INNOVATIONS

A PLAYBOOK FOR INNOVATION
Coal-to-Products and General Innovation in Northwestern Colorado

COLORADO

AGNC

ASSOCIATED GOVERNMENTS OF NORTHWEST COLORADO

Produced by Grow Economy, Inc., Associated Governments of Northwest Colorado (AGNC), and Nathan Perry, PhD in partnership with the Rural Policy Public Lands Institute (RRPPL) Colorado Department of Local Affairs (DOLA) and U.S. Economic Development Administration (EDA)

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[1] Nathan Perry is an Associate Professor of Economics at Colorado Mesa University.

ASSOCIATED GOVERNMENTS
OF NORTHWEST COLORADO

PO Box 593
Grand Junction, CO 81502
970-665-1095

This report is available digitally
at AGNC.org

Since the mid-1800s, coal has been part of the culture and economy of northwestern Colorado and eastern Utah, providing fuel for electricity, industry, and transportation in the process. Beyond this, it has provided the region with well-paying jobs and economic stability for innumerable workers, families, and communities. However, changes in the coal economy have led to powerplant and mine closures. As this continues, the last remaining coal power stations and mines that supply them are threatened.

Despite this, coal is still a useful resource that can continue to play an economic role as the feedstock for many innovative products. Through these products, it also has the potential to help alleviate domestic supply chain constraints and make the country more self-reliant.

This playbook is a product of the Coal Communities Innovation Project conducted between September 2019 and March 2022. During this project, Grow Economy collaborated with RPPL, AGNC and Nathan Perry, PhD to conduct in-depth economic analysis of six coal-impacted counties in northwestern Colorado and eastern Utah. The counties addressed were Moffat, Routt, and Rio Blanco Counties in Colorado and Emery, Carbon, and San Juan Counties in Utah. This effort resulted economic playbooks for the AGNC and eastern Utah regions, as well as a larger economic analysis known as the Data Intensive Economic Report (DIER).

The playbook that follows contains recommendations for establishing a local coal-to-products industry and other innovation initiatives in the AGNC region. This includes recommendations for projects that focus on specific innovation activities and supporting infrastructure projects.

This document is the product of in-depth research conducted by Grow Economy and Nathan Perry, Ph.D. Funding for this project was provided by the Colorado Department of Local Affairs (DOLA), Rural Policy Public Lands Institute (RPPL), and the U.S. Economic Development Administration (EDA).

It is our hope that the information provided herein will help the region move forward as it adapts to changes in the coal Industry. Moreover, that the efforts it encourages will provide the region with resources to create jobs, encourage industry, and diversify local economies in the process.

Bonnie Petersen
EXECUTIVE DIRECTOR, AGNC

Joshua Jack Riley, MHP
EXECUTIVE DIRECTOR, GROW ECONOMY

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Introduction

This playbook provides recommendations for seeding high-value innovation initiatives in the AGNC region. Although these will help encourage economic diversity and job creation, they are not meant to replace coal in terms of wages and revenue generation. Accomplishing this will only occur over time as the industries encouraged by these initiatives grow. Likewise, coal-to-products (as discussed in this playbook) should not be viewed as a replacement consumer for coal. Rather, it should be viewed as a component of a larger innovation framework that encourages other industries as well.

The playbook itself is organized into three basic sections. The first of these discuss the competitive advantage of Moffat, Routt, and Rio Blanco Counties. This includes local economic strengths, which provide opportunities for economic growth and diversity in the region.

The second section recommends innovation priorities based on regional competitive advantage. This includes a physical innovation space, advanced/light manufacturing, workforce development, remote work support, and broadband expansion.

The third section of the playbook provides recommendations for implementation. The first of these is an implementation strategy for coal-to-products. This contains implementation steps and makes recommendations like forming foreign partnerships and aligning programs to state policies to increase program support. Following this is a strategy for general innovation program implementation. This strategy is applicable to the innovation priorities recommended in this playbook, as well as others that may emerge later.

Ultimately, the recommendations put forth in this playbook will help encourage economic diversity, innovation, and resilience within the region. The result for northwest Colorado's coal communities will be increased regional growth, economic sustainability, and prosperity for its residents.

Competitive Advantage in the AGNC Region

Moffat County

ENERGY AND ENERGY INFRASTRUCTURE (COAL, OIL, AND GAS): Moffat County has two coal mines Trapper Mine and Colowyo Mine (shared with Rio Blanco County). The county also has a coal power station (Craig Station) that contains all the infrastructure necessary to connect to the electric grid. As the power station shuts down, opportunities to use the infrastructure for other forms of power generation (such as solar or small-scale nuclear) is possible. Using the facilities

for light and advanced manufacturing is another possibility. Additionally, Moffat County is home to railroad lines which could be used to transport manufacturing products.

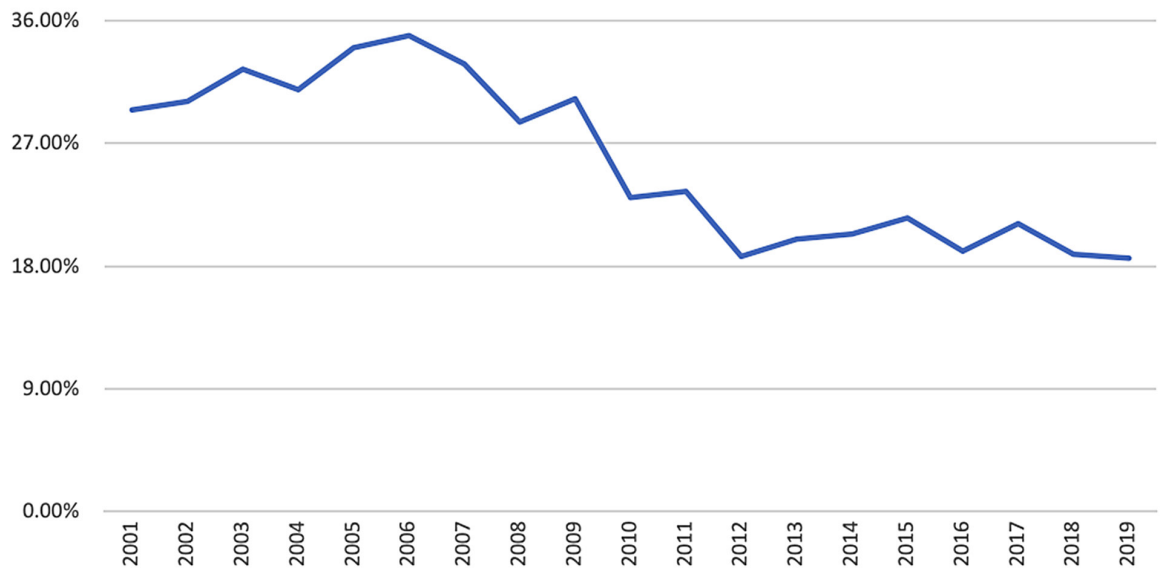

Figure 1: Oil, gas, and coal percentage of GDP Moffat County
AUTHOR CALCULATED WITH DATA FROM BEA.GOV

AGRICULTURAL HERITAGE: According to the 2017 Census of Agriculture, Moffat County has 462 farms and 953,100 acres of farmland for an average of 2,063 per farm. 81% of this land is pastureland, which supports cattle, sheep, and goats. The top crops are hay, grains, oilseeds, dry beans, and dry peas. The views are picturesque and the small-town agricultural feel is attractive to those who desire a rural setting. This is one of several reasons why it is appealing to certain retirees and younger workers. There are approximately 602 people employed by agriculture, equating to 8.34% of total jobs. This equates to a much lower percentage of wages (1.85%), and 4.44% of GDP.

