COLORADO'S ENERGY INDUSTRY

Strategic Development Through Collaboration

Prepared by BCS Incorporated

for Colorado Office of Economic Development
and International Trade, Colorado Energy Office,
Colorado Department of Natural Resources, and
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Robert Naranjo of BCS, Incorporated provided project management to the BCS team throughout the Energy KIN effort. Tony Frank, Ryan Jobes, and Mary Jeffreys facilitated eight industry listening sessions, a Steering Committee meeting, and six Tactical Team meetings throughout the Energy KIN effort to collect input from industry and other stakeholders. The project team also conducted additional outreach to industry and other stakeholders, collected inputs from an online survey, and conducted research to provide an overview of Colorado's Energy industry and context for the recommended strategies and actions. The final report was prepared by Robert Naranjo, Tony Frank, Ryan Jobes, Feridun Albayrak, Mary Jeffreys, Garrett Shields, Andrea Bailey, and Morgan Evans. Final document layout was developed by Borys Mar and Jared Largen.

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DISCLAIMER

This report was completed by BCS, Incorporated for the Colorado Office of Economic Development and International Trade, Colorado Energy Office, Colorado Department of Natural Resources, and Colorado Department of Public Health and Environment. The statements, findings, and recommendations included in the report were gathered from industry stakeholders and synthesized by the authors. These statements do not necessarily reflect the views and opinions of the Colorado Office of Economic Development and International Trade, Colorado Energy Office, Colorado Department of Natural Resources, and Colorado Department of Public Health and Environment, and are being presented to the state and industry stakeholders for consideration in future efforts to enhance Colorado's Energy industry.

Contents

LIST OF ACRONYMS

ACRONYM	DESCRIPTION
ACEE	American Council for an Energy-Efficient Economy
ACRE	Advancing Colorado's Renewable Energy
AAS	Associate of Applied Science
AFV	Alternative Fuel Vehicle
AIA	Advanced Industries Accelerator Act
AMI	Advanced Metering Infrastructure
APCD	Air Pollution Control Division
ARRA	American Recovery and Reinvestment Act
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
Bcf	Billion Cubic Feet
BMP	Best Management Practice
Btu	British Thermal Unit
CCA	Compliance Cost Assessment
CCCS	Colorado Community College System
CCIA	Colorado Cleantech Industries Association
CCS	Carbon Capture and Storage
CDE	Colorado Department of Education
CDHE	Colorado Department of Higher Education
CDLE	Colorado Department of Labor and Employment
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CEO	Colorado Energy Office
CEO	Chief Executive Officer
CEU	Continuing Education Unit
CEFFIA	Clean Energy Finance and Investment Authority
CFR	Code of Federal Regulations
CHP	Combined Heat and Power
CLEEN	Cluster for Energy and Environment
CNG	Compressed Natural Gas

CO	Colorado
CO_2	Carbon Dioxide
COGCC	Colorado Oil and Gas Conservation Commission
CPUC	California Public Utilities Commission
CRS	Community Resource Center
CREED	Center for Renewable Energy and Economic Development
CSU	Colorado State University
CSM	Colorado School of Mines
CTE	Career and Technical Education
CU	Colorado University
CWDC	Colorado Workforce Development Council
DG	Distributed Generation
DNR	Colorado Department of Natural Resources
DOE	United States Department of Energy
DOT	United States Department of Transportation
DSM	Demand Side Management
E85	Fuel blend of 85% denatured ethanol and 15% gasoline
EC	European Commission
EEBC	Energy Efficiency Business Coalition
EIA	United States Energy Information Administration
EPA	United States Environmental Protection Agency
EPD	Environmental Protection Division
ERT	European Roundtable of Industrialists
EV	Electric Vehicle
FIT	Feed-in-Tariff
FortZED	Fort Collins Zero Energy District
FSEC	Florida Solar Energy Center
FTZ	Foreign Trade Zone
GDA	Generation Development Area
GEFA	Georgia Environmental Finance Authority
GM	General Manager
G&T	Generation and Transmission
GW	Gigawatt
GWh	Gigawatt Hours

HAN	Home Area Network
HB	House Bill
HEA	Highline Electric Association
HERS	Home Energy Rating System
HF	Hydraulic Fracturing
HOT	High Occupancy Toll [Lane]
HOV	High Occupancy Vehicle
ICAST	International Center for Appropriate and Sustainable Technologies
IECC	International Energy Conservation Code
IP	Intellectual Property
IOU	Investor Owned Utility
K	Thousand
KIN	Key Industry Network
LEED	Leadership in Energy Efficiency and Design
LIPA	Long Island Power Authority
LNG	Liquefied Natural Gas
MACT	Maximum Achievable Control Technology
MESA	Mathematics, Engineering, and Science Achievement
MLS	Metro Listing Service
MOU	Memorandum of Understanding
MW	Megawatt
MWth	Megawatt Thermal
NASEO	National Association of State Energy Officials
NEED	National Energy Education Development
NEPA	National Environmental Policy Act
NGA	National Governors Association
NREL	National Renewable Energy Laboratory
NYPA	New York Power Authority
NYSERDA	New York State Energy Research and Development Authority
OCGA	Official Code of Georgia Annotated
OEDIT	Colorado Office of Economic Development and International Trade
OEM	Original Equipment Manufacturer
OMB	Office of Management and Budget

PACE	Property Assessed Clean Energy
PSC	Public Service Commission
PV	Photovoltaic
QECB	Qualified Energy Conservation Bond
Quads	Quadrillion Btu
R&D	Research and Development
RD&D	Research, Development, and Demonstration
REA	Rural Electric Association
REC	Renewable Energy Credit
RFP	Request for Proposal
RIA	Regulatory Impact Statement
RMI	Rocky Mountain Innosphere
RPS	Renewable Portfolio Standard
SB	Senate Bill
SEP	State Energy Program
SLV	San Luis Valley
SolarTAC	Solar Technology Acceleration Center
STEM	Science, Technology, Engineering, and Math
STRONGER	State Review of Oil and Natural Gas Environmental Regulations
Tcf	Trillion Cubic Feet
T2M	Technology to Market
TCEQ	Texas Commission on Environmental Quality
UL	Underwriters Laboratories
UK	United Kingdom
U.S.	United States
USC	United States Code
USCIS	United States Citizenship and Immigration Services
USDA	United States Department of Agriculture
USDOT	United States Department of Transportation
VOC	Volatile Organic Compound
WFC	Workforce Center
WIRED	Workforce Innovation in Regional Economic Development

