



The New Mexico Jobs Project

A Guide to Creating Jobs in Advanced Solar Technology

A Letter from the

American Jobs Project

It is no secret that America's middle class is in crisis; of the millions of jobs lost during the recession, most were good-paying, middle-class jobs. Unfortunately, many of the jobs created during the recovery have been in low-skill, low-paying occupations. It is true that the United States is unlikely to attract the traditional manufacturing jobs of the past, but our research shows that with innovative policies and a smart focus on industrial sectors, states can become global hubs of innovation and create new jobs in advanced industries that capitalize on each state's strengths.

Our analysis starts with identifying the biggest market opportunity of our era. The world has embarked on a historic energy transformation, and the growing demand for advanced energy and its enabling technology draws on "the mother of all markets" for U.S. businesses to build and sell those solutions. Strategically minded businesspeople are taking advantage of this accelerating market and seeing outsized returns. In 2016, the private sector reported \$1.4 trillion in global advanced energy revenues, which is equal to that of the global apparel industry and nearly twice as much as the global airline industry. And jobs? At least 9.8 million people were employed in the global advanced energy industry in 2016, and market growth could support over 14 million additional jobs by 2030. The question for the United States is: Where will those new jobs be created?

At least 9.8 million people were employed in the global advanced energy sector in 2016, and market growth could support 24 million jobs by 2030.

We believe that our states are the answer to this question. If countries across the globe are seeking solutions for growing energy needs, how can U.S. businesses take advantage of this demand and build products locally that can be exported to the world? And how can we equip Americans with the skills those businesses need?

The American Jobs Project gives policymakers tools to spur economic growth and create good-paying jobs in their states. Our analyses chart pathways designed to accelerate and expand a state's advanced energy economy. We propose innovative solutions built on extensive research and tailored to each state. These solutions are written with a focus on streamlining bureaucracy and are seasoned with the principles of competition, local control, and fewer regulations.

The American Jobs Project empowers state and local leaders to build prosperous and equitable advanced energy economies that will transform our nation's energy future. If these recommendations are adopted, hard-working Americans will be among the first to benefit.

About Us

The American Jobs Project

The American Jobs Project is a nonprofit, nonpartisan, think-and-do tank focused on creating good-paying jobs in advanced energy and manufacturing through bottom-up, data-driven, comprehensive economic development. Our experts tailor best practice strategies for bolstering advanced energy and manufacturing, identify assets across the value chain, estimate an industry's job-supporting potential, and support stakeholder-led initiatives by communicating ideas and analyses. Through engagement with a broad cross-section of stakeholders, we develop a shared vision of effective strategies to leverage the unique competitive advantages offered by each state and generate positive economic impacts.



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Bureau of Business and Economic Research, The University of New Mexico

The Bureau of Business and Economic Research (BBER) is the recognized expert in providing socioeconomic data and forecasting in New Mexico. With more than seventy years of experience, BBER's research team provides economic forecasting as well as research services and communication tools tailored to the needs of clients—public, private, nonprofit, and philanthropic—seeking to understand and shape public policy on the state, regional, and local levels. BBER's services and research help leaders in New Mexico to understand, forecast and identify trends and changing economic markets across the state of New Mexico in order to inform decision-making.



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Acknowledgments

This report would not be possible without the support of The JPB Foundation and Incite Labs.

Dozens of hands were involved in the process of researching, writing, designing, and reviewing the report. Kate Ringness and Tiffany Wong were the lead authors. Henry Love led economic analysis. Amariah Baker, Mat Squillante, and Madeleine Valdez led graphic design. Supporting researchers were Leah Daoud, Christopher Eldred, Laura Hobbs, Jimmy Mahady, Sam Schabacker, and Santos Vazquez. Jeff Mitchell, Ph.D. and Julian Baca of the Bureau of Business and Economic Research at The University of New Mexico provided expert guidance and input.

We extend our sincere gratitude to the many individuals from businesses, government, nonprofits, utilities, and universities for meeting with us, exploring ideas, participating in working groups, collaborating on the report, and sharing their vision for the future.

We thank the following individuals and organizations—in addition to those who respectfully choose to remain anonymous—for offering their insight and perspectives on this work.

Cathy Aguilar-Morgan
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Solstar Energy Devices

Steve Black
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Angie Brown
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Terry Brunner
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New Mexico Angels

Janie Chermak, Ph.D.
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New Mexico - Los Alamos*

Daniel Dietz
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Robert Foster
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Jeff Franchell
CED GreenTech

Dominic Gabello

Raymond Griego
Navajo Technical University

David Griscom
New Mexico Tourism Department

Carrie Hamblen
Las Cruces Green Chamber of Commerce

Kathryn Hansen
*Arrowhead Center, New Mexico
State University*

Annemarie Henton
Albuquerque Economic Development

Rachel Hillier
*Renewable Energy Industries Association
of New Mexico*

Acknowledgments

Kelly Hunt

*New Mexico Regulation and
Licensing Department*

Debra Inman

Albuquerque Economic Development

Anne Jakle

New Mexico EPSCoR

Thomas Jenkins

New Mexico State University

Jackie Kerby Moore

Sandia Science and Technology Park

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Santa Fe Green Chamber of Commerce

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Conservation Voters New Mexico

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Interstate Renewable Energy Council

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*New Mexico Manufacturing
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Cameron Stark

Fraunhofer CSE Albuquerque

Jeri Sullivan Graham, Ph.D.

*Center for Water and the Environment,
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Reena Szczepanski

*Office of the Speaker, New Mexico House
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Margie Tatro

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New Mexico State University

Bobbie Williams

Strategic Action Forum

Tim Willink

GRID Alternatives

Air Force Research Laboratory

*New Mexico Energy, Minerals and Natural
Resources Department, Energy Conservation
and Management Division*

Sun Mountain Capital

EXECUTIVE SUMMARY

New Mexico's advanced solar industry is a significant economic opportunity for job growth, having the potential to support an annual average of over 6,800 jobs through 2030. New Mexico can capitalize on this opportunity by bolstering the innovation ecosystem, access to capital, workforce development, value chain, and local market.

EXECUTIVE SUMMARY

The American Jobs Project was born of two problems: the loss of middle-income jobs and congressional paralysis in the United States. It seeks to address these problems by taking advantage of one of the biggest market opportunities of our era—the advanced energy industry—and building states’ manufacturing capacity to capitalize on increasing global demand. The American Jobs Project aims to spur job creation by identifying state-level economic opportunities in advanced energy manufacturing and crafting customized solutions for in-state growth. State and local leaders who seek to capitalize on state resources to create skilled, good-paying jobs can use this report as a foundation for action.

New Mexico faces a growing need for good-paying jobs to address high unemployment and a significant population of underemployed and low-wage workers. The state’s 6.1 percent unemployment rate jumps to 11.3 percent when accounting for marginally attached and underemployed workers, which is among the highest in the nation. Economic growth has been stifled by New Mexico’s overreliance on revenue from the oil and gas industry and on employment by the federal government. Efforts to diversify the state economy and foster good-paying manufacturing jobs could expand workforce opportunities for New Mexicans and stimulate economic growth.

Extensive research and over sixty interviews with stakeholders and experts in New Mexico have identified the advanced solar industry as a promising job creator and economic driver in the state. Whereas New Mexico has seen growth in multiple advanced energy industries, such as natural gas and wind, the advanced solar industry holds the most potential to increase manufacturing jobs in the state. (*See Appendix 1 for other technology opportunities in the state.*) While Chinese manufacturers have cornered the global market for conventional solar cells, our research shows that New Mexico is poised to capture a growing segment of the solar market by becoming a leading producer of advanced solar technologies. These technologies leverage enhanced form and function to create hyper-efficient, inexpensive, multifunctional, and easy-to-integrate products. For example, next-generation solar cells can be embedded in building facades, window film, or roof tiles for on-site electricity generation, and concentrating solar power with thermal energy storage can quickly meet demand across a utility network.

Through the advanced solar manufacturing industry, New Mexico can leverage its numerous strengths to take advantage of expanding opportunities, such as:

- **Capitalizing on increasing technology demand.**

The North American advanced solar industry is projected to grow 16.8 percent annually through 2030, and New Mexico could benefit from this growth.

- **Diversifying the economy through increased manufacturing capacity.**

Advanced solar manufacturing, which is already supported by fifteen New Mexican manufacturers, could mitigate the impact of volatility in state revenue from the oil and gas industry, reduce dependence on government jobs, and bolster the state's manufacturing base.

- **Strengthening the local solar market.**

By deploying New Mexico-made technologies, local advanced solar businesses could capitalize on increasing in-state solar demand and bolster the current installed solar capacity of 691.6 MW.

- **Leveraging cross-cutting research and industry expertise.**

New Mexico is home to three national labs and three research universities that could drive innovative research and technology transfer in advanced solar, materials science, nanotechnology, photonics, and microelectronics.

- **Bolstering creative innovations in infrastructure.**

The state's vibrant visual arts culture could design creative solar applications that enable energy generation while enhancing local aesthetics and preserving the scenic landscape.

- **Supporting quality local jobs statewide.**

With forward-thinking solutions, the advanced solar

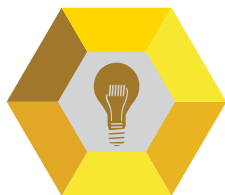
industry could support over 6,800 direct, indirect, and induced jobs in New Mexico annually through 2030. This projection more than doubles the current solar workforce.

To realize these opportunities, state and local leaders can pursue strategies that create a strong foundation for industry growth in advanced solar technology and help New Mexico's businesses grow, innovate, and outcompete regional, national, and global competitors. In today's competitive, globalized economy, businesses are more likely to thrive in cities and states that offer a rich innovation ecosystem, provide fertile grounds for capital investment, boast a highly skilled workforce, and offer clear policy signals. By having a close network of partners and suppliers, New Mexican companies can reap the benefits of increased productivity and operational efficiency, amplifying local job creation and economic growth.

Capitalizing on this opportunity offers real benefits for the state economy and New Mexico's residents. Annually through 2030, advanced solar technology can support over 6,800 direct jobs from manufacturing and materials development, indirect jobs from suppliers, and induced jobs from spending in the local economy. This industry offers a diverse array of good-paying jobs that cater to various education and experience levels, including electrical engineering technicians, materials scientists, and industrial production managers. Policymakers can support these jobs by taking advantage of increasing global demand and overcoming barriers to industry growth.

Summary of Recommendations

The analysis presented in this report culminates in recommendations for New Mexico's leaders based on best practices in the United States and abroad. Each recommendation identifies strategies to address barriers to industry growth or capitalize on untapped opportunities in the advanced solar industry. Specifically, New Mexico could target challenges in each foundational building block: the innovation ecosystem, access to capital, workforce development, value chain build-out, and local market growth for advanced solar technology. While the recommendations are intended to be complementary and would be more powerful if adopted as a package, each can also be viewed as a stand-alone option.



Innovation Ecosystem

Policy 1: Establish an Advanced Solar Center of Excellence

New Mexico could establish a Center of Excellence to strategically coordinate advanced solar-related R&D across universities, house open-access testing services, and offer entrepreneurial expertise to support executive training and business development.

Policy 2: Bolster Commercialization of University Innovation

To cultivate a strong commercialization culture, New Mexico's public universities could acknowledge technology transfer activities in tenure and promotion reviews, institute faculty mentorship and/or startup support programs, and support entrepreneurial leaves of absence.

Policy 3: Facilitate Community-Based Pilot Programs

New Mexico's non-governmental organizations and philanthropic foundations could help fund small-scale demonstration projects to help local advanced solar startups validate their products while extending access to electricity and other basic services to local communities.

Policy 4: Appoint a Foundation Liaison to Increase Funding for Essential Programs

New Mexico could appoint a Foundation Liaison to connect with and broker support from philanthropic foundations as an alternative funding pathway for public investments in workforce training, technology development, and industry growth.

Summary of Recommendations



Access to Capital

Policy 5: Establish a Technology Maturation Loan Fund to Fill Financing Gaps

To bridge the commercialization “valley of death” for local startups, the New Mexico Legislature could establish a new Technology Maturation Loan Fund, offering low-interest, non-recourse loans that are convertible into equity for future fundraising rounds.

Policy 6: Expand Sources of Capital Available to Startups

To follow on state efforts like the Catalyst Fund, New Mexico could continue to increase and diversify available startup capital by attracting program-related investments from philanthropic foundations. Because foundations’ scope of returns is broader than just market return, they are able to make direct, long-term investments in startups, especially those pursuing high-risk, cutting-edge technologies with social benefits.



Workforce Development

Policy 7: Increase Work-Based Learning Opportunities for Students

New Mexico could improve youth engagement in education and employment by increasing opportunities to develop job readiness and industry-related skills, such as simulated workplaces and integrated basic education and skills training.

Policy 8: Target Student Loan Repayment Assistance to Improve Talent Retention

In light of significant out-migration of talent, New Mexico could incentivize and attract college graduates to work in the state by providing a tax credit for student loan repayments, possibly leveraging a portion of the Lottery Scholarship program.

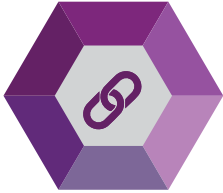
Policy 9: Coordinate Regional Solar Training to Align with Industry Needs

Either through a community college or industry association, New Mexico could formalize coordination between in-state solar businesses and solar training programs to ensure that these programs are responsive to industry needs and creating pathways to local jobs.

Policy 10: Encourage Complementary Skills Training

To meet future solar workforce demand in New Mexico, solar training programs could apply to become state-approved electrical continuing education and strengthen pathways for electricians to work in the solar industry.

Summary of Recommendations



Value Chain

Policy 11: Build a Comprehensive Advanced Solar Cluster Development Strategy

In order to put New Mexico on the map as an advanced solar cluster, stakeholders across industry, academia, and government could collaborate to create and execute a comprehensive cluster development strategy that encourages knowledge sharing, asset growth, and high-impact marketing.

Policy 12: Bolster Foreign Direct Investment Efforts

The New Mexico Legislature could increase funding for foreign direct investment efforts to support new jobs and inject capital into the economy while strengthening the state's position as an advanced solar hub. State efforts could include promoting cluster assets on international platforms, building relationships with target countries, and assisting foreign companies interested in locating in New Mexico.



Local Market

Policy 13: Streamline Solar Permitting Processes

New Mexico's Regulation and Licensing Department could create an online portal for solar permitting that cities and counties can opt to use, helping to standardize approval processes and reduce soft costs for potential customers and businesses.

Policy 14: Enable Inclusive Financing Mechanisms for Electrical Upgrades

New Mexico could enable on-bill financing to reduce the high upfront cost of energy upgrades like advanced solar. This inclusive lending mechanism allows customers to finance energy upgrades incrementally on their utility bill.

Policy 15: Include a Concentrating Solar Power Carve-out in an Expanded Renewable Portfolio Standard

In light of power plant closures, the New Mexico Legislature could increase the renewable portfolio standard to accommodate a carve-out for concentrating solar power with thermal energy storage, which offers utilities a consistent and fast-ramping power supply.



INTRODUCTION

New Mexico can tap into the growing global advanced energy market to foster and support good-paying jobs for New Mexicans. Through the strategic cluster-based development of the advanced solar industry, New Mexico could support over 6,800 direct, indirect, and induced jobs annually through 2030.

INTRODUCTION

The American Jobs Project aims to spur job creation in the advanced energy industry by identifying state-level economic opportunities and crafting right-fit solutions for in-state growth. This national initiative takes advantage of the accelerating demand for advanced energy and leverages states' competitive advantages to build robust economic clusters. The American Jobs Project believes that manufacturing is a cornerstone of the U.S. economy—providing workers with good wages and causing a multiplier effect on local revenue and employment—and resolves to support industry jobs that are resistant to offshoring and automation. State and local leaders who seek to capitalize on state resources to create skilled, good-paying jobs can use this report as a foundation for action.

Extensive research and nearly sixty interviews with stakeholders and experts in New Mexico have identified the advanced solar industry as showing particular promise in the state. Given the groundbreaking research across universities and national labs, generous state support for manufacturers, growing industry value chain, and immense solar resource, New Mexico is well positioned to benefit from the rising demand for advanced solar technology. Opportunities to leverage these strengths to serve growing regional, national, and global markets offer substantial benefits for both the state economy and New Mexico's residents. Strategic state-level collaboration and coordination could elevate in-state companies in the marketplace and facilitate middle-income job growth. By fostering growth in the advanced solar industry, New Mexico could support an average of over 6,800 direct, indirect, and induced manufacturing and supply chain jobs from 2018 through 2030 annually. This opportunity could more than double the existing solar workforce.

By developing the advanced solar industry in the state, New Mexico could support an annual average of over 6,800 jobs from 2018 through 2030.



\$287.5 BILLION

GLOBAL INVESTMENT IN ADVANCED ENERGY IN 2016

Advanced Energy Market Opportunity: Demand for advanced energy has soared in recent years and is poised for continued growth. In 2016, investment in the advanced energy industry was \$287.5 billion worldwide, nearly five times that of 2004. By 2040, investments are expected to total \$7.4 trillion. The advanced energy market is a clear opportunity for increased revenue and job growth.

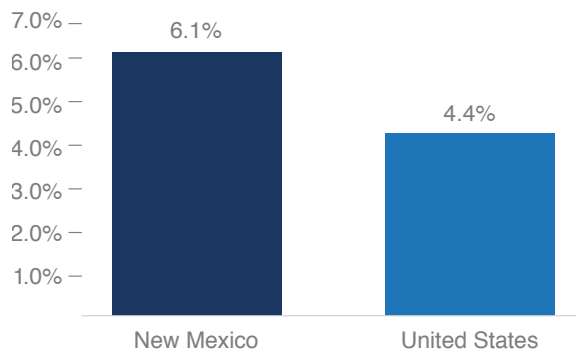
New Mexico's Need for Good-Paying Jobs

New Mexico needs good-paying jobs to help address the state's high unemployment, reduce disparities in labor market participation and wage gaps, and give underemployed workers the chance to be fully integrated into the labor force. At 6.1 percent, the state's unemployment rate is nearly 1.4 times higher than the U.S. average of 4.4 percent. This rate jumps to 11.3 percent when also accounting for marginally attached and underemployed workers. These measures are particularly severe across racial groups. The American Indian community faces a 16 percent unemployment rate and 56 percent labor participation rate, while persons identifying as Black/African American report an 8.8 percent unemployment rate. Additionally, 31.2 percent of New Mexicans are employed in low-wage jobs, the seventh-largest proportion of low-wage workers in the United States. Strategic economic development could reduce barriers to full employment and provide all New Mexicans the security of a good-paying job.