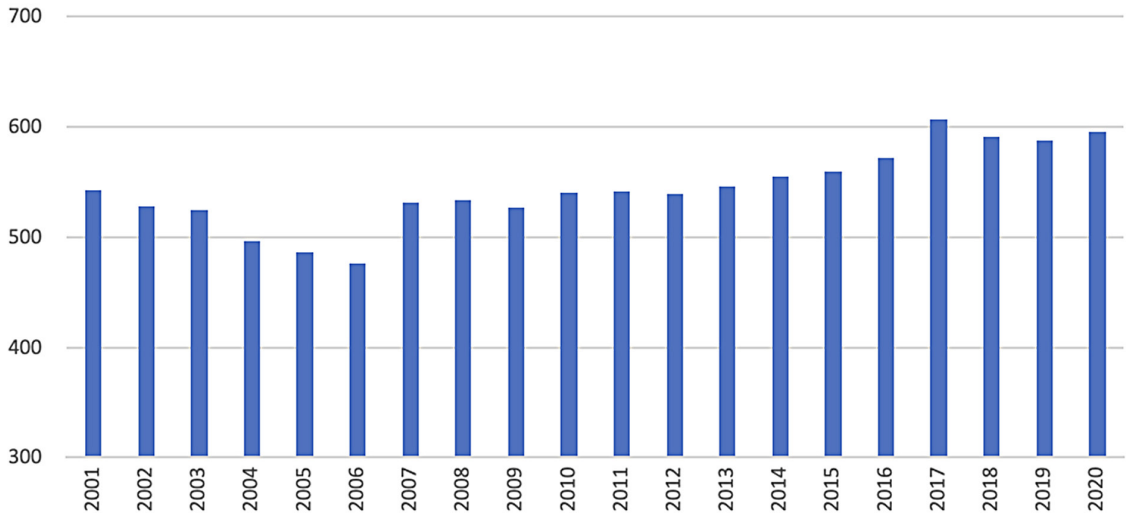

Figure 2: Agriculture Employment for Moffat County
AUTHOR CALCULATED WITH DATA FROM BEA.GOV

OUTDOOR RECREATION: Moffat County has 1.7 million acres of public land that supports activities like hunting, fishing, hiking, wildlife viewing, ATV riding, rafting, touring, camping, and golfing (see https://www.visitmoffatcounty.com/). Moffat County is rich in landscapes including the Yampa and Green Rivers, Dinosaur National Monument, and Desolation Canyon. There is ample opportunity for outdoor recreation tourism, as well as attracting remote workers to the county. It should be noted that Colorado offers strong support for the outdoor sector and state money may be available for certain projects.

Rio Blanco County

MINING (COAL, OIL, AND GAS): Rio Blanco shares a coal heritage with Moffat County and is home to employees in all the coal mines mentioned above. Additionally, the county is home to the Desarado Mine, which provides high paying jobs to many of its residents. In Eastern Rio Blanco County, oil and gas is still operational. However, this will likely be at a lower output moving forward.

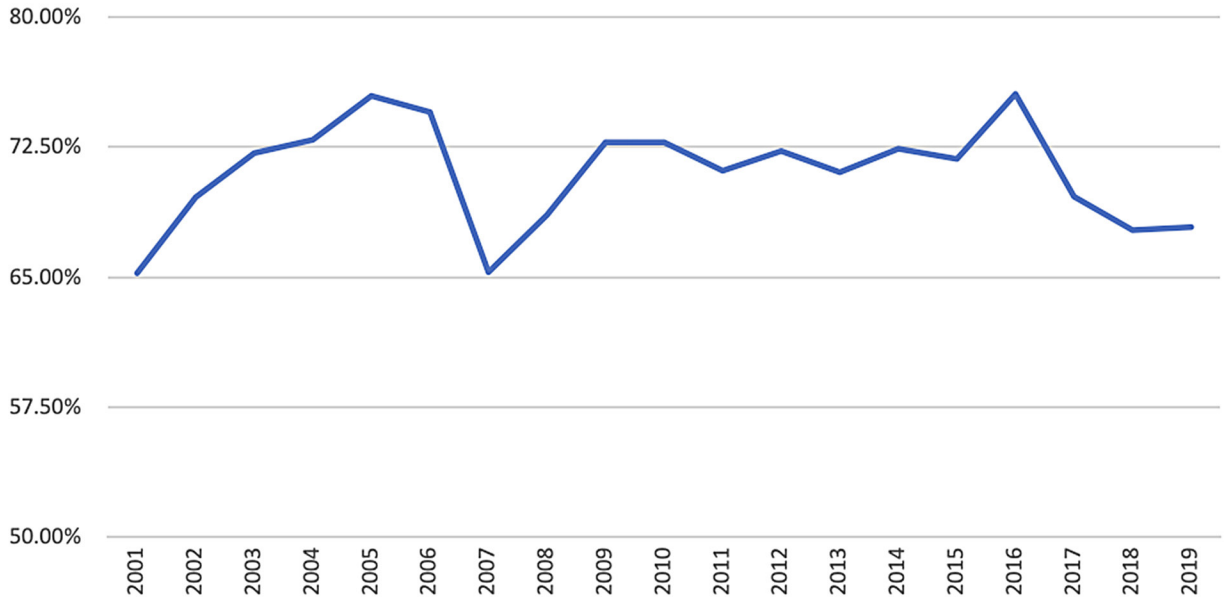

Figure 3: Oil, gas, and coal percentage of GDP Rio Blanco County
AUTHOR CALCULATED WITH DATA FROM BEA.GOV

OUTDOOR RECREATION: Rio Blanco County has 1,514,622 acres of federally owned land, which makes up almost 74% of the total land in the County. The White River National Forest located in the county provides excellent opportunities for recreation activities, including hiking, ATV riding, camping, hunting, fishing, backpacking, horseback riding, and other activities. This brand of outdoor recreation is strengthened by the Meeker Sportsman's Club, which is a gun and archery range that contributes to Rio Blanco's role as an outdoor destination.

AIRPORT AND FLIGHT SCHOOL: The CNCC aviation program provides opportunities for students who want to enter aviation. The program and facilities provide students with

a competitive advantage for aviation training and access to connections on the front range with aviation and aerospace companies.

AGRICULTURAL HERITAGE: According to the 2017 Census of Agriculture, Rio Blanco County has 320 farms and 410,923 acres of farmland for an average of 1,284 per farm. 82% percent of this land is pastureland, which supports mostly cattle. The top crops are hay, grains, oilseeds, dry beans, and dry peas. Like Moffat County, the views are picturesque and the small-town agricultural feel is attractive to those who desire a country setting. For this and other reasons, it is appealing to certain retirees and younger workers. Rio Blanco's agriculture makes up 10.5% of jobs, 1.86% of wages, and 6% of total output.

