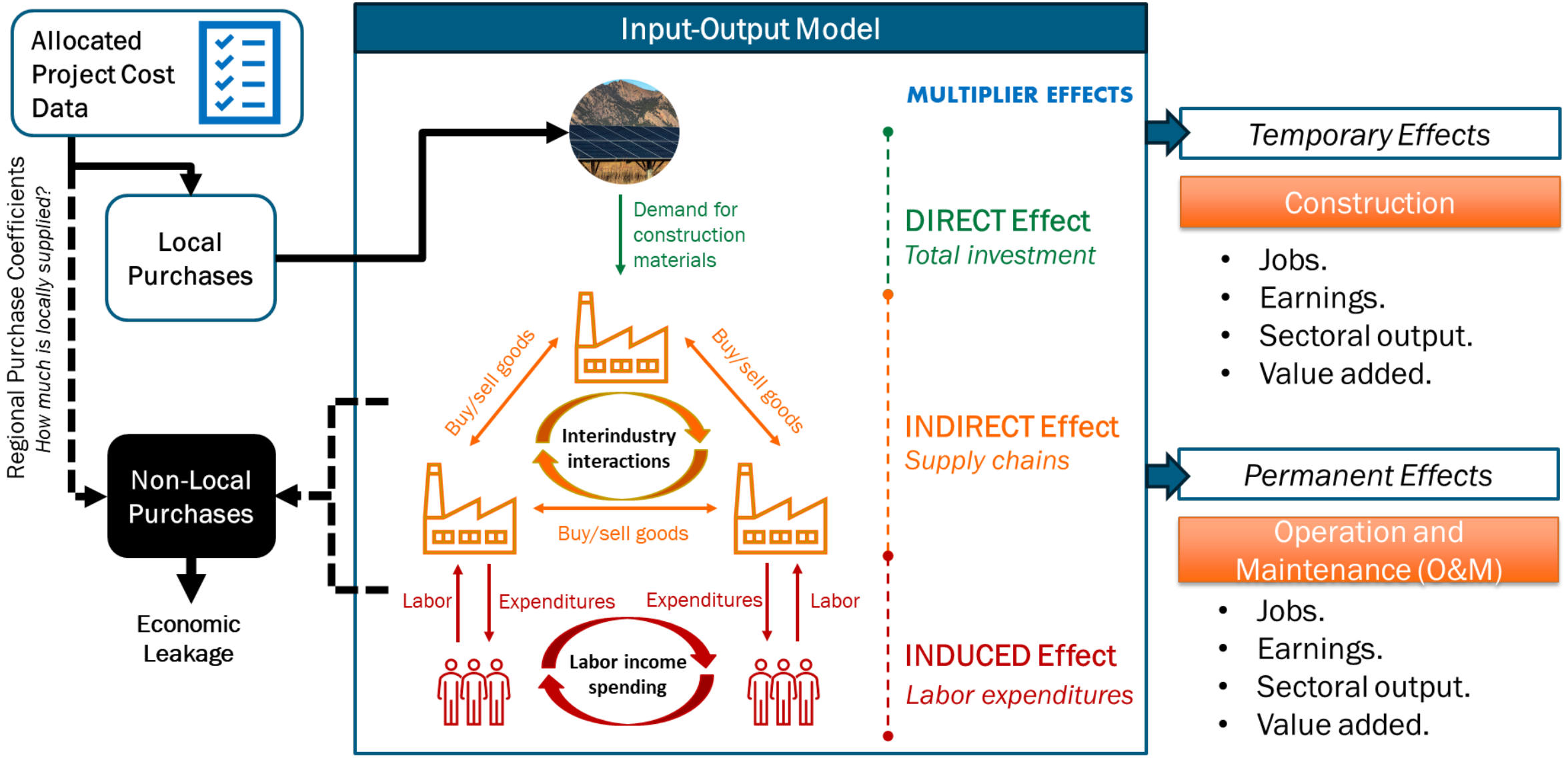
Output multiplier: 1.6 $/$ inv.

JOBS

Direct	2.11
Indirect	0.96
Induced	2.51
Total	5.58

Jobs multiplier: 5.6 jobs/$MM inv.

Economic Impact Analysis Methodology



Economic Metrics Definitions

- **Jobs**: Sum of full-time equivalent (FTE = 2,080 hr/yr) workers employed at the place of business. All jobs *supported* by local companies are accounted for, including those of out-of-state commuters (who might spend part of their wages outside the state). Includes salary and wage employees + proprietors (business owners, partners, and tax-exempt cooperative members).

- **Value added**: Represents the wealth generated by an economic activity and includes compensation of employees (wages and benefits), profit-type income, property income, and taxes on production.

- **Earnings**: The portion of the **value added** that represents pre-tax total compensation of employees (wages and benefits) and proprietor income (income of sole proprietorships, partnerships, and tax-exempt cooperatives).

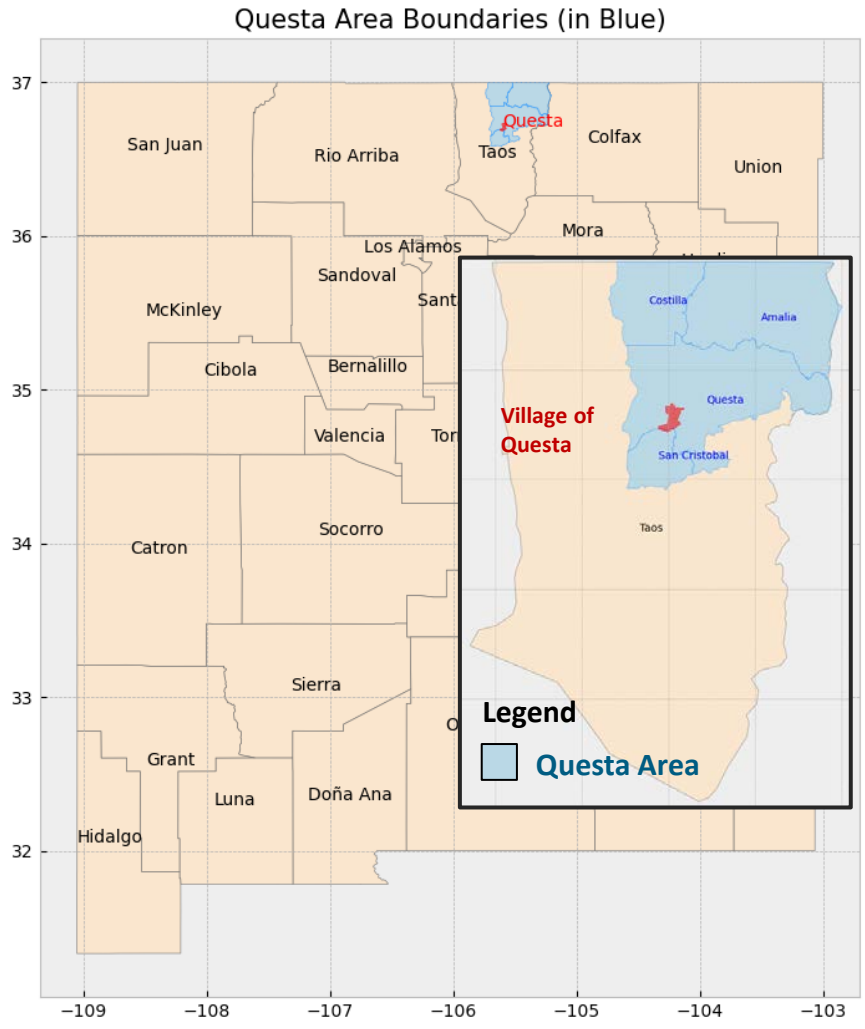
- **Tax revenue**: Represents local, county, and federal **taxes** collected throughout the production process.

Data and Assumptions

Assumptions

Economic Area: "Questa Area" comprises 5 ZIP codes (87512, 87519, 87524, 87556, 87564).

- **IMPLAN data** were adjusted to better reflect current conditions expressed by the coalition members.
- **Cost allocation** is primarily based on IMPLAN's regional purchase coefficients (i.e., % of local purchases by sector), information from the coalition, and availability of suppliers in NM. Our Mid scenario assumptions for suppliers are:
  - The electrolyzer and stationary fuel cells are supplied by NM companies located outside Taos County. Solar modules are imported from outside the United States.
  - Engineering services come from the rest of Taos County and the rest of New Mexico, and building permits go through Taos County.
- **Additional scenarios** were developed to explore sensitivities in which suppliers are more or less local than in our Mid scenario.



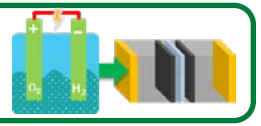
Taos County and Village of Questa area boundaries (in blue).
Image by Francisco-Solis and Atom. Data from U.S. Census Bureau

Three Scenarios' Specifications

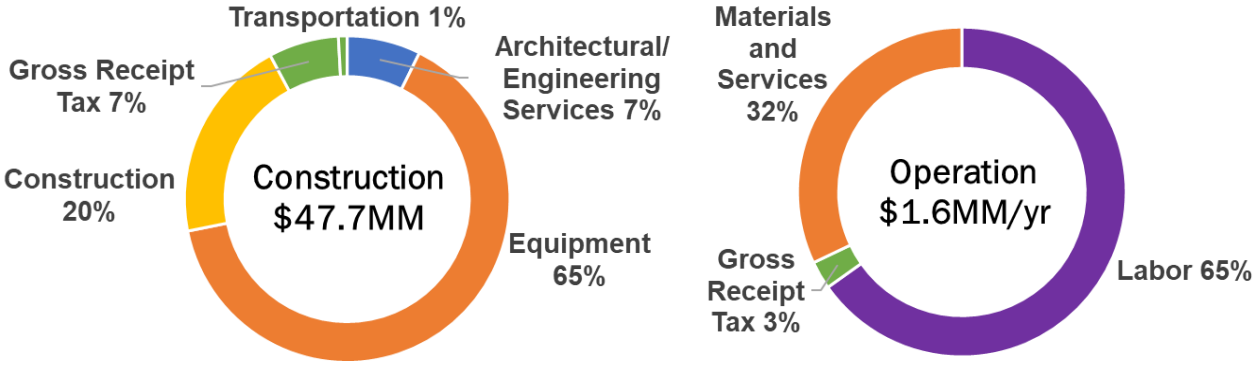
		Least Local Scenario	Mid Scenario	Most Local Scenario
Hydrogen Facility	Electrolyzer	Outside NM	NM	NM
	Stationary fuel cells	Outside NM	NM	NM
Solar Facility	Modules	Outside NM	Outside NM	NM
	Electrical equipment	Outside NM	NM	NM
Services	Construction	Rest of Taos County	Rest of Taos/Questa	Questa area
	Engineering	Outside NM	NM/Rest of Taos	Rest of Taos County
	Transportation	Outside NM	NM/Rest of Taos/Questa	Questa area
O&M	Labor	Rest of Taos County	Questa area	Questa area
	Parts/services	Outside NM	NM	NM
	Construction phase:	*Only construction impacts in NM.*	*Uses currently available information about suppliers + average regional purchase coefficients.*	*All equipment, materials, and services are sourced from NM.*
	Operation phase:	*Workers come from outside Questa.*	*Labor breakdown between Questa/Taos.*	*Most of the labor comes from Questa.*

Cost Assumptions

Hydrogen Facility A: Grid-Tied

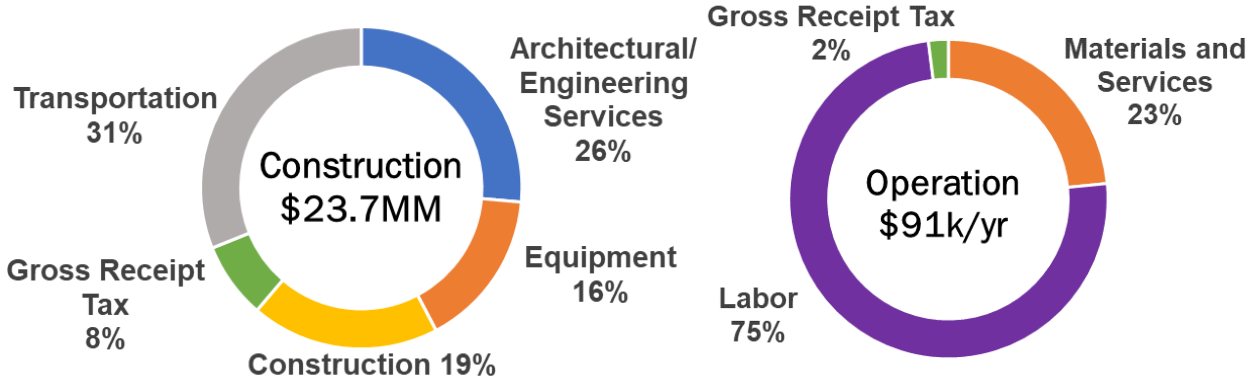


- **Location:** Chevron tailing facility under consideration.
- **Equipment configuration and size:**
  - 32-MW PEM electrolyzer
  - 14-ton compressed hydrogen gas storage
  - 7.5-MW PEM fuel cell.
- **Cost Data:** NREL (Facility A case study) (Topolski et al. 2023).