New Mexico would benefit from diversifying its economy and developing the private sector to attract more investment and jobs to the state, particularly by growing its small manufacturing base. New Mexico currently ranks forty-ninth in manufacturing share of total employment at 3.2 percent, and the state has lost one-quarter of manufacturing jobs

since the onset of the recession. Changes in the global energy market, overreliance on government jobs, and a reduction in tourism have contributed to a slow post-recession recovery that has hindered employment growth and depressed median income, which is the lowest in the region. Manufacturing facilitates a strong labor market with good-paying job opportunities in the local economy, which can support groups facing severe employment barriers and low wages. Targeting advanced solar manufacturing could support thousands of jobs and position the state for economic growth.

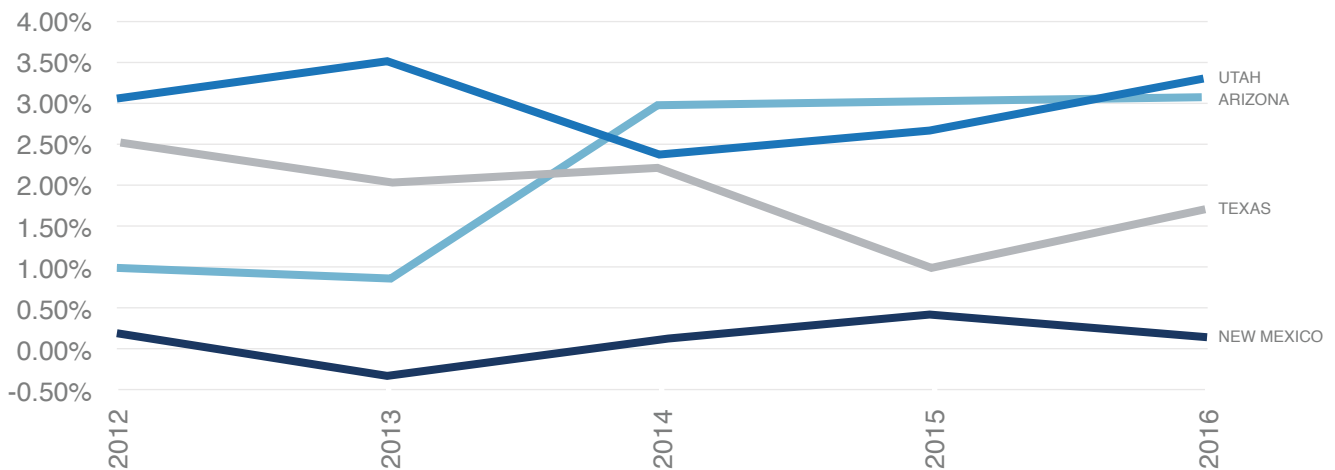
UNEMPLOYMENT RATE, 2017 ANNUAL AVERAGE



Source: U.S. Bureau of Labor Statistics

REGIONAL POST-RECESSION EMPLOYMENT GROWTH RATES

Source: New Mexico Department of Workforce Solutions

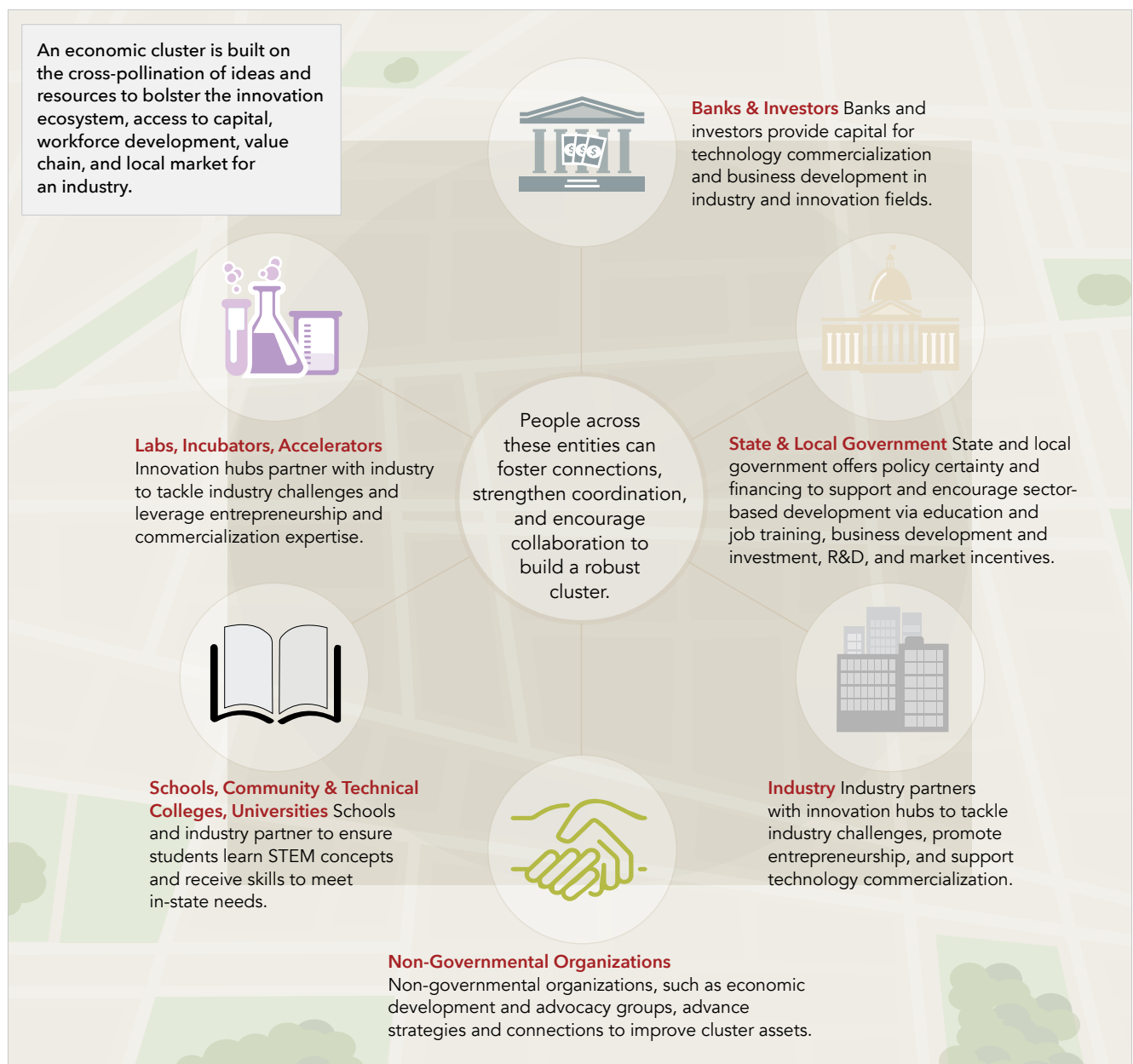


The Benefits of Cluster-Based Development

Economic clusters are regionally situated groups of interconnected companies and institutions organized around a particular industry. In today's competitive globalized economy, businesses are more likely to thrive in cities and states that cultivate the foundational building blocks of cluster development: a rich innovation ecosystem, fertile grounds for capital investment, a highly skilled workforce, a robust value chain, and clear policy signals. Geographic

proximity and repeated exchanges of information help foster an environment of coordination and cooperation among these companies and institutions, leveraging a trained workforce and each actor's unique expertise. By having a close network of suppliers and partners, companies can reap the benefits of increased productivity and operational efficiency, amplifying local job creation and wage growth.

HOW DOES AN ECONOMIC CLUSTER WORK?

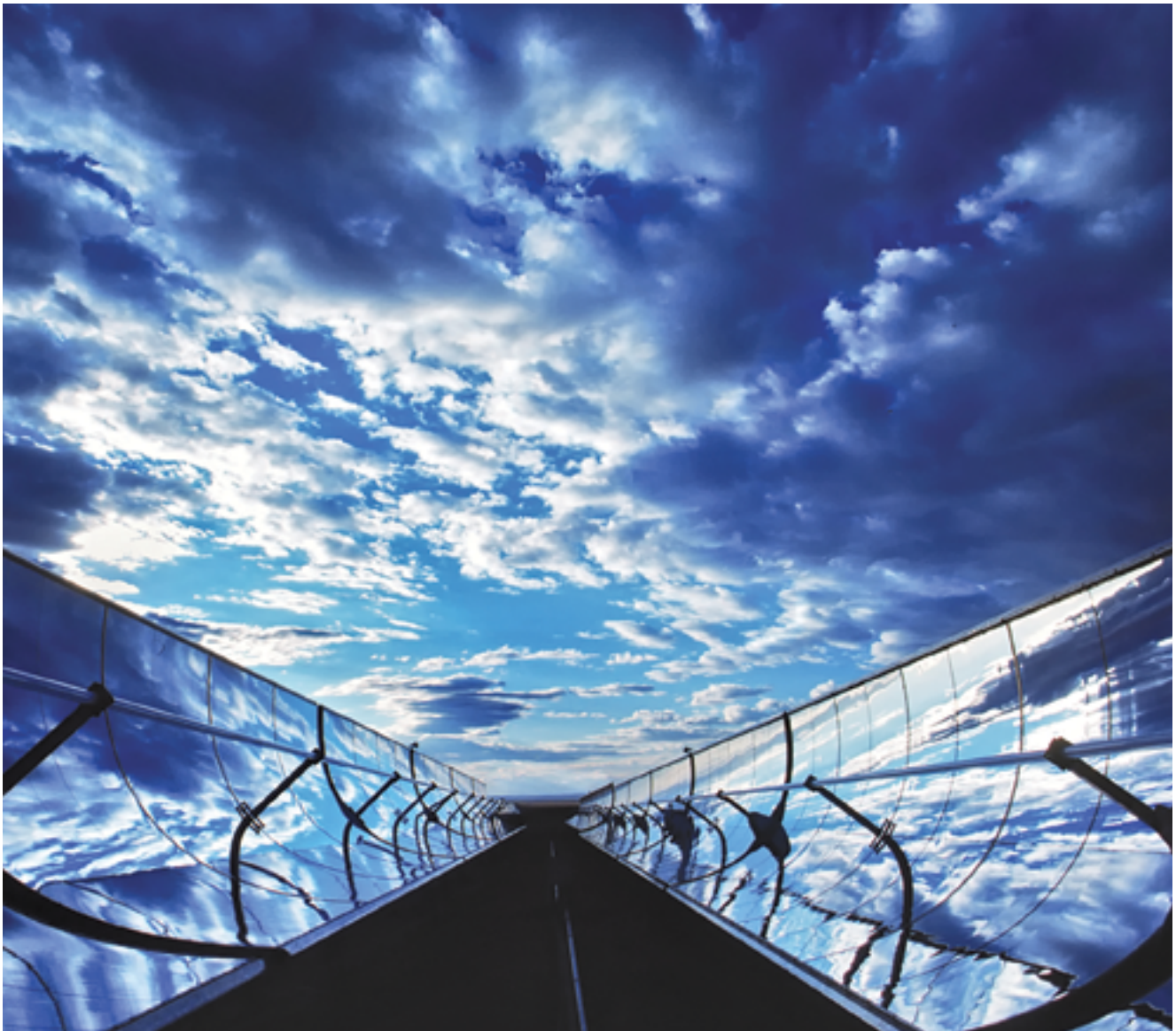


NEW MEXICO'S ECONOMIC OPPORTUNITY IN ADVANCED SOLAR TECHNOLOGY

New Mexico is well positioned to capitalize on rising market demand for hyper-efficient, low-cost, and versatile solar technologies given the state's groundbreaking research across universities and national labs, generous state support for manufacturers, growing industry value chain, and immense solar resource.

NEW MEXICO'S ECONOMIC OPPORTUNITY IN ADVANCED SOLAR TECHNOLOGY

Advanced solar is a unique opportunity for New Mexico because of increasing market demand for the technology, an urgent need for economic diversification, the potential to support a strong local market, and an active research environment and visual arts culture that can foster innovative technologies. While Chinese manufacturers have cornered the global market for conventional solar cells, New Mexico is poised to capture a growing segment of the solar market by becoming a leading producer of advanced solar technologies. The federal tariff on imported solar cells could also boost the cost-competitiveness of non-photovoltaic technologies, such as concentrating solar power. State and local leaders could realize New Mexico's manufacturing potential through innovative strategies that leverage the state's competitive advantages and strategically target areas for growth.



What is Advanced Solar?

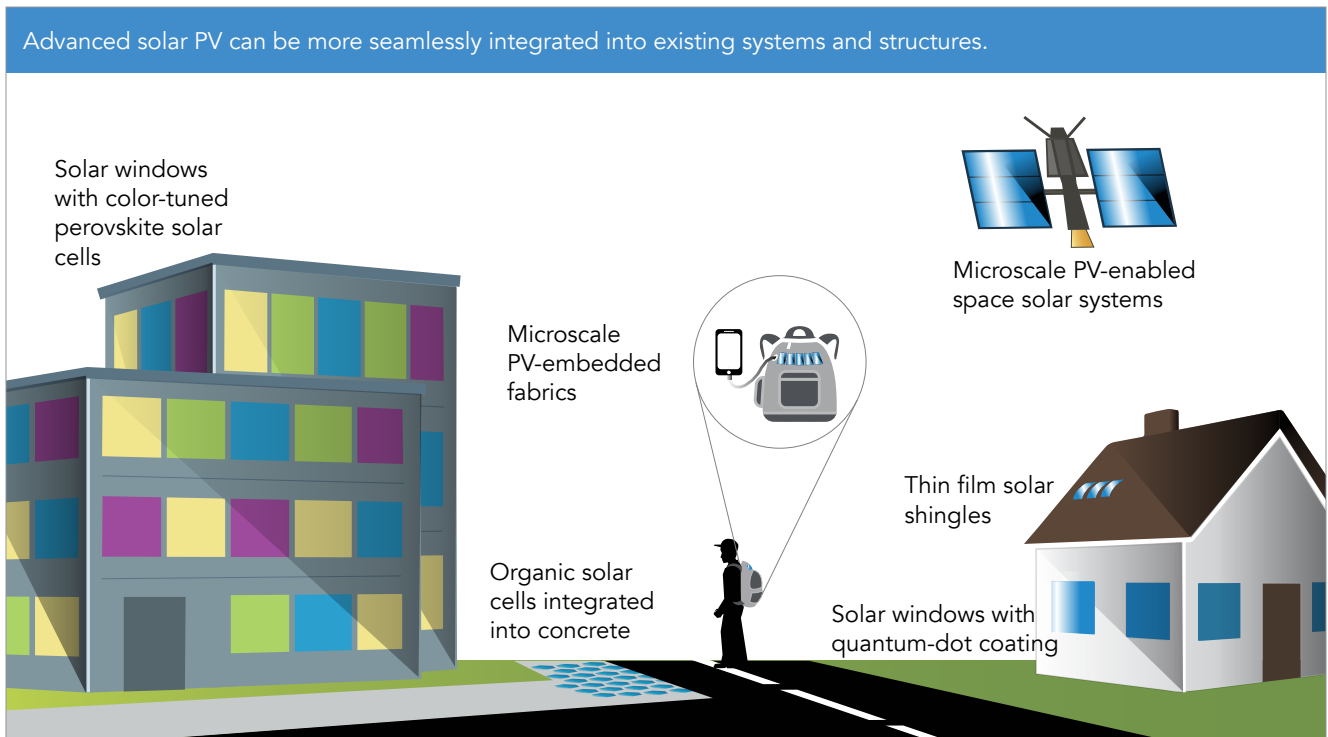
Advanced solar technologies leverage enhanced form and function to create hyper-efficient, inexpensive, multifunctional, and easy-to-integrate products. Advanced solar photovoltaics and concentrating solar power technologies differ in how they generate electricity, and thus, foster unique innovations from novel materials to new devices and processes. While these technologies stem from cutting-edge research, many are commercially viable products ranging from recent market entries (microscale solar cells) to established systems (concentrating solar power with molten salt energy storage).

Advanced Solar Photovoltaics

Solar photovoltaics (PV) use semiconductor-based solar cells to absorb sunlight and directly convert it to electricity. Efforts to increase functionality and efficiency at low cost are giving way to advanced solar cells with unique compositions, structures, and applications. Novel solar cells continue to open doors for new and exciting solar PV applications.

- Flexible perovskite solar cells can be tuned to be different colors and utilized in glazing to enable colorful, electricity-producing glass buildings. Nanoscale quantum-dot coating can also help concentrate light on windows to reduce the number of solar panels needed.
- Thin film solar shingles can replace traditional roofing and offer easier solar installation options for building owners.
- Organic solar cells integrated into concrete material can enable “solar active” building facades, supporting on-site electricity generation.
- Microscale solar cells, or “solar glitter,” can be embedded into flexible, lightweight materials, such as fabrics. Sheets of solar glitter can also be folded or bent to adapt to multiple end-use applications, including aerospace vehicles, emergency response equipment, and buildings.

EXAMPLES OF ADVANCED SOLAR PHOTOVOLTAICS



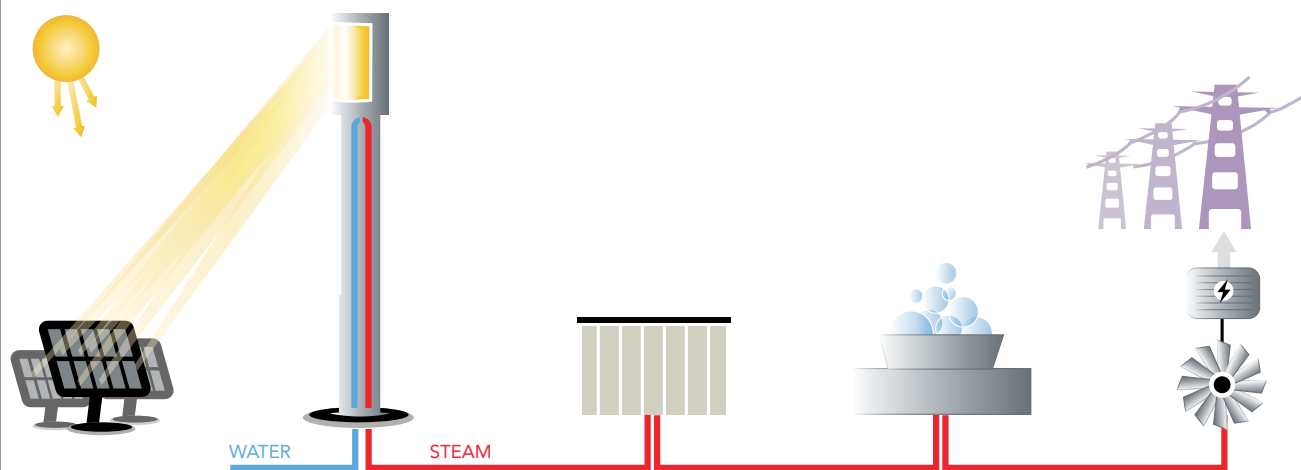
Concentrating Solar Power

Concentrating solar power (CSP) uses mirrors called heliostats to reflect and concentrate sunlight to heat a fluid and drive electricity-generating turbines. Innovations in this field aim to improve performance efficiency, reduce water consumption, and cut hardware, operations, and maintenance costs. Current projects target heliostats, power cycles, thermal storage, steam condensers, and other CSP components.