EXECUTIVE SUMMARY

The Energy industry in Colorado is diverse, complex, and critical to the state's economic success. The state's Energy industry is composed of an exceptional range of emerging and established businesses, organizations, research institutions, and government agencies. The Colorado Energy industry is also an enabler to other industries in the state, the nation, and the globe, providing the power to grow and open new markets. Continued pursuit of economic development opportunities for the Energy industry—including advances in technology innovation, policy and regulation, and education and training—will be crucial to strengthening the Colorado economy now and in the future. Through the Colorado Blueprint process, the state has focused on the Energy industry—with support from BCS, Incorporated (BCS)—as 1 of 14 Key Industries. BCS has supported this joint effort of the Colorado Office of Economic Development and International Trade (OEDIT), Colorado Energy Office (CEO), Colorado Department of Natural Resources (DNR), and Colorado Department of Public Health and Environment (CDPHE) to develop a strategic economic development report for the Colorado Energy industry that provides actionable recommendations for advancing the industry over the next 6–18 months. In developing this report for the Energy Key Industry Network (Energy KIN), BCS conducted outreach to more than 400 Energy industry leaders and facilitated a statewide energy listening tour, as well as focused meetings with the Steering Committee and Tactical Teams.

This report, prepared by BCS for the State of Colorado's participating agencies, provides an overview of the economic importance of the Energy industry to the state, assesses current challenges to overcome and opportunities to pursue, and provides a set of strategic recommendations for the industry and state to consider for advancing the Energy industry and economy. This report provides the recommended strategies and actions identified by the Steering Committee and Tactical Teams and will serve as input for a future statewide energy plan that will be developed by the state. It will also serve as a framework for collaborative initiatives among industry, academia, and state organizations to pursue and undertake activities for the benefit of increasing the global competitiveness of the Energy industry in Colorado.

COLORADO BLUEPRINT PROCESS

Upon taking office in January 2011, Governor John Hickenlooper issued Executive Order D 2011-003, directing a statewide economic development strategy based on local and regional collaboration. This bottom-up economic development initiative asked business and communities across Colorado to identify and assess the state's opportunities and challenges for economic growth. The resulting statewide strategic plan—the Colorado Blueprint, published in July 2011—provides a framework around six Core Objectives for collaborative economic development:

1. Build a Business-Friendly Environment;
2. Retain, Grow, and Recruit Companies;
3. Increase Access to Capital;
4. Create and Market a Stronger Colorado Brand;
5. Educate and Train the Workforce of the Future; and,
6. Cultivate Innovation and Technology.

OEDIT completed an analysis of employment and gross state product data for each of Colorado's primary industries, which resulted in the identification of 14 key industries—including Energy. For each key industry, OEDIT has partnered with the relevant organizations to establish Key Industry Networks (KINs), which are groups of industry leaders and stakeholders who work together to develop a strategic plan for growing each key industry.

The Energy KIN process began with a statewide listening tour that covered eight regions of the state to solicit feedback from industry stakeholders about challenges and opportunities in Colorado's Energy industry and identified potential opportunities for growth at the local and statewide level. The eight Energy industry listening sessions involved more than 160 participants, and were conducted between July 22 and August 26, 2013. The sessions took place across Colorado in the following locations: Limon, Eagle, Monte Vista, Durango, Loveland, Denver, Grand Junction, and Sterling.

Building on the input provided by the listening sessions, a Steering Committee of 34 executive-level representatives of Energy industry businesses met on September 12, 2013, to identify and prioritize opportunities for economic growth. This feedback was a primary input that guided development of this strategic energy report. On September 23–24, 2013, tactical teams were convened—one for each Core Objective—to develop the Steering Committee's prioritized strategies into recommended actions that would enable greater growth in Colorado's Energy industry over the next 6–18 months. To create an actionable set of recommended strategies, Tactical Team members were asked to assess strategies and actions according to the length of time needed for implementation; the resources required, both financial and non-financial; and the overall complexity of each item.

ENERGY IS A KEY INDUSTRY IN COLORADO

Economic Role

The Energy industry has been a key part of Colorado's economy throughout its history. Coal mining first began in Colorado in 1859, and the Energy industry has grown to include a diverse range of industry segments for fossil fuels, renewable energy, energy efficiency, and advanced technologies. In general, Colorado's Energy industry has recorded strong growth in several fronts. In 2011, the state's coal production was 26.89 million short tons, compared to just 17.20 million short tons in 1985, a 56.34% increase.[1] In the late 1980s, natural gas production began to rise steadily. In 1986, Colorado produced 176 billion cubic feet of natural gas; in 2011, the state produced more than 1.6 trillion cubic feet, a

nine-fold increase from 1986.[2] In recent years, driven by voter approved Amendment 37 and other legislation, renewable sources, such as wind and solar, have achieved substantial growth in the state. Current wind capacity in Colorado is 2,301 megawatts (MW), up from 1,299 in 2010.[3] Solar energy and other renewable energy sources have become substantial parts of the state's Energy industry as well, with Colorado's solar electric capacity growing by 31% to 298 MW in 2012 alone.[4]

The Energy industry in Colorado is a significant source of economic activity. In 2012, the Energy industry in Colorado produced more than $24 billion in exports, bringing new money into the state's economy from other states and foreign countries. This is larger than the state's exports of $17 billion from the Food and Agricultural industry and $7.7 billion from the Aerospace industry.[5] Overall, the Energy industry in Colorado produced more than $41 billion in revenue in 2012.[6]

Energy Jobs in Colorado

Colorado's employment in the Energy industry has grown significantly in the past decade.

> *Currently, there are more than 122,400 people employed in the state's Energy industry, up 56.2% since 2003. Energy industry job growth is considerably higher than the national increase of 26.2% demonstrating a strong energy economy in the state.*[7]

More than 35,000 of these new jobs from 2003 to 2013 were within the oil and gas extraction sector and support activities, an industry that currently employs more than 51,000 people in the state.[8] This sector has seen significant growth in Colorado, as new oil and gas reserves have been discovered, and innovative technologies and processes have been developed to extract these resources.

Energy jobs in Colorado pay on average $80,891 per year. This is slightly lower than the national average of $86,535. Although Colorado's energy jobs are slightly lower than the national average, these jobs pay considerably more than Colorado's median household income of $57,685.[9] Geographic distribution of jobs within the state is aligned with population centers, as well as resource areas.

Research and Development Institutions

Colorado is uniquely positioned as a leader in energy technology research. The state is home to world-class research facilities, such as the U.S. Department of Energy's National Renewable Energy Laboratory (NREL)—the only federal laboratory in the United States solely dedicated to the research, development, commercialization, and deployment of renewable energy and energy efficiency technologies; the Solar Technology Acceleration Center (SolarTAC); and the Colorado Energy Research Collaboratory (the Collaboratory), consisting of the Colorado School of Mines, the University of Colorado, Colorado State University, and NREL. The Collaboratory provides a vehicle for research collaboration and information sharing between researchers and provides training for careers in the Energy industry. Colorado is also home to the Central Region Headquarters of the National Oceanic and Atmospheric Administration (NOAA), and the National Center for Atmospheric Research (NCAR). These institutions offer companies unique proximity to research and development facilities and opportunities for collaboration.

MAJOR FINDINGS

Colorado is Rich in Multiple Energy Resources and Human Talent

A prominent strength of Colorado's Energy industry is its diversity of energy resources and the broad range of companies and human capital that develop those resources in the state. Industry leaders throughout Colorado have voiced that it is critical for industry and government leaders to better leverage this strength into an opportunity that brings Colorado's diverse set of Energy industry segments into collaborative efforts. These efforts will allow for integrated approaches to position Colorado as a leader in creating technology innovations and practices for energy production, renewable energy integration, smart grid deployment, and energy efficiency. A stronger Colorado Energy industry vision based on the integration of diverse resources will establish a focus on technologies and system integration approaches that can be exported nationally and globally to key markets seeking energy solutions. Colorado, with its abundant fossil fuels, renewable energy, energy-related minerals, and highly skilled and educated workforce, is in a unique position to remain and grow as a global Energy industry leader.

Colorado has a Strong Foundation for Energy Innovation

A growing segment of the state's economy is clean technology, which includes energy efficiency, renewable energy generation technologies, and technologies that allow for cleaner and more efficient use of traditional energy and natural resources. In its 2012 state index of the U.S. clean technology sector, Clean Edge ranks Colorado fifth among all states in terms of measures for technology, policy and capital.[10] Several leading clean technology companies have located operations in Colorado in recent years including Vestas, Cool Planet Energy Systems, Abengoa, SMA Solar, and Solix Biosystems. Colorado has many unique opportunities to advance several sectors of the clean technology industry, including wind, solar, smart grid, alternative fuel vehicles, and bio-derived energy resources.

Colorado can be a Global Leader in Collaboration and Integration Among Sectors

Today more than any other time in history, electricity generated from different energy sources are pouring onto the grid, and consumers have more options for how they heat their homes and fuel their cars. Colorado is at the center of this diversity and technology innovation, which presents both great challenges and great opportunities, e.g., questions such as how do we manage a grid that is fed by the sun and the wind as well as traditional sources; how do we plan a transportation system in a city, a region or a nation when multiple vehicle types and fuel types are demanded. Colorado's great opportunity is to develop a collaborative environment where the state's abundant and diverse energy resources and technology innovations can be united and integrated to allow the industry to grow in a manner that will provide energy solutions that serve the state, national and global markets. The perception that policymakers may be picking "winners" and "losers" between technologies prevents collaboration among key industry sectors to advance a larger vision for the state—and for the Energy industry globally.

STRATEGIC ACTIONS TO ADVANCE THE COLORADO ENERGY INDUSTRY

Through the input provided by Energy KIN Steering Committee and Tactical Teams the following 5 to 10 year Energy industry vision has been developed:

> *Colorado will continue to be a global energy leader by combining its diverse resources, talent, innovation and capital to create energy production and efficiency solutions for state, national and world markets.*

A set of recommended strategies and actions have been developed to support this vision through the input provided by industry leaders across Colorado during the listening tour, and with further guidance from the Steering Committee and Tactical Teams. These recommended strategies are shown in Table 1, where the strategies are correlated with the Colorado Blueprint's six Core Objectives to show their relevance and alignment. It is important to note that several of these recommended strategies have applicability to other Core Objectives within the Colorado Blueprint, which are indicated in the table below as having cross-cutting strategies. These recommended strategies and actions for their implementation are described in detail in the *Recommended Strategies and Actions* section of this report on page 30.

TABLE 1 Aligning Strategic Actions with Colorado Blueprint Core Objectives

	RECOMMENDED STRATEGIES	Relevance to Core Objectives					
		1	2	3	4	5	6
1	**Build a Business-Friendly Environment**						
A	Identify duplicative (and conflicting) regulations and reporting for oil and gas production across multiple government agencies (federal, state, and local)	•					
B	Establish regulatory consistency between local jurisdictions for energy development	•					
C	Establish a clear long-term state energy plan	•	◦				
D	Improve the air permitting review process within Colorado Department of Public Health and Environment's (CDPHE's) Air Pollution Control Division	•					
E	Establish replicable standards and mechanisms for energy efficiency and distributed generation technologies to be integrated into new and existing building construction	•	◦				
F	Increase the use of memorandums of understanding (MOUs) between industry and local governments to support the use of specific/advanced technologies and to address potential impacts from oil and gas production within urban/suburban areas of the state	•	◦				
G	Identify cost-benefit analysis approaches to evaluate the impact of regulation on industry	•	◦				
H	Establish more efficient ways to transport energy production feedstock and manufactured energy products	•					
2	**Retain, Grow, and Recruit Companies**						
A	Establish greater communication on regulatory issues among industry, utilities, policy makers, and regulators to more effectively plan for future development opportunities	◦	•				
B	Identify and assess the business incentives, tax policy and resources related to Colorado's Energy industry for maintaining and attracting energy companies		•				
C	Establish reasonable standards for the sharing of consumer utility data to third-party contractors to evaluate energy efficiency improvements and for development of energy tracking tools		•				
D	Develop a regulatory and risk sharing framework to allow for quicker deployment of new energy technologies		•				
E	Market Foreign Trade Zones in Colorado to energy companies dealing with international vendors and customers	◦	•				
F	Develop a coordinated planning effort for the deployment and promotion of alternative fuel vehicle infrastructure	◦	•				

- • Primary Core Objective
- ◦ Secondary Core Objective

	RECOMMENDED STRATEGIES	Relevance to Core Objectives					
		1	2	3	4	5	6
3	**Increase Access to Capital**						
A	Increase funding from private and government sources across the continuum of idea, seed, and early-stage businesses in order to increase the commercialization of new energy technologies			•			
B	Facilitate information sharing to strengthen financing for energy efficiency and distributed generation projects			•			
4	**Create and Market a Stronger Colorado Brand**						
A	Develop a cross-segment industry communication network that can promote the state's energy resources, strengths, and innovation climate				•		
5	**Educate and Train the Workforce of the Future**						
A	Increase industry engagement among current science and engineering students to increase their interest in pursuing Energy industry careers					•	
B	Expand science, technology, engineering, and math (STEM) education programs for the Energy industry					•	
C	Develop technical training programs for the Energy industry					•	
D	Develop energy career pathways through the state education and workforce development systems					•	
E	Establish energy career academies for high schools in areas of the state with strong energy resources					•	
F	Collaborate to address work visas and H1B issues for the Energy industry					•	
6	**Cultivate Innovation and Technology**						
A	Establish greater industry and research alliances for the integrated and regional research and development approach						•
B	Increase industry involvement in research efforts that advance clean energy technologies						•

INTRODUCTION – PURPOSE AND GOALS OF THE REPORT

OVERVIEW AND PURPOSE

Upon taking office in January 2011, Governor John Hickenlooper issued Executive Order D 2011-003, directing a statewide economic development strategy based on local and regional collaboration. This bottom-up economic development initiative resulted in a statewide economic development plan—the Colorado Blueprint, published in July 2011. The Colorado Blueprint, based on public meetings with the Governor in each of Colorado's 64 counties, as well as several online surveys submitted by Coloradans, identified and assessed the state's opportunities and challenges for economic growth and laid out six Core Objectives for development. Taking the process to the next level, the Office of Economic Development and International Trade (OEDIT) completed an analysis of employment and gross state product data for each of the state's industries and began strategic business planning on an industry-by-industry basis. This effort resulted in the identification of 14 Key Industries, including the energy Key Industry. Both the Core Objectives and the Key Industries are listed in Table 1 below.

TABLE 1 Six Core Colorado Blueprint Objectives and Colorado's 14 Key Industry Networks

CORE COLORADO BLUEPRINT OBJECTIVES	
1 **Build a Business-Friendly Environment**	2 **Retain, Grow & Recruit Companies**
3 **Increase Access to Capital**	4 **Create & Market a Stronger Colorado Brand**
5 **Educate & Train the Workforce of the Future**	6 **Cultivate Innovation & Technology**

COLORADO KEY INDUSTRIES	
Advanced Manufacturing	Aerospace
Bioscience	Creative Industries
Defense & Homeland Security	Electronics
Energy	Financial Services
Food & Agriculture	Health & Wellness
Infrastructure Engineering	Technology & Information
Tourism & Outdoor Recreation	Transportation & Logistics

Each Key Industry consists a network of related businesses, organizations, and institutions whose collective excellence, collaboration, and knowledge base provides a sustainable, competitive advantage that Colorado can leverage to grow their industry. A strong KIN will create tangible benefits by allowing related businesses to have shared access to suppliers, services, resources, technology, and workforce. KINs will also allow businesses to work together to reduce barriers to growth, achieve new economies of scale and distribution and supply channels, and ultimately lead to increased profitability. Overall, a higher level of focus on Colorado's Key Industries will help identify opportunities for growth and foster an environment for greater investment and job creation.

DEVELOPING AN ENERGY KEY INDUSTRY NETWORK

Colorado's Key Industries have been further integrated and aligned based on common themes and principles. The Advanced Industries rely heavily on research and development and commercialization of new technologies and account for a high concentration of occupations that are classified as STEM—Science, Technology, Engineering and Math. The state is focusing on such industries because together they account for a large share of the state's exports, bringing dollars and investment into the Colorado economy. In addition, such Advanced Industries represent a significant portion of the state's revenues and wages. Energy is one of the state's seven Advanced Industries. In 2013, the Energy industry employed 122,449 people in Colorado across all sub-sectors.[11]

The Colorado Blueprint established the foundation for the Energy KIN necessary to create a strategic action plan for economic development. In creating such a strategic plan, OEDIT, the Colorado Energy Office (CEO), the Colorado Department of Natural Resources (DNR), and the Colorado Department of Public Health and Environment (CDPHE) collaborated with BCS, Incorporated (BCS) to create an economic development strategy to advance all sectors of Colorado's energy economy—increasing efficiency and innovation while protecting Colorado's environment. The project focused on the opportunities to serve the national and global energy market, while also addressing the energy produced and used within the borders of Colorado.

This project's overall objective was to conduct a statewide assessment to outline strategies and opportunities that will sustain and grow Colorado's Energy industry, both nationally and globally.

This project also aimed to identify how to most effectively tap the state's diverse energy resources in a responsible manner that is protective of the communities, landscapes, water, wildlife, and air. Additionally, the objective was to be carried out in a manner that emphasized innovation, creativity, and partnership, without preference to industry, technology, or geography.

The Energy KIN and this report do not attempt to provide a comprehensive economic development strategy for the total range of natural resources in the state; rather, it has focused on those natural resources that are vital inputs to the energy economy, such as coal mining. The state is conducting additional outreach, outside the scope of the Energy KIN or this report, to collaborate with additional stakeholders in the Natural Resources industry to develop applicable economic development strategies.

Listening Sessions

The process began with a statewide listening tour that covered the entire state with eight regional sessions. The eight Energy industry listening sessions were conducted between July 22 and August 26, 2013, in the following locations:

1. Eastern Plains: Limon—July 22
2. Central Mountain: Eagle—July 24
3. San Luis Valley: Monte Vista—July 31
4. Southwest: Durango—August 1
5. Northern Front Range: Loveland—August 12
6. Front Range: Denver—August 14
7. Western Slope: Grand Junction—August 16
8. Northeastern Plains: Sterling—August 26

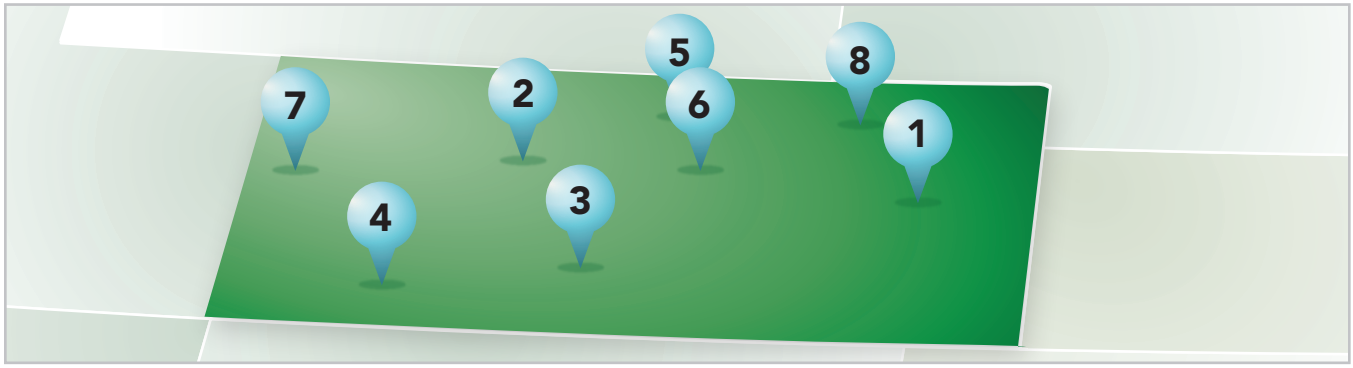
The objective of the listening sessions was to solicit feedback from Energy industry stakeholders from all across Colorado about issues and opportunities in Colorado's Energy industry. Stakeholders in Colorado's Energy industry shared their concerns and identified potential opportunities for growth at the local and statewide levels.

In addition to the eight listening sessions conducted throughout the state, an online survey was made available for other members of the public to have their voices heard. The survey was designed with open-ended questions so that respondents could expand their thoughts and share details on specific issues. Although less than 20 individuals participated in the survey, it provided an additional mechanism to gather information from industry, and the inputs from the survey are included in the analysis of this report. The survey questions can be found in Appendix A. BCS also conducted several one-on-one interviews with individuals that provided valuable insight and expertise on issues and opportunities identified during the listening sessions.

Steering Committee

The Energy KIN Steering Committee, which met on September 12, 2013, consisted of 34 executive-level representatives from businesses, industry associations, and research institutions, which are listed in Appendix B. Prior to the meeting, the Steering Committee members were provided with a summary of the issues and opportunities that were identified during the eight listening sessions. Committee members built on the input from the listening sessions, discussed those issues and added their own, with the end goal of identifying and prioritizing the greatest opportunities for growth. The results of this meeting include the establishment of a set of strategic initiatives for further discussion and analysis by Tactical Teams. In addition the meeting provided unique insights and novel ideas from the Committee members, and critical direction and input to guide the formulation of a strategic economic development plan for the energy sector.

FIGURE 1 Colorado Energy Listening Tour Locations, July 22–August 26, 2013



Tactical Team

The six Energy KIN Tactical Teams (one for each of the Colorado Blueprint's Core Objectives) consisted of a broad collection of representatives from industry, academia, workforce development, government, economic development organizations, industry associations, and others. Members for each Tactical Team are listed in Appendix C. The Tactical Teams convened between September 23–24, 2013 in facilitated meetings to discuss and work the Steering Committee's prioritized initiatives into actionable steps that would enable greater growth in Colorado's Energy industry over the next 6–18 months. To create a practical plan, Tactical Team members were asked to assess the Committee's recommendations according to length of time necessary to implement each initiative; the resources required, both human and financial/non-financial; and the overall complexity of each item.

Moving Forward

The process used to develop the Energy KIN engaged industry representatives from across a wide range of energy sectors, stakeholders in local communities, and state agencies, which has allowed for the creation of a stronger diverse industry network. The recommendations contained within this report have been developed by BCS from industry stakeholder input during the process. The report identifies key stakeholders necessary to support the implementation of the recommendations, including individual organizations, industry trade associations, state agencies, and other parties. The successful implementation of the recommended strategies will require action from all sides of the Energy industry. The Energy KIN will be assessed by its ability to turn the recommended strategies and strategic actions outlined in this report into a living, actionable strategic plan, with continual implementation over the next 6–18 months. It will also be a framework for collaboration between industry, academia, and government and nonprofit organizations. The findings of the report, along with the significant industry and stakeholder input that was recorded and synthesized during the process, will be one of the resources the state will use to craft a state energy plan. This state energy plan will include policy and implementation priorities for Colorado's energy future.

COLORADO'S ENERGY ECONOMY

DEFINING THE ENERGY INDUSTRY – MARKET SECTORS

Colorado's Energy industry is diverse and well positioned, containing abundant natural resources, renewable energy potential, and basic and applied research capabilities focused on energy technologies; all of these contribute to the broad range of activities and opportunities for the state's Energy industry. Additionally, companies in Colorado are constantly seeking to advance innovation with new technologies for more efficient production and consumption of all types of energy. Table 2 provides a list of Energy industry sectors defined by the Energy KIN, where each represents its own unique aspects of the market.

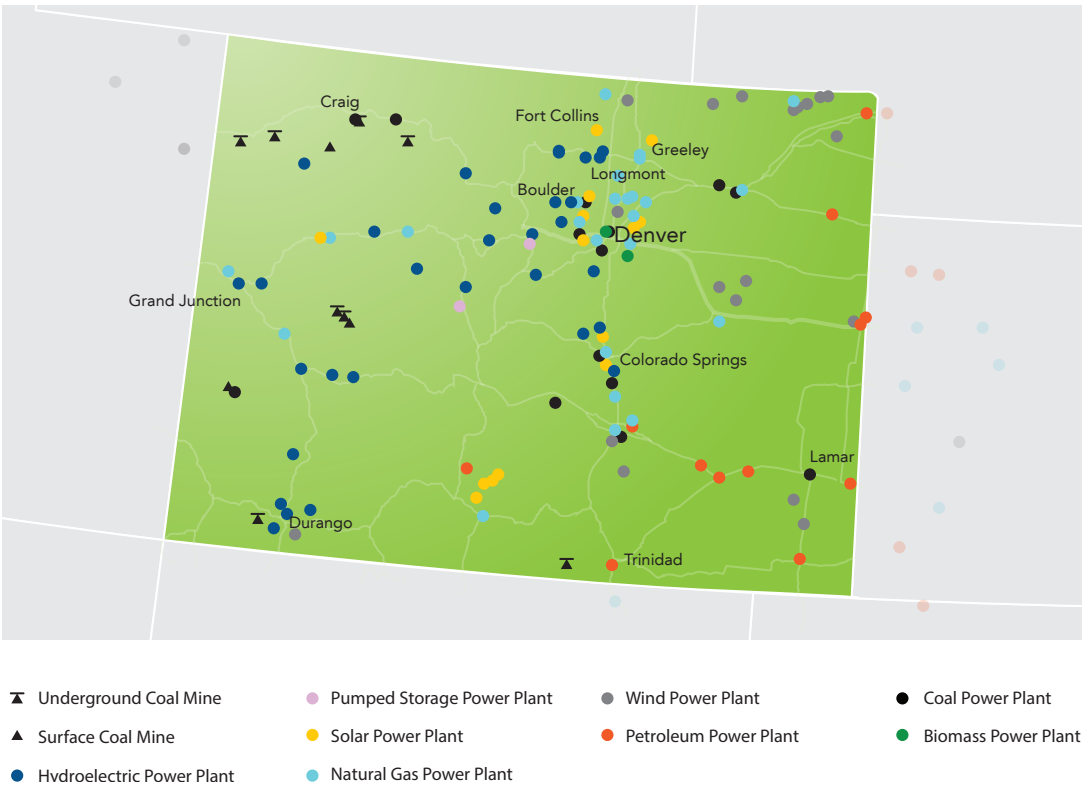
TABLE 2 Colorado's Energy Industry Sectors

Utility	Oil and Natural Gas	Coal Mining	Hydropower
Alternative Fuel Vehicles	Refining	Other Mining for Natural Resources	Geothermal
Biofuels	Pipeline	Solar	Energy Efficiency
Biomass for Power or Heat	Drilling/Siting Services	Wind	Advanced Energy Technology Research

The Energy industry has been a key part of Colorado's economy throughout its history. Coal mining first began in Colorado in 1859, outside of Boulder. Colorado's coal production in 2011 was 26.89 million short tons, compared to just 17.20 million short tons in 1985, a more than 56% increase.[12] In the late 1980s, natural gas production began to rise steadily. In 1986, Colorado produced 176 billion cubic feet (Bcf) of natural gas; in 2011, the state produced more than 1.6 trillion cubic feet (Tcf), a nine-fold increase from 1986.[13] Figure 2 provides a geographical representation of the Energy industry's physical assets across the State of Colorado.

Renewable energy sources, such as wind and solar, have also achieved growth in the state in recent years - driven in large part by incentives, policies, and legislation from both the state and federal government. Current wind capacity in Colorado is 2,301 megawatts (MW), up from 1,299 in 2010.[14] Solar energy and other renewable energy sources have carved out niches in the state's Energy industry as well, with Colorado's solar electric capacity growing by 31% to 298 MW in 2012 alone.[15] Growth in these industry segments has been driven by market demands for new energy resources, advances in technologies to harness these sources, and innovative end-use applications for these energy sources.

FIGURE 2 Colorado Energy Profile



Source: U.S. Department of Energy, available at http://www.eia.gov/state/?sid=CO.

Energy production resources are just one aspect of the Energy industry in the state. Other important aspect of the Colorado Energy industry include electricity generation facilities and transmission, building efficiency, alternative fuel vehicles, clean technology manufacturing, and research have proven to be significant sectors in the Energy industry. This is evidenced by the growth and activities in these sectors, including an increase in alternative fuel vehicle (AFV) fleets and the work on major smart grid pilot projects, such as the Fort Collins Zero Energy District (Fort ZED) in Fort Collins.

ECONOMIC OUTPUT

The Energy industry in Colorado is a significant source of economic activity. In 2012, the Energy industry in Colorado produced more than $24 billion in exports of goods and services, bringing new money into the state's economy from other states and foreign countries.[16] This is larger than the state's exports of $17 billion from the Food and Agricultural industry and $7.7 billion from the Aerospace industry.[17] Overall, the energy and natural resources industry in Colorado produced more than $41 billion in revenue in 2012.[18] The Colorado energy industry's largest revenue producers are listed in Table 3, including their contribution to employment.[19]

TABLE 3 Colorado's Top Energy Sectors by Economic Output (2012)

SECTOR	REVENUE	EXPORTS	JOBS
Oil and Natural Gas Extraction	$12.7 billion	$11.7 billion	36,085
Petroleum Refineries	$5.0 billion	$1.2 billion	545
Support Activities for Oil and Gas	$3.9 billion	$2.4 billion	13,889
Electric Power Distribution	$3.1 billion	$1 billion	5,219
Plumbing, HVAC Contractors	$2.4 billion	$304 million	20,316
Natural Gas Distribution	$1.9 billion	$535 million	1,116
Drilling Oil and Gas Wells	$1.4 billion	$691 million	2,732
Bituminous Coal Underground Mining	$1.1 billion	$844 million	2,058
Semiconductor and Related Device Manufacturing	$800 million	$455 million	3,237
Construction and Mining Machinery Rental and Leasing	$676 million	$265 million	2,198

EMPLOYMENT TRENDS

Colorado's Energy industry has grown significantly in the past decade. Currently, there are more than 122,400 people employed in the energy industry in the state, as described in Table 2, up 56.2% since 2003—considerably higher than the national increase of 26.2% over the same time period.[20] More than 35,000 of these new jobs from 2003 to 2013 were within the oil and gas extraction sector and related support activities, an industry that currently employs more than 51,000 people in the state.[21] This sector has seen significant growth in Colorado, as new oil and gas reserves have been discovered, and innovative technologies and processes have been developed to extract these resources (e.g., directional and horizontal drilling, 3-D and 4-D seismic imaging technology, and multilateral wells). In addition to the oil and gas sector, the coal mining and metal ore mining industries, including support activities, directly employ roughly 5,000 people across the state. In 2003, the coal and metal ore mining industries employed less than 3,000 people; this represents industry growth of more than 61% in the past 10 years.[22]

Energy jobs in Colorado pay on average $80,891 per year. This is slightly lower than the national average of $86,535.[23] Although Colorado's energy jobs are slightly lower than the national average, these jobs pay considerably more than Colorado's median household income of $57,685.[24] Geographic distribution of jobs within the state is aligned with population centers, as well as resource areas. The majority of Energy industry jobs are located within the Front Range counties of Denver, Arapahoe, Adams, and Weld. Additionally, Mesa, Garfield, and La Plata counties on Colorado's Western Slope contain a large portion of Energy industry jobs that have seen high growth in the oil and gas sector from 2003 to 2013.

INDUSTRY TRENDS

Over the past decade, advances in energy production technologies have impacted the U.S. energy industry with substantial growth in production from multiple resources. Colorado companies and research institutions have been leaders in developing these advanced production technologies supporting electricity, heating and transportation energy uses and making the state a global leader in the development of wind, solar, biomass and smart grid technologies, among others. Energy resource production, particularly the production of natural gas and oil, has increased considerably around the country, including in Colorado, due to new extraction technologies and processes generally referred to as hydraulic fracturing ("fracking") and horizontal drilling. Installed wind energy capacity continues to make up a larger share of the nation's and Colorado's electric production; although, the wind industry has faced sharp drops in development in some recent years due to the instability of the federal production tax credit incentive. Solar photovoltaic (PV) panels and installations are becoming more cost effective due in part to manufacturing overseas, reaching cost parity at the utility scale in many locations across the nation. Additionally, alternative fuel vehicles (AFVs), such as electric vehicles (EVs) and compressed natural gas (CNG) vehicles, have become more widely available based on federal and state initiatives, and the market now looks to expand the charging and refueling infrastructure to increase the use of these vehicles.

Traditional Energy Production

Fossil fuel energy production is a large sector within the state's Energy industry. Colorado is home to sizeable reserves, including an estimated 24,821 Bcf (24.82 Tcf) of natural gas, 225 million short tons of coal, and 423 million barrels of oil.[25] In 2011, Colorado ranked fifth in the nation for natural gas production, ninth for crude oil production, and eleventh for coal production.[26] Natural gas production has increased 45% since 2005 to 1.60 Tcf in 2011.[27] Oil production in the state increased from 39 million barrels in 2011 to 49 million barrels in 2012.[28] Colorado coal production did experience some growth from 2011 to 2012, but declined in the years leading up to 2011; it has been declining in 2013 as well.[29] This reflects the trend in declining coal consumption in the United States as utilities switch to or select lower priced and cleaner-burning natural gas for power generation, and also in response to the Environmental Protection Agency's (EPA's) development of stricter clean-air regulations—addressing greenhouse gas emissions—which has led to the closing of aging coal-fired power plants. Table 4 highlights Colorado's 2011 energy production and national rank.

TABLE 4 Colorado Fossil Fuel Production 2011

SOURCE	PRODUCTION	UNITS	U.S. RANK (2011)
Total Energy	2.747	Quads	7th
Natural Gas	1.64 (1.71 in 2012)	Trillion Cubic Feet	5th
Oil	39.1 (49 in 2012)	Million Barrels	9th
Coal	26.9 (28.8 in 2012)	Million Short Tons	11th
Ethanol*	125	Million Gallons	18th

Source: U.S. Energy Information Administration, State Energy Database System, Colorado State Energy Profile and Energy Estimates.
*Renewable Fuels Association and Nebraska Energy Office.

Colorado contains several fossil fuel-rich basins, including the Sand Walsh, Piceance, Paradox, and San Juan basins in the West, and the Denver and Raton basins in the East. Ten of the nation's 100 largest natural gas fields and three of its 100 largest oil fields are found in Colorado. Substantial deposits of bituminous, sub-bituminous, and lignite coal are also found in the state.

Coal

Coal mining in Colorado produced approximately 29 million short tons in 2012, ranking Colorado ninth among coal-producing states and higher than the ranking of eleventh in 2011.[30] Today, Colorado's demonstrated coal reserve base is 16 billion tons, which places the state at eighth highest in the nation. At the current utilization rate, this is enough coal to produce electricity for the entire country for the next 20 years. Economically recoverable coal reserves (under existing economic and operating conditions) are much smaller, estimated at 225 million tons, which represents 1.2% of U.S. reserves.[31] Direct employment at the state's coal mines, including transportation, is 6,200.[32]

There are currently three surface mines and eight underground mines in Colorado, near Trinidad, Steamboat Springs, Craig, Rangely, Paonia, Nucla, and Durango. Colorado's coal is mostly bituminous and sub-bituminous, and is characterized as a high heat content, low sulfur, low-to-medium ash, and low mercury coal, which makes it cleaner-burning, as compared with coal produced in the eastern United States and many international sources as well. Coal is used to generate more than 60% of Colorado's electricity and currently provides the base-load fuel source for most of today's electrical needs. A large portion of Colorado's coal production is shipped in and out of the state by rail. In 2011, Colorado used 43% of its coal output and transported the remainder to markets throughout the United States and other countries.[33]

Crude Oil

Colorado's crude oil proved reserves are estimated at 423 million barrels, which represents less than 2% of U.S. reserves of about 26.5 billion barrels.[34] Proved reserves are defined as the "estimated volumes of hydrocarbon resources that analysis of geologic and engineering data demonstrates with reasonable certainty are recoverable under existing economic and operating conditions."[35] Colorado's annual oil production accounts for about 1% of the U.S. total, and most of this production comes from the Denver and Piceance basins. Crude oil output serves Colorado's two refineries in Commerce City north of Denver. In terms of the refining capacity of the 143 facilities in the United States, Colorado ranks twenty-fifth out of the 31 states with refineries.[36] Several petroleum product pipelines from Wyoming, Texas, and Oklahoma help supply the Colorado market. Colorado also has enormous deposits of oil shale, which can be converted into crude oil. Development of these resources remains uneconomical as well as due to the environmental concerns associated with extraction, processing and waste disposal of spent shale.

Natural Gas

Colorado is the fifth largest natural gas producer in the United States, has the third largest gas reserves, and has the largest U.S. reserves of coalbed methane—approximately 8 Tcf.[37] Conventional and unconventional output from several Colorado basins typically accounts for about 6% of U.S. natural gas production. In 2011, Colorado produced 1.6 Tcf of natural gas, whereas the U.S. production was 22.5 Tcf.[38] Coalbed methane—unconventional natural gas produced from coal seams—accounts for more than 40% of Colorado's natural gas production, and almost 30% of all coalbed methane produced in the United States is active in the San Juan and Raton Basins, and further development is possible in northwest Colorado's Piceance Basin, which holds the second largest proved reserves in the United States.[39] Colorado's natural gas production has been growing, and construction of the 1,700-mile Rockies Express Pipeline (completed in 2009) is helping transport the rapidly increasing natural gas output from the Rocky Mountain supply region to the Midwest.

> *Colorado consumes only about two-fifths of its natural gas production, and the remaining 59% is transported to markets in the West and Midwest, generating economic benefits to Colorado.*[40]

In 2012, natural gas accounted for 51% of total sales-based value of production in the oil and gas sector, followed by oil at about 46%.[41] While the oil and natural gas industry has substantial operations on state and federal lands, more than 69% occurs on private lands.[42]

Minerals

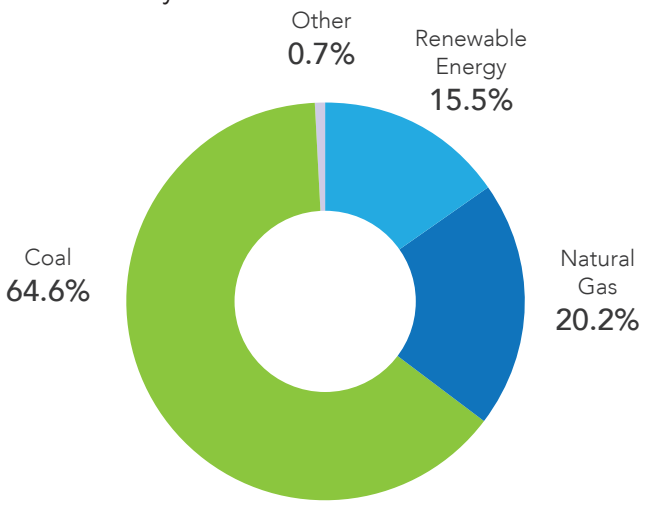
Colorado is a national leader in the mining of minerals that are critical inputs to the energy industry. Colorado has proven reserves and existing mining operations for key inputs to the energy industry, such as molybdenum, gold, silver, and uranium. Molybdenum production in Colorado is critical for automobile manufacturing and is an agent for removing sulfur from crude oil. The Henderson Mine in Clear Creek County is the nation's largest primary molybdenum mine with about 35 million pounds produced annually.[43] Colorado gold and silver resources are used in the development of a wide range of

electronic equipment and scientific instruments. In 2011, Colorado ranked fourth in the nation for gold production with an estimated 265,000 ounces produced for a net value of $318 million.[44] Silver is currently produced in Colorado as a byproduct of gold mining. In recent years, more than 90,000 ounces of silver have been produced worth more than $1 million.[45] Although Colorado currently has no active uranium production, approximately $16 million worth of uranium was produced in the state in 2008.[46]

Electricity Generation

Electricity in Colorado is generated from a variety of fuel sources, including coal, natural gas, hydroelectric, wind, solar, and biomass. In 2012, Colorado generated 53.6 million megawatt-hours of electricity.[47] As shown in Figure 3, coal accounted for almost 65% of the total electricity generation in 2012.[48] As a comparison, coal-based electricity generation was about 82% of the fuel mix in 1999.[49]

FIGURE 3 Colorado 2012 Electricity Generation by Source



Source: U.S. Department of Energy, Energy Information Administration

Renewable Energy

Wind, solar, biomass, geothermal, and other renewable energy sources have been on the rise in Colorado for the past decade with a substantial increase beginning after the passage of Amendment 37 in 2004. The state's Renewable Portfolio Standard requires that by 2020 30% of the state's electricity come from renewable energy for investor-owned utilities (IOUs), as well as 20% for electric cooperatives serving 100,000 or more meters (including Tri-State Generation & Transmission Association, Inc. that provides wholesale power to 18 of Colorado's 22 electric cooperatives) and 10% for electric cooperative serving less than 100,000 customers and municipal utilities serving more than 40,000 customers.[50]

Wind

Wind energy is the largest source of renewable power in the state, providing a capacity of 2,301 MW, or 11.3% of Colorado's electricity.[51] Colorado ranks thirteenth nationally in wind resource potential at an 80 meter hub height and was ranked tenth nationally in 2012 for installed wind capacity.[52, 53] On April 15, 2012, Xcel Energy set a U.S. record for generating nearly 57% of its energy for Colorado customers from wind power during the early morning hours.[54] Many wind developers have established a presence in Colorado, including Horizon Wind Energy, Iberdrola Renewables, and RES Americas. These developers have national and global project portfolios that compete for capital investment; they allocate resources to the markets with the fewest barriers and the lowest costs of doing business.

As stated in the recent Colorado Cleantech Action Plan, "Colorado's wind sector includes activity throughout the value chain, including research and development (R&D), manufacturing, and project development. These components of the value chain are strong, in large part due to the foundations established earlier—a strong innovation base, access to markets, and a base of wind companies with operations in Colorado. The innovation and project development in the wind sector have driven growth in manufacturing; the manufacture of wind turbines and components now employs more workers in Colorado than either the research of wind technologies or the development of wind projects."[55] For example, the world's largest wind turbine manufacturer, Vestas, invested $1 billion in Colorado, which raised the state's profile in terms of clean technology manufacturing.

Solar

Solar energy in the state is also on the rise with 298 MW of current capacity, ranking sixth in the nation.[56] In 2012 alone, Colorado installed an additional 70 MW of capacity, ranking the state ninth nationally in terms of new installed capacity.[57] With more than 300 days of sunshine a year, Colorado ranks fifth nationally in solar resource potential. In addition to solar electricity, solar thermal technologies for heating have been installed throughout the state and provide significant potential for future development. A recent report from the Solar Thermal Alliance of Colorado stated, "According to researchers at the National Renewable Energy Laboratory (NREL) and the Florida Solar Energy Center (FSEC), solar thermal technologies perform better in Colorado than in any other state in the U.S."[58] The report estimates that installed solar thermal capacity in Colorado for 2010 was 150 MWth and currently growing at 5 MWth annually.[59]

In recent years, the solar industry in Colorado has made significant progress across the value chain, including R&D and manufacturing. Although several promising solar manufacturing endeavors and installers have gone out of business in Colorado in recent years, there are currently about 340 solar companies in Colorado, employing 3,600 workers—including 33 manufacturers, 14 manufacturing facilities, and 185 contractor/installers.[60] In 2012, approximately $187 million was invested in Colorado to install solar panels on homes and businesses.[61] To support R&D, the state is home to major solar research and testing facilities, including both privately and publicly funded facilities, such as NREL and SolarTAC.

Bio-Derived Products

Colorado's bio-derived products sector is active in the state with substantial public-private partnerships pursuing the development of biomass feedstock to end use capabilities. As stated in the Colorado Cleantech Action Plan, "Colorado's startups and research institutions conduct extensive research to address all elements of the bio-derived value chain, from feedstock production to end use. NREL's world-class biomass facilities enable private-sector companies to affordably explore multiple biofuels pathways, creating an attractive draw for the bio-derived sector to Colorado. In addition, NREL is the co-leader of DOE's National Advanced Biofuels Consortium, a $34 million public-private collaboration to develop advanced drop-in biofuels that can supplement petroleum