Solar Facility

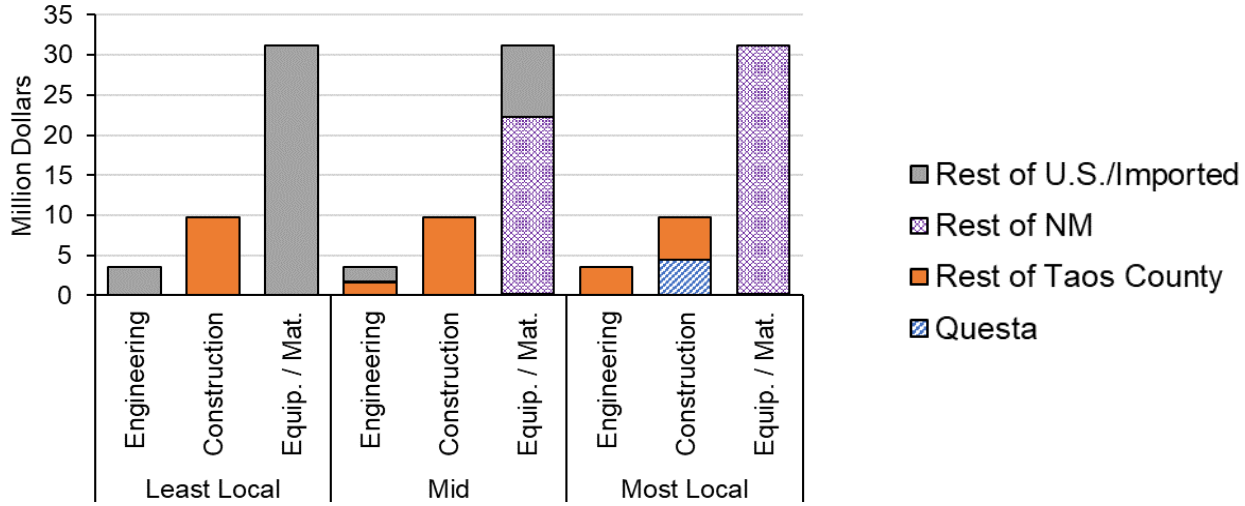
- **Location:** Chevron tailing facility under consideration.
- **Equipment configuration and size:**
  - 15 MW
  - Single-axis tracking system
  - Total area ~120 acres.
- **Cost Data:** Based on Kit Carson Taos-Mesa Solar Facility (15 MW) and Jobs and Economic Development Impacts (JEDI) PV Model (rel. PV05.20.21) (NREL 2021).



Construction Cost Allocation across Regions and Scenarios

Hydrogen Facility A: Grid-tied

Source of materials and services

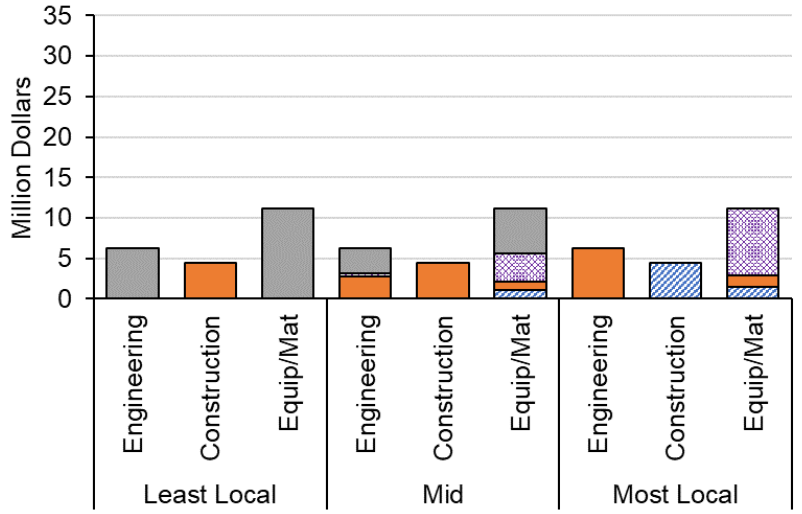


Location of suppliers as a % of total costs

	Least Local	Mid	Most Local
Questa	0%	0.4%	10.2%
Rest of Taos County	21.8%	25.2%	19.8%
Rest of NM	0%	50.4%	70%
Rest of U.S./Imported	78.2%	24%	0%

Solar Facility

Source of materials and services



Location of suppliers as a % of total costs

	Least Local	Mid	Most Local
Questa	0%	5.7%	27.2%
Rest of Taos County	20.5%	37.3%	35.2%
Rest of NM	0%	18%	37.6%
Rest of U.S./Imported	79.5%	39%	0%

Results and Conclusions

Overview of Results: Hydrogen and Solar Facilities (Mid Scenario)

	Jobs (FTE)	Earnings (Thousand $)	Tax Revenue (Thousand $)
Construction *(Temporary Impacts)*			
Questa	11	$600	$800
Taos County	235	$9,300	$900
New Mexico	164	$10,700	$4,600
Total	410	$20,600	$6,300
O&M *(Annual Impacts)*			
Questa	11	$1,100	$214
Taos County	5	$200	$570
New Mexico	4	$300	$400
Total	20	$1,600	$1,220

Note: Monetary values are in 2020 dollars. Numbers may not add up due to rounding.
**Earnings include both wages/salaries and benefits as well as proprietor income.*

Detailed Results: All of NM (Mid Scenario)

Top Occupations Directly Supported during Construction

SOC	Occupation Description	FTE	Median Profile Requirements		
			Education	Training	Experience
53-3032	Heavy and tractor-trailer truck drivers	14	High school[a]	1-3 mo	6 mo-1 yr
51-2028	Electrical, electronic, and electromechanical assemblers[b]	7	High school	3-6 mo	6 mo-1 yr
47-2061	Construction laborers	6	High school	3-6 mo	1-3 mo
43-9061	Office clerks, general	5	Some college	1-3 mo	1-2 yr
47-2031	Carpenters	4	High school	1-2 yr	1-2 yr
53-7062	Laborers and freight, stock, and material movers, hand	4	High school	<1 mo	<1 mo
47-2111	Electricians	4	High school +[c]	2-4 yr	4-6 yr
11-1021	General and operations managers	3	Associate's degree	3-6 mo	2-4 yr
47-1011	First-line supervisors of construction trades and extraction workers	3	High school +	6 mo-1 yr	1-2 yr
	Proprietors (construction, transportation general, and subcontractors)[d]	83			

[a]A commercial driver's license (CDL) truck driver job requires a CDL.

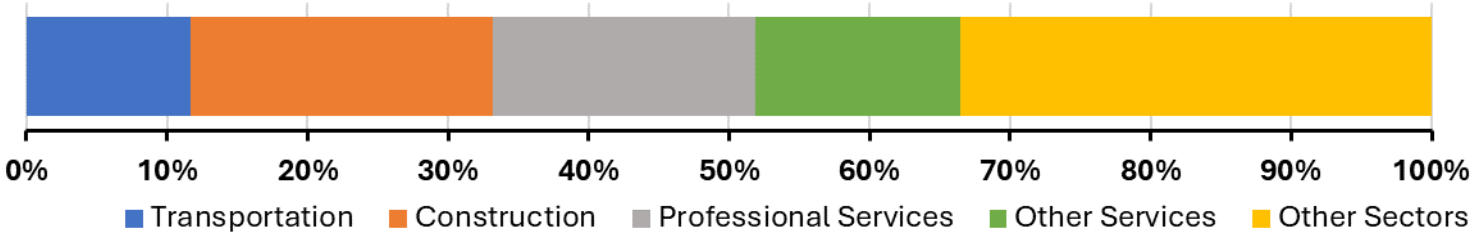
[b]Except coil winders, tapers, and finishers.

[c]High school+: Post-secondary certificate.

[d]Proprietors' jobs are mainly composed of independent contractors (owner-operators) in construction and transportation (e.g., truck drivers who own their own trucks, a carpenter that owns his own company and is the sole employee, etc.).

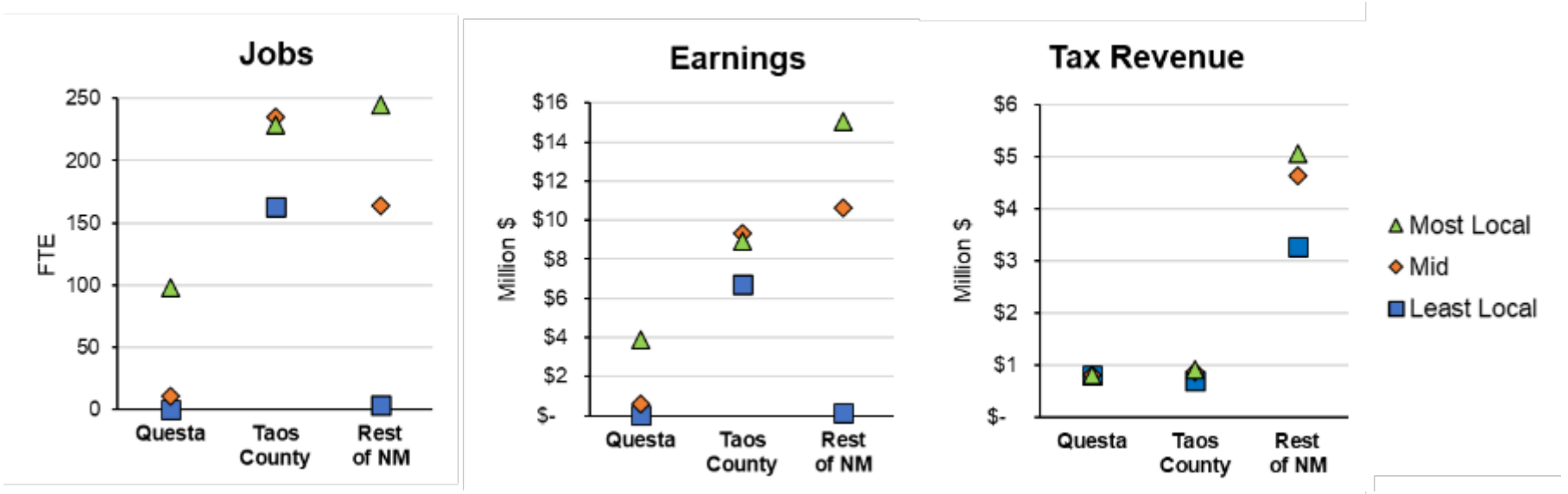
Workforce Profile Data: 2019 Occupation Dataset from IMPLAN