- Lightweight, highly reflective panels can reduce the cost of conventional, heavy glass mirrors while improving optical efficiency. Anti-soiling coating and water recovery systems on heliostats can also minimize maintenance needs, water use, and impaired performance due to accumulated dust.
- Supercritical carbon dioxide has the potential to be a low-cost option for greater thermal-to-electric power conversion efficiency.
- Molten salt energy storage for large-scale CSP plants can store enough thermal energy for fifteen hours of generation in some cases, increasing plant capacity and enabling a reliable power supply.
- Innovative dry cooling and hybrid wet/dry cooling systems can significantly reduce water consumption compared to conventional CSP systems, in some cases by 90 percent.

CONCENTRATING SOLAR POWER

Advanced solar thermal technologies can significantly increase efficiency, incorporate energy storage, reduce water consumption, and cut costs.



Heliostats

Lightweight, highly reflective panels with anti-soiling coating can reduce hardware costs, water use, and maintenance needs.

Collection Tower

Thermal Storage

Molten salt can store enough thermal energy to generate 15 hours of electricity.

Steam Condenser

Alternative cooling systems can reduce water consumption by up to 90 percent.

Turbine & Generator

Supercritical carbon dioxide can replace steam to increase power conversion efficiency.

Why Advanced Solar in New Mexico?

New Mexico could catalyze economic growth and job creation by capitalizing on opportunities and building on its strengths in the advanced solar industry. Advanced solar presents a ripe market that could diversify the state's economy and leverage its rich innovation ecosystem.

Capitalizes on Increasing Technology Demand

The market for advanced solar products is growing due to increased demand for low-cost, high-performing solar technologies that seamlessly integrate into existing systems and structures. These high-tech innovations are set to capture a larger share of the broader solar market. The North American advanced solar industry revenue is projected to grow 16.8 percent annually through 2030. This projection accounts for market growth across technology components, such as thin film and quantum dot solar cells, as well as full systems, such as building-integrated PV and concentrating solar power. Thin film solar cells occupy the largest market segment for advanced solar and are projected to grow 15.7 percent annually and become a \$4 billion market by 2021. Although the smallest market segment, quantum dot solar cells are expected to have the fastest annual growth at 45.3 percent through 2022. Building-integrated PV will grow by 13.8 percent annually to create a \$1 billion market in 2021 while concentrating solar power technologies will increase 19.2 percent each year to reach a \$2.2 billion market in 2025. New Mexico is well positioned to meet this rising regional and global demand.

Diversifies the Economy Through Increased Manufacturing Capacity

The strategic growth of New Mexico's advanced solar industry could bolster the in-state manufacturing base and diversify the economy. Manufacturing accounts for only 4.6 percent of the state's total output and 3.4 percent of the workforce, ranking it among the bottom five states in share of total state employment. The state also faced job displacement from Intel, its largest manufacturer and a major employer, which has downsized its Rio Rancho workforce in recent years. New Mexico's advanced solar industry includes fifteen

advanced solar manufacturers, making everything from solar cells to solar trackers. (See Appendix 2 for a full list of advanced solar manufacturers.) The state could engage anchor companies, such as Array Technologies, SolAero Technologies, and Unirac, in economic development activities to foster industry growth, attract more manufacturers, and support unemployed and displaced workers. These efforts could particularly benefit tribal communities with interests in advanced manufacturing on reclaimed lands and create sustainable employment opportunities, as seen with the Black Mesa Solar Project.

Strengthens the Local Solar Market

Advanced solar technologies dovetail with opportunities for cost savings and resource diversification in New Mexico's energy economy. New Mexico is ranked fifteenth in total installed solar capacity, and 37 percent of the state's 691.6 MW capacity was installed in 2016 alone. Utility deployment and distributed generation are on track meet the state's renewable portfolio standard, which requires utilities to derive 20 percent of electricity supply from renewables by 2020, with a 20 percent solar carve-out. The state's renewable energy potential has also been a key to attracting new businesses, such as Facebook's Los Lunas Data Center. The facility will be completely powered by renewable energy and has led to new solar projects and partnerships with local companies, including Array Technologies and Affordable Solar. By providing innovative ways to meet local needs, advanced solar companies could take advantage of the growing in-state demand for solar energy.

Leverages Cross-Cutting Research and Industry Expertise

New Mexico's booming research environment is supported by three national labs and research programs across its state universities. For example, Los Alamos National Laboratory is a key partner of the Center for Advanced Solar Photophysics, which aims to increase the light-to-energy conversion efficiency. Sandia National Laboratories foster work on microscale solar cells and operate its National Solar Thermal Test Facility in Albuquerque to support the development of next-generation concentrating

solar power. In addition to solar-specific research, New Mexico's research and industrial base houses a wealth of expertise in materials science, nanotechnology, photonics, and microelectronics, which can lead to new solar technologies and enabling devices, such as solar trackers and optical lenses. UNM houses a well-established, interdisciplinary optical science and engineering program, and as of 2015, the state had ninety-six firms engaged in the photonics industry. NMSU and NM Tech also offer significant research on thin film technology and microelectronics in the state. New Mexico's robust research hub has produced a wealth of innovative solar startups and technologies, such as mPower Technology's microscale PV cells, UbiQD's quantum dots, and 35 Solar's efficient thin film manufacturing process. Through streamlined technology transfer and greater industry engagement, New Mexico could bring more original ideas from the labs and universities to market and expand the advanced solar value chain.

Bolsters Innovations in Infrastructure

The state's vibrant visual arts culture could support the seamless integration of advanced solar technologies into traditional systems and structures. Through a focus on creative design, solar applications could provide needed services while accounting for existing infrastructure and enhancing the aesthetics of local communities. For example, building-integrated PV can support both on-site energy generation and

creative placemaking in neighborhoods. Additionally, as demonstrated by a recent Navajo Nation community proposal, solar-powered broadband can expand internet connectivity for New Mexicans in rural tribal areas. By creatively designing projects, advanced solar can expand access to electricity and additional services while preserving the state's scenic landscape.

Supports Quality Local Jobs Statewide

The advanced solar industry could help address New Mexico's need for good-paying jobs while offering a diverse array of employment opportunities that cater to different education and experience levels. New Mexico is already home to over 2,500 solar jobs, with 29 percent being manufacturing-based. The state ranks eighth nationally in solar's share of total employment. By employing forward-thinking solutions, advanced solar could support an average of over 6,800 jobs annually through 2030, increasing the existing solar workforce by more than twofold. This estimate includes direct jobs from manufacturing and materials development, indirect jobs from suppliers, and induced jobs from spending in the local economy. (See Appendix 3 for jobs modeling methodology.) While economic growth may be concentrated near manufacturing facilities, New Mexico could foster a local market for technology deployment to support job creation in installation, operation, and maintenance businesses distributed across the state.

JOB OPPORTUNITIES IN ADVANCED SOLAR



Materials Scientists
Study substances at the atomic and molecular levels and the ways in which the substances interact with one another.
TYPICAL ENTRY-LEVEL REQUIREMENTS:
Bachelor's Degree
Wage: \$62.77



Electrical and Electronics Engineering Technicians
Assist engineers and often work in product evaluation and testing, using measuring and diagnostic devices to adjust, test, and repair equipment.
TYPICAL ENTRY-LEVEL REQUIREMENTS:
Associate Degree
Wage: \$29.33



Industrial Production Managers
Oversee the daily operations of manufacturing and related plants.
TYPICAL ENTRY-LEVEL REQUIREMENTS:
Bachelor's Degree
Wage: \$47.96



Welders, Cutters, Solderers, and Brazers
Use hand-held or remote-controlled equipment to join or cut metal parts.
TYPICAL ENTRY-LEVEL REQUIREMENTS:
High School Diploma or Equivalent
Wage: \$24.45



Electricians
Install, maintain, and repair electrical power, communications, lighting, and control systems in homes, businesses, and factories
TYPICAL ENTRY-LEVEL REQUIREMENTS:
High School Diploma or Equivalent
Wage: \$24.16

STATE ASSETS TO SUPPORT ADVANCED SOLAR CLUSTER DEVELOPMENT

There are five foundational building blocks for clusters: the innovation ecosystem, access to capital, workforce development, value chain build-out, and local market growth. New Mexico has many assets that can be aligned with cluster-based development, including an active innovation ecosystem, job training incentives, large photonics and nanotechnology clusters, and resources for in-state manufacturing.

STATE ASSETS TO SUPPORT ADVANCED SOLAR CLUSTER DEVELOPMENT

New Mexico can capitalize on its strengths in advanced solar by strategically building an economic cluster. Clusters require several foundational building blocks coordinated for growth: an innovation ecosystem that cultivates new ideas, access to capital for new and expanding businesses, education and training for a skilled workforce, a comprehensive value chain, and a local market for New Mexico-made goods. When reinforced by clear market signals and policy certainty, these assets translate into major opportunities for business growth and job creation in the target industry, laying the groundwork to catalyze economic opportunity for thousands of New Mexicans.

The following visual guides break down the key assets for a robust cluster. This section will use these guides to illustrate the state's strengths in each foundational building block and showcase significant resources for New Mexico's advanced solar industry.



Innovation Ecosystem: Innovation is essential for business and industry competitiveness, and a strong knowledge hub can be a beacon for talent and investment. The innovation ecosystem supports fundamental research across universities and labs, fosters an entrepreneurial culture that seeks to advance and disrupt industries, and brings ideas to market.



Access to Capital: Access to investors or competitively priced non-dilutive capital can be the difference between success and failure for a new or expanding business. It is also important for consistent access to capital across development from the seed and early/growth stages to the late stage. An active investment environment can attract more entrepreneurs and investors to the state.



Workforce Development: Trained and skilled workers are fundamental to industry success, and strategic workforce development can support talent recruitment and retention. Workforce development requires collaboration across schools, businesses, and government offices to integrate STEM education, foster industry-ready skills via apprenticeships and career-integrated curriculum, enable stackable credentials that offer multiple entries and exits, and provide resources that match skills to available jobs.



Value Chain: An industry value chain is composed of an array of companies engaged in the manufacturing, sale, marketing, and distribution of technologies. It also includes organizations that represent business interests across platforms. This base provides a solid foundation from which to attract more companies and customers.



Local Market: Creating a local market for products sends a market signal to businesses that encourages investment in new facilities and employees. High local demand can attract a local company base that could then expand to regional, national, and global markets. Clear utility and business regulatory environments coupled with resources for project development and end-user adoption can create a strong local market.



NEW MEXICO'S INNOVATION ECOSYSTEM ASSETS

Working Together to Bring Ideas to Market

Key components of an innovation ecosystem are technical, financial, and capacity-building resources that support entrepreneurship, research and development, and commercialization. New Mexico's three national labs and three research universities—along with their technology transfer offices—anchor research, development, and commercialization in the state. Entrepreneurs and businesses have access to a multitude of resources to support their innovations, with a few highlighted below.

EPSCoR and Innovate NM help coordinate research activity, infrastructure, and resources across the national labs and higher education network to accelerate commercialization and stimulate economic growth.

NATIONAL LABS



Sandia National Lab



Air Force Research Lab

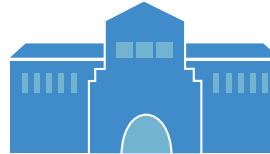


Los Alamos National Lab

UNIVERSITIES



University of New Mexico



New Mexico State University



New Mexico Tech

Technical Assistance	Financial Assistance	Business Incubators & Accelerators
<ul style="list-style-type: none"> • SNL Center for Collaboration & Commercialization (C3): Multi-tenant facility dedicated to strengthening lab-industry partnerships via entrepreneurial training, technology maturation, investor access, and retiree mentoring. • Center for Integrated Nanotechnologies • UNM Manufacturing Training and Technology Center • NM Center for High Technology Materials Nanofabrication Facility • CFV Solar Test Laboratory • Manufacturing Extension Partnership (MEP) • FAST SBIR/STTR Assistance • Small Business Development Center (SBDC) 	<ul style="list-style-type: none"> • New Mexico Small Business Assistance Program (NMSBA): Grants for small businesses with special technical challenges to connect with lab, university, or MEP experts. • Technology Jobs and R&D Tax Credit • Innovation Voucher Program: Grants for early-stage science or technology companies to access approved business development programs. • SBIR Matching Grant 	<ul style="list-style-type: none"> • Arrowhead Technology Incubator: Entrepreneurial support for innovations in the water-energy-agriculture nexus. • Cecchi VentureLab • ABQid • TEAM Technologies Accelerator: Advanced engineering and manufacturing support. • Santa Fe Business Incubator • WESST Enterprise Center • Creative Startups • South Valley Economic Development Center • San Juan College Enterprise Center • CNM Ignite



NEW MEXICO'S ACCESS TO CAPITAL ASSETS

Investing in New and Growing Businesses

Key components of access to capital are diverse and robust funding for seed-stage, early/growth-stage, and late-stage businesses. While New Mexico has funds and programs in place along the business life cycle, the state has to significantly scale up available capital in order to support robust growth of new and expanding businesses.



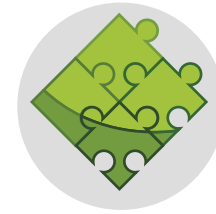
The **Catalyst Fund** allocates \$20M to support New Mexico venture capital funds investing in the state.

At least 15 private New Mexico venture capital firms invest in the state, such as **Flywheel Ventures** and **Verge Fund**. In particular, **Cottonwood Technology Fund** has invested over \$20M in New Mexico-based companies since 2010, with those companies gaining more than \$300M in additional capital.



Qualified investors can receive up to \$62,500 or 25% of their investment in a New Mexico startup through the **Angel Investment Tax Credit**.

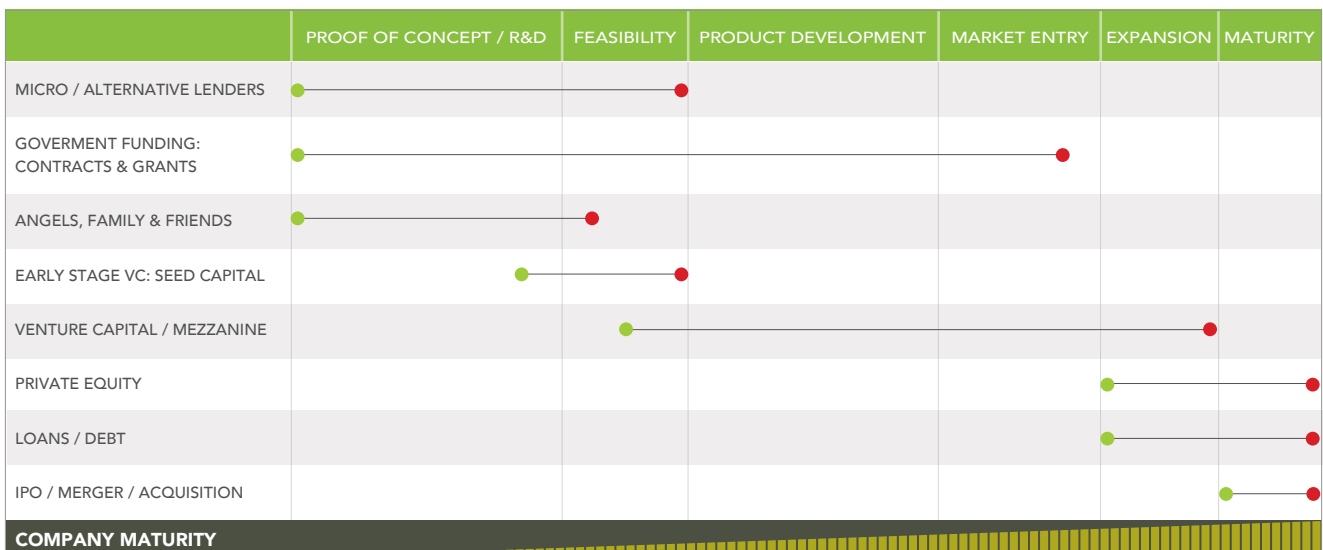
The **New Mexico Angels** have invested over \$11.5M in New Mexico startups since 1999.



Targeting Northern New Mexico, the **Venture Acceleration Fund** has contributed \$3.6M in 60 startups, resulting in a \$160.7M ROI and nearly 700 jobs created or retained.

Groups like **Accion**, **The Loan Fund**, and **WESST** offer debt financing to New Mexico businesses.