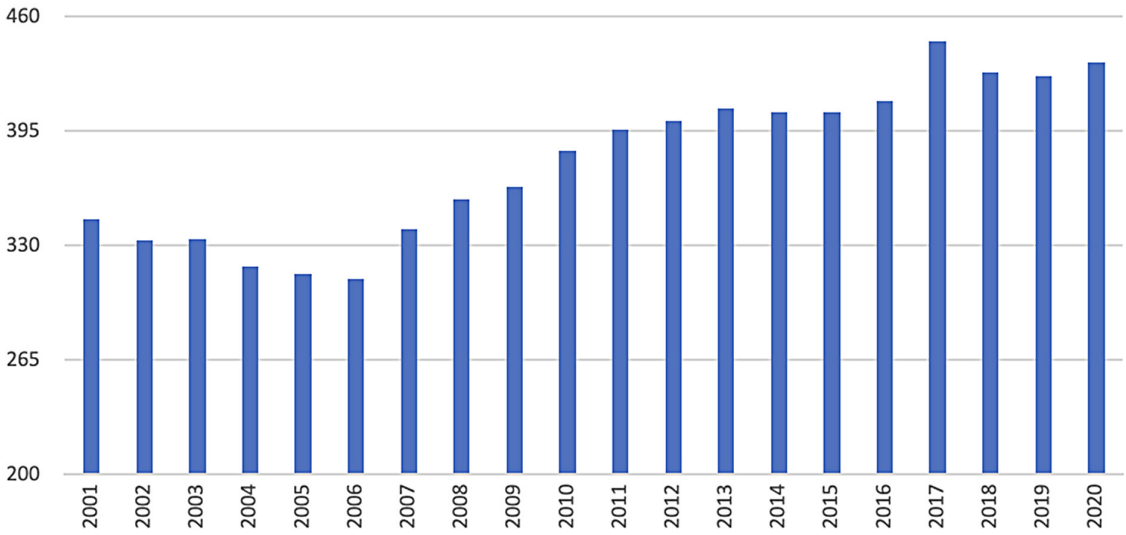

Figure 4: Agriculture Employment for Rio Blanco County
AUTHOR CALCULATED WITH BEA.GOV DATA

NATURAL SODA (RIO BLANCO): Natural Soda takes advantage of a very specific quarry of $NaCO_2$ in Rio Blanco County. Therefore, opportunity exists to expand the soda industry in the region beyond Natural Soda. It may also be possible to provide incentives to connect Natural Soda and other businesses by rail and encourage clustering in the region.

Routt County

TOURISM: Routt County is anchored by Steamboat Springs, which is a high-end resort town. Steamboat Springs offers access to skiing through the Steamboat Springs Ski Resort. This resort community not only has access to skiing, it also possesses a historic downtown and access to other outdoor recreation activities as well. There are 2,052 people employed in the arts, entertainment, and recreation sector in Routt County.

PROFESSIONAL SERVICES: Routt County's education level and contribution of professional services is significantly higher than Moffat and Rio Blanco Counties. This provides Routt County with an advantage to expand professional services throughout the western portion of the county. There are 1,433 jobs in professional and technical services in Routt County.

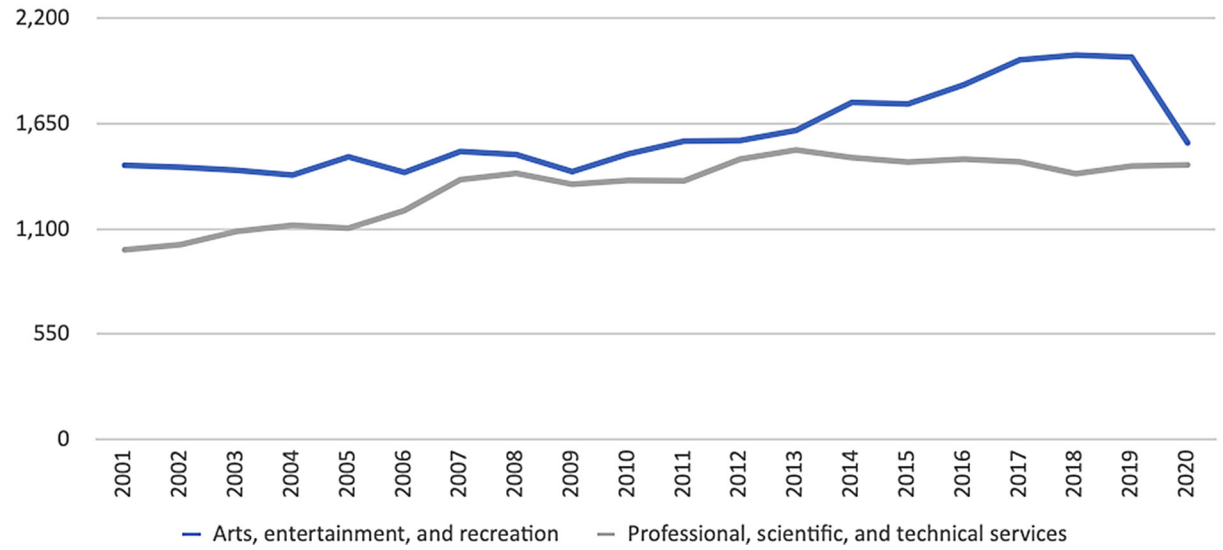

Figure 5: Arts, Entertainment and Recreation, and Professional Services Routt County
AUTHOR CALCULATED WITH BEA.GOV DATA

BROADBAND: In part because of project THOR, there is a reasonable broadband infrastructure in place that can be expanded to enhance service. This provides advantages for remote workers, technology companies, and professional services within the community, and provides opportunities for broadband expansion into the rest of the region.

Program Priorities

Below is a list of recommended programs and activities that align with regional competitive advantage. Although it may not be possible to address all these priorities in a single program, multiple priorities may be pursued under a single umbrella program. Desired programs that fall outside of this program, lack resources for development, or compete with higher priorities should only be pursued after these. The development of an effective priority plan for the region will help ensure that the most critical activities are addressed first.

1: Coal-to-Products

Due to the presence of local feedstock and other resources in the region potential exists for a coal-to-products industry. Efforts to support this industry could be part of a larger manufacturing initiative and a focus of an innovation center. Although efforts to promote coal-to-products could result in business and job creation, it should not be viewed as a replacement of coal in terms of consumption or wage and revenue generation. Additionally, due to policy challenges on the state level, foreign partnership is recommended to increase the likelihood of success. This is discussed in the step-by-step guide to coal innovation found on pages 15-20 of this playbook. For further information on coal-to-products, refer to Chapter 4 of the DIER.

2: Physical Innovation Space

Physical innovation spaces range from simple makerspaces to innovation centers, which provide a wide range of

business support services. These include manufacturing/fabrication space, office and floor space rental for startups, business incubators, workforce development, and innovation outreach. A full-service innovation center that supports multiple program priorities would encourage business creation, job growth, and economic diversification in the region.

For maximum effectiveness, the innovation center should involve a local academic partner. Potential academic partners and other resources are discussed in Chapter 3 of the DIER. Support for the innovation center could come through several sources. One of these is through participation in grants that the managing non-profit helps businesses in the incubator program win. Other potential sources are floorspace rent and user fees charged to businesses and community members who use the site. For information on existing programs in the United States with innovation centers, makerspaces, and other facilities that fall into this category, refer to Chapter 6 of the DIER.