Distribution of Jobs Supported by Industry

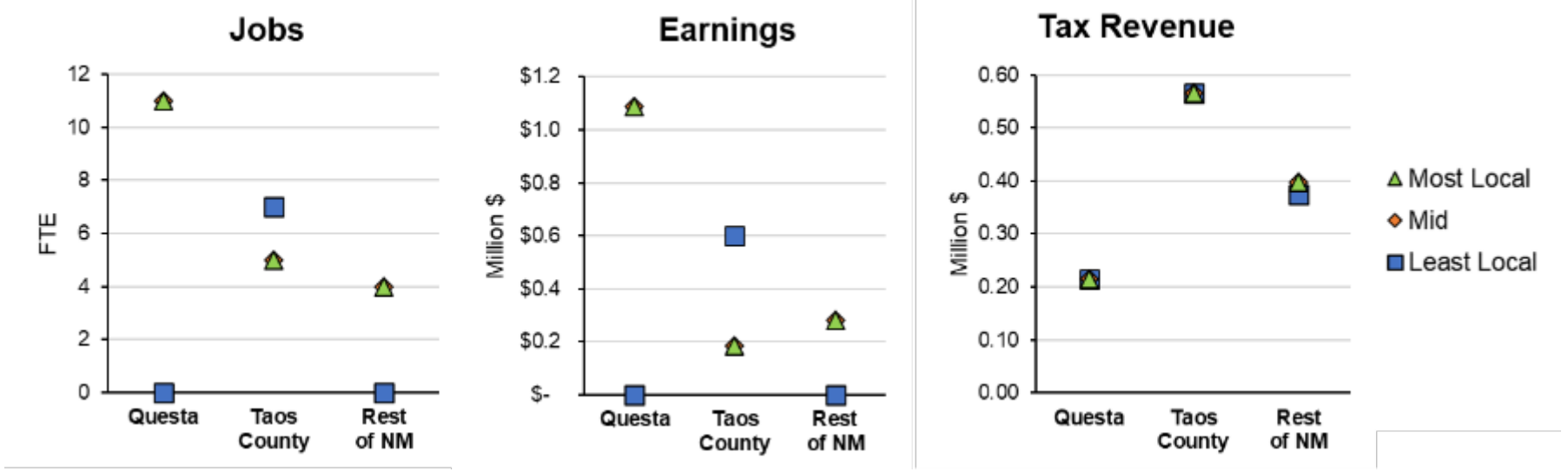


Overview of Results: Hydrogen and Solar Facilities

Construction *(Temporary Impacts)*



O&M *(Annual Impacts)*



Detailed Results: Questa Area (Mid Scenario)

Top Occupations Supported during Construction

SOC	Occupation Description	FTE	Median Profile Requirements		
			Education	Training	Experience
53-3032	Heavy and tractor-trailer truck drivers	2.0	High school[a]	1-3 mo	6 mo-1 yr
53-7062	Laborers and freight, stock, and material movers	0.3	High school	<1 mo	<1 mo
43-9061	Office clerks, general	0.2	Some college	1-3 mo	1-2 yr
47-2061	Construction laborers	0.1	High school	3-6 mo	1-3 mo
49-3031	Bus and truck mechanics and diesel engine specialists	0.1	High school	6 mo-1 yr	2-4 yr
53-3033	Light truck drivers	0.1	High school	<1 mo	1-3 mo
47-2031	Carpenters	0.1	High school	1-2 yr	1-2 yr
53-1047	First-line supervisors of transportation and material-moving workers	0.1	High school	6 mo-1 yr	2-4 yr
11-1021	General and operations managers	0.1	Associate's degree	3-6 mo	2-4 yr
	Proprietors (construction, transportation general, and subcontractors)[b]	6.0			

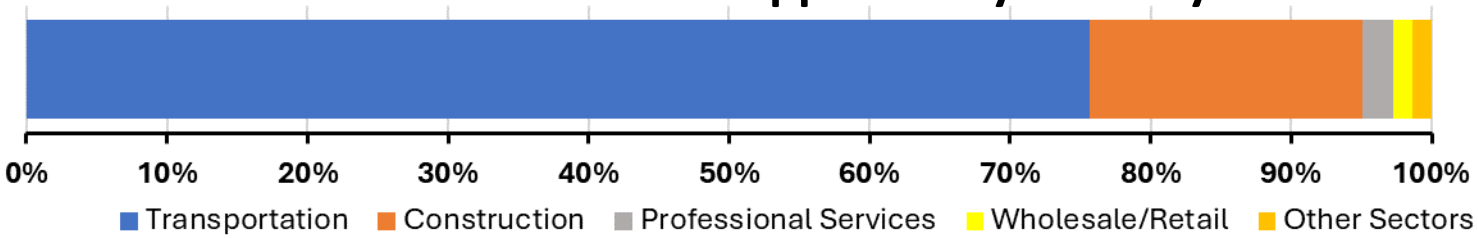
[a]A CDL truck driver job requires a CDL.

Workforce Profile Data: 2019 Occupation Dataset from IMPLAN

[b]Proprietors' jobs are mainly composed of independent contractors (owner-operators) in construction and transportation (e.g., truck drivers who own their own trucks, a carpenter that owns his own company and is the sole employee, etc.).

SOC = Standard Occupation Classification

Distribution of Jobs Supported by Industry



Detailed Results: Questa Area (Mid Scenario)

Top Occupations Supported *Annually* during Operation

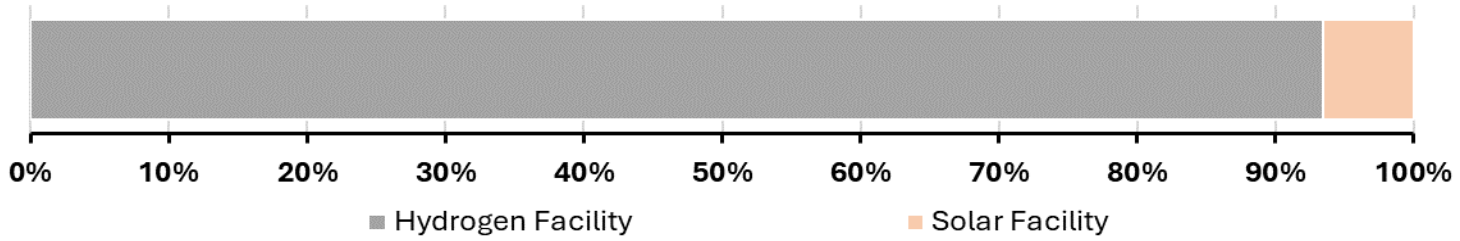
SOC	Occupation Description	FTE	Median Profile Requirements		
			Education	Training	Experience
51-8091	Chemical plant and system operators	4	High school	6 mo-1 yr	1-2 yr
51-1011	First-line supervisors of production and operating workers[b]	2	High school +[a]	3-6 mo	1-2 yr
11-3051	Industrial production managers	1	Associate's degree	6 mo-1 yr	2-4 yr
49-1011	First-line supervisors of mechanics, installers, and repairers[b]	1	High school +	6 mo-1 yr	2-4 yr
49-9041	Industrial machinery mechanics	1	High school +	6 mo-1 yr	2-4 yr
43-9061	Office clerks, general	1	Some college	1-3 mo	1-2 yr
49-2095	Electrical and electronics repairers, powerhouse, substation, and relay	0.5	High school +	2-4 yr	2-4 yr

[a]High school+: Post-secondary certificate.

[b]Supervisors also act as safety officers.

Workforce Profile Data: 2019 Occupation Dataset from IMPLAN

Distribution of Jobs Supported by Industry



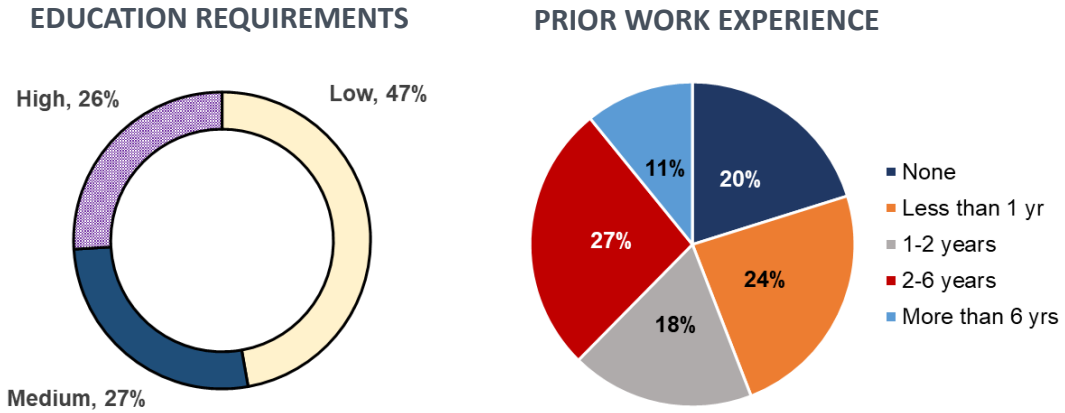
Occupation Results: Rest of Taos County (Mid Scenario)

Construction and Installation Phase (Temporary Jobs)

Top five major occupation groups supported during construction

SOC	Occupation Description	FTE
47-0000	Construction and extraction occupations	31
43-0000	Office and administrative support occupations	18
17-0000	Architecture and engineering occupations	9
33-0000	Protective service occupations	9
53-0000	Transportation and material-moving occupations	9

Workforce Profile

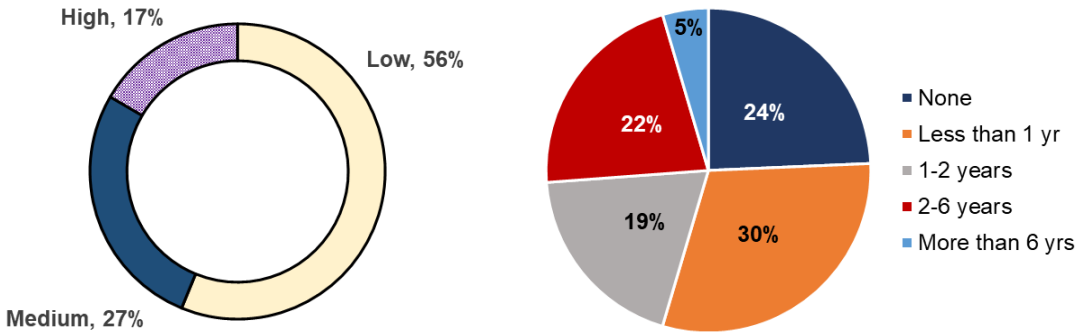


O&M Phase (Permanent Jobs)

Top four major occupation groups supported annually

SOC	Occupation Description	FTE/yr
35-0000	Food preparation and serving-related occupations	0.6
41-0000	Sales and related occupations	0.4
43-0000	Office and administrative support occupations	0.4
49-0000	Installation, maintenance, and repair occupations	0.3

Workforce Profile



Low: High school diploma or less
Medium: Associate's degree or less
High: Bachelor's degree or above

Occupation Results: Rest of New Mexico (Mid Scenario)

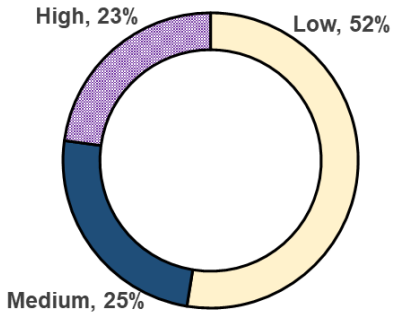
Construction and Installation Phase (Temporary Jobs)

Top five major occupation groups supported during construction

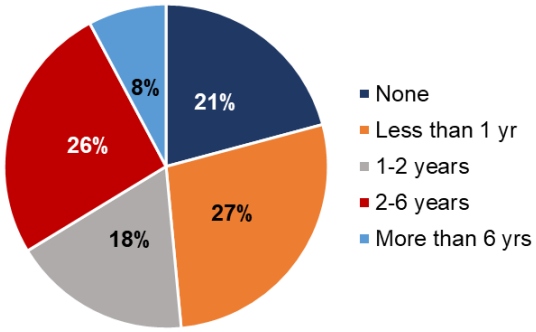
SOC	Occupation Description	FTE
53-0000	Transportation and material-moving occupations	23
51-0000	Production occupations	22
43-0000	Office and administrative support occupations	17
41-0000	Sales and related occupations	10
11-0000	Management occupations	8

Workforce Profile

EDUCATION REQUIREMENTS



PRIOR WORK EXPERIENCE



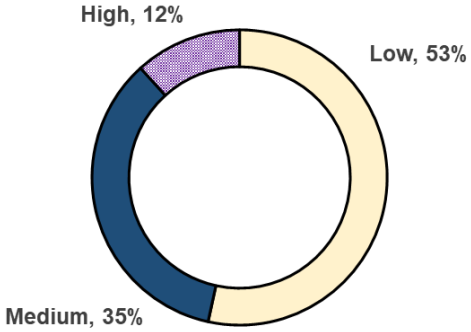
O&M Phase (Permanent Jobs)