BUSINESS FUNDING SPECTRUM





NEW MEXICO'S WORKFORCE DEVELOPMENT ASSETS

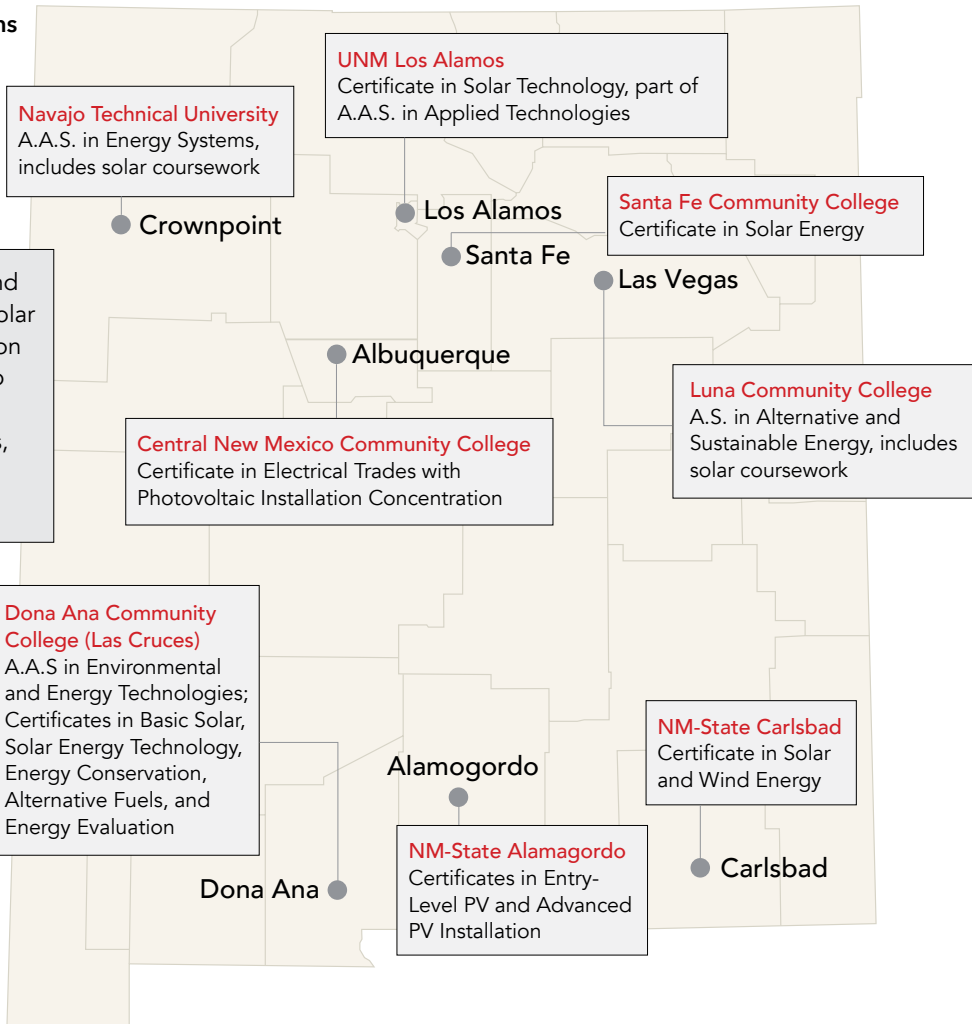
Building a Skilled Industry-Ready Workforce

Key components of workforce development are STEM education, work-integrated learning, flexible career pathways, apprenticeships, skill-matching resources, and interagency cooperation. New Mexico could extend opportunities for solar-specific training to people across education and experience levels to improve industry skills development and talent retention.

● Solar Training Programs

Seven campuses currently offer solar-relevant certificates and/or associate degrees.

New Mexico ranks second in the nation for future solar training demand based on projected installation job growth, current difficulty finding qualified workers, and available training programs.



Education and Training Programs

Early College High Schools

A promising practice shown to increase graduation and college matriculation rates that has been adopted by about 20 schools in the state.

Job Training Incentive Program (JTIP)

A state program that has supported over 46,000 new jobs across 1,500 companies since 1972, and 2,009 new jobs at an

average wage of \$17.45 in 2017 alone. JTIP recipients are also eligible for tax credits for creating high-wage jobs and jobs in rural areas. Increased state funding could amplify the program's impact.

Innovate+Educate

A nonprofit advancing worker assessments, skill matching, and job placement resources to support New Mexicans

facing employment barriers. TalentABQ, a collaborative pilot program with support from the City of Albuquerque, Kellogg Foundation, and Central New Mexico Community College, leverages a skills-based hiring model to bolster the city's workforce and currently engages over 60 employers and more than 1,000 job seekers each month.



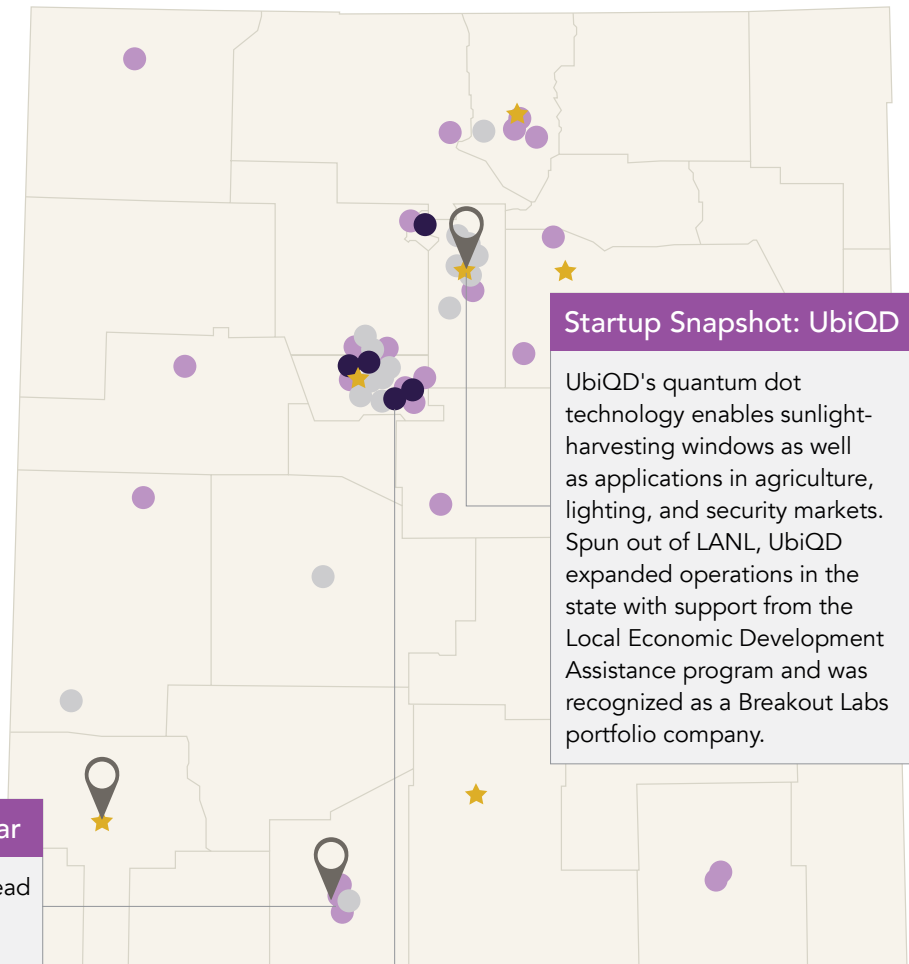
NEW MEXICO'S VALUE CHAIN ASSETS

Expanding In-State Industry Capabilities

Key components of an industry value chain are businesses that anchor manufacturing, supply, installation, operations and maintenance, project development, construction, and extraction as well as resources that support business attraction, retention, and advocacy. New Mexico has a number of value chain assets that could support the growing advanced solar manufacturing base, including industry associations, innovative startups, robust photonics and nanotechnology clusters, and local installers.

LEGEND

- Advanced Solar Manufacturers
- Solar Installers
- Other Solar Businesses
- 📍 Green Chambers of Commerce
A member-based coalition of businesses and organizations focused on strengthening advanced energy industries in New Mexico, including solar.
- ★ New Mexico Solar Energy Association Chapters



Startup Snapshot: 35 Solar

Supported by NMSU's Arrowhead Center, 35 Solar has leveraged the NMSBA program and a crowdfunding platform to demonstrate its efficient thin film manufacturing process with solar design prototypes.

Startup Snapshot: UbiQD

UbiQD's quantum dot technology enables sunlight-harvesting windows as well as applications in agriculture, lighting, and security markets. Spun out of LANL, UbiQD expanded operations in the state with support from the Local Economic Development Assistance program and was recognized as a Breakout Labs portfolio company.

Startup Snapshot: mPower Technology

Founded by a scientist-turned entrepreneur, mPower integrates microscale PV cells from SNL into lightweight, flexible sheets that enable solar power generation. With its fully developed technology, mPower can now target applications in the aerospace, biomedical, and building energy efficiency markets.



Synergistic Cluster
The advanced solar industry could leverage 96 photonics and nanotechnology firms in supplier networks and innovation activities.



NEW MEXICO'S LOCAL MARKETS ASSETS

Encouraging Investment in New Mexico-Made Goods

Key components of a local market are end-user and project development resources, a favorable energy regulatory environment, and a business-friendly climate. New Mexico has a wide slate of incentives and resources for both the in-state manufacturing and installation of solar technology. By reducing red tape for solar projects and increasing availability of end-user financing options, local businesses can bolster the state's competitiveness in the solar industry.



BUSINESS-FRIENDLY CLIMATE

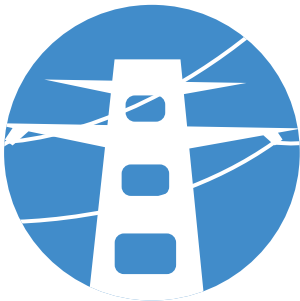
Solar Gross Receipts Tax Exemption: Solar companies can exempt revenue from the sale and installation of solar energy systems from gross receipts tax.

Alternative Energy Product Manufacturer's Tax Credit: Solar companies can receive a tax credit for solar manufacturing equipment.

Investment Tax Credit for Manufacturers

Industrial Revenue Bonds

Solar/Wind Construction Permitting Standards

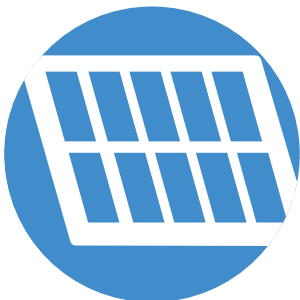


ENERGY REGULATORY ENVIRONMENT

Renewable Portfolio Standard: Utilities must derive 20% of their electricity supply from renewables by 2020, with at least 20% coming from solar energy.

Net Metering & Interconnection Standards

Utility Green Power Options



END-USER & PROJECT DEVELOPMENT RESOURCES

Property-Assessed Clean Energy: New Mexico allows municipalities and counties to loan the upfront cost for a renewable energy system that property owners can pay back through their property taxes. However, there are no active PACE programs due to restrictive legislation and budgetary constraints.

Renewable Energy Production Tax Credit: Companies with solar energy systems can receive a tax incentive that averages \$0.027 per kWh annually. This incentive is no longer open to new applicants.

Property Tax Exemption for Residential Solar Systems

Clean Energy Revenue Bonds: State agencies, universities, and public schools can receive financial support for energy efficiency and renewable energy projects.

Solar Easements & Rights Laws

Performance Contracting

POLICY RECOMMENDATIONS

To grow the advanced solar industry, state and local leaders can address barriers and capitalize on opportunities across foundational building blocks, such as supporting technological innovation and knowledge sharing, increasing available capital for startups, targeting talent retention and recruitment, collaborating to create and execute a cluster development plan, and reducing the cost of in-state technology deployment. These forward-thinking policies, programs, and ideas are intended to serve as stepping stones to discussion and collaboration.



POLICY RECOMMENDATIONS

To help create thousands of jobs and strengthen the state’s manufacturing industry, New Mexico’s leaders can capitalize on the state’s competitive strengths and demonstrate their commitment to the advanced solar industry by catalyzing forward-thinking policies and non-legislative solutions. In particular, state and local leaders can apply innovative strategies that address barriers and missed opportunities across foundational building blocks, as noted by the icons. These broad strategies include fostering technology development and commercialization, increasing business access to financial resources, improving workforce training, and growing the in-state value chain. New Mexico can also build a local market for advanced solar products as an opportunity for industry growth. Robust demand near manufacturing facilities can help create synergies that drive innovation, train and retain talent, and attract out-of-state investors.

Whether taken as a whole or as piecemeal solutions, the following recommendations could attract private investment, stimulate the state’s economy, and create good-paying jobs for New Mexicans.



Innovation Ecosystem: Bridges the commercialization gap by coordinating product testing and demonstration resources for advanced solar startups, and builds “connective tissue” in New Mexico’s research and entrepreneurial community.



Access to Capital: Expands available capital for New Mexico’s advanced solar startups, especially flexible, long-term funding opportunities to support commercialization.



Workforce Development: Targets talent retention and recruitment through work-integrated learning models, financial incentives, industry coordination, and expanded pathways to careers in New Mexico’s advanced solar industry.



Value Chain: Encourages strategic collaboration across stakeholders to strengthen New Mexico’s advanced solar industry and attract investment from outside the state.



Local Market: Incentivizes and reduces the cost barrier of adopting advanced solar technologies for New Mexico utilities and electricity customers.



Policy 1: Establish an Advanced Solar Center of Excellence

BARRIER

New Mexico is home to a wealth of research universities, national labs, incubators, and accelerators; however, current investments and resources do not chart a streamlined path towards commercialization. While the state's universities excel at basic research in photonics and nanotechnology, there lacks a strategic coordinating body with a focus on high-impact, applied R&D in advanced solar, limiting potential growth of the innovation ecosystem. At the startup level, New Mexico entrepreneurs lack access to equipment and space for pilot manufacturing or pre-commercial production, which helps validate product feasibility and manufacturability outside of a lab environment. These barriers are especially significant as advanced solar technology becomes increasingly integrated and serves diverse applications, requiring not only extensive testing but skills and expertise across multiple fields.

Additionally, New Mexico faces a workforce gap in early-stage, C-suite leadership, inhibiting the potential for long-term business growth. While in-state entrepreneurs could develop innovative businesses, there lacks a substantial pool of seasoned entrepreneurs that could provide executive leadership with a strong national network and an understanding of global markets. With investments and resources targeting the commercialization gap, New Mexico could attract seasoned entrepreneurs from outside the state to help lead homegrown businesses and mentor potential New Mexico executives.

SOLUTION

New Mexico could establish an Advanced Solar Center of Excellence (CoE) dedicated to applied R&D and technology development. To address barriers in the state, the CoE's objectives could be to:

- Stimulate commercialization, increase research revenues, and attract investment by serving as an applied R&D hub for advanced solar and coordinating related research across universities.
- Support local entrepreneurship and innovation through open-access testing and prototyping equipment and services.

- Increase the number of seasoned entrepreneurs by recruiting entrepreneurs who could be embedded in local companies to support executive training and business development.

Graduate and undergraduate students could be embedded in the CoE's R&D activities and public-facing services to support interdisciplinary hands-on education and training in advanced solar manufacturing.

Applied R&D Hub for Commercialization

The CoE could support coordination and collaboration of applied solar R&D across the universities (see case study). The CoE could support coordination and collaboration of applied solar R&D across the universities. Bolstering R&D at the state's universities could ensure robust data based on the different regional climates in northern and southern New Mexico. By establishing an inventory of solar R&D expertise and infrastructure in the state, the CoE could target large research contracts that effectively leverage the state's resources. The CoE could also house a library of solar-related technologies across the participating universities available for licensing.

Open-Access Testing and Prototyping

The CoE could also serve as a user facility to support the development of advanced solar technologies and integrated systems. Given that existing equipment is needed for R&D, the CoE could multiply their value by extending use to the public as well. Universities and partners could have dedicated wings to support in-house innovation while the rest of the CoE could be open to the public for testing, prototyping, and pilot manufacturing. By centralizing needed equipment and streamlining access, the user facility could help decrease costs, expedite time to market, and encourage knowledge sharing for local businesses and entrepreneurs.

Embedded Entrepreneurs

The CoE could place entrepreneurs in participating companies to support executive training and business development. Given New Mexico's small population of seasoned entrepreneurs, the CoE could initially recruit out-of-state entrepreneurs to serve this role and expose them to what New Mexico has to offer. In a year-long or two-term residency, rotating



embedded entrepreneurs could be charged with supporting a select cohort of students, faculty, and

local entrepreneurs starting businesses. In partnership with business schools and local incubators/accelerators, this application-based mentorship and workforce development program could cover topics such as validating products, acquiring first customers, marketing, and running a company. If a company spins off from the CoE, team members could look to embedded entrepreneurs as potential CEOs and advisors to take the company to success. This model is often seen in venture capital firms, where investors deploy their own operating talent to work alongside portfolio companies to ensure business growth. In fact, venture capital firms that have robust operating talent have shown higher returns on investments. New Mexico could also look to Oregon's successful Venture Catalyst program as a model for effectively deploying entrepreneurial expertise in the state (see case study). By emulating this embedded entrepreneur model through the CoE, New Mexico could build the capacity of local entrepreneurs and amplify the economic impact of homegrown companies.

To build on existing resources, the CoE could be housed at UNM's Center for High Technology Materials (CHTM), which boasts strong expertise and scalable infrastructure in photonics, microelectronics, and nanotechnology research. With an annual research budget of \$7 million, CHTM has created 190 patents that comprise 35 percent of STC.UNM's portfolio and participates in national research consortia, such as the Quantum Energy and Substantial Solar Technologies Engineering Research

Center. An interdisciplinary center, CHTM attracts faculty and students in optical sciences, electrical and computer engineering, physics, and chemistry and houses robust user facilities with streamlined, all-day access for local entrepreneurs and businesses. CHTM is also committed to advancing educational opportunities and professional development through K-12 outreach, undergraduate mentorships, research internships, and graduate student researchers.

Given that these areas of research are fundamental to advanced solar, CHTM could expand its scope and fortify the state's R&D leadership. UNM could present a formal funding proposal to the New Mexico Legislature to help reorient existing research and infrastructure to support an advanced solar focus while retaining CHTM's core strengths and commitment to education. Direct state support could also ensure maintenance and expansion of CHTM's user facilities. This effort could amplify CHTM's economic impact in New Mexico, which already includes fifteen spin-off businesses, 131 in-state jobs, \$6.5 million in labor income, and \$11.7 million in annual economic output. Additionally, this effort would closely align with the UNM 2020 strategic plan and the Innovate ABQ master development plan.

By helping bridge the gap between R&D and commercialization, the CoE could significantly bolster New Mexico's advanced solar industry and foster cluster growth as a magnet for talent and investment.

Key Players: Center for High Technology Materials, Universities, Innovate ABQ, Entrepreneurial Community, State Legislature, Governor's Office

Case Study: Oregon's Venture Catalyst Program

Coordinated by the Oregon Entrepreneurs Network (OEN), the Venture Catalyst program deploys seasoned entrepreneurs across counties to serve as coaches and resource connectors for local entrepreneurs. Often working out of regional economic development offices, they share business development expertise, startup events and training resources, and investor networks with entrepreneurs throughout their designated region. OEN currently funds three Venture Catalysts, all of whom are experienced entrepreneurs and investors. Since 2016, they have supported 500 companies, which accounts for 346 new jobs and \$55 million in revenue. The program's success likely stems from its focus on education and capacity-building and Venture Catalysts' understanding of local companies. OEN continues to expand the program statewide with support from foundations.



Case Study: Clemson University International Center for Automotive Research (CU-ICAR)

CU-ICAR is an automotive center of excellence dedicated to quality education, industry-focused research, public outreach, and economic development. The center anchors South Carolina's automotive cluster and grew out of early discussions with BMW on how to stimulate technology commercialization and build a local skilled workforce. The South Carolina Department of Commerce provided an initial investment of \$40 million and other founding partners across government, academia, and industry—including BMW, Michelin, and Timken—have contributed follow-on funding. CU-ICAR houses the only U.S. graduate program in automotive engineering and has seven strategic research areas derived from industry needs, which include advanced powertrains, manufacturing and materials, vehicle performance, and systems integration. With over twenty campus partners, CU-ICAR actively engages its network to locate and collaborate on commercial R&D projects, support graduate student internships and capstones, and leverage the center's commercial-scale equipment and testing services. Since 2003, the center has attracted \$250 million from public and private investments, supported 770 on-campus jobs and thousands more across partner companies, and channeled hundreds of graduates into automotive jobs, with a quarter employed in the state.