Below are the types of services this resource should offer:

- Lab/prototyping space
- Incubation services
- Remote work support
- Workforce development support
- Coworking space
- Remote worker support

3: Advanced/Light Manufacturing

GENERAL LIGHT MANUFACTURING: The region's transition from energy provides an opportunity for light and advanced manufacturing. This is especially true for workers in the energy sector, as their skillsets transfers well to manufacturing. For more information about energy/coal sector skillset transfer, refer to Table 28 in the DIER. The region is also competitive in terms of cost of living and labor costs. Therefore, it may be possible to locate manufacturing efforts within it such as metal fabrication and light manufacturing. This would enable companies in more expensive areas of the state to expand while reducing production costs at the same time. Local rail transportation resources also provide excellent access to shipping for finished goods and raw materials.

DEFENSE/AEROSPACE MANUFACTURING: The abundance of transferable skills to manufacturing is an opportunity to connect to the supply chain in the aerospace and defense industry on the Front Range of Colorado. On page 10 of this playbook is a list of companies in this sector on the front range that are discussed in greater detail on pages 122-124 of the DIER. These companies provide a wide range of manufacturing services and bring billions of dollars into the state in prime defense contracts. These firms may be interested in located some of their manufacturing efforts in the region to lower costs or to subcontract with local manufacturing companies to produce components for larger systems.

4: Alternative Energy

SMALL-SCALE NUCLEAR PLANTS: These types of plants generate 345 MW of power (enough to power 250,000 homes). However, they

have enough capacity to produce up to 500 MW of power during peak demand. A good example of a plant like this is operated by TerraPower in Kemmerer, WY. This plant employed 2,000 workers during construction and 250 people during operation. Most of these 250 people have high-paying jobs that have similar economic value to those in the coal industry. Small-scale nuclear power plants are also much more stable than their larger counterparts and are lower risk for reactor meltdowns. With the existing energy infrastructure in Moffat County, water access from the Yampa River, and uranium mining potential in the region, Craig Station is a reasonable match for a small-scale nuclear conversion. For further information on small-scale nuclear, refer to page 145-146 of the DIER.

SOLAR POWER: With Colorado's recent focus on clean energy and that of the national landscape as well, solar manufacturing and power generation is a growth industry. Although solar generation is less labor intensive than that of coal, it does have potential to offset lost ad valorem tax revenue from coal powerplant closures. Additionally, it has potential to offset job losses in this sector (refer to the tables below for revenue and job creation potential). Furthermore, displaced coal workers provide a transferable skill set that could be utilized for these purposes with some retraining. For further information on solar power, refer to Chapter 5 of the DIER.

	Nameplate Size	Employment	Labor Income	Regional GDP	Output
Construction	145 MW	263.84	$19,278,482	$28,920,444	$37,132,226
	600 MW	1,092.16	$79,792,165	$119,699,011	$153,705,389
	1200 MW	2,184.51	$159,592,870	$239,411,436	$307,437,080
O&M	145 MW	11.53	$800,927	$1,910,438	$3,702,644
	600 MW	47.79	$3,319,154	$7,912,314	$15,334,640
	1200 MW	95.61	$6,639,610	$15,826,768	$30,673,523

Table 1: Economic Contribution of Solar, IMPLAN model

PERRY (2020)

Model	Direct Employment	145 MW	600 MW	1200 MW
Statistical model	Construction Phase (Yearly)	192.38	514.83	940.05
	O&M Phase (Yearly)	6.67	18.55	34.21
IMPLAN model	Construction Phase (Yearly)	163.98	678.56	1,357.12
	O&M Phase (Yearly)	6.72	27.81	55.61

Table 2: Employment Estimates

PERRY (2020)

5: Workforce Development

RETRAINING FOR HIGH DEMAND TRADES AND PROFESSIONS: Providing educational opportunities for coal industry workers to retrain in high-demand careers is another innovation possibility for the region. Developing such a program in partnership with local colleges and universities such as Colorado Mesa University (CMU), Colorado Mountain College (CMC), and Colorado Northwest Community College (CNCC) would ensure that the program meets local needs. Furthermore, its support could come through state funding and from coal industry employers as part of their workforce transition efforts. The program would essentially allow coal workers to continue to earn wages while they earn degrees and certificates in fields like nursing, welding, electrical, plumbing, and home building, all of which are in high demand locally. Worker retraining that fits regional needs while supporting business development in the trades, can help the region recover from coal job losses. Additionally, it may help alleviate labor and housing shortages by increasing the number of construction workers in the region.

6: Remote Work Support

COWORKING AT THE INNOVATION SPACES: This region is ripe for a business development center that caters to the specific needs of the region. A coworking space component would also benefit remote workers and could potentially support the cybersecurity program at CNCC. An innovation center with a multifaceted purpose would spur entrepreneurship and the makerspace facilities it contains would help local businesses and innovation in the manufacturing sector.

Local Remote Work Contact

- Brian Watson
- ALT SPACE
- Website: www.altspacecowork.com
- Email: altspacetelluride@gmail.com
- Phone: 970-239-1272

7: Broadband Expansion

Program Partnerships

For broadband related activities, the AGNC region should work in partnership with other Colorado programs and jurisdictions like Region 10 that have successfully completed broadband related projects. Below is a description of some of these:

- REGION 10: Region 10 has previously implemented rural broadband in the Delta and Montrose region and is interested in connecting their network to Grand Junction, Collbran, Rifle, the Front Range, Utah, and northwestern Colorado. Therefore, there is a potential to partner with Region 10 to provide a more connected network that will hedge against outages and connectivity issues.

- YAMPA VALLEY ELECTRIC ASSOCIATION (YVEA): YVEA is expanding broadband in several areas in NW Colorado through Luminate Broadband. https://www.luminatebroadband.com/service-areas/

- PROJECT THOR: This program was developed through a partnership of the Northwest Colorado Council of Governments (NWCCOG) and Critical Broadband

Infrastructure. There is potential to build off Project THOR in the Steamboat region to reach more rural areas. Neo Connect provided the broadband plan for Region 10 and could be considered for consulting services.

Broadband Consultants

In addition to pursuing partnerships, the AGNC region should contact a broadband consultant capable of developing an effective plan. Neo Connect Inc. is the entity that helped Region 10 with their 2015 plan. Below is their contact information:

- Neo Connect, Inc.
- Website: http://neoconnect.us/
- Phone: 970-309-3500
- Email: info@NEOconnect.us
- Address: PO Box 2664
- Glenwood Springs, CO 81602

Planning Approach

In addition to strong partnerships and capable consultants, certain planning approaches will facilitate a phased expansion that takes place as resources become available. Such an approach should contain the following:

- GIS-BASED BROADBAND MAP: GIS provides a visual resource for mapping out areas where proposed broadband projects should take place. As far as broadband is concerned, an effective map will show existing coverage, fiberoptic infrastructure, and telecommunication towers. Expansion areas in all these categories may also be added to the map in layers, which can be updated as needed.
- EXPANSION BY PRIORITY AREA: The GIS-based map should include expansion priority areas for broadband projects. Priority areas consist of defined geographical areas where expansion will take place within a specified number of years. Projects that will be carried out the soonest are the ones with the highest priority. An example of what priority areas consist of is as follows:
  Priority 1 (0-5 years)
  Priority 2 (6-10 years)
  Priority 3 (10-20 years)

Program Implementation

INGREDIENTS FOR A SUCCESSFUL INITIATIVE

Several ingredients are required for successful innovation initiatives. These include the following:

- INFRASTRUCTURE: Certain innovation programs like coal-to-products and advanced/light manufacturing require industrial facilities to operate in. If available, these may come in the form of existing facilities that could be retooled as manufacturing centers. Transportations resources like railroads and feedstock sources such as coal mines are examples of other forms of infrastructure useful to these initiatives.
- POTENTIAL PARTNERS: These are entities that have the potential to support a local initiative. This is because a successful program requires partnerships with entities that provide research and

development expertise, funding sources, long term vision, and investment. Potential partners include academic institutions, government entities, private industry, and foreign partners.