Top four major occupation groups supported annually

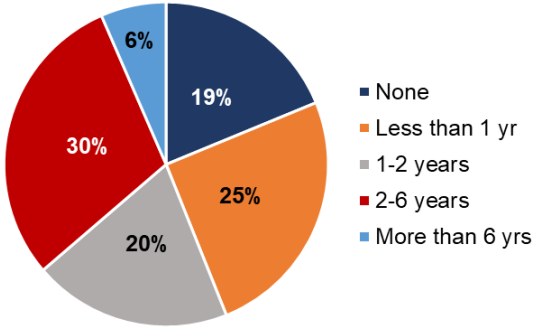
SOC	Occupation Description	FTE/yr
49-0000	Installation, maintenance, and repair occupations	0.7
43-0000	Office and administrative support occupations	0.3
41-0000	Sales and related occupations	0.2
51-0000	Production occupations	0.2

Workforce Profile

EDUCATION REQUIREMENTS



PRIOR WORK EXPERIENCE



Low: High school diploma or less
Medium: Associate's degree or less
High: Bachelor's degree or above

Conclusions

- Most economic benefits for Questa, especially tax revenue and jobs, occur during construction: we estimate that 11 jobs will be supported in the Village of Questa mainly from construction and transportation services, with the village expected to collect $0.8 million in tax revenues.
  - Temporary jobs supported during construction primarily include truck drivers, material movers, and construction-related (laborers, carpenters, electricians) occupations.
- During operation, the village will benefit the most in the long term if the new facilities' permanent workers reside in Questa (~11 workers/yr). The village is expected to collect $0.21 million in tax revenues per year, mainly from property taxes for the facilities.
  - Permanent jobs supported during operation primarily include plant operators, supervisors, and electrical maintenance.
- As shown in the sensitivity scenarios (Most Local/Least Local), impacts vary significantly depending on which businesses supply materials, equipment, and services, and where workers reside. Choosing local suppliers would provide more benefits to the Questa and New Mexico economies, adding up to 400 additional jobs during construction and 13 more long-term jobs to the state.

*Caveats: Economic impacts are for Facility A only. Details on Facilities A and B are available in https://www.nrel.gov/docs/fy23osti/86665.pdf.

Limitations and Gaps: Economic Impacts

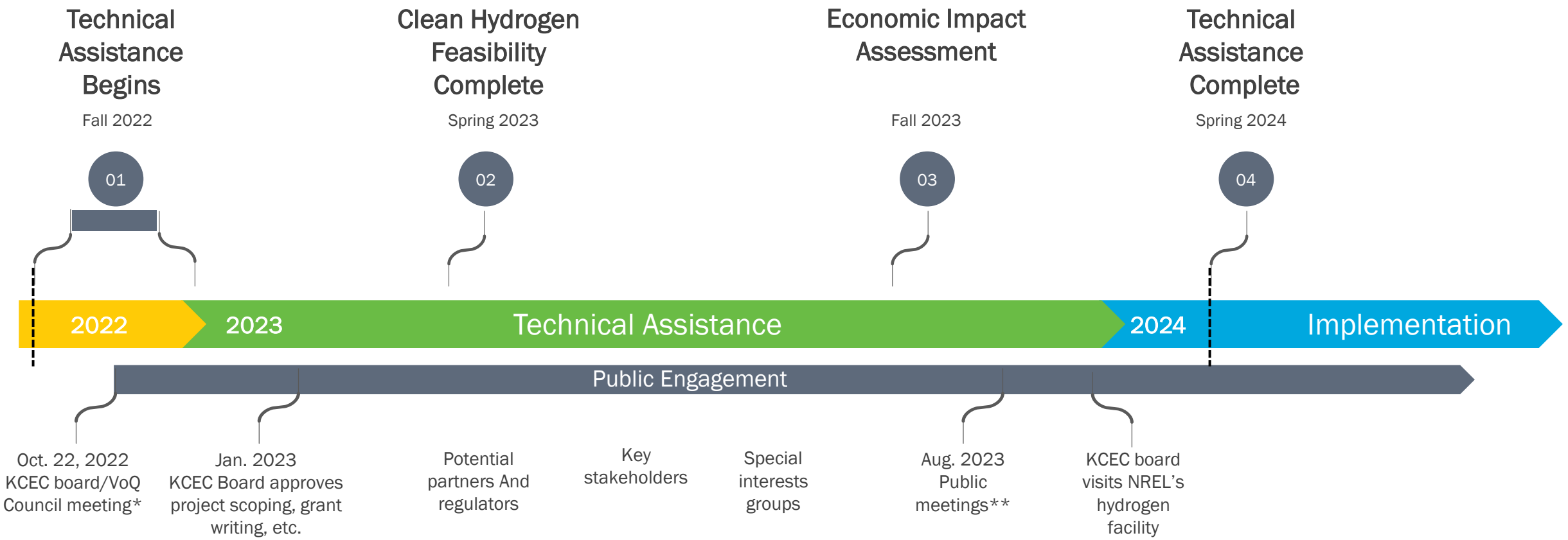
- The results from this study should be interpreted within the context of the assumptions employed in the modeling exercise, as well as limitations of the input-output framework. Thus, the results provided are estimates and not a precise forecast.
  - The model employed for this analysis is a static model and represents the economy-wide linkages and spending patterns in New Mexico regions in 2019. The model does not account for dynamic impacts or changes over time. As such, estimates do not account for changes in the economic structure (such as energy systems, population change, or businesses conditions) over time, instead reflecting economic conditions pre-COVID-19.
  - This study did not assess potential increased demand on public services (safety, roads, water treatment, housing, schools, etc.), environmental impacts, cultural impacts, potential spinoff business or industry expansion, or ownership and distribution of benefits. It did not assess cost-recovery or impact on rate payers.
  - This study did not assess workforce training needs or how the community could pursue clean hydrogen development equitably.
  - The workforce profile results are based on the average national characteristics of U.S. workers provided by the O*NET database (U.S. Department of Labor 2022).[1] Thus, this data does not exactly represent local conditions of the economies analyzed.

[1] https://www.onetcenter.org/dictionary/25.1/excel/

Project Conclusions

Is Clean Hydrogen Production a Good Fit for Questa?

Questa's Communities LEAP Timeline



Publications

- *Project introduction: https://www.nrel.gov/docs/fy23osti/84348.pdf
- **Intermediate feasibility study results: https://www.nrel.gov/docs/fy23osti/86665.pdf
  - Public meetings and outreach: https://www.energy.gov/communitiesLEAP/questa-new-Mexico.
- Economic Impacts Study: this deck and accompanying report https://www.nrel.gov/docs/fy24osti/88932.pdf

Summary of Study Findings

Coalition Goals		Finding	Trade-Offs and Considerations
Economic Impacts	Create jobs in Questa (Village of Questa, Chevron)	Potentially	Is this a net job gain for the local workforce? How does hydrogen production compare to other industries?
	Attract more economic activity (Village of Questa, Chevron)	Yes	Uncertain magnitude. Is this the kind of industry Questa wants?
	Increase tax base (Village of Questa)	Yes	It is unclear if tax revenues generated would be sufficient to manage impacts and risks.
Power Sector	Deliver clean, reliable electricity during non-solar and other hard-to-serve times (KCEC)	Yes	Requires water consumption and hydrogen leak management. Relies on new technology.
	Maintain affordable energy bills during the transition to clean electricity (KCEC, Village of Questa)	Potentially	Calculated LCOE (to supply 3.1% of demand during hard-to-serve times) is $0.45/kWh, including estimated IRA incentives. Cost to members may increase, depending on facility ownership, incentives captured, and financing.
	Be a replicable model for other rural and Tribal communities (KCEC, Village of Questa).	Potentially	Full impacts to host community are uncertain. Are benefits widely shared with community members?
Mine Site Remediation	Put existing assets to beneficial use (Chevron)	Potentially	Impacts of new industrial facility on land and water, land and water agreements are uncertain.
	Support corporate carbon-reduction goals (Chevron)	Yes	Requires water consumption, hydrogen leak management, and relies on new technology

Study Findings: *Power Sector*

Coalition Goals	Potential Impact	Trade-Offs and Considerations
Deliver clean, reliable electricity during non-solar and other hard-to-serve times (KCEC)	Long-term hydrogen energy storage effectively shifts excess local solar generation to hard-to-serve times like winter peaks. Water electrolysis and fuel cell components are in final stages of commercial readiness.	• Requires water, with cost and use displacement uncertain. • Requires leak detection and management to minimize adverse impacts of hydrogen release. • The power sector is in the early stages of adopting long-term hydrogen energy storage. • New Mexico may not have commercially available suppliers and manufacturers to meet mid-scenario assumptions.
Maintain affordable energy bills during the transition to clean electricity (KCEC, Village of Questa)	Calculated LCOE (to supply 3.1% of demand during hard-to-serve times) is $0.45/kWh, including estimated IRA incentives. Rate impacts depend on facility ownership, financing, and incentives captured.	• Ownership unknown • Cost to members may increase, depending on ownership, incentives captured, and financing. • Technology costs and incentives may change.
Be a replicable model for other rural and tribal communities (KCEC, Village of Questa)	Rural co-ops can be leaders in the energy transition--deploying technological solutions and supporting job creation--by being responsive to their members.	• Continuous, transparent, and meaningful public engagement required to deliver benefits to diverse community members. • Questa would receive some of the economic benefits but all impacts from hosting project.

Study Findings: *Economic Impacts*

Coalition Goals	Potential Impact	Trade-Offs and Considerations
Create jobs in Questa (Village of Questa, Chevron)	Likely 11 construction jobs and 11 long-term jobs (mid-scenario) to the Village.	• Is this a net job gain or a shift from other occupations? • Is local workforce going to fill these jobs? • Would another industry create more jobs from this scale of investment? • What industry does the community prefer to attract?
Attract more economic activity (Village of Questa, Chevron)	Likely $1.5 million in output (with $600k in earnings) during construction and $2.5k per year (with $1.1 million per year in earnings) thereafter to the Village.	• Is this the type of industry Questa residents want? • We can't predict spinoff industry or expansion
Increase tax base (Village of Questa)	Would provide approx. $800k in taxes to the Village during construction and $214k (mostly from gross receipts and property taxes) per year thereafter. The Village of Questa is expected to collect $89k/yr in gross receipts tax and $117k/yr in property taxes.*	• It is unclear if tax revenues generated would be sufficient to expand fire and other safety services as may be needed to manage hydrogen risks. • Potential increased demand on public services (roads, water treatment, housing, schools, etc.).

*Detailed economic analysis for Facility A is available in https://www.nrel.gov/docs/fy24osti/88932.pdf.

Study Findings: *Mine Site Remediation*

Coalition Goals	Potential Impact	Trade-Offs and Considerations
Put existing assets to beneficial use (Chevron)	Brownfield reuse for solar. Hydrogen facility on Chevron land near existing transmission lines. Source of water rights unknown.	• Visual and other impacts of new industrial facility with increase in traffic, noise, light, etc. • Land lease terms and water rights agreements unknown.
Support corporate carbon reduction goals (Chevron)	Clean hydrogen fuel-cell equipped vehicles (not combustion engines) have no climate-forcing emissions and do not emit particulate matter.	• Requires water, with cost and use displacement uncertainty. • Leaks must be monitored and managed to minimize climate forcing. • Heavy-duty fuel cell vehicles are new technology.