Policy 2: Bolster Commercialization of University Innovation

OPPORTUNITY

Universities with a strong commercialization culture experience numerous benefits, including improved industry relations and funding opportunities, increased regional economic development, and positive publicity for recruitment and retention of faculty and students. While universities continue to be a resource for entrepreneurs and their extensive research on emerging technologies, faculty members are often more encouraged to publish than they are to explore commercializing research. New Mexico's universities are no different. In the Milken Institute's 2017 report on top universities in tech transfer, UNM ranked twenty-eighth and NMSU ranked 172nd. Both universities' engineering programs account for patents in tenure and promotion assessments, but this policy could be extended university-wide and complemented by mentorship networks and resources for faculty entrepreneurs. Although not ranked, NM Tech could expand on recent efforts to promote commercialization and increase entrepreneurial networking opportunities through innovative policies and programs. New Mexican universities could improve their national rankings by incentivizing university faculty to embrace an entrepreneurial culture.

SOLUTION

New Mexico's public universities could implement incentives to promote university commercialization practices. Adopting commercialization criteria

for tenure review processes, instituting faculty mentorship and startup support programs, and supporting entrepreneurial leaves of absence are three proven methods for fostering the commercialization culture at universities. Universities could recognize faculty members for authoring patents or accelerating university innovation by expressly including technology transfer activities in the criteria considered for promotion and tenure (see *call-out box*). New Mexico's universities could also look to create mentorship and support programs to help faculty members navigate the commercialization process, such as connecting faculty members with seasoned entrepreneurs and establishing pre-negotiated relationships with firms frequently used by startups (see *case study*). STC.UNM, NMSU's Arrowhead Center, and NM Tech's Center for Leadership in Technology Commercialization could be proactive program partners to encourage entrepreneurship education and support business development. A complementary strategy could be to facilitate one- to two-year entrepreneurial leaves of absence for faculty, during which fringe benefits are still available and will accrue (see *case study*). Any or all of these activities could accelerate commercialization opportunities and shift university culture to a more innovative environment.

Key Players: Universities, Higher Education Department



Case Study: University of Utah

In addition to including specific commercialization language in its tenure policies, the University of Utah has created programs to encourage an entrepreneurial mindset for faculty members. In 2007, the University of Utah launched its Entrepreneurial Faculty Scholars (EFS) program to support faculty members wanting to commercialize their research. EFS leverages a network of 155 seasoned faculty entrepreneurs university-wide to help faculty members take their ideas to market. Alongside EFS, the University of Utah's Technology Venture Commercialization (TVC) offers the Lean Cohort, a seven-week accelerator program to help faculty navigate commercialization. As a result, there is a strong culture of innovation at the university. Between 2012 and 2015, the University of Utah generated \$211.8 million in licensing income and recorded sixty-nine start-ups. The University of Utah was ranked number one on the 2017 Milken Institute Innovation Index.



Case Study: University of California, Los Angeles

The University of California, Los Angeles (UCLA) recognizes that a strong commercialization culture provides several benefits to the university, including supporting small businesses, revenue from licensing intellectual property, and providing job opportunities to their graduate students. Among other innovative programs, UCLA has created a dedicated program for university community members looking to commercialize, which has resulted in multiple startup spinoffs. UCLA's "Startup in a Box" program aims to launch startups using university intellectual property. The program offers pre-negotiated partnerships with local law, accounting, commercial real estate, marketing, web, human resources, insurance, and finance firms. Due in part to this initiative, UCLA was ranked first for the number of startups in the 2017 Milken Institute report. As of fiscal year 2016, UCLA had has \$65.9 million from licensing shares and 1,075 active U.S. patents.



Case Study: University of Minnesota

The University of Minnesota successfully implemented an entrepreneurial leave of absence policy for faculty members. Their Entrepreneurial Leave Program allows faculty to explore commercializing university intellectual property without compromising their benefits. Faculty members are allowed up to eighteen months of unpaid leave to work on startup projects, during which they continue to maintain health benefits, accrue vacation time, and earn other fringe benefits. This policy, coupled with a Venture Center to assist startups, has led to an active startup scene with 78 percent of portfolio companies still active in 2018. The University of Minnesota ranks fourteenth on the Milken Institute list of top commercialization universities.

Sample Language for Incorporating Entrepreneurial Activities in Tenure and Promotion Review

- **Virginia Polytechnic Institute and State University (Virginia Tech)**

- "Economic contributions and entrepreneurship:
 1. Start-up businesses (including competitive grants and contracts such as SBIR awards and other notable business achievements),
 2. Commercialization of discoveries,
 3. Other. Intellectual properties: 1. Software, 2. Patents, 3. Disclosures (pre-patent)"

- **The Ohio State University**

- "... creative works pertinent to the candidate's professional focus:...Inventions and patents, including disclosures, options, and commercial licenses"

- **The University of Arizona**

- "...integrative and applied forms of scholarship that involve cross-cutting collaborations with business and community partners, including translational research, commercialization activities, and patents"



Policy 3: Facilitate Community-Based Pilot Programs

BARRIER

New Mexico has numerous innovation assets dedicated to technology research and development; however, New Mexico entrepreneurs have limited opportunities to demonstrate their technologies to assist with first customer acquisition and market development. Pilot or demonstration projects offer a valuable opportunity to validate commercial potential and identify key markets. By ensuring public education and community outreach, local partners could support startups and ensure that demonstration projects also benefit local communities.

SOLUTION

To support the startup ecosystem and low-cost access to new technologies for local communities, non-governmental organizations and foundations could help fund small-scale implementation of fully developed and locally manufactured advanced solar products in New Mexico. On the business side, these demonstration projects could offer benefits such as customer development, permitting case studies, and hands-on training. By seeing homegrown products in operation, potential customers and investors may be more open to purchasing products. Businesses also benefit from experience with navigating local regulations, such as permitting and interconnection. These case studies, along with performance analyses, can help improve their business line. In addition to employee training, funders could require that

businesses partner with local community colleges to increase exposure to solar and electrician trades. New Mexico could look at Smart City San Diego as a model for how to engage multiple partners in addressing community needs and leveraging local businesses' products and expertise (see case study).

These pilot programs could be especially beneficial to communities in remote and frontier areas, where energy infrastructure is limited and costly. Businesses could purposefully engage with rural and tribal groups about installing and maintaining demonstration projects, clearly communicating accountability and risks. The value of solar could be extended to these New Mexican communities through projects such as solar panels on street lights, solar shingles on school buildings, and solar-powered networks for rural broadband.

Community-based pilot programs could offer technological upgrades while fostering a strong market for New Mexico businesses. Through strategic engagement, these demonstration projects could also provide enriching workforce training opportunities and prepare New Mexicans for advanced solar jobs.

Key Players: Non-Governmental Organizations, Philanthropic Community, Startups, Municipalities, Tribal Governments, Community Colleges



Case Study: Smart City San Diego

Smart City San Diego is a collaborative effort to build a twenty-first century energy ecosystem that improves public services, emphasizes energy savings, empowers consumers, and drives economic growth. Launched in 2011, this multi-year partnership is led by Cleantech San Diego, a regional trade organization, and engages the City of San Diego, San Diego Gas & Electric (SDG&E), General Electric (GE), and University of California, San Diego, among other partners. Smart City San Diego is working to deploy Internet of Things technologies through local projects. These projects include solar-to-electric vehicle charging stations managed by SDG&E; a smart building demonstration site at the Port of San Diego that integrates technology solutions from OSIsoft, Black & Veatch, and SDG&E; and a partnership with GE, which includes San Diego-based company, Proximity, to upgrade streetlights with smart sensors for energy efficiency, traffic optimization, enhanced public safety, and air quality monitoring. One project to replace 25 percent of San Diego's outdoor lighting with LED technology is projected to save \$2.4 million in annual energy costs.



Policy 4: Appoint a Foundation Liaison to Increase Funding for Essential Programs

BARRIER

New Mexico faces severe budget instability due to volatility in the oil and gas market, lack of economic diversification, and slow post-recession recovery. This instability has led to multiple years of deficits and spending cuts. The state must continue to invest in programs that educate its workforce, facilitate technology development, and promote industry growth, but it is a challenge to make non-critical public investments when the budget is tight.

SOLUTION

New Mexico could appoint a Foundation Liaison to connect with and broker support from philanthropic foundations as an alternative funding pathway. The state is home to many charitable organizations, which share the goals of supporting youth education, fostering arts and culture, promoting public health, and serving the needs of communities. In 2014, 195 New Mexico-based foundations with \$1.7 billion in assets gave a total of \$95 million in grants. The Foundation Liaison could also attract and solicit support from national philanthropic organizations with potential interests in New Mexico, such as those wanting to support displaced coal workers and

indigenous communities. This effort could increase foundation investments in the state, which fall far below typical philanthropic spending levels for other Southwestern states.

The Governor's Office could reach out to the leading foundations in the state and enlist their help in appointing a Foundation Liaison and contributing a portion of the Liaison's salary. This nonpartisan, state-level position could work closely with Grow New Mexico to leverage its network and expertise. Grow New Mexico is a nonprofit that supports community development projects by accessing potential federal and foundation grants and offering technical assistance. Key priorities of the Foundation Liaison could include funding pilot programs in disadvantaged communities, world-class educational facilities, energy-focused incubators and accelerators, education and workforce training, and targeted cluster growth. Through this position, New Mexico and the grantmaking community could leverage one another's investments and efforts, working together to support in-state business, innovation, and jobs.

Key Players: Governor's Office, Philanthropic Community

Case Study: Michigan Governor's Office of Foundation Liaison

As the first of its kind in the nation, the Michigan Governor's Office of Foundation Liaison (OFL) builds funding partnerships and strategic collaborations between the state government and the philanthropic community to support programs that improve education and health for all Michigan residents. Foundations are actively engaged throughout OFL activities. The nonpartisan Foundation Liaison and OFL staff come to the state on loan from participating foundations while contributing funders and nonprofits partly comprise the OFL Advisory Committee. Since 2003, OFL has brokered investments from seventeen foundations, totaling more than \$150 million.

Case Study: Newark Philanthropic Liaison

Based on the success of Michigan's OFL, the Council of New Jersey Grantmakers and the City of Newark established the city's first Philanthropic Liaison in 2007. In close partnership with the Mayor's Office, the Office of the Newark Philanthropic Liaison garners and leverages support for public projects from the grantmaking community. From 2007 to 2016, the Office brokered over \$50 million in philanthropic investments for initiatives, such as expanding summer youth employment and improving community literacy.



Policy 5: Establish a Technology Maturation Loan Fund to Fill Financing Gaps

BARRIER

Early-stage technology needs maturation before it can be commercialized; prototyping and testing in simulated or actual conditions to de-risk the technology must be completed to attract commercial investment. Venture capital firms and angel investors shy away from investing in technology that has not matured or not yet proven to have commercial applications. This shortage of funding opportunities, often called the “valley of death,” causes many promising innovations to fail to reach commercialization. Fifty percent of U.S. states are funding at least one program that aims to mature locally developed technologies to benefit the state economy. New Mexico does not fund any programs addressing this gap and is missing out on the economic benefits of homegrown innovations.

SOLUTION

New Mexico should consider establishing a dedicated loan fund to increase the number of promising innovations that reach commercial development in the state. The State Legislature could create a new Technology Maturation Loan Fund (TMLF) to serve this purpose. These low-interest loans can be structured as non-recourse loans on a two-

year repayment cycle and converted into equity when the company secures its next round of private financing (see case study). If the resulting intellectual property leaves the state or is licensed out of state,

the funds should be payable immediately. The TMLF could eventually be self-funded by liquidity events. To limit risk, the loans could be tranching or structured so that specific amounts of funds are released at set milestones. The program's goal should be to establish cooperative development and engage in private sector partnerships to drive investments, possibly aiming for a 1:1 match of funds from outside sources. The TMLF should be managed by a team of scientists as well as industry and finance experts, who are well equipped to evaluate technology commercialization potential and likelihood of success. It should have full transparency and be subject to regular audits.

“Technology maturation funding accelerates the successful transfer of technologies licensed from national laboratories and can often provide the necessary link between an innovative process for technology and a real-world application with powerful market potential.” - U.S. Senator Martin Heinrich

Key Players: State Legislature, Scientists, Industry, Capital Investors



Case Study: Maryland's Technology Commercialization Fund

Maryland launched its Technology Commercialization Fund (TCF) in 2004 to support companies as they develop and market innovations. The TCF offered convertible notes in two tranches to companies needing funding for product development and technology commercialization. Interest on the convertible notes was charged at 8 percent. As of December 2016, the TCF provided \$12 million in funding to 176 companies, which then went on to earn more than \$532 million in downstream funding.

Case Study: Utah's USTAR Technology Acceleration Program

USTAR is a comprehensive cluster-based program that supports Utah's technology innovation pipeline. In 2016, USTAR launched the Technology Acceleration Program to support private-sector companies advancing new technologies at the proof of concept, validation, and early product development stages. Companies must be Utah-based and have fewer than fifty employees to apply for this grant-based program. Grants are available on a rolling basis and are not capped. Additionally, all grantees gain access to USTAR's broad partner networks. This grant program complements the Technology Commercialization and Innovation Program, which provides similar funding for technologies developed at Utah's research institutions.



Policy 6: Expand Sources of Capital Available to Startups

BARRIER

New Mexico has taken significant steps to support local startups by providing them with the resources they need to succeed. The recent deployment of the New Mexico Catalyst Fund, a \$20 million finance vehicle that invests in venture capital portfolios in the state, serves to provide much-needed capital resources to startups across the state. However, this fund limits its investment to venture capital funds, which only serve a portion of the startups in the state. Many high-tech companies are not suitable for venture capital due to the nature of their business model and product type. These companies contribute jobs and wealth to the New Mexican economy, but without adequate sources of funding in the state, the best companies will move to places where there is easier access to capital and develop homegrown innovations elsewhere.

SOLUTION

One underutilized source of capital is known as a program-related investment (PRI) by foundations. Through PRIs, foundations can invest in small and growing businesses, rather than just award grants. Since foundations can prioritize the impact of the investment rather than narrowly looking at the direct market return, they can invest in high-risk, cutting-edge technologies and provide capital on longer timelines than traditional financing options.

Program-Related Investment

A program-related investment is an investment made by a foundation in the pursuit of its charitable mission, not primarily to generate income. The investment can be a loan, equity investment, or guarantee in a for-profit business or a nonprofit organization. Because these are mission-related investments and generating returns is not a significant purpose, they can be treated by the IRS as similar to grants to not jeopardize the foundation's tax status.

To attract this kind of capital to New Mexico, public or private sector leaders could designate a specialist to facilitate PRIs in the state. The Foundation Liaison (see *Policy 4*), the Advanced Solar Center of Excellence (see *Policy 1*), or the New Mexico Economic Development Department's Finance Development Team could lead this initiative. The new PRI specialist could work hand-in-hand with the existing advanced solar startup community as well as national and local foundations. Streamlining PRIs could unlock millions of dollars of additional capital for businesses in New Mexico's advanced solar cluster, driving economic growth throughout the state.

Key Players: State Legislature, Foundation Liaison, Center of Excellence, Economic Development Department

Case Study: PRIME Coalition

Launched in mid-2015, PRIME Coalition encourages more foundations to prioritize PRIs by connecting them with budding companies. PRIME is a charity that facilitates investments by working with both philanthropic organizations and early-stage, for-profit clean energy companies. PRIME reduces the barriers that make PRIs difficult for foundations by providing industry expertise and connections to best-in-class companies. Although PRIME has started small, it has already facilitated investment in six companies and is currently working on funding an additional three firms.

Case Study: Gates Foundation

In recent years, several organizations have set out to dramatically increase the amount of PRIs, especially for energy technology firms. For example, one foundation that has been focusing heavily on PRIs is the Gates Foundation. After making its first PRI in 2009, it now has \$1.5 billion dedicated to PRIs around the globe.



Policy 7: Increase Work-Based Learning Opportunities for Students

BARRIER

New Mexico suffers from the highest rates of youth disconnection in the nation: More than one in six New Mexicans between the ages of sixteen and twenty-four are neither working nor in school. Part of this problem may be due to the state's high school graduation rates, which rank among the lowest across the country. Seventy-one percent of high school students graduated in the 2015–2016 school year; however, this rate is an improvement from the past year. With employment in occupations requiring at least a bachelor's degree projected to grow faster than those requiring a high school diploma or less through 2022, New Mexico risks a growing number of disconnected youth and a widening talent gap. While the state has drawn on best practices to combat this issue, such as early college high schools, there remain further opportunities to boost youth academic engagement and workforce readiness.

SOLUTION

New Mexico could pilot West Virginia's successful simulated workplace model across its high schools to help students gain professional skills and prepare for real-world job expectations (see case study). In a simulated workplace, students receive technical training in an environment designed to mimic that of a real company. Through industry partners, program organizers can integrate the professional needs of local employers. For example, students may have to apply and interview to enroll in the class, clock in on time, undertake leadership positions, submit quarterly and annual reports, and participate in random drug testing. By offering students "on-the-job training" and insights into potential employer

expectations, simulated workplaces could keep students involved in school and engaged in the workforce post-graduation.

New Mexico could also extend Integrated Basic Education and Skills Training (I-BEST) to support students interested in solar career pathways. By employing a team-teaching approach, I-BEST enables students to simultaneously gain a basic education in mathematics and literacy and develop core competencies in high-demand occupational areas. The I-BEST framework helps to engage ESL, GED, and developmental education students, as well as unemployed and underemployed workers in the state, propelling them through school and into good-paying jobs faster. Called SUN PATH in New Mexico, this accelerated learning opportunity has demonstrated success and could serve as a foundation to bolster education and workforce development (see case study). Specifically, the state could develop SUN PATH curriculum for a solar career pathway to increase job opportunities for New Mexican youth and support the high-growth industry.

By implementing one or both of these strategies for technical education and professional development, New Mexico could better engage youth in learning and job training opportunities to improve its high school graduation rate and support greater workforce participation in the advanced solar industry and the broader economy.