- FUNDING CAPACITY: A successful innovation initiative depends on adequate funding. Funding is necessary to support any needed research and development, equip facilities, and scale products to manufacturing levels (if a product is involved). Potential funding sources include federal and state grants, private industry investment, low-cost loans, and investment from foreign partners.

- REGULATORY ENVIRONMENT: The final ingredient to a successful program is a favorable regulatory environment. The regulatory environment determines the regional support for a given initiative. This is especially true for coal-to-products, which involves the extraction of a resource and its processing/manufacturing into a finished product. A supportive environment will provide investment opportunities and advocacy, while a non-supportive one can challenge outside investment and competitiveness. In areas where the regulatory environment is not favorable, finding a way to compromise and align with broader regional goals is key.

Below are available resources for implementation that the AGNC region may capitalize on for a successful initiative (further information, refer to Chapter 3 of the DIER).

INNOVATION RESOURCES

LOCAL INFRASTRUCTURE

Power Stations

Power stations provide access to industrial grade utilities and infrastructure that could support advanced manufacturing and other initiatives. The AGNC region is home to two coal fired power plants that are set to retire in 7-14 years. Therefore, opportunity exists to utilize these facilities in local innovation programs like the following:

- Coal-to-products
- Advanced/light manufacturing
- Workforce development
- Remote work support
- Physical innovation spaces

AGNC Coal-Fired Power Stations

- Craig Power Station
- Hayden Power Station

Railroad Resources

Railroad resources provide the region with a cost-effective method for transporting raw materials and finished goods. The AGNC region is home to one major railroad and a short line railway. Both have potential to support innovation programs such as the following:

- Coal-to-products
- Advanced/light manufacturing

AGNC Railroads

- Union Pacific Railroad
- Deseret Power Railway

Coal Mines

The AGNC region has four active coal mines. Most of these mines produce low-sulfur

subbituminous coal that is used for power generation. Additionally, two active mines exist in Colorado outside of the AGNC region, which produce bituminous coal. For further information on coal types (ranks) and the materials that can be produced from them, refer to Chapter 4 of the DIER. Coal mines like these could be used to help support the following:

- Coal-to-products
- Advanced/light manufacturing

AGNC Mines

- Colowyo Mine (Moffat County)
- Trapper Mine (Moffat County)
- Deserado Mine (Rio Blanco County)
- Twentymile Mine (Routt)

Other Colorado Mines

- King Coal II Mine (La Plata County)
- West Elk Mine (Gunnison County)

POTENTIAL INNOVATION PARTNERSHIPS

Academic

Academic institution involvement is necessary for certain innovation programs like coal-to-products and workforce development. However, it can benefit other programs as well. Academic partners can provide expertise, exposure to other partnerships, and access to potential funding opportunities. Academic partnerships should be pursued for the following programs:

- Coal-to-products
- Advanced/light manufacturing
- Workforce development
- Remote work support
- Physical innovation spaces

In State Academic Institutions

- Colorado School of Mines
- Colorado Northwest Community College (CNCC)
- Colorado Mesa University (CMU)

Out of State Academic Institutions

- Montana Technological University
- University of Wyoming

Department of Energy (DOE) Laboratories

DOE laboratories are actively involved in coal material, sustainable power technologies, and energy development. DOE laboratory partnerships can benefit the following:

- Coal-to-products
- Advanced/light manufacturing

DOE Laboratories in Colorado

- National Renewal Energy Laboratory (NREL)

DOE Laboratories Outside of Colorado

- NETL
- Oak Ridge National Laboratory (ORNL)

Coal Sector Companies

Companies in the coal sector provide opportunities for partnership and are sources for personnel that could participate in multiple innovation programs. They could also help support programs like workforce development, help provide feedstock for coal to products, and help test power technologies. The following initiatives could benefit from their involvement:

- Coal-to-products
- Advanced/light manufacturing
- Workforce development
- Physical innovation spaces

Local Power Companies
- Tri State

Coal Mine Operators
- Tri-State and its subsidiaries Elk Ridge Mining and Reclamation, LLC, and Colowyo Coal Company: Colowyo Mine.
- Platte River, Tri-State Generation & Transmission, Inc., Xcel Energy, the Salt River Project, and Pacificorp: Trapper Mine
- Deseret Generation & Transmission Co-operative and Blue Mountain Energy (operator): Deserado Mine
- Peabody Energy: Twenty Mile Mine

Defense Industries on the Front Range

A strong defense industry is one of Colorado's key innovation assets. Defense firms on the front range have the potential to support advanced/light manufacturing in the AGNC region by locating manufacturing facilities and subcontracting with local firms to produce goods. Below are local defense firms that could help support a local advanced/light manufacturing initiative:
- Lockheed Martin (Colorado Springs and Littleton)
- Northrop Grumman (Colorado Springs)
- Raytheon Technologies (Colorado Springs)
- Ball Aerospace (Broomfield)
- Sierra Nevada Corporation (Centennial and Broomfield)
- United Launch Alliance (Denver)
- Leidos (Denver)
- Ball Corporation (Broomfield)
- Boeing (Colorado Springs)
- General Atomics (Englewood)
- GA-ASI (Centennial)
- Barber Nichols, Inc. (Arvada)
- Boom Supersonic (Englewood)

POTENTIAL FOREIGN PARTNERS FOR COAL-TO-PRODUCTS

Carbon fiber is useful to a variety of industries such as aerospace, automobile manufacturing, sporting goods, and energy production. It is also used in aerospace where it replaces alloys such as aluminum and titanium. In sporting goods, it is used for tennis rackets, golf clubs, hockey sticks, bats, bows, and arrows. In energy production, it is used as a lightweight material for wind turbine blades. And, in the automotive industry it is used to reduce vehicle weight, increase energy efficiency, and reduce material cost. Below are foreign countries with documented coal-to-products interests that may be able to help support a program of this type (refer to Chapter 3 of the DIER for further information):
- South Korea
- Japan
- Mexico
- Taiwan
- India
- The Eurozone

FUNDING SOURCES

Coal-to-products and other innovation programs require funding to get started. Some of this funding will be needed to construct infrastructure, while other sources will be needed to develop products and managed programs. Although local funds can be used to get programs started, grants available through public agencies on state and Federal levels will make larger programs possible. Below are some potential sources to investigate:

Federal Level

- EDA: Grants are available from EDA with 0-50% match funds required. These can be used to construct and equip facilities and industries if they are owned by a non-profit entity. These grants should be investigated for physical facilities and equipment.

- DOE: Grants are available from DOE with 0-50% match funds required. These grants aim at supporting research that benefits power generation, renewable energy, and alternative uses for coal. These grants should be investigated for funding product development related to these areas.