Is Clean Hydrogen Production a Good Fit for Questa? Potential Next Steps

- Assess feasibility and life-cycle impacts of other technology options and economic development opportunities:
  - Could evaluate alternatives to reaching 100% renewable energy. Could evaluate other industries to attract jobs and other economic activity. Could assess environmental impacts of clean hydrogen development and its alternatives, including land and water use, using life-cycle analysis, land use analysis, and related approaches.
- Workforce gap analysis:
  - Could answer the question: What training does our local workforce need to qualify for potential new jobs?
- Third-party validation, cost-benefit analysis, and safety design:
  - Could confirm assumptions of costs and benefits and assess safety considerations before taking on major financial risk.
- Continuous, transparent, meaningful outreach and engagement:
  - Could increase community knowledge and support. Could improve project outcomes and benefits to a variety of stakeholders.
- Develop community benefits agreements and workforce development programs:
  - Could ensure Questa receives benefits commensurate with project risks and remediation for unintended impacts.

*"Without **local-hiring commitments,** communities can fail to gain from the economic benefits associated with additional and/or greater salaries in their neighborhoods."*
– U.S. Department of Energy

Community benefits agreements* *are mutually beneficial agreements outlining developer commitments in exchange for project support. These may be local-hiring commitments and workforce training programs, provision of equipment or staff, remediation funds, local purchasing commitments, or agreements to paying higher taxes to local jurisdictions to support public services.*

*More information on community benefits agreements can be found at https://www.nrel.gov/docs/fy23osti/84348.pdf.

References

Federal Register. 2023. "Section 45V Credit for Production of Clean Hydrogen; Section 48(a)(15) Election To Treat Clean Hydrogen Production Facilities as Energy Property, 88 F.R. 89220 (proposed Dec. 22, 2023) (to be codified at 22 C.F.R. 1)". https://www.federalregister.gov/documents/2023/12/26/2023-28359/section-45v-credit-for-production-of-clean-hydrogen-section-48a15-election-to-treat-clean-hydrogen.

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U.S. Department of Labor (2022). ONET Resource Center. Available online at https://www.onetcenter.org/overview.html

Topolski, K., E. Hale, C. Scarpitti, H. Niaz, A. F. T. Avelino, and A. Franco. 2023. "Is clean hydrogen production a good fit for Questa? Intermediate feasibility study results." Presented on August 17, 2023. https://www.nrel.gov/docs/fy23osti/86665.pdf.

Thank you

www.energy.gov/communitiesLEAP

DOE/GO-102024-6271

Backmatter

Overview of Results (Least Local Scenario)

Construction *(Temporary Impacts)*

	Jobs (FTE)	Earnings (Million $)	Tax Revenue (Million $)
Questa	0	$0	$0.8
Taos County	163	$7	$0.7
New Mexico	4	$0	$3.3
Total	167	$7	$4.8

O&M *(Annual Impacts)*

Questa	0	$0.0	$0.21
Taos County	7	$0.6	$0.57
New Mexico	0	$0.0	$0.37
Total	7	$0.6	$1.15

Note: FTE: full-time equivalent (2,080 hr/yr). Monetary values are in 2020 dollars. Numbers may not add up due to rounding.

**Earnings include both wages/salaries and benefits, as well as proprietor income.*

Overview of Results (Most Local Scenario)

	Jobs (FTE)	Earnings (Million $)	Tax Revenue (Million $)
Construction *(Temporary Impacts)*			
Questa	98	$4	$0.8
Taos County	229	$9	$0.9
New Mexico	245	$15	$5.1
Total	572	$28	$6.8
O&M *(Annual Impacts)*			
Questa	11	$1.1	$0.21
Taos County	5	$0.2	$0.57
New Mexico	4	$0.3	$0.40
Total	20	$1.6	$1.18

Note: FTE: full-time equivalent (2,080 hr/yr). Monetary values are in 2020 dollars. Numbers may not add up due to rounding.

**Earnings include both wages/salaries and benefits, as well as proprietor income.*

Detailed Results: Questa Area (Least Local Scenario)

Construction and Installation Phase (Temporary Impacts)

Construction

	Jobs (FTE)	Earnings (Million $)	Tax Revenue (Million $)
Construction and Installation	0	$0.0	$0.7
Transportation Services and Others	0	$0.0	$0.1
Subtotal Direct Impacts	**0**	**$0.0**	**$0.8**
Indirect (supply-chain) Impacts	0	$0.0	$0.0
Induced (labor expenditure) Impacts	0	$0.0	$0.0
Total Impacts	**0**	**$0.0**	**$0.8**

O&M Phase (Annual Impacts)

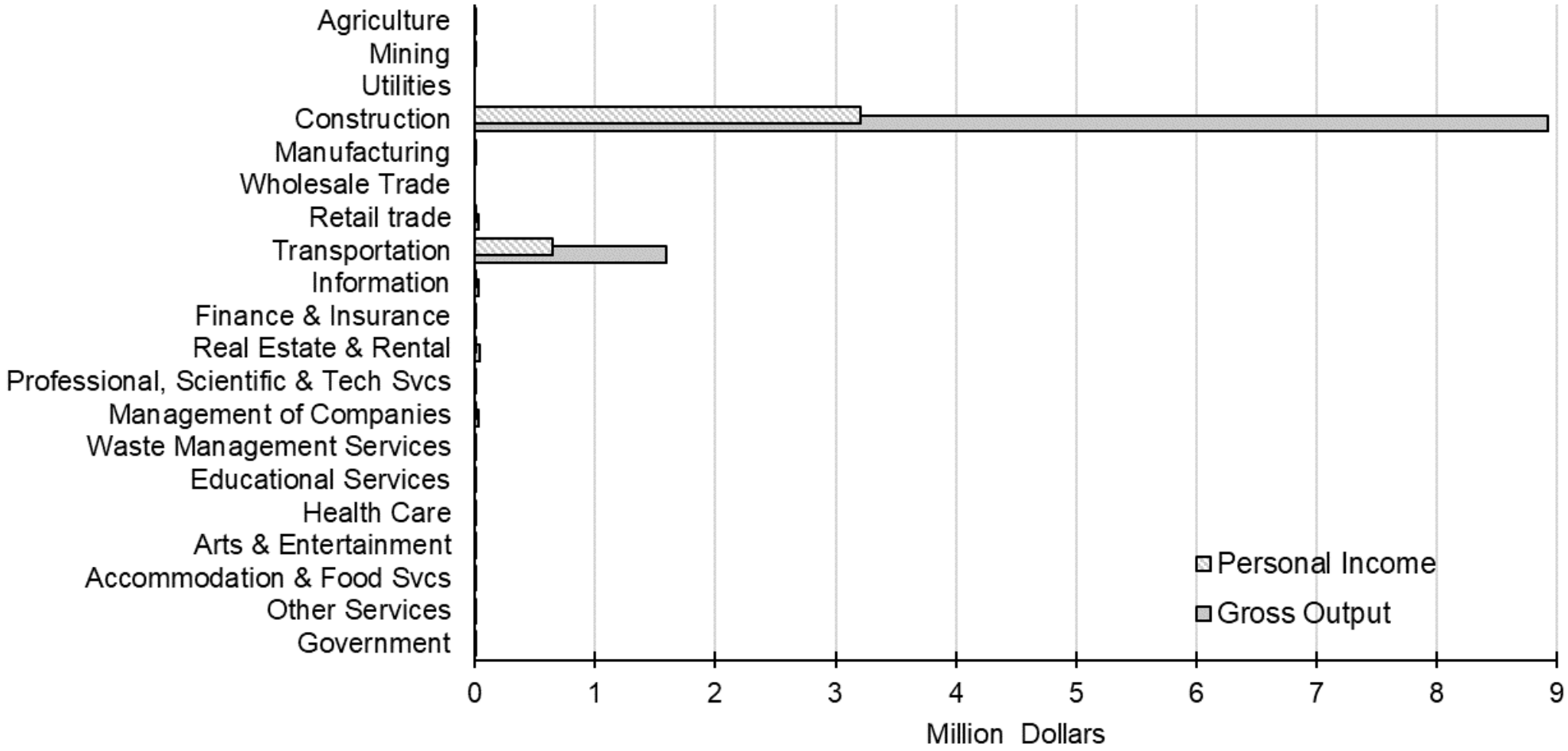
O&M

	Jobs (FTE / yr)	Earnings (Million $/yr)	Tax Revenue (Million $/yr)
Labor and Equipment Maintenance	0	$0.0	$0.21
Subtotal Direct Impacts	**0**	**$0.0**	**$0.21**
Indirect (supply-chain) Impacts	0	$0.0	$0.0
Induced (labor expenditure) Impacts	0	$0.0	$0.0
Total Impacts	**0**	**$0.0**	**$0.21**

Note: Jobs are measured in FTE. Earnings, output, and taxes are presented in 2020 dollars.

Detailed Results: Questa: Construction Phase (Most Local Scenario)

Cumulative Results by Sector in the Economic Area of Questa, in Million Dollars



Detailed Results: Questa Area (Most Local Scenario)

Construction and Installation Phase (Temporary Impacts)

Construction

	Jobs (FTE)	Earnings (Million $)	Tax Revenue (Million $)
Construction and Installation	86	$3.2	$0.7
Transportation Services and Others	10	$0.8	$0.1
Subtotal Direct Impacts	**96**	**$4.0**	**$0.8**
Indirect (supply-chain) Impacts	2	$0.0	$0.0
Induced (labor expenditure) Impacts	0	$0.0	$0.0
Total Impacts	**98**	**$4.0**	**$0.8**

O&M Phase (Annual Impacts)

O&M

	Jobs (FTE / yr)	Earnings (Million $/yr)	Tax Revenue (Million $/yr)
Labor and Equipment Maintenance	11	$1.1	$0.21
Subtotal Direct Impacts	**11**	**$1.1**	**$0.21**
Indirect (supply-chain) Impacts	0	$0.0	$0.0
Induced (labor expenditure) Impacts	0	$0.0	$0.0
Total Impacts	**11**	**$1.1**	**$0.21**

Note: Jobs are measured in FTE. Earnings, output, and taxes are presented in 2020 dollars.

Detailed Results: Questa Area (Most Local Scenario)

Top Occupations Supported During Construction			Median Profile Requirements		
SOC	Occupation Description	FTE	Education	Training	Experience
47-2061	Construction laborers	6	High school	3-6 mo	1-3 mo
47-2031	Carpenters	4	High school	1-2 yr	1-2 yr
47-2111	Electricians	3	High school +	2-4 yr	4-6 yr
53-3032	Heavy and tractor-trailer truck drivers	3	High school[a]	1-3 mo	6 mo-1 yr
47-1011	First-line supervisors of construction trades and extraction workers	3	High school +[b]	6 mo-1 yr	1-2 yr
47-2152	Plumbers, pipefitters, and steamfitters	2	High school	3-6 mo	6 mo-1 yr
43-9061	Office clerks, general	2	Some college	1-3 mo	1-2 yr
47-2073	Operating engineers and other construction equipment operators	2	High school	1-3 mo	2-4 yr
49-9021	Heating, air conditioning, and refrigeration mechanics and installers	2	High school	3-6 mo	6 mo-1 yr
11-9021	Construction managers	2	College	1-2 yr	4-6 yr
	Proprietors (construction, transportation general, and subcontractors)[c]	46			

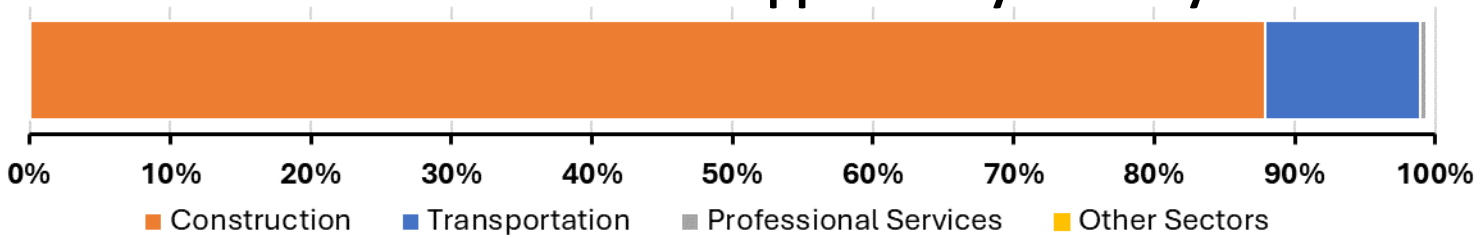
Workforce Profile Data: 2019 Occupation Dataset from IMPLAN

[a]A CDL truck driver job requires a CDL.