Key Players: Public Education Department, Higher Education Department, Department of Workforce Solutions, State Legislature, Governor's Office, Local Workforce Development Boards

Case Study: Simulated Workplaces in West Virginia

The West Virginia Department of Education established the first simulated workplaces in 2013 to address local business leaders' need for workers with both technical and professional skills, ranging from punctuality to safety. Funding from the state's workforce development board and employer engagement mobilized by the West Virginia Chamber of Commerce helped drive the program's initial success. Students play the role of employees to transform the classroom into a business environment for technical training, and all simulated workplaces adhere to twelve guidelines designed in partnership with business experts to mimic the needs of West Virginia employers. The model has since been scaled up to support roughly 24,000 students in over 1,200 classrooms each year. Simulated workplaces have a significant impact on student achievement: 37 percent of high school seniors completed a technical degree program in 2016, more than double the percentage in 2010, and 98.4 percent of participants graduate drug-free. Ninety-six percent of students were satisfied with the program while employers give overwhelming approval of the program and its outcomes.



Case Study: SUN PATH I-BEST Program

Drawing on the I-BEST model, New Mexico's Skill Up Network: Pathways Acceleration in Technology and Healthcare (SUN PATH) was established through a grant from the U.S. Department of Labor's Employment Training Administration and designed to help students obtain credentials that transition them into high-demand fields. Launched in late 2014, SUN PATH has eleven participating community colleges and over forty employer partners. These business and industry partners provide input on relevant skills and certificates to integrate into the program and support internship and job opportunities for students. As of June 2017, 1,787 students completed at least one certificate program. SUN PATH graduates are estimated to earn nearly \$8,000 per year more than the typical New Mexico high school graduate. Additionally, the state economy gains roughly \$2.22 for every dollar invested in the program.



Policy 8: Target Student Loan Repayment Assistance to Improve Talent Retention

BARRIER

A robust workforce primes a state for growth by maintaining a stable tax base and ensuring employers can fill jobs, and the viability of the New Mexico workforce is at risk due to significant out-migration. From 2010 to 2016, nearly 38,000 more people moved out of the state than into the state, resulting in reduced population growth of 1.1 percent. This trend is particularly pronounced among young, educated New Mexicans: About 66 percent of net out-migrants had bachelor's degrees while there remained a slight in-migration of graduate degree holders from 2011 to 2016. Additionally, a recent survey of UNM graduates found that nearly two-thirds were planning to leave the state, primarily because of the limited availability of good-paying jobs.

SOLUTION

Programs that assist with student loan debt, a financial burden carried by 58 percent of U.S. college graduates, could serve as a tool to entice more people to live and work in New Mexico. The state could draw on the Opportunity Maine program, which provides a tax credit for qualified Maine workers to help offset student loan payments (see *case study*). The program is designed to incentivize Maine college graduates to remain in the state after graduation and to attract qualified graduates from outside the state. Closer to home, New Mexico

offers a similar program to attract and retain health professionals (see *case study*).

To strengthen talent retention and recruitment, the New Mexico Legislature should consider allocating a portion of the Lottery Scholarship program to support student loan repayment assistance for graduates who remain in the state. The program currently covers 60 percent of all eligible students' tuition, regardless of whether they remain in New Mexico post-graduation. The Opportunity Maine program cost \$9.3 million in the 2017 fiscal year, less than a quarter of the \$39.5 million in lottery proceeds expected for the 2018 fiscal year. Dedicating a small portion of existing funds to incentivize graduates to stay in the state could have lasting impacts on the New Mexico economy.

New Mexico can mitigate the impacts of significant out-migration by creating a similar program to retain graduates and attract young workers to the state. To emphasize talent retention over recruitment of out-of-state residents, a larger tax credit could be offered to those graduating from local colleges and universities. Retaining and recruiting top talent to fill available jobs would not only be a crucial asset to New Mexico employers, but also ensure a reliable tax base and resilient economy.

Key Players: State Legislature, Higher Education Department



Case Study: Opportunity Maine

In 2008, Maine established the Opportunity Maine program to retain college graduates and recruit newcomers to the state in response to the pressure of an aging workforce and a high rate of "brain drain." The program provides individuals or employers with a tax credit for student loan payments. Eligible candidates include graduates who work and pay taxes in Maine for at least nine months out of the year. Individuals receive refundable tax credits for associate and bachelor's degrees in STEM fields, while non-STEM degree recipients and graduate degrees earned in Maine are nonrefundable, carrying forward for up to ten years. If an employer pays the employee's monthly student loan balance, the value is deducted from the state tax return. There is a cap of \$377 per month for an individual credit, but there is no credit cap if the employer pays. The program was expanded in 2016. While not attributable to the Opportunity Maine program alone, Maine was ranked second in the nation for domestic net migration of people with a bachelor's degree or higher from 2010 to 2014.



Case Study: New Mexico's Health Professional Loan Repayment Program (HPLRP)

New Mexico established HPLRP in 2014 to bolster the state's healthcare workforce. Through the program, health professionals who commit to two years of medical practice in underserved areas can apply to receive up to \$25,000 each year to cover outstanding student loans. Applicants must also be New Mexico residents and have a professional license from the state by the initial funding date. Awardees are able to re-apply after the end of their program commitment. The program prioritizes funding for certain health occupations during each application cycle. HPLRP is a highly competitive program: 29 out of 114 applicants were awarded in 2017, with similar rates in previous years. The program has effectively deployed health professionals throughout the state, expanding the availability of healthcare services in underserved areas.



Policy 9: Coordinate Regional Solar Training to Align with Industry Needs

OPPORTUNITY

While New Mexico has a number of solar-related degree and certificate programs, the state has the opportunity to expand their reach and scope to better address future workforce needs. Although advanced solar manufacturers are largely based in Albuquerque, most training programs are located outside of this area and focused on installation and system design. As New Mexico's advanced solar industry evolves and grows, better coordination and strategic development could ensure that workforce training aligns with industry needs, such as manufacturing expertise and knowledge of new solar applications. The state could nimbly scale up and orient current training to set up New Mexicans for these good-paying jobs.

SOLUTION

New Mexico could formalize coordination between in-state solar businesses and higher education institutions offering solar-related degree and certificate programs to ensure that these programs

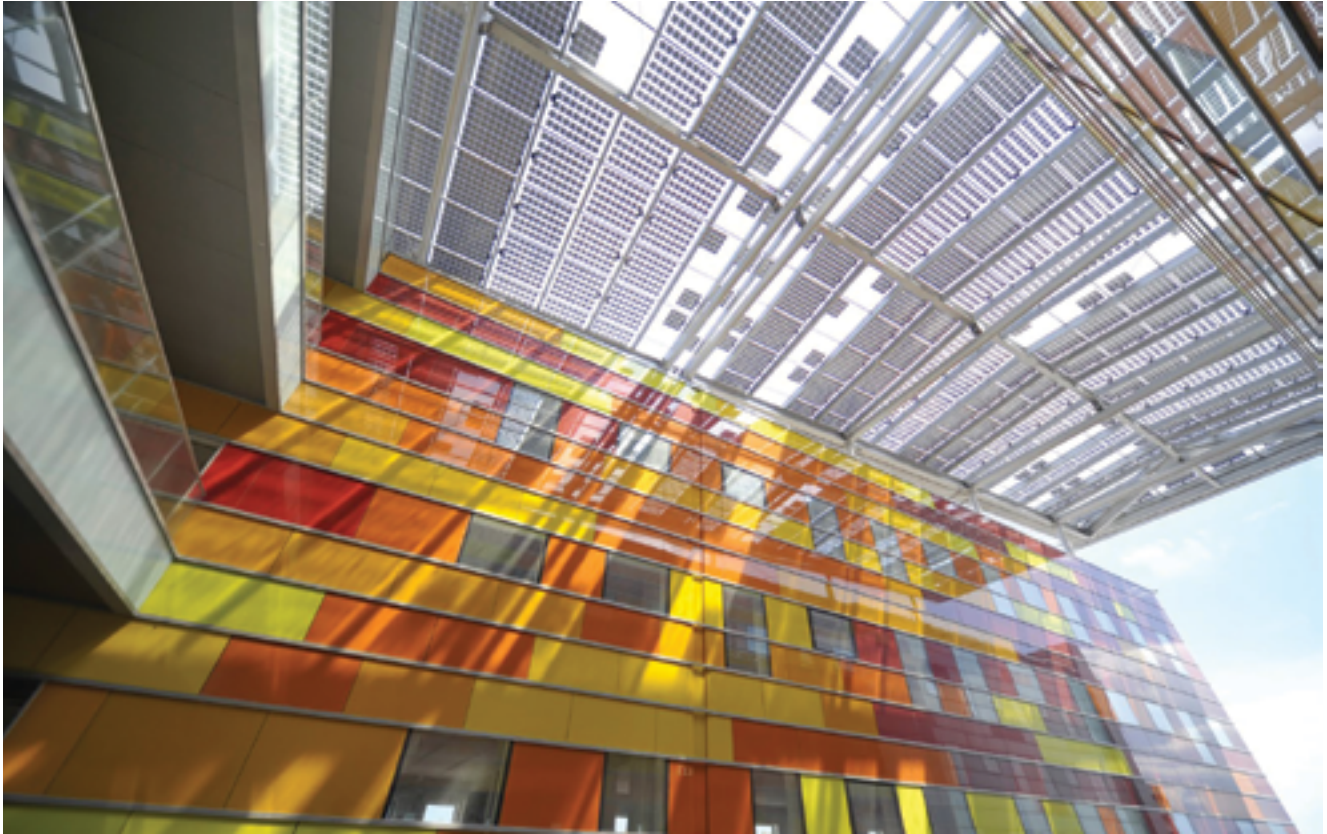
are responsive to industry needs and creating pathways to local jobs. This effort could be led by a community college or driven by industry members via the New Mexico Solar Energy Association, drawing on models from Massachusetts, Kentucky, and Washington (*see case studies*). Through a coordinating body, New Mexico's education and business communities could develop career pathways for advanced solar manufacturing and installation that align with professional credential requirements, such as NABCEP. This activity could also inform SUN PATH curriculum for accelerated solar workforce development (*see Policy 7*). Active coordination could enable the state to respond quickly to innovations in the advanced solar industry to keep the workforce current.

Key Players: Higher Education Department, Public Education Department, Department of Workforce Solutions, Economic Development Department, New Mexico Solar Energy Association



Case Study: Pacific Northwest Center of Excellence for Clean Energy (PNCECE)

PNCECE is part of a statewide network of college centers charged with developing and delivering flexible training and educational programs that are responsive to local employer needs in targeted industries. Housed at Centralia College, PNCECE is the lead institution on a \$9.98 million grant to develop programs to prepare job seekers for entry-level, pre-apprenticeship, and apprenticeship occupations in the clean energy, advanced manufacturing, and construction industries. In collaboration with industry, it developed skill standards for relevant occupations across clean energy production and deployment. PNCECE also established the Power Utility Training Consortium for local power companies to share best practices and keep up with evolving industry standards.



Case Study: Massachusetts Advancement Center Workforce Innovation Collaborative (MACWIC)

MACWIC was founded in 2012 to improve the coordination of manufacturing-related training programs in the state. Led by manufacturing employers of all sizes and in collaboration with a number of educational institutions, its membership has grown to over 200 firms. One of MACWIC's core achievements is the Advanced Manufacturing Technology Pathway Certification, a five-tiered series of consecutive training modules offered at area community colleges. This credential pathway includes multiple entry and exit points, provides opportunities for work-based learning, and helps workers progress from as low as middle school math and reading skills to an associate degree in manufacturing technology. It also helps coordinate and sponsor the state's Machine Operator Apprenticeship program. MACWIC has been recognized as an excellent model of industry-led coordination by MIT, Jobs for the Future, and the Center for Law and Social Policy.



Case Study: Kentucky Federation for Advanced Manufacturing Education (KYFAME)

KYFAME is a partnership of regional manufacturers who have created dual-track apprenticeship programs in collaboration with Kentucky's higher education network. KYFAME's programs are divided into regional chapters organized around local manufacturing clusters, allowing them to be customized to the needs of specific employers and regional economic conditions. Students spend forty hours per week working for a partnership member and taking classes at a community college. Most students earn enough money on work days to cover their tuition costs. After five semesters, students receive an A.A.S. in Industrial Maintenance Technology, Advanced Manufacturing Technician Track. KYFAME was named the "Best Career Program in the U.S." in 2013 by the Department of Labor and has been replicated in eight states.



Policy 10: Encourage Complementary Skills Training

OPPORTUNITY

New Mexico's future solar training demand ranks second in the nation based on projected installation job growth, current difficulty finding qualified workers, and availability of training programs. In addition to expanding regional training programs, New Mexico could enable complementary skills building through electrical trades to increase exposure to the solar industry and build the solar-ready workforce. Through these training pathways, in-state electricians who depend on short-term or seasonal work can benefit from additional opportunities in the solar industry.

SOLUTION

As a low-cost solution, solar training programs could apply for approval from the New Mexico Construction Industries Division to qualify as electrical continuing education. To renew their three-year license, in-state electricians must complete sixteen hours of instruction, half of which are dedicated to recent National Electrical Code changes and the other half are industry-related. Many electricians have basic skills and knowledge that can easily translate into solar PV installation and design work. In fact, New Mexico requires electrical licenses to work on

these projects. However, there are currently only four solar courses listed as state-approved continuing education for electrical trades. Oregon and Washington, which have similar requirements, have fourteen and sixteen state-approved solar courses, respectively. Compared to these states, New Mexico electricians have limited access to formal learning on solar PV installation techniques and pathways to relevant credentials.

To boost the number of approved solar courses, the Center of Excellence (*see Policy 1*) or New Mexico Solar Energy Association could promote this opportunity across training programs and provide application assistance as needed. While a full list of approved courses is available on the state website, they could also host a solar-specific list on their websites to inform electricians of these offerings. Since many solar installation jobs are part-time or seasonal in nature, encouraging New Mexicans with complementary skills to invest in solar training could bolster the supply of qualified solar technicians and help meet the rising demand for solar installation jobs.

Key Players: Regulation and Licensing Department, Solar Training Programs, Universities





Policy 11: Build a Comprehensive Advanced Solar Cluster Development Strategy

BARRIER

New Mexico has made significant strides to establish a favorable business climate and fortify its cluster assets for high-tech businesses, but the state has not effectively communicated this message to support business retention, expansion, and attraction. While the state has many competitive advantages in the advanced solar industry, ranging from rich photonics research across industry and academia to a vibrant arts culture and robust solar potential, these assets are not marketed in a unified, cohesive narrative.

SOLUTION

In order to help put New Mexico on the map as an advanced solar cluster, stakeholders could join together and create a comprehensive and highly integrated cluster development strategy. Industry players, university researchers, and government leaders could partner to coordinate efforts and collaborate across the value chain in such areas as knowledge sharing, asset growth, and policy advocacy.

Specifically, this public-private partnership could conduct a variety of inward- and outward-facing activities to support its participants and grow the industry. Inward-facing activities could pursue shared interests through internal coordination, such as:

- Mapping the supply chain and broader value chain of the state's advanced solar industry to serve as a business resource, marketing asset, and recruitment tool, with Wisconsin's Supply Chain Marketplace as a model (see case study).
- Developing a shared research agenda that tackles industry challenges.
- Collaborating on large regional and federal contract opportunities.
- Supporting the development of STEM curriculum and industry-specific training programs.

Outward-facing activities could help communicate the industry's economic impacts and market opportunities by:

- Conducting a cohesive and high-impact outreach campaign to promote investment in advanced solar technology, drawing on the state's New Mexico True tourism campaign and South Carolina's Just Right for Business platform (see case studies).
- Hosting knowledge-sharing events for policymakers and other stakeholders.





- Organizing research projects and hackathons to solve industry challenges.
- Supporting participation in trade shows and networking events to help local businesses find their first customers and expand their client base.
- Advocating for policies that increase demand for advanced solar technologies and services and support business development.

The partnership could engage and draw on the existing resources, expertise, and networks of in-state industry associations—such as the New Mexico Solar Energy Association or the Renewable Energy Industries Association—that are working to advance the interests of solar and solar-related companies in the state. Additionally, the partnership could work closely with the proposed Advanced Solar Center of Excellence (see *Policy 1*) to bolster research and knowledge-sharing activities. Any state departments

engaged in the partnership could receive additional funding for its involvement and potential activities. New Mexico could look to North Carolina as a strong public-private partnership model for cluster development (see case study).

An advanced solar partnership could provide enormous value for New Mexico businesses and the state by facilitating exchange, strengthening cluster assets, and presenting a unified voice on policies that impact the industry. A purpose-driven advanced solar partnership would signal New Mexico’s commitment to cultivating the cluster in the state and create the “buzz” that the state’s industry needs to attract investment.

Key Players: Economic Development Department, Tourism Department, Businesses, Universities, State Legislature



Case Study: Wisconsin Supply Chain Marketplace

The Supply Chain Marketplace is a dynamic online platform for Wisconsin suppliers to engage new customers and facilitate buyer connections, supporting local business growth and access to new market opportunities. It is open to all businesses free of charge so that suppliers can showcase their business capabilities; be readily searchable to potential buyers by targeted industries, certifications, and ownership; and access requests for proposals and calls for innovation. The Supply Chain Marketplace was initially launched by New North, the northeast Wisconsin economic development group, as a regional economic diversification asset, with support from the U.S. Department of Defense’s Office of Economic Adjustment. In 2017, the state awarded \$99,000 to New North to expand the platform statewide and include other industries, and it now boasts over 1,000 local businesses. With the planned arrival of Foxconn Technology Group, a Taiwanese electronics manufacturer, the platform also hosted a page where 500 companies pitched their skills to support Foxconn’s future construction and supply chain needs.



Case Study: New Mexico True

In light of declining tourism, the New Mexico Tourism Department launched the \$2 million New Mexico True campaign in 2012 to cultivate the state's image as a place of adventure and authenticity. Combatting perceptions of a barren, dull, pass-through state, New Mexico True features vibrant, visually stimulating photos of the best that New Mexico has to offer, from outdoor activities to local cuisine. People who had seen the ads were 133 percent more likely to consider New Mexico a good place to start a business and 154 percent more likely to agree that it is a good place to start a career. The high-impact campaign has also delivered strong economic returns since its inception, supporting thousands of jobs and bringing in millions of dollars in state and local taxes. Initially targeting tourists driving through the region, New Mexico True is estimated to have brought \$30 in visitor spending at local businesses and \$3 in tax revenue for every dollar spent on advertising in its first year. Between 2013 and 2015, outreach across five airports increased return on investment to \$72 in visitor spending and \$7 in tax revenue.