- USDA: Low-cost loans are available from USDA that could be used to construct, renovate, and equip facilities. These loans should be investigated for physical facilities that fall outside of EDA's scope or match funds are not available for a traditional grant. Please note that these funds cannot be used as a match source for any Federal grants.

State Level

State level programs can provide funding for smaller projects and be used as match sources for larger innovation grants on the federal level. In addition to general appropriation funds, the Colorado Department of Local Affairs (DOLA) is another potential funding source for innovation projects. This agency is responsible for strengthening Colorado's local communities and building capacity by providing strategic training, research, technical assistance, and funding to localities. DOLA has several funding options, including COVID relief fund programs, standard funding programs, and energy impact funds. Available programs include the following:

DOLA Business and Innovation Funding

- COVID Relief Funds (business assistance and grants)
- Colorado Stimulus Funds (business assistance and grants)
- Innovative Affordable Housing Strategies (housing development support)
- Main Street: Open for Business (façade renewal and downtown revitalization)
- Renewable and Clean Energy Initiative (renewable energy development)

Other DOLA Programs

- Broadband Program
- Community Crime Prevention Initiative (Community Development Block Grant
- Community Services Block Grant
- Rural Economic Development Initiative
- Energy/Mineral Impact Assistance Fund (subject to funding availability)

In addition to DOLA, Colorado Office of Economic Development and International Trade (OEDIT) provides economic development and funding programs for economic development OEDIT has put a specific emphasis on creating and retaining rural jobs, which could provide northwestern Colorado with and advantage for funding. Below are several programs that may be of interest to the AGNC region (for a compressive list of OEDIT programs, visit https://oedit.colorado.gov/programs-and-funding):

- Advanced Industries Collaborative Infrastructure Grant
- Outdoor Industry Business Development
- Rural Jump-Start Program

REGULATORY CHALLENGES AFFECTING COAL AND OTHER FOSSIL FUELS

Coal and Other Fossil Fuels

Although Colorado's renewable energy goals impact the coal industry, other important regulations impact fossil fuels in the state. Below is a list of important legislation that creates regulatory challenges for not only coal, but oil and gas as well (for more information refer to Chapter 6 of the DIER):

- Colorado Renewable Energy Goal: the State of Colorado has a goal to operate on 100% renewable energy by 2040 and Excel Energy aims to reach the same by 2050. As part of this goal, Excel Energy intends to produce 80% of its energy from renewable sources by 2030. This has made coal-fired power plants a target for decommissioning. It is important to note that Colorado's renewable energy mandate affects coal-fired power plants, but not coal mines directly. However, they are indirectly affected since mines like Colowyo and Trapper primarily supply coal to power stations like Craig and Hayden.

- HB 19-1261: this bill aims to reduce greenhouse gas pollution by 26% by 2025, 50% by 2030, and 90% by 2050 (compared to 2005 levels).

- Regulation 22: this regulation results from SB 181 and requires the emissions reporting from oil and gas operators and other greenhouse gas emitters to the state of Colorado.

- Regulation 7: this regulation requires all drilling operators monitor air quality before, during, and after drilling operations.

- HB 1266: this bill has several components that will affect oil, gas, and coal in the region. The first is the creation of an environmental justice task force who makes recommendations to the general assembly on addressing environmental justice inequities within disproportionately impacted communities. The bill also directs the Air Quality and Control Commission (AQCC) to adopt rules that target near term reductions in greenhouse gas emissions. In terms of oil and gas exploration, production, processing, transmission, and storage it requires operations to reduce emissions 36% by 2025 and 60% by 2030 (relative to 2005 levels).

- SB 19-236: This bill codifies Excel's 100% carbon-free by 2050 goal. This bill also requires utilities retiring power generation facilities to produce a workforce transition plan for workers who lose their jobs.

Oil and Gas Specific

Although the regulations above affect coal, oil, and gas, SB 181 is oil and gas specific. Therefore, it has had a big impact on the industry in the Piceance Basin. Below is a summary of SB 181:

- Applicability to Local Government Jurisdiction: provides local jurisdictions with the power to impose stricter regulation than those imposed by the

Colorado Oil and Gas Conservation Commission (COGCC).

- COGCC Mission Restructuring: this restructuring changed COGCC's mission from fostering oil and gas development to a regulatory agency role with authority to protect public health and the environment.

- Pooling, Drilling, and Operating Requirements: This portion of SB 181 alters forced pooling, which allows oil and gas drilling to take place even if some mineral owners do not consent to drilling.

Overcoming the Challenges

The regulatory challenges listed above are important to consider for local innovation programs involving fossil fuels. In the case of programs involving coal like coal-to-products, the main challenges will be offsetting lost revenue from powerplant closures. A coal-to-products industry with a domestic focus does not have the ability to consume the level of coal that power generation does, which will result in mine closures, making domestic investment riskier. Therefore, domestic partners like the American auto industry, RAMACO Carbon, and others will be drawn to coal producing states with coal friendly laws. This makes foreign partnerships important, as they will have other incentives that determine profitability and have the potential to consume more feedstock in their coal-to-products industries. For further information, refer to Chapter 3 of the DIER.

In addition to foreign partnerships for coal innovation, converting power infrastructure to other forms of generation should be investigated to offset policy challenges with fossil fuels. Recommended power sources include solar and small-scale nuclear.

Steps to Innovation

STEPS TO COAL INNOVATION

Below are recommendations for seeding a coal-to-products industry in the AGNC region. Due to policy challenges on the state level, project stakeholders should consider the recommendations below:

- *Involvement of one or more foreign partners:* Policy challenges surrounding coal in Colorado will make it difficult to attract investment from domestic companies at the outset of a project. This is because it is easier and less risky to invest in programs in states with coal-friendly policies. However, foreign countries that conduct research on advanced materials or have industries that could benefit from coal products are potential partners. As such, they could bring investment and international recognition to the program. Therefore, the AGNC region should partner with one or more foreign entities early in the project. They also should reach out to the Colorado Office of Economic Development and International Trade and the federal International Trade Administration in Denver.

- *Collaboration with Colorado universities and out of state universities:* Due to the recent emergence of coal-to-products,

partnership with academic institutions is essential. Therefore, program stakeholders should pursue a partnership with a university that has the resources and expertise to carry out coal materials research. They should also pursue other partnerships with universities in different coal producing states, which could provide resources and strategic alignment for funding.

- *Incorporate coal-to-products into a larger innovation program:* To increase the likelihood of funding, program competitiveness, and promote increased economic diversity, coal-to-products should be a component of a broader innovation program. This program should focus on light manufacturing, workforce development, and remote work support. It should also utilize an innovation space, especially during the early stages of the project. Additionally, it should be tied into programs that have broad appeal such as green energy, battery technology, critical materials, and similar areas.

- *Keep program goals in line with policy, funding, and infrastructure realities:* Although it may be tempting to envision a big program, goals should be in line with the direction Colorado is taking with coal, the likelihood of available funding, and the type of facilities that will be needed to produce a given material. For this reason, it is best to start small, develop a program with broad support, and focus on products most suited for local coal.

- *Invest in research and development prior to manufacturing:* Although it may be tempting to focus on building manufacturing infrastructure for coal products, investment in research and development should take place first. This is because many technologies are at a bench scale level of development and patented by other entities. This necessitates collaboration with patent holders and efforts to improve existing technologies or develop new approaches altogether. Collaboration with existing patent holders can take place by engaging universities involved in material research.