[b]High school+: Post-secondary certificate.

[c]Proprietors' jobs are mainly composed of independent contractors (owner-operators) in construction and transportation (e.g., truck drivers who own their own trucks, a carpenter that owns his own company and is the sole employee, etc.).

Distribution of Jobs Supported by Industry



Detailed Results: Questa Area (Most Local Scenario)

Top Occupations Supported *Annually* During Operation

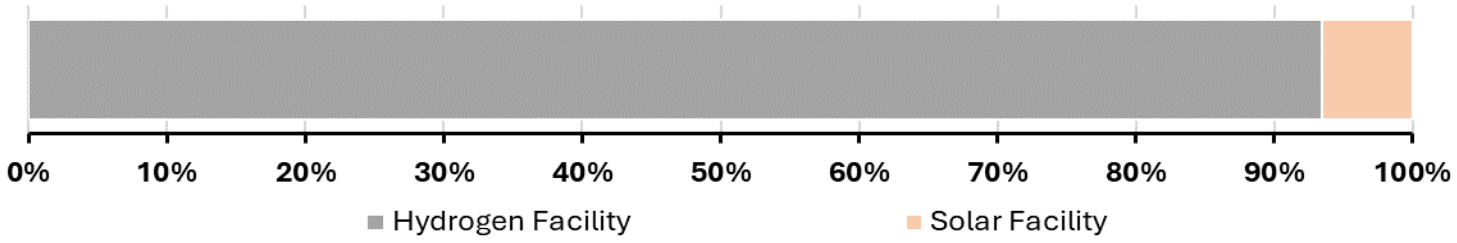
SOC	Occupation Description	FTE	Median Profile Requirements		
			Education	Training	Experience
51-8091	Chemical plant and system operators	4	High school	6 mo-1 yr	1-2 yr
51-1011	First-line supervisors of production and operating workers[b]	2	High school +[a]	3-6 mo	1-2 yr
11-3051	Industrial production managers	1	Associate's degree	6 mo-1 yr	2-4 yr
49-1011	First-line supervisors of mechanics, installers, and repairers[b]	1	High school +	6 mo-1 yr	2-4 yr
49-9041	Industrial machinery mechanics	1	High school +	6 mo-1 yr	2-4 yr
43-9061	Office clerks, general	1	Some college	1-3 mo	1-2 yr
49-2095	Electrical and electronics repairers, powerhouse, substation, and relay	0.5	High school +	2-4 yr	2-4 yr

[a]High school+: Post-secondary certificate.

[b]Supervisors also act as Safety Officers.

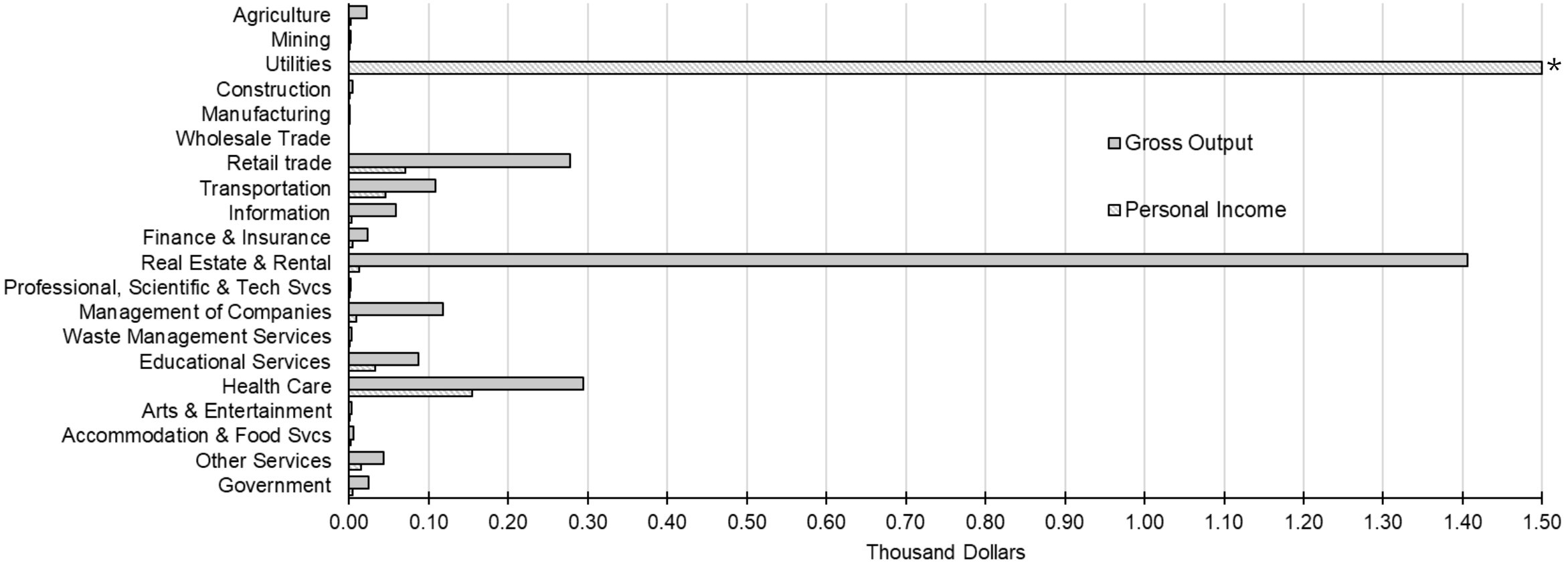
Workforce Profile Data: 2019 Occupation Dataset from IMPLAN

Distribution of Jobs Supported by Industry



Detailed Results: All of NM: O&M (Mid Scenario)

Cumulative Results by Sector in the Economic Area of Questa, in Thousand Dollars



**Values go beyond scale shown: personal income $1,087 thousand.*

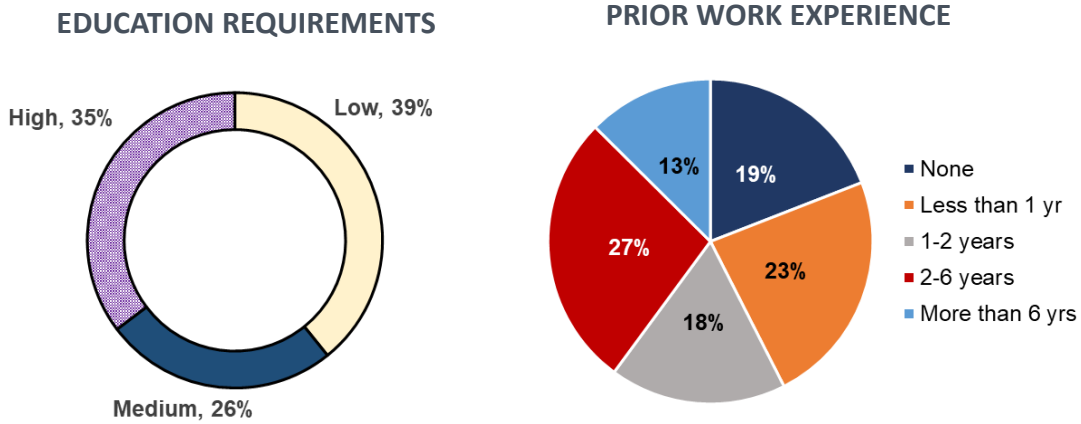
Occupation Results: Rest of Taos and NM (Most Local Scenario)

Construction and Installation Phase (Temporary Jobs): Rest of Taos

Top five major occupation groups supported during construction

SOC	Occupation Description	FTE
17-0000	Architecture and engineering occupations	18
43-0000	Office and administrative support occupations	17
35-0000	Food preparation and serving-related occupations	10
53-0000	Transportation and material-moving occupations	9
33-0000	Protective service occupations	9

Workforce Profile

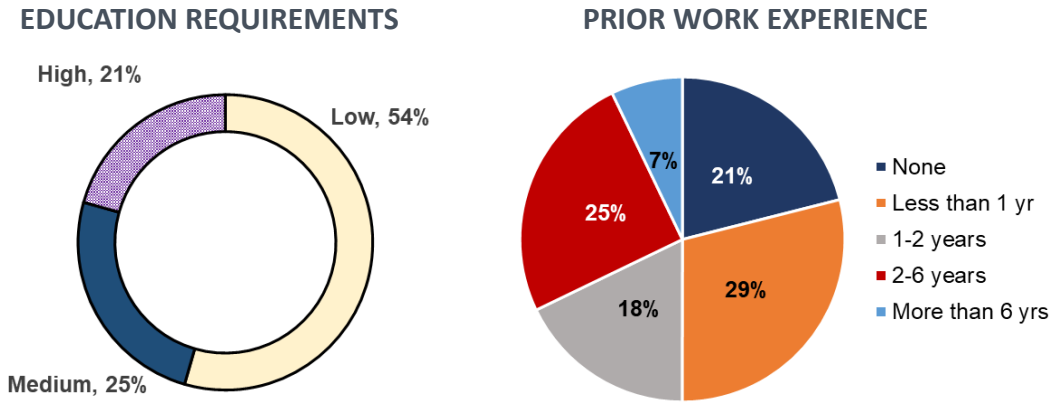


Construction and Installation Phase (Temporary Jobs): Rest of NM

Top five major occupation groups supported during construction

SOC	Occupation Description	FTE
51-0000	Production occupations	41
53-0000	Transportation and material-moving occupations	32
43-0000	Office and administrative support occupations	25
41-0000	Sales and related occupations	15
11-0000	Management occupations	12

Workforce Profile



Low: High school diploma or less
Medium: Associate's degree or less
High: Bachelor's degree or above

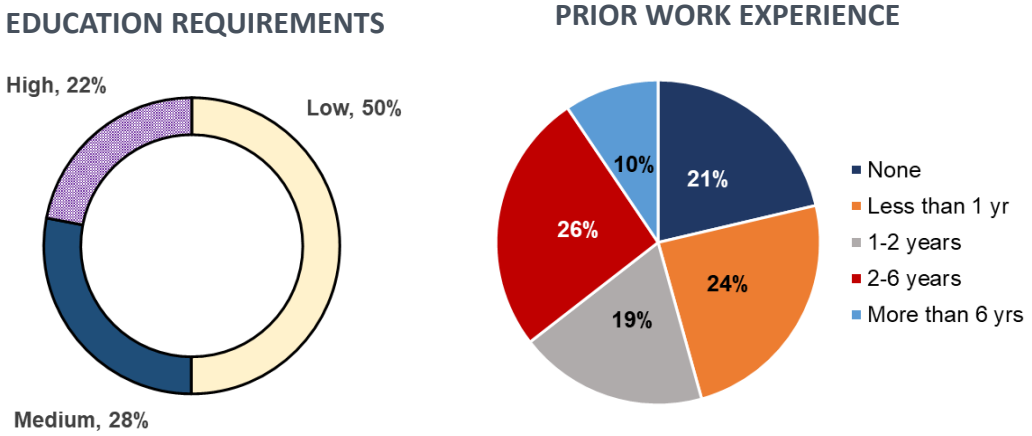
Occupation Results: All regions (Least vs. Most Local Scenarios)

Construction and Installation Phase (Temporary Jobs): Least Local

Top five major occupation groups supported during construction

SOC	Occupation Description	FTE
47-0000	Construction and extraction occupations	30
43-0000	Office and administrative support occupations	14
33-0000	Protective service occupations	8
49-0000	Installation, maintenance, and repair occupations	6
11-0000	Management occupations	6