Case Study: Research Triangle Cleantech Cluster

North Carolina's Research Triangle Regional Partnership—an association of economic development agencies in the state's Research Triangle region—founded the Research Triangle Cleantech Cluster (RTCC) as a way to strategically engage industry leaders in the regional development of the cleantech industry. Notably, while RTCC's Advisory Council bridges the public-private divide by drawing from industry, academia, and government, the Board of Directors that steers the cluster is composed exclusively of business leaders. This organizational structure positions industry players to contribute valuable insight and to substantially influence the cleantech industry's regional growth strategy. RTCC strategically targeted the smart grid industry for growth, engaged local anchor companies to spearhead efforts to build the cluster, and focused the bulk of its efforts on developing the state's smart grid cluster.

Case Study: South Carolina Just Right for Business

South Carolina has a well-regarded economic development marketing program. The South Carolina Department of Commerce expanded on the statewide brand "Just Right" to create a cohesive message and presentation across its marketing assets, including a clear, informative website for local businesses and those hoping to move to the state. South Carolina's marketing team has outperformed: In 2014, South Carolina's economic development team directly won 146 projects that represent \$5 billion in investment, leading to the creation of over 19,000 jobs.



New Mexico's Advanced Solar Partnership

New Mexico's advanced solar partnership could be a key driver of cluster development, convening stakeholders and resources to engage in strategic initiatives.

Initial Engagement

Identify and engage with key stakeholders in industry, government, academia, and other relevant fields.

Cluster Analysis

Map value chain and evaluate intercompany linkages, externalities, and synergies.

Define and evaluate cluster assets.

Conduct market trend and competitive position analyses.

Strategy Formation

Develop vision and goals for the cluster based on analyses.

Create strategic policy and programmatic initiatives to improve competitiveness and identify lead stakeholders for each cluster initiative.

Strategy Implementation

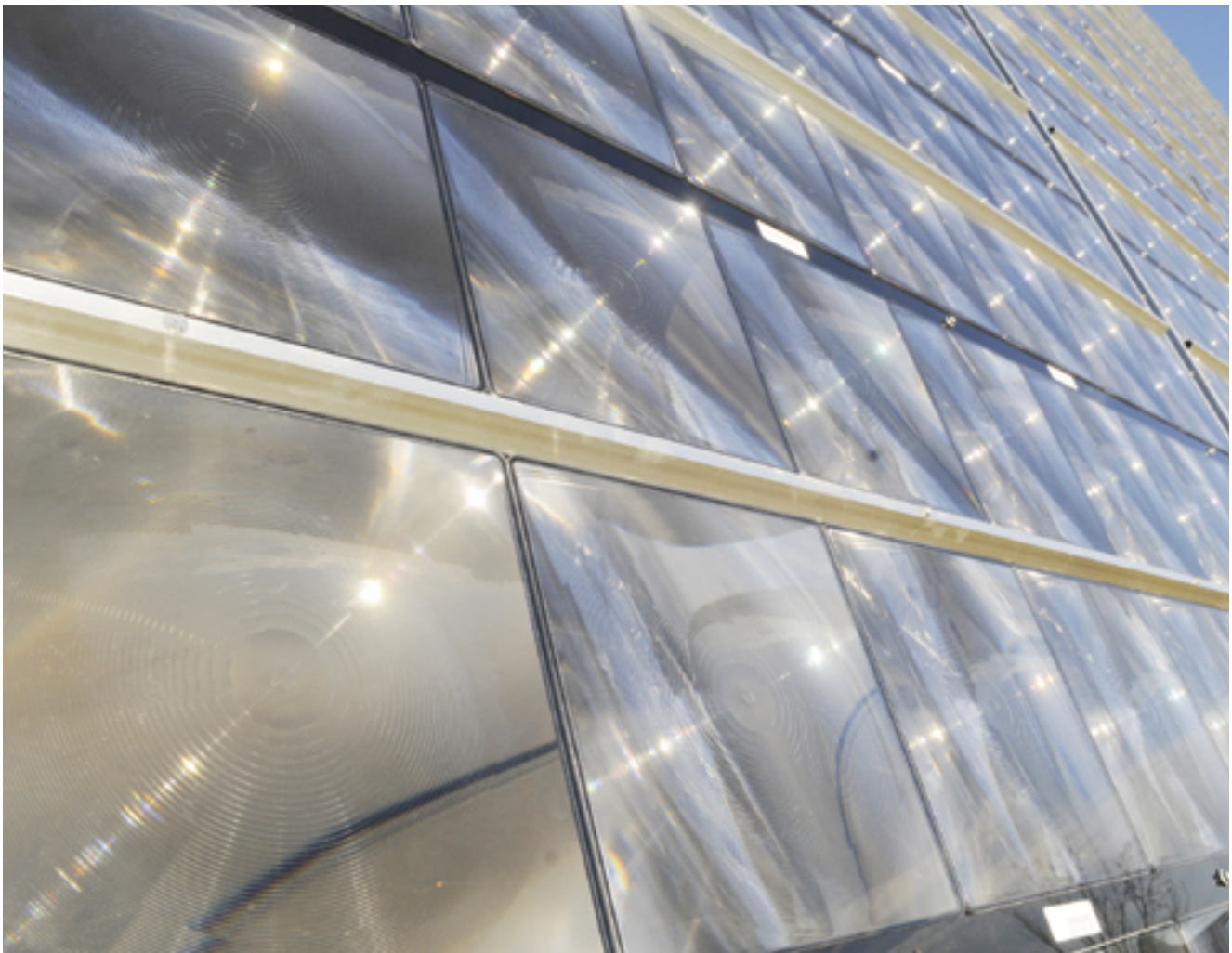
Set initiatives in motion.

Mobilize investment and public-private partnerships.

Improve the business environment.

Cluster Sustainability

Establish formal or informal organizational structure to continue cluster initiatives and investments.





Policy 12: Bolster Foreign Direct Investment Efforts

BARRIER

Working to attract foreign direct investment (FDI) is a common strategy to bring new jobs and capital into the state economy. FDI can be of particular value to New Mexico's advanced solar industry, as some of the largest companies in the solar supply chain are based outside of the United States. New Mexico has a long way to go to realize its potential; in 2015, the state ranked forty-ninth out of fifty states in FDI jobs per capita. Furthermore, the state only has one office overseas, compared to nine overseas trade offices for Tennessee and thirteen for Florida. New Mexico could enhance its FDI program to create new jobs and strengthen its advanced solar cluster. By highlighting New Mexico's cluster assets to key organizations, improving relationships with targeted countries, and providing customized assistance for foreign companies looking to locate in the state, New Mexico's leaders could fill key supply chain gaps and make New Mexico a desirable option for advanced solar firms looking to expand to the United States.

SOLUTION

The State Legislature should consider providing additional funding to the Office of International Trade to identify and capitalize on FDI opportunities. There are many platforms that serve as gateways for connecting U.S. and international companies, such as SelectUSA, the U.S. Cluster Mapping Project, and the European Cluster Collaboration Platform. State leaders can build relationships with international solar cluster and industry associations like the Architectural Solar Association in the European Union, Southeast Asia, India, and the Middle East; the Asian Photovoltaic Industry Association in Singapore; Solartys Spanish Solar Energy & Energy Efficiency Cluster; and NAMEC, a European cluster dedicated to nanotechnology, solar thermal, and photovoltaics. New Mexico could leverage relationships with these organizations to highlight its advanced solar cluster assets and attract foreign firms.

New Mexico could also enhance its presence abroad by establishing more formal relationships with potential trade partners, particularly in Germany and Japan, where a number of advanced solar firms are located. An alternative to establishing more overseas trade offices is to forge partnerships with key countries. As seen with the Massachusetts-Israel Innovation Partnership, these connections can begin as research collaborations and can grow into more robust trade relationships (*see case study*).

New Mexico could also establish a state program to smooth the pathway for foreign firms looking to invest in the state. Drawing on the Texas International Business Accelerator, such a program could help companies with investment business plans, economic impact studies, and general advice to help them navigate the complex immigration, legal, and business landscape of opening an office in a new country (*see case study*). This model differs from New Mexico's International Business Accelerator, which provides assistance for in-state businesses hoping to enter the global market. New Mexico could model its activities after the Texas International Business Accelerator, which provides assistance to foreign companies rather than in-state businesses. With such a program in place, New Mexico could actively identify and engage with companies that may be interested in locating operations in the state. In addition to the economic development resources mentioned above, New Mexico could actively seek assistance from SelectUSA, lead generation consultants like WAVTEQ and OCO Global, and local universities to assess potential FDI opportunities. This strong network of partners could help bring leading advanced solar firms to New Mexico, creating jobs and fortifying the state's value chain.

Key Players: State Legislature, Economic Development Department, New Mexico Solar Energy Association, Universities



Case Study: Massachusetts–Israel Innovation Partnership

The Massachusetts–Israel Innovation Partnership offers a creative model for facilitating global connections. Launched in 2011 following the governor’s trade mission to Israel, the partnership grew from an industry research collaborative to a joint FDI partnership. Major Israeli companies have expanded operations to the state and Massachusetts companies have invested in Israeli intellectual property and R&D operations. As of 2015, more than 200 Israeli-founded companies have made a home in Massachusetts. These businesses accounted for \$9 billion in direct revenue, \$18 billion in total economic impact, and 4 percent of the state GDP, as well as 9,000 direct jobs and 27,000 indirect and induced jobs.

Case Study: Texas International Business Accelerator (TIBA)

TIBA provides critical assistance to foreign firms looking to invest in the Lone Star State. While the United States is known globally for its open business environment, investing in a new country is always a legal, logistical, and cultural challenge. TIBA eases that transition by providing technical assistance and practical local market knowledge to help clients set up investment projects and succeed at establishing operations. Many of TIBA’s clients are small and medium-sized enterprises that are overlooked by consulting firms. Since its inception in 2011, TIBA has brought over \$136 million in FDI to Texas.

Best Practices for FDI and Exporting Programs

The U.S. Department of Commerce commissioned an extensive study of the most successful FDI and exporting programs around the country and found that state leaders of these programs share several key practices. The report found that they:

- Engage universities in making international connections and economic development.
- Foster strong relationships with economic development resources engaged in FDI.
- Collect good data about companies in the cluster.
- Develop contact points at companies overseas.
- Embrace and adapt to cultural differences, e.g., language-specific business cards and marketing materials.
- Commit to long-term involvement in FDI efforts.



Policy 13: Streamline Solar Permitting Processes

BARRIER

New Mexico's inconsistent approval processes for distributed solar building permits burden the growth of advanced solar technologies. From Doña Ana to Rio Rancho, and from Albuquerque to Las Cruces, counties and municipalities have varying solar permitting procedures and timelines for distributed solar projects: Depending upon the jurisdiction, the process could take anywhere from a few days to a few weeks. This patchwork of solar approval processes significantly slows the solar installation process and increases costs to customers and installers—a big disincentive to New Mexico businesses hoping to find a local market.

SOLUTION

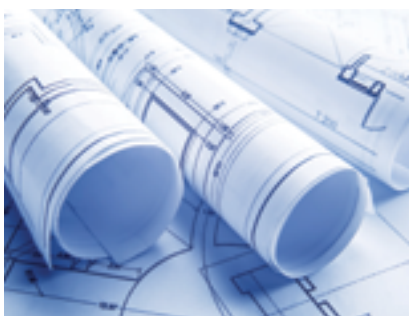
New Mexico could establish an online portal to streamline and standardize solar permitting that cities and counties can opt to use. Modernizing solar permitting for residential and non-residential customers is a low-cost, straightforward way to strengthen the state's solar markets. Projections show that streamlining permitting processes could reduce the cost of the average residential solar project by \$700 and that standardizing local regulatory regimes could reduce the cost of a project by over \$2,500.

The New Mexico Regulation and Licensing Department could initially build an online portal to standardize permitting managed by the Construction Industries Division and then create a model webpage that cities and counties could adopt and customize to meet local needs. This portal could draw on the City of Las Cruces' online application platform for solar installation and energy efficiency retrofit permits, which has been reported as being the most

streamlined permitting process in the state. An online portal would allow New Mexico's local and state permitting authorities to share information, forms, procedures, and technical requirements and make them readily available online. Offering this information online allows customers and installers to submit, review, print, and pay for permits in one convenient location. Integrating a permit checklist into a website that offers access to information and resources on solar installation can reduce mistakes while curbing time related to the permitting processes. Additionally, New Mexico could develop incentives to encourage more uniform and smooth solar permitting processes at the local level, drawing on New York State's Unified Solar Permit program (see case study).

New Mexico municipalities could also individually or jointly apply for free technical assistance through the U.S. Department of Energy's SolSmart program. Eligible communities can leverage SolSmart to signal that they are open for business by making improvements across eight focus areas: permitting; planning, zoning, and development regulations; inspection; construction codes; solar rights; utility engagement; community engagement; and market development and finance. To date, there are over 180 communities that benefit from SolSmart designation. By eliminating unnecessary fees and reducing the variability in permitting requirements across the state, New Mexico could help lower the overall soft costs of installing advanced solar technologies and stimulate a strong local market for New Mexico-made goods.

Key Players: Regulation and Licensing Department, City of Las Cruces, Local Permitting Authorities



Case Study: New York State Unified Solar Permit Program

New York has a Unified Solar Permit program that offers up to \$250,000 in financial incentives to any municipality that streamlines its solar permitting process to match a set of best practices developed collaboratively through a statewide planning process. The New York State Energy Research and Development Authority administers the program, offering step-by-step instructions, model ordinance language, and on-site installer training to municipalities that want to align their permitting process with the state's best practices, which include an online application portal. Nearly 300 of the state's 1,550 municipalities have adopted the Unified Solar Permit model.



Policy 14: Enable Inclusive Financing Mechanisms for Electrical Upgrades

BARRIER

Advanced solar technologies have the potential to provide electricity cost savings to many New Mexicans. For example, nano-filaments embedded in exterior paint, window film, or roof tiles provide multiple ways to generate electricity in the average home. Indeed, over 67 percent of New Mexicans own their homes, representing a potentially vast local market that could drive the adoption of these technologies. However, New Mexican companies seeking to connect with this local market face a few problems. First, advanced solar technologies will require a substantial upfront financial commitment from homeowners who want to utilize them in their homes. Compounding this challenge is that the median household income in New Mexico is just over \$45,000, making upfront investments in energy technology out of reach for many in the state. The New Mexico Legislature authorized the designation of residential property-assessed clean energy (PACE) financing districts to allow homeowners to repay investments in residential energy improvements on their property tax bills. Unfortunately, multiple barriers stand in the way of local adoption and PACE financing is not currently being made available to most homeowners in the state. New Mexico could explore alternative financing mechanisms, such as on-bill financing, to reduce the cost barrier for electrical upgrades.

SOLUTION

On-bill financing is an innovative program that empowers consumers to invest in energy upgrades like advanced solar without the need to make payments upfront. This inclusive lending mechanism typically uses the utility bill as the repayment mechanism to finance energy technology upgrades.

New Mexico could implement one of several variations of this inclusive lending mechanism.

- **On-Bill Financing (OBF):** Under an OBF program, an energy utility furnishes a building owner whether for a residence, small business, municipal government, or nonprofit organization—with a loan to purchase renewable energy technology and/or conduct energy efficiency upgrades. The

utility customer then pays back a portion of this loan on each utility bill. These payments continue until the loan is repaid.

- **On-Bill Repayment (OBR):** Similar to OBF, the main distinction is that a third party—rather than the utility itself—furnishes the capital for OBR programs. As with OBF, the consumer repays the loan via the utility bill. OBR programs are a potential mechanism to unlock new reserves of capital to finance energy upgrades, beyond what the utility has available or can raise.
- **Tariffed On-Bill (TOB):** Under TOB programs, rather than a utility or third party offering a loan, the utility purchases the clean energy technology. In exchange, the utility then places a fixed fee or tariff on the customer's utility bill that is significantly less than the savings from the upgrade. When the energy savings have covered the upgrade costs, the customer's tariff payments end.

A major advantage of these types of programs is that the loan or tariff stays with the meter, not with the ratepayer. The building owner or ratepayer will not have a loan, lien, or debt associated with the energy upgrade. That means that if the building owner sells the property or the ratepayer moves, the new owner assumes responsibility for continued repayment (so-called “stay with the meter” financing). This financing mechanism works well for those who have poor credit and either cannot qualify for loans or cannot afford to pay high interest rates.

The repayment time horizon, loan amount, and fee structure vary with these programs (see *case studies*). No matter how structured, the results are impressive: Default rates from energy efficiency finance programs, a category in which on-bill financing falls, are 0 to 3 percent. In a virtuous cycle, improved repayment rates may lead to better financing terms for the consumer who wants to access advanced solar technologies, such as lower interest rates or reduced fees.

Currently, no New Mexico utilities offer this service. On-bill financing could be a unique way to empower New Mexico's residential and commercial building



owners, as well as tenants, to finance cutting-edge advanced solar technologies. Critically, it would be a program open to lower- and middle-income households, cash-strapped businesses, and those with poor credit histories across New Mexico.

Key Players: Energy, Minerals and Natural Resources Department, Public Regulation Commission, Publicly Regulated Utilities, Municipal and Rural Electric Cooperatives, Third-Party Lenders



Case Study: On-Bill Financing (OBF): North Carolina's Rural Electrical Cooperatives

Rural electrical cooperatives are member-owned utilities that provide energy to rural and small towns across the country. In North Carolina, several of them—including Roanoke Electric Cooperative and Brunswick Electric Membership Corporation—have deployed on-bill financing programs to incentivize consumers to invest in energy efficiency upgrades. The funding for these programs has come from credit unions and banks, as well as from the cooperatives themselves.

Case Study: On-Bill Repayment (OBR): New York's Outside Administrator

New York passed legislation to create an on-bill energy efficiency upgrade program in 2011. For residential homeowners, the loans are capped at \$25,000; the limit for small businesses and nonprofit organizations is \$50,000. This program is administered through the New York State Energy Research and Development Authority—the equivalent of New Mexico's Energy Conservation and Management Division—which holds the liability for the issued loans and provides the capital. The utility is responsible for billing the consumer each month. The loans range from five to fifteen years with an annual interest rate of 3.49 percent. Since the program's inception, the New York on-bill program has financed over \$30 million in energy upgrades across the state, with strong year-over-year growth.

Case Study: Tariffed On-Bill (TOB): Kentucky's How\$martKY Program

This innovative TOB program has been a huge success in the heart of Kentucky's coal country. Started by the Mountain Association for Community Economic Development, the How\$martKY Program provides TOB for energy efficiency upgrades in four high-poverty Kentucky counties served by rural electrical cooperatives. As of 2014, the program financed energy efficiency upgrades and retrofits in 162 homes, generating annual savings of \$100,000 and 5,400 kWh. The success prompted the Kentucky Public Service Commission to grant the program permanent approval, paving the way for expansion.