After considering the recommendations above, the steps below will guide the development of a local coal-to-products industry in northwestern Colorado:

Step 1: Program Development Plan

Action A: Establish a Program Entity
Before efforts begin to establish a coal-to-products industry, project stakeholders should designate or establish a non-profit organization to serve as a program entity. This entity should carry out program management tasks, participate in program development, and manage the initiative once manufacturing begins. Therefore, it should consist of individuals who understand the region, funding development, and the coal-to-products industry.

Action B: Define a Location
After establishing a program entity, project stakeholders should identify the main location where work will be carried out. This location should be an area with a strong coal presence and possess infrastructure that is suitable for advanced manufacturing. Moffat County is an example of such a location. Also, as program resources permit, satellite locations may be in Rio Blanco and Routt Counties.

Action C: Define Product Specialty and Coal Sources
The next action is identifying the coal products to focus on and suitable feedstock. Chapter 4 of the DIER discusses feedstock suitability and the products that can be made from coal. Product specialization will depend on markets, partnerships, and the suitability of local coal as a feedstock source.

Action D: Framework for Research, Development, and Product Scaling
Coal products are a relatively new area of research. Many technologies that exist do so at a "bench" or laboratory scale. Others require finetuning and development. The projects that this program focusses on should be limited to one or a few related products at first. This is because methods for producing these will have to be scaled to industrial levels. Also, the program will need an effective testing strategy for coal samples, to fully identify the best coal sources for a given product.

Step 2: Organize a Partnership

Action A: Define the Partnership
Following the formation of a development plan, a program partnership should be organized. Partnerships like these ensure that programs are well thought out, operate efficiently, and attract investment from public and private sources. This partnership should include key stakeholders such as government agencies, non-profit enterprises, academic institutions, private industries, and foreign entities. Partners should be selected based on strategic contributions, expertise, and program relevance. For further information on foreign partnerships, refer to Chapter 3 of the DIER.

Due to coal policy challenges in northwestern, foreign partnerships are key to making a program successful. For further information on foreign partnerships, refer to Chapter 3 of the DIER.

Step 3: Industry Plan

Action A: Identify Target Industry
A successful coal-to-products initiative requires an industrial focus. By targeting a specific sector or industry, the region can specialize and encourage cluster development. However, it is important that this specialization is in line with existing skillsets and economic realities of the region. The DIER, which accompanies this playbook contains useful information on local skillsets, industry clusters, economic diversity, and industry potential within the region. Therefore, project stakeholders should consult this document when identifying a target industry.

Action B: Identify Target Industry Partners
Once project stakeholders find a target industry, they should identify potential partnerships within that industry. This includes foreign and domestic companies that are relevant to the program. Other target industry partners are government agencies that work with the targeted industry, as well as state and local governments that support these industries in their jurisdictions.
Action C: Formulate a Manufacturing Plan
After project stakeholders have identified the targeted industries and partners, a manufacturing plan can take place. This plan is where stakeholders should identify where manufacturing facilities will be located, how they will be constructed/equipped, and how they will operate. This plan will also include what research and development resources are needed to perfect bench scale technologies and rescale them to industrial levels.

Step 4: Budget Development

Action A: Identify Program Needs
Following an effective industry plan, budget development should take place. The first part of this step is identifying the resources needed to execute the manufacturing plan and larger program development plan. Resources include the people, facilities, and capital necessary to bring a local coal-to-products industry to production and self-sustaining operation.

Action B: Identify Program Costs
During this process, program stakeholders will generate budget line items and specific cost amounts. To ensure competitiveness, program scope and costs should be adjusted to reflect funding realities.

Action C: Consider Long Term Funding Mechanisms
It is important that the budget not only reflect the costs of launching a program, but also of sustaining it. A variety of mechanisms can be employed for this purpose. Annual membership fees through a manufacturing initiative, private equity stakes, foreign investment, and domestic business partnerships could help fund the program long term.

Action C: Budget Finalization
During the budget finalization process, project stakeholders should make final adjustments to line items and amounts. These should reflect the funding levels that will be pursued during Phase 1 and 2 funding development. The budget should be drafted so it is ready for use in funding proposals.

Step 5: Establish Program Parameters

Action A: Scale Program to Reflect Funding Reality and Research Needs
During this step, final adjustments to the scope of work should take place so that they are in line with the budget. This may make it necessary to scale the project down to meet funding realities or expand it to meet increased research needs if resources permit.

Action B: Encourage Foreign and Domestic Manufacturing at the Site
Due to the importance of investment in this initiative, foreign and domestic

manufacturing should both be encouraged at the site. Potential exists to manufacture coal products for major industries in countries that lack a domestic coal source. This is because it is more cost effective and less regulatory to ship finished products made from coal rather than raw coal. Encouraging this type of manufacturing will also help the reach of the program expand through increased partnerships.

Step 6: Secure Phase 1 Research and Development Funding

Action A: Determine Scope of Funding
Phase 1 of this program includes efforts like testing coal samples to determine suitability for target products. It also includes developing products and manufacturing methods at the bench scale and exploring ways to scale these to industrial levels. Therefore, at a minimum, phase one funding will need to support research efforts, facilities, program management, and funding development efforts for phase II.
Action B: Applicable Funding
Programs offered by the Department of Energy, Department of Defense, National Science Foundation, NASA, and Department of Transportation could fund research and development on a national level. Programs offered by EDA that fund infrastructure and equipment could help support the project by paying for equipment and facilities.

On a state level, programs that fund research development and partnerships with local academic institutions could help support these efforts and provide matches for larger grants. It should be noted that academic partnerships will be essential for carrying out Phase I research and scaling products to industrial levels.

Although programs on federal and state levels should both be pursued, programs should be well targeted to ensure maximum competitive. Therefore, efforts to engage one or two agencies will be far more effective than targeting all programs at once. And in all cases, agency interface, collaboration, and effective program development are essential to funding competitiveness.

Step 7: Secure Phase 2 Project Scaling and Infrastructure Funding

Action A: Identify Remaining Infrastructure Needs
When Phase II funding development begins, it will be important to identify any remaining infrastructure needs. This is because research and development efforts may change the direction of the project or requirements for industrial scaling. Infrastructure pursued at this stage will also need to facilitate project scaling and production until the program becomes self-sustaining.

Action B: Identify Product Scaling Methods
The work carried out during Phase I should demonstrate the feasibility of one or more bench scale production technologies. The next priority will be determining how to scale these technologies to industrial production levels. Therefore, project stakeholders will need to explore potential methods for scaling, identify the resources needed to do this, and determine what it will take to construct and equip a manufacturing facility. For this purpose,

they should develop a detailed scaling plan prior to pursuing funding for manufacturing infrastructure.

Action C: Applicable Funding
For infrastructure funding, project stakeholders should purse grants from EDA and low-cost loans from USDA and the SBA. Applications for all these programs will require a well-designed facility, suitable locations, applicable matches, and environmental reviews when necessary. Therefore, engagement with the appropriate agencies should occur prior to the application process.

For project scaling, a combination of federal and state grants and private investment should be pursued. Foreign partner investment will also be key in this effort. Although project stakeholders should have already engaged one or more foreign partners by this point, this may be an opportunity to engage other partners if needed. It may also be possible to attract domestic investors due to reduced risks.