Workforce Profile

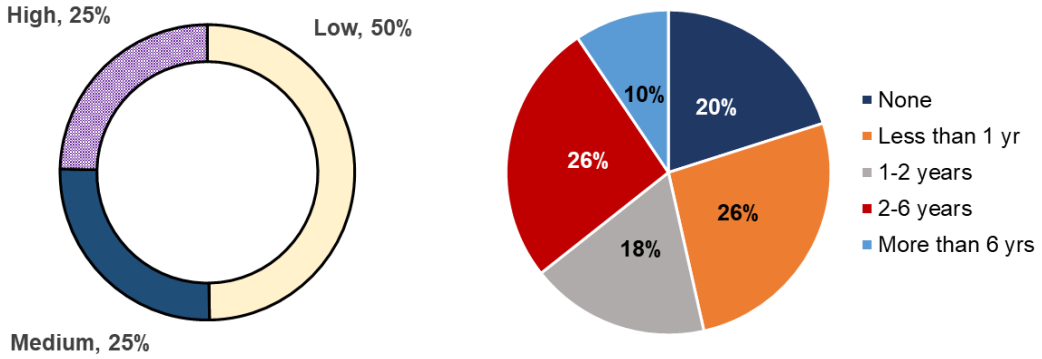


Construction and Installation Phase (Temporary Jobs): Most Local

Top five major occupation groups supported during construction

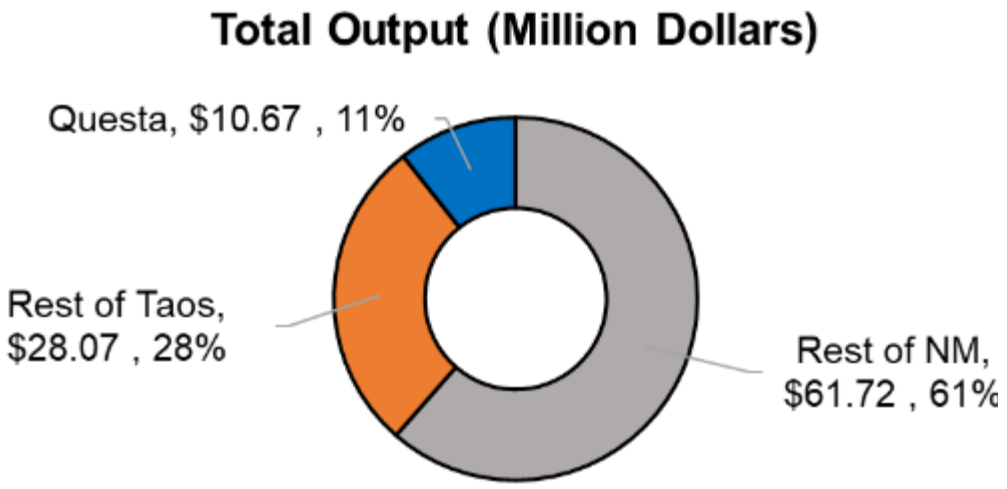
SOC	Occupation Description	FTE
43-0000	Office and administrative support occupations	47
53-0000	Transportation and material-moving occupations	46
51-0000	Production occupations	45
47-0000	Construction and extraction occupations	36
17-0000	Architecture and engineering occupations	28

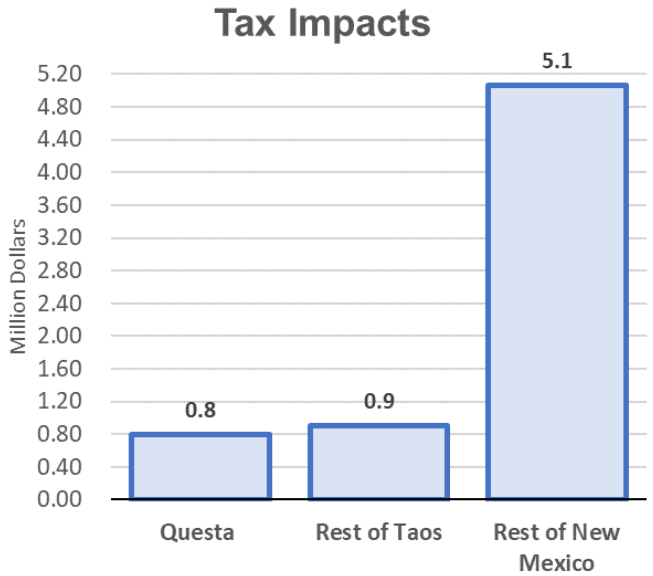
Workforce Profile

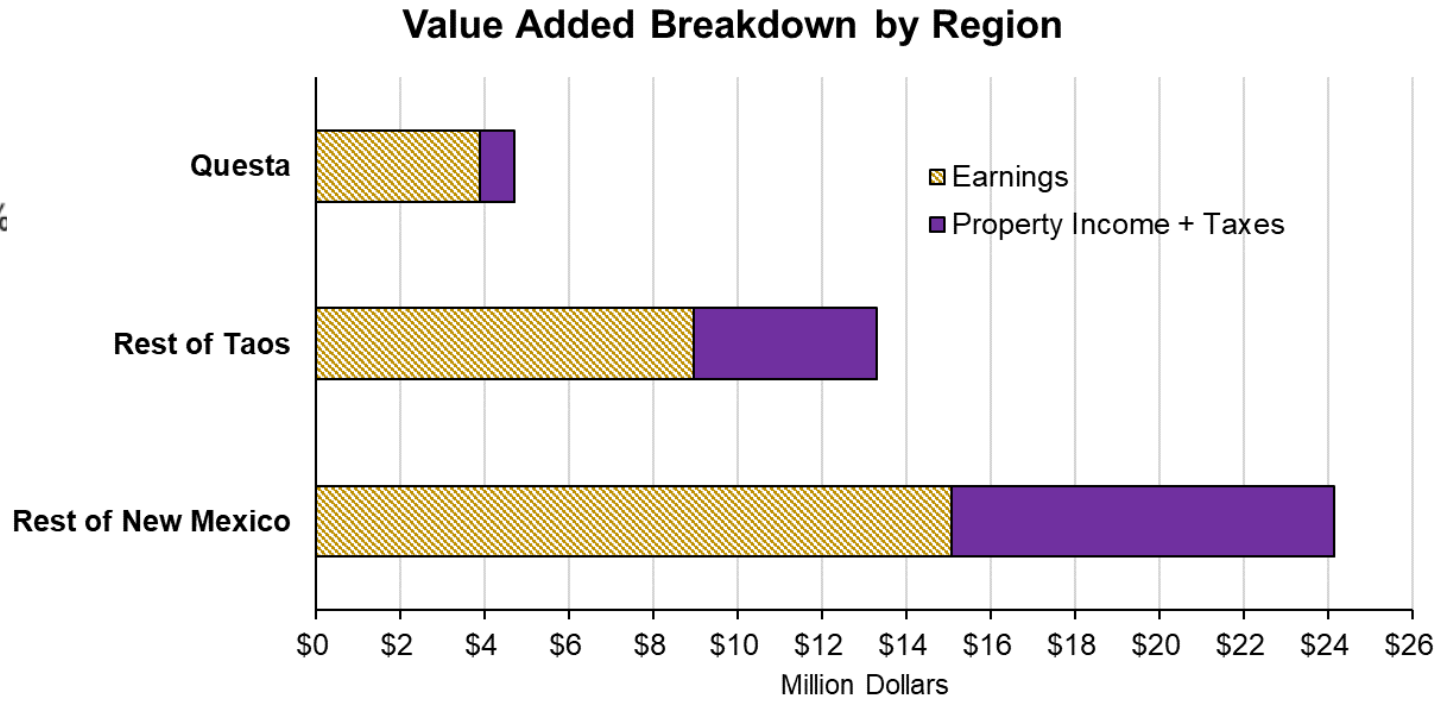


Low: High school diploma or less
Medium: Associate's degree or less
High: Bachelor's degree or above

Detailed Results: All of NM: Construction Phase (Most Local Scenario)