Policy 15: Include a Concentrating Solar Power Carve-out in an Expanded Renewable Portfolio Standard

OPPORTUNITY

New Mexico ranks ninth in the nation for utility-scale solar generating capacity, with a significant potential to scale up and be competitive with neighboring states. To help drive that growth, the state's RPS requires investor-owned utilities to derive 20 percent of electricity supply from renewables, with a 20 percent solar carve-out. Utility deployment and distributed generation are on track to meet the RPS. With the retirement of the San Juan Generating Station and future divestment from the Four Corners Generating Station, New Mexico could leverage the RPS to meet the increased demand for flexible peak capacity and signal that the state is open for business.

SOLUTION

The New Mexico Legislature could increase the RPS to support a carve-out for CSP electricity generation capacity, requiring thermal energy storage for improved grid resiliency. The CSP carve-out takes advantage of the state's high solar insolation and could support 3,000 GW of generation capacity on suitable land. While system costs are relatively high, CSP plants face sharp cost reductions, have no fuel costs, and offer tremendous value to the grid. CSP-plus-storage offers a consistent power supply that can be quickly adjusted and dispatched on demand because of its storage capacity and thermal inertia. In other words, CSP-plus-storage provides stable, dispatchable, and renewable electricity with quick ramp-up speeds to serve peak demand periods.

In the United States, increases in CSP capacity have been mainly driven by state RPSs, the federal solar investment tax credit, and federal loan guarantees for projects; New Mexico could leverage an RPS carve-out to boost CSP deployment. Eighteen states have carve-outs for solar or distributed generation, including New Mexico. RPS carve-outs have been an effective means to encourage U.S. solar deployment: In 2016, 13 percent of new solar projects were added to meet carve-out requirements. This impact was particularly robust in Massachusetts where utilities achieved the solar target of 400 MW by 2020 six years early and led to a fourfold increase of the 2020 target. New Mexico could also draw on policy successes in other countries to encourage CSP deployment (see *case study*).

To reduce customer impacts while incentivizing deployment, the New Mexico Legislature could reevaluate current cost mitigation measures in its RPS to properly account for capital costs, reliable system capacity, ancillary services, and long-term benefits to the grid. Encouraging utilities to develop this flexible, dispatchable solar resource could not only boost grid stability but also create a stronger market for local manufacturers and developers.

Key Players: State Legislature, Public Regulation Commission



Case Study: International CSP Incentives

On an international level, performance-based incentives and national capacity targets have been significant drivers of CSP deployment. In its thirteenth Five-Year Plan adopted in 2016, China targeted 5 GW of CSP capacity by 2020 and has since approved twenty pilot projects with a total capacity of 1.35 GW. South Africa's renewable procurement program also favors CSP-plus-storage in its tariff-based, competitive bidding process partly due to favorable time-of-day pricing. Since 2011, South Africa has contracted 600 MW of capacity across seven CSP projects.



Optimizing New Mexico's Electricity Transmission System

In addition to increasing solar energy generation, New Mexico could bolster its renewable energy transmission capacity to better distribute electricity statewide and to export power to neighboring states where there is high demand for renewable energy. While current projects aim to improve the state's export potential, the state could pursue long-term solutions to address barriers to system upgrades in New Mexico. These barriers include an onerous siting process, complex cost recovery mechanisms, limited transmission infrastructure in renewable-rich areas, need for upgrades to existing lines, lack of interconnections with the eastern market, and minimal state funding for the Renewable Energy Transmission Authority. In particular, the state could take direction from the 2018 New Mexico Energy Roadmap, which includes specific strategies for optimizing transmission capacity developed by a diverse steering committee. These strategies are analyzing future needs for transmission assets, identifying regulatory and cost barriers for new projects, and streamlining permitting and approval via regulatory restructuring.



Call to Action

New Mexico’s emerging advanced solar cluster is a solid foundation upon which the state can grow its economy, support over 6,800 jobs, and become a leader in the production and deployment of advanced energy technology. The policies recommended in this report are complementary and intended to help New Mexico manufacture products within the state, foster entrepreneurship for technological advances, fund innovation with accessible capital, equip workers with needed skills, and grow demand for advanced solar technology.

To fully realize New Mexico’s potential in the advanced solar industry and position the state for continued growth, policymakers will need to make a concerted effort to seize the opportunity presented by increasing global demand. Strong leadership plays an important role in promoting New Mexico’s competitive advantage in the industry and creating quality jobs. State and local economic development depend on the collective work of many partners across government, universities, industry, and other stakeholders. This report recommends actions that each group can take to support the advanced solar industry. As effective first steps, New Mexico’s leaders could build a comprehensive cluster development strategy to chart a path moving forward and establish a center of excellence to catalyze innovation and entrepreneurship in advanced solar. Continued collaboration is necessary to address barriers to cluster growth and demonstrate that the state is ripe for investment.

New Mexico has the opportunity to support over 6,800 direct, indirect, and induced jobs in the advanced solar industry from 2018 through 2030. This cluster is well positioned to serve a significant portion of national demand, especially considering the groundbreaking research across universities and national labs, generous state support for manufacturers, growing industry value chain, and immense solar resource.

New Mexico’s leaders can draw from among dozens of innovative strategies that city, county, and state governments across the country and abroad have implemented in order to create job opportunities in the advanced energy industry. Examples of these best practices and a fully cited version of this report can be found on the American Jobs Project website at <http://americanjobsproject.us/>. Furthermore, the American Jobs Project can continue to serve as a partner to New Mexico by organizing working groups and conducting deeper analyses, such as identifying value chain gaps, exploring policy strategies, and evaluating the state’s comparative advantage in other advanced industries.

When a state succeeds in building an economic cluster, the benefits are felt throughout the state: a more resilient state economy, a skilled twenty-first century workforce that is trained for the jobs of tomorrow, a firm base of young people optimistic about job opportunities close to home, and a rich hub for innovation and collaboration.

Growing the Advanced Solar Cluster, Growing Jobs

- Establish an Advanced Solar Center of Excellence
- Bolster Commercialization of University Innovation
- Facilitate Community-Based Pilot Programs
- Appoint a Foundation Liaison to Increase Funding for Essential Programs
- Establish a Technology Maturation Loan Fund to Fill Financing Gaps
- Expand Sources of Capital Available to Startups
- Increase Work-Based Learning Opportunities for Students
- Target Student Loan Repayment Assistance to Improve Talent Retention
- Coordinate Regional Solar Training to Align with Industry Needs
- Encourage Complementary Skills Training
- Build a Comprehensive Advanced Solar Cluster Development Strategy
- Bolster Foreign Direct Investment Efforts
- Streamline Solar Permitting Processes
- Enable Inclusive Financing Mechanisms for Electrical Upgrades
- Include a Concentrating Solar Power Carve-out in an Expanded Renewable Portfolio Standard

APPENDIX 1: OTHER TECHNOLOGIES THAT SHOW PROMISE FOR NEW MEXICO

The American Jobs Project chooses a target advanced energy technology for each state it works in by taking into account manufacturing capacity, resource availability, political feasibility, level of state investment, jobs and economic outlook, capacity for decarbonizing the economy, and level of commercialization readiness, among other criteria. Based on New Mexico's competitive advantages, we identified advanced solar as the best opportunity for the state to bolster its manufacturing base and support good-paying jobs, as presented in this report. Given that diversification is critical for New Mexico's economy, we will briefly outline other advanced energy technologies that we considered and that show promise in the state as well as reasons why these technologies were not chosen as the focus technology for the report.

Grid Modernization

- New Mexico's universities have made significant investments in grid research and development as represented by NMSU's Interdisciplinary Center of Research Excellence in Design of Intelligent Technologies for Smart Grids (iCREDITS) and UNM's Center for Emerging Energy Technologies (CEET).
- LANL and SNL also conduct critical grid studies as part of the Grid Modernization Laboratory Consortium and seek to actively collaborate with academia, government, and industry.
- New Mexico sits at the nexus of three major power grids: Eastern Interconnection, Western Interconnection, and Texas Interconnection.
- Current transmission projects aim to expand electricity access in the state and strengthen New Mexico's interconnection with outside markets.
- Intel's supply chain and skilled technical workforce could support in-state manufacturing of grid technologies.
- Santa Fe Community College received a federal grant to build a Building Energy Automation and Microgrid Training Center (BEAMTC) to support advanced energy workforce training.

- There is no manufacturing of cables, sensors, and other grid components in the state.

Wind Power Technologies

- New Mexico is seeing the fastest growth in wind energy generation in the United States.
- The RPS has a wind carve-out that requires at least 30 percent of utilities' renewable energy portfolio to be wind power.
- The North American Wind Research and Training Center at Mesalands Community College is an exceptional workforce training facility for wind turbine technicians.
- There are no active wind manufacturing facilities in the state.

Value-Added Natural Gas Products

- New Mexico could leverage its robust natural gas supply chain and workforce to create value-added products.
- There is little chemical, plastic, and synthetic fiber manufacturing in the state.
- Sustained low gas prices may disincentivize developers to come to New Mexico.

Cross-Cutting Technologies for the Water-Energy Nexus

- Water rights and water conservation are key issues in New Mexico.
- Local startup IX Power Clean Water and its breakthrough water-cleansing technology for oil and gas operations grew out of research at LANL and NM Tech.
- Most advanced technologies are still in the R&D phase.
- The opportunity to export products is limited due to ease of local sourcing of key parts.

APPENDIX 2: NEW MEXICO'S ADVANCED SOLAR MANUFACTURERS



- 35 Solar
- Alpha-Omega Power Technologies
- Array Technologies
- Emcore Solar Power
- Energy Related Devices
- mPower Technology
- Optomec
- Osazda Energy
- SolAero Technologies
- Solstar Energy Devices
- Suncore Photovoltaics
- UbiQD
- Unirac
- Zomeworks

APPENDIX 3: ECONOMIC IMPACTS, JOBS ESTIMATES, AND MODELING METHODOLOGY

The American Jobs Project believes the key to job creation lies in local action. Our jobs estimates are intended to start a conversation about how state and local leaders can work together to set their goals and utilize the same tools and data that we have used to estimate potential impacts.

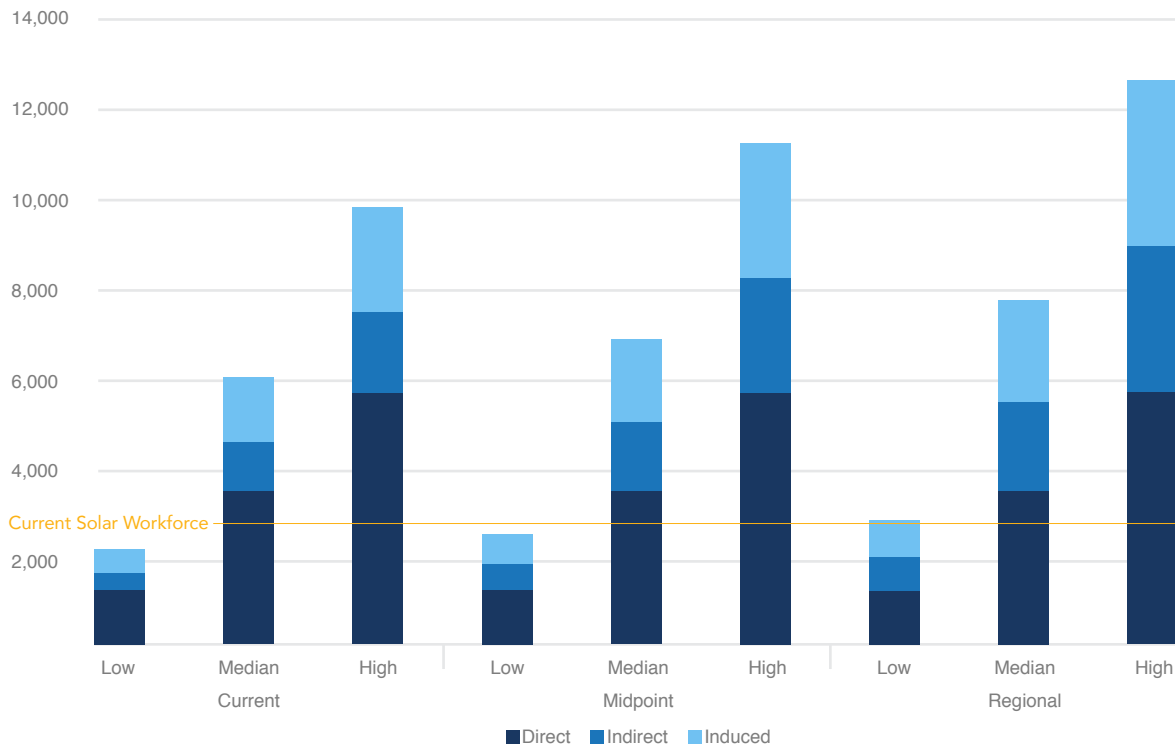
To estimate jobs potential for the advanced solar industry in New Mexico, we utilize several reputable tools, analyses, and projections to determine global and national estimates of future demand, the current estimated state market penetration for advanced solar businesses, and industry benchmarks for wages and profits. We use these inputs to generate multiple industry growth scenarios based on varying levels of market penetration and supply chain concentration. Each scenario shows the average number of jobs that the in-state manufacturing industry could support annually from 2018 through 2030. The actual number of jobs in any given year could vary significantly

from the average, and the annual average is intended to be a target over the analysis timeline.

We suggest that the Median market penetration and the Midpoint supply chain concentration are realistic goals for New Mexico. If New Mexico can grow its market share and build a supply chain to these levels, the industry could support an annual average of over 6,800 direct, indirect, and induced jobs from 2018 through 2030. Thus, the advanced solar industry could serve as a major vehicle for future state economic growth while creating quality jobs for New Mexicans.

From 2018 through 2030, New Mexico's advanced solar industry could support an annual average of over 6,800 direct jobs from manufacturing and materials development, indirect jobs from suppliers, and induced jobs from spending in the local economy.

AVERAGE ANNUAL JOBS IN NEW MEXICO'S ADVANCED SOLAR INDUSTRY
By Market Penetration and Supply Chain Concentration, 2018-2030



Definitions

Market Penetration: Amount of sales of a product as a percentage of the total sales volume for that product in a defined market.

Supply Chain Concentration: Level at which target industries could meet supply chain needs from in-state companies.

Direct Jobs: Jobs created or sustained due to direct increases in sales to companies in the target state industry.

Indirect Jobs: Jobs created or sustained due to higher demand for equipment, materials, and services from supplying industries that support the target state industry.

Induced Jobs: Jobs created or sustained due to increased local spending by employees of the target state industry and its supplying industries.

Multiplier Effect: Refers to when the economic impact generated is larger than the initial investment due to cascading spending from target state industry to its supplying industries and workforce to products and services in the local economy.

Modeling Approach

We utilize IMPLAN, a proprietary model maintained by the Minnesota IMPLAN Group, and its 2013 data package to conduct our regional economic analysis. IMPLAN uses average expenditure data to estimate how industry spending cascades throughout the economy to suppliers and consumer-facing industries. IMPLAN tracks multiple rounds of indirect and induced spending impacts, until that spending “leaks” out of the selected regional economy, as determined by local purchasing coefficients built into the model.

Drawing from reputable sources, we develop multiple scenarios in which New Mexico could grow its advanced solar industry. Each scenario represents varying levels of market penetration and supply chain concentration, which generate different inputs for the IMPLAN model.

Market penetration is shown at three levels (Low, Median, High), with the lower bound being New Mexico’s current estimated market share and the upper bound being the estimated market share of the current regional market leader for advanced solar. Another level represents the median between both bounds. We use Bureau of Labor Statistics’ (BLS)

Quarterly Census of Employment and Wages (QCEW) and IBISWorld data to estimate market share as a function of establishments, wages, and revenue.

Three supply chain concentration levels (Current, Midpoint, Regional) are presented to identify the impacts of growing New Mexico’s supply chain. The lower bound uses the current state economy, demonstrating the effect of merely maintaining the present level of supply chain concentration. The upper bound uses the Southwest Region (AZ, NM, TX, and OK) as the model to represent the impacts of New Mexico having as complete of an advanced solar supply chain as is available in the selected states. Another level gives the midpoint between both bounds.

It is important to note that we do not include any financial impacts associated with the construction of new facilities that may result from an increased number of advanced solar firms locating in the New Mexico economy during the analysis timeline, nor do we include consulting, services, construction, or installation jobs associated with advanced solar as these developments would be purely speculative.

Model Inputs

We define advanced solar as a subset of the overall solar industry focused on new materials, applications, and improvements to existing technologies. Our analysis utilizes North American Industry Classification System (NAICS) codes, the basis for most macroeconomic analysis and reporting. To estimate the economic impacts of advanced solar, we look at several associated technologies:

- Thin Film Photovoltaics
- Building-Integrated Photovoltaics
- Quantum Dot Photovoltaics
- Concentrating Solar Power

Estimates of market demand for advanced solar technologies are taken from BCC Research, BIS Research, Grand View Research, and IBISWorld reports. Annual demand is derived from the current estimates and compound annual growth rates through 2030. We assume that the rates stay constant through 2030 if they do not project through our analysis timeline.

Estimates of average wages are taken from IBISWorld, IMPLAN, and BLS QCEW. Owner income is also derived from IBISWorld and IMPLAN, wherever possible.

The current market penetration of New Mexico's advanced solar industry is estimated as a function of current estimated employment and firms. IBISWorld's

ratio for employment per unit of revenue and the current concentration of firms in New Mexico, as well as QCEW employment and firms data, are applied to BIS Research, Grand View Research, and BCC's market demand totals to estimate current employment and revenues.

Model Outputs

Once the data is prepared for input into IMPLAN, we run the model for each scenario and generate the following direct, indirect, and induced estimates for New Mexico's advanced solar industry: employment, labor income, GDP, total economic output, state/local tax revenue, and federal tax revenue. Only employment outcomes are given in this report. Additional output estimates are available by request.

We present employment as an average of annual jobs sustained. These outcomes are based on the total job-years, or one full-time equivalent job sustained for one year, that exist within the timeframe of our analysis. Jobs in any given year can vary greatly within the timeframe. Additionally, job losses in industries that compete with those in our analysis are not evaluated. Models do not perfectly predict behavior, so job estimates could vary based on the reality of what is purchased locally and the impact of foreign and domestic competition. The estimates presented in this report are highly dependent on sustained local action towards developing and maintaining the target state industry.

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APRIL 2018



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