Action D: Construct the Facility and Manage the Program
The final action is to construct/equip the facility and manage it. The program entity identified during Step 1 should manage the program through a non-profit organization. However, manufacturing efforts and sales should be carried out by private industry partners.

STEPS TO GENERAL INNOVATION

The sections on Competitive Advantage and Program Priorities in this playbook discuss regional strengths and recommend areas of focus for local innovation. Below is a strategy that can be used to develop programs from these areas of focus. This strategy is intended for use by individual counties, AOGs, or a multiregional coalition as they develop innovation projects.

Due to the need for effective project development, stakeholders should carry out initiatives in three general phases:

PHASE 1: This phase consists of identifying a program entity, developing a program focus, and formulating partnerships for implementation.

PHASE 2: This phase consists of developing a detailed implementation plan and securing funding to carry it out.

PHASE 3: This phase consists of implementing and managing the project.

Phase 1

- *Create/identify an entity to manage all program priorities:* The first step to developing an effective innovation program is designating or establish a non-profit organization to serve as the program entity. This entity should carry out program management tasks, participate in program development, and manage the initiative once operation begins. Therefore, it should consist of individuals who understand the region, funding development, and the selected focus of the program.
- *Partnership development:* Partnerships are a critical element of any innovation program. These include partnerships with relevant industries, academic

programs, and government entities. The first step to developing an effective partnership is identification. This occurs through research, effective outreach, and stakeholder involvement in program development. Once partnerships are developed, they can work collectively to develop program focus and general program design.

- *Develop Program Focus:* Before step one of this phase, a rough program focus should already exist. However, during this step the focus should include things like project goals, participant roles, and a vision to carry work out under. This step should involve the partners identified in the previous step, other relevant stakeholders, and key beneficiaries of the project.

- *Formulate a Program Plan:* Once program stakeholders are on board and a focus is developed, the next step is planning how it will function, be funded, and managed. An effective plan should include the following elements:
  - Vision: A short statement that describes what the program does
  - Goals: The program goals identified during the previous step
  - Staffing Plan: The staff roles and the people filling or needed to fill them
  - Management Plan: How the program will be developed, carried out, and improved
  - Cost Projection: A projection of the costs to launch the program, perform any necessary infrastructure work, purchase equipment, and maintain it on an annual basis
  - Sustainability Plan: A revenue generation strategy for long term sustainability
  - Scope of Work for Phase 2: A budget with actions, deliverables, and potential match sources identified
  - Metrics of Success: A method for measuring program success so it can be modified during the project if needed

- *Secure Funding for Phase 2 Development:* Planning effective project implementation and securing grants takes resources. To accomplish Phase 2, project stakeholders will need to develop funding hire individuals to design infrastructure, assist with environmental reviews, write funding proposals, and manage these activities. Securing the best support possible in this area is critical. Although there are limits on what types of federal funding can be used for this purpose, programs on local and state levels, as well as private sources should be pursued. Once adequate funding for Phase 2 is secured, work can begin on designing physical infrastructure and securing implementation funding.

Phase 2

1. *Determine Locations of Physical Infrastructure:* The first step of Phase to is selecting a location for any physical infrastructure needed for the project. These locations may include vacant land or new facilities that can be renovated or rehabilitated. In the case of the latter, they may include historic buildings (50 years or older) which may make certain activities eligible for additional funding opportunities.

2. *Formulate a Project Budget and Scope of Work for Phase 3:* After a location for the project is selected, the next task will be to develop a budget. This should detail all the building/renovation costs, equipment, and personnel costs associated with bring the facility into operation. This budget should be included in a scope of work that discusses the various tasks involved in this process. This scope should also illustrate relevant labor costs and have an equipment list, all of which are necessary to secure implementation funding.

3. *Design Physical Infrastructure:* With the budget and scope of work in place, the next task will designing any physical infrastructure for the project. Funding from the EDA and other entities will require design plans as part of the implementation process, as will many private sources of capital.

4. *Formulate a Phased Development Plan:* Another plan that is recommended for larger projects is a phased development plan. This type of plan can divide the project into smaller segments, which is useful for projects that consist of multiple sites, buildings, or improvements. Higher priority items should be constructed first with others following based on priority levels and funding realities.

5. *Select Funding Sources:* Potential funding opportunities for innovation projects include local, state, Federal, and private capital sources. When selecting funding sources, it is best to concentrate on a few with high potential rather than taking a random approach with opportunities that have low potential. This will conserve resources and make applications more competitive.

6. *Formulate Implementation Proposal/ Application:* The tasks that took place during steps 1-4 will provide many of the items necessary to formulate a strong implementation proposal. However, other items may be required depending on the funding agency and program. Well organized proposals that show a high level of collaboration and stakeholder support are typically the most competitive. In most cases, grant opportunities will include a notice of funding opportunity (NOFO) that will describe all the necessary elements for a successful application. These should be thoroughly reviewed before any application begins. Other factors that contribute to application success include the following:

- Agency Engagement: Most NOFOs on the Federal level will list a representative within an agency who interfaces with applicants. Discussions these representatives will help applicants produce better applications and make local agency offices aware of the project.

- Qualified Proposal Development Staff: Although often overlooked, it is very important engaging professionals with strong proposal development skills to produce an application. Therefore, it is important to set aside funds to hire individuals to conduct these services.

- Policy Alignment: Government agencies on Federal and state levels typically operate under administrations with everchanging funding priorities. However, applications that relate to current priorities have a better chance of receiving funding. Therefore, understanding the priorities and designing programs that target them is very important.

- Securable Match Source: Most funding sources on the Federal level and many on the state level require match funding. Depending on the source, this may be cash or in-kind (labor, buildings, equipment, etc.) dedicated to the project at a specified ratio. These generally range from 10% to 50% matches. Having an adequate match source identified and committed to the project ahead of application is one of the most important elements of a success.

Phase 3

- Construct and Equip Physical Facilities: After implementation funding is secured, constructing, and equipping physical facilities may take place. This process should follow the scope of work developed previously and be completed within the timeframe specified in the award. This timeframe will vary based on the project scale, but in most will range from 1-2 years from the date of the award.

- Recruit Program Staff in Accordance with Program Plan: Once the facility is constructed, the next step will be to staff it with qualified people. The number of positions and people needed to fill them will depend on the facility. However, it will at least require a facility manager and other support staff as specified by the scope of work.

- Manage the Program in Accordance with the Program Plan: During Phase 1, a program plan will have been developed. This plan should have outlined the management, sustainability, and metrics of success for the program. Prior to managing the program, this should be reviewed and updated it if necessary. At this point, the program should be managed according to the plan. However, regular updates should take place to reflect any changes that occur as operation takes place.

Conclusion

This playbook has discussed the competitive advantage of the AGNC region and provided a starting point for local stakeholders to foster innovation. To these ends, it has discussed initiatives that encourage new uses for local resources like coal. It has also discussed other efforts that will promote economic diversity, clustering, and a broader culture of innovation. The program implementation strategies recommended herein also provide a roadmap for developing a competitive coal-to-products cluster and other programs that can offset local job losses. The approach from here should be multifaceted, focusing on innovation, economic development in multiple sectors, and similar strategies recommended in this playbook. The result for the region will be greater economic diversity, innovation, and resilience. And, in short, a better future for northwestern Colorado's coal communities. ■