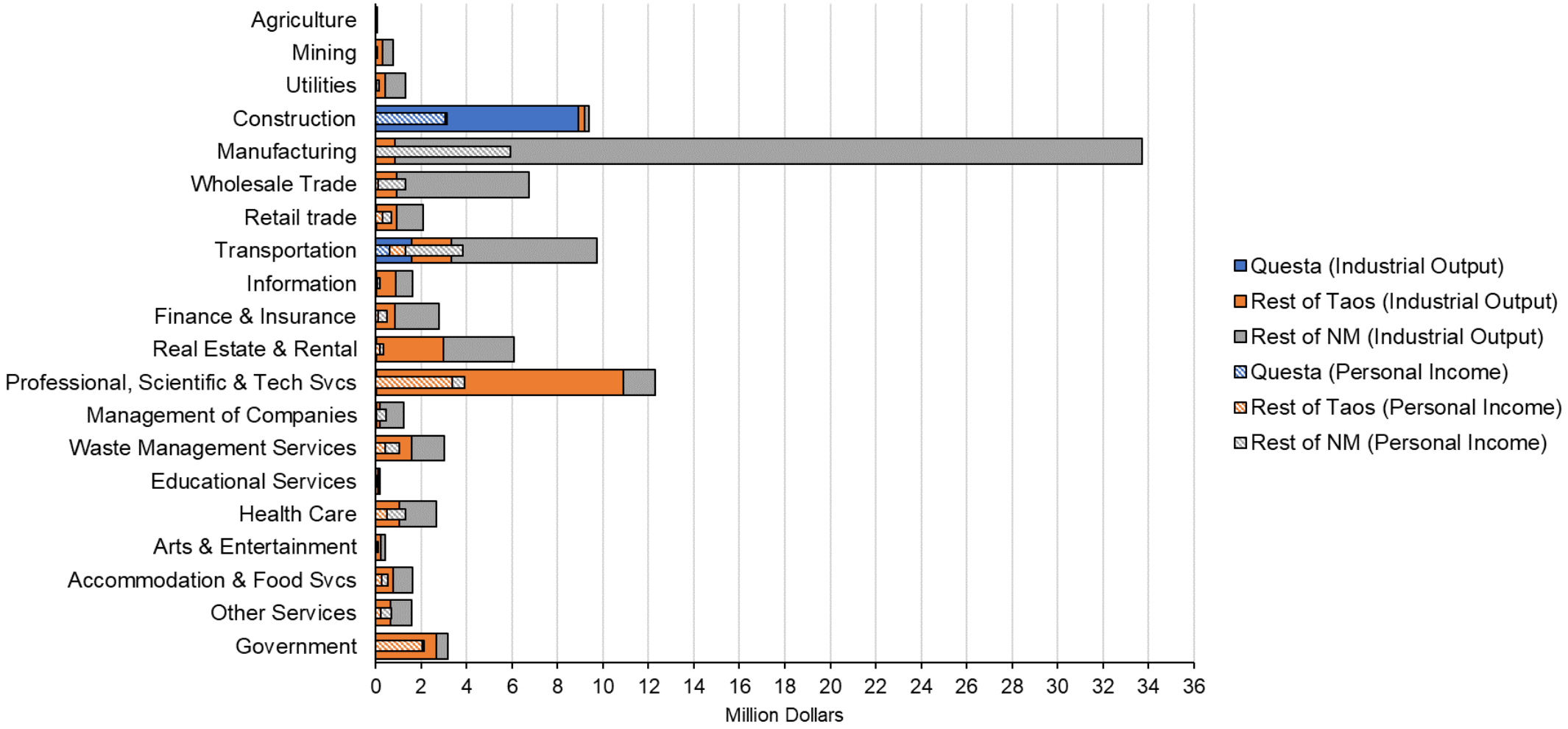






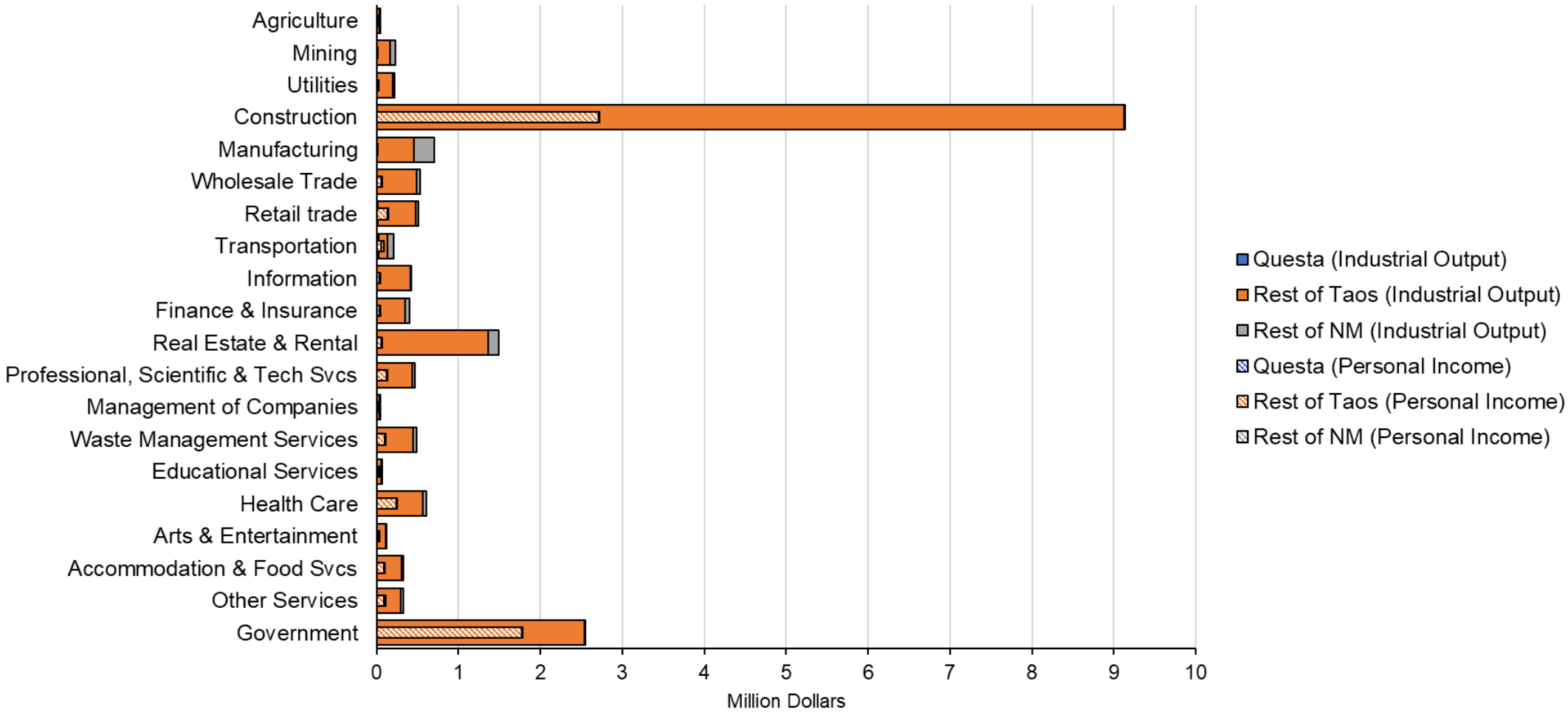
Detailed Results: All of NM: Construction Phase (Most Local Scenario)

Cumulative Results by Sector in all NM (all regions combined)

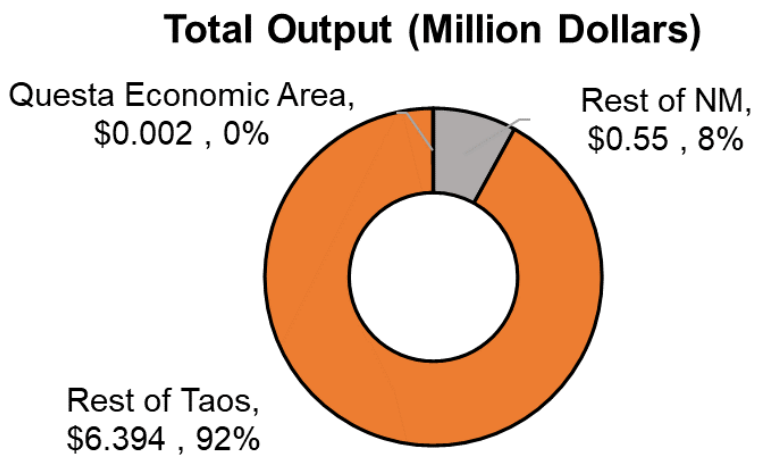


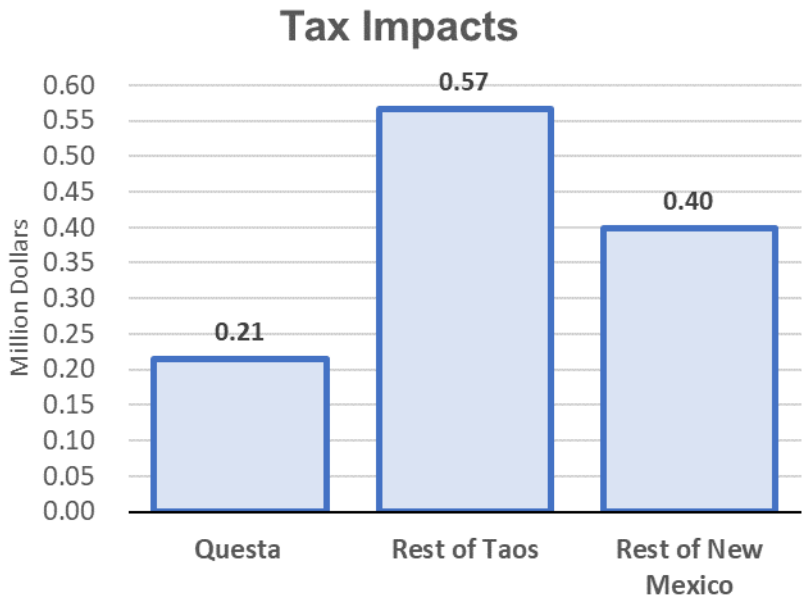
Detailed Results: All of NM: Construction Phase (Least Local Scenario)

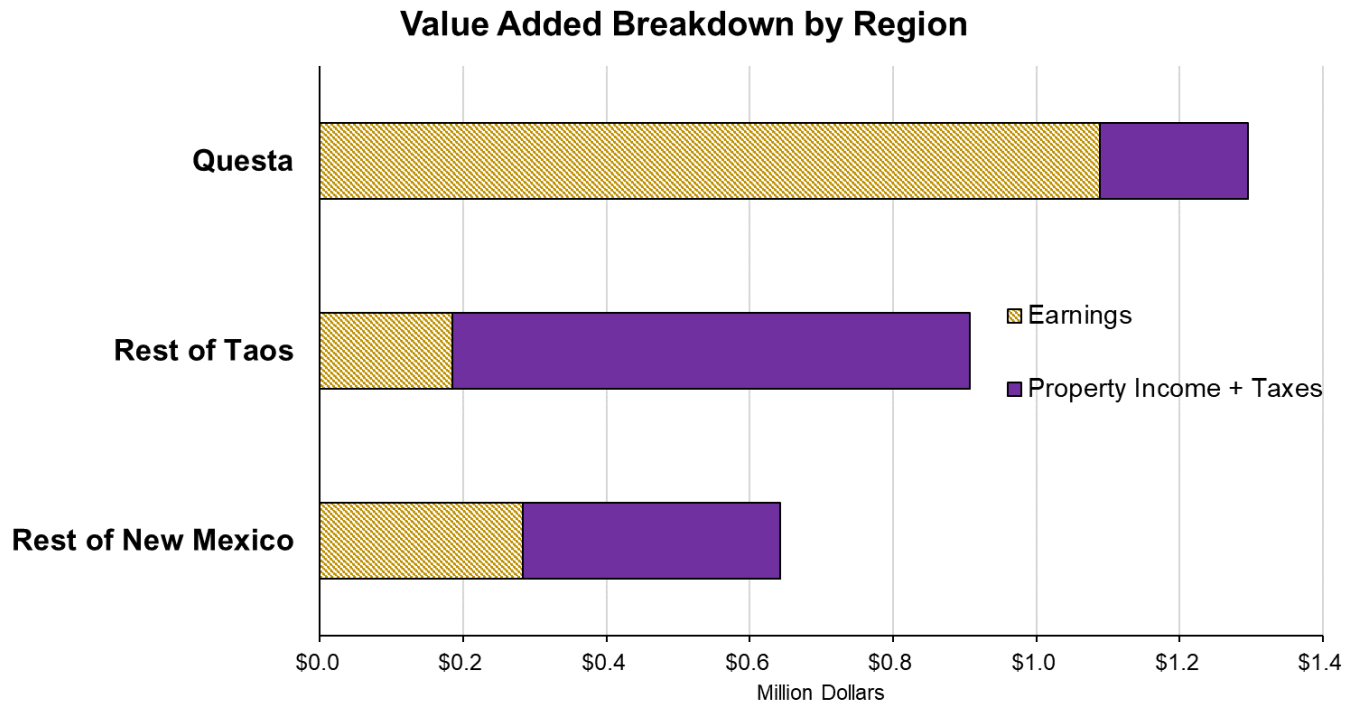
Cumulative Results by Sector in all NM (all regions combined)



Results: All of NM: O&M (Mid Scenario)

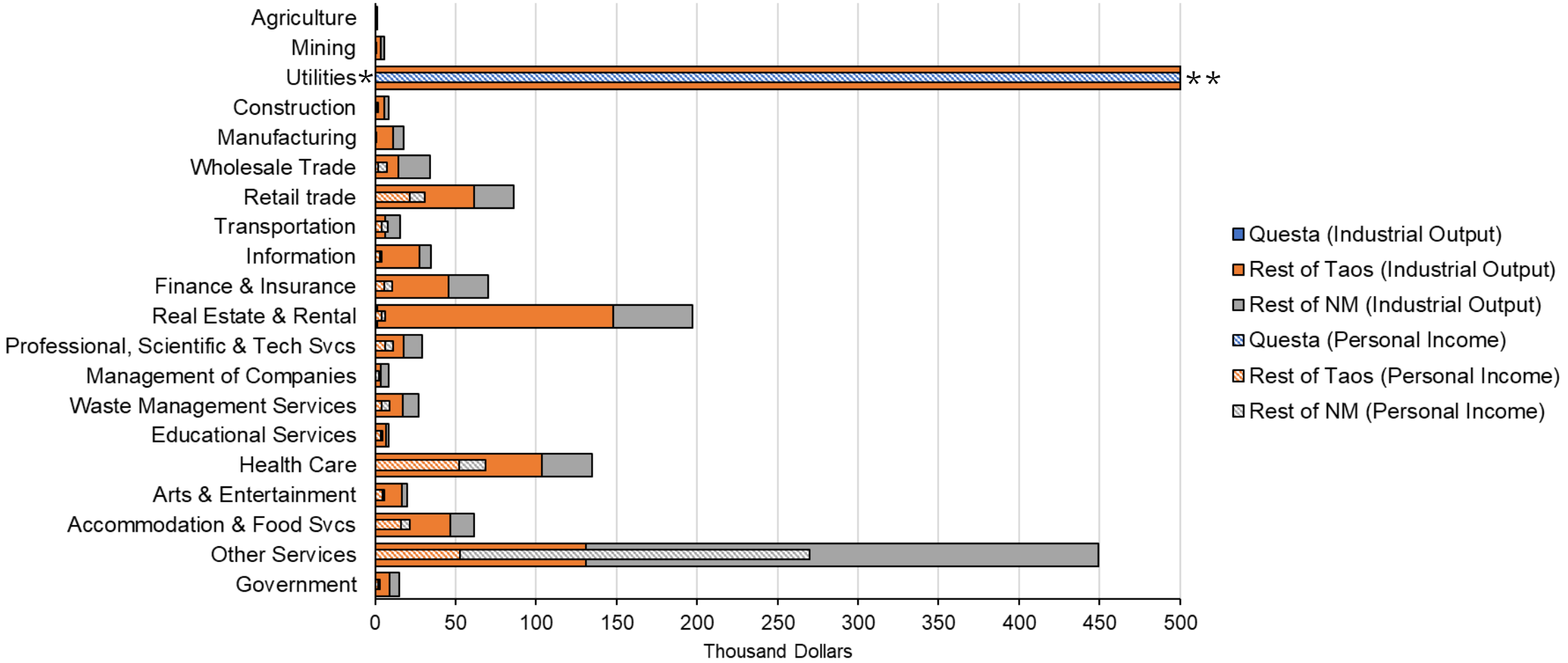






Detailed Results: All of NM: O&M (Mid Scenario)

Cumulative Results by Sector in all NM (all regions combined)



*"Utilities" includes both the hydrogen and solar facilities.

**Values go beyond scale shown: gross output $5.70 million and personal income $1.09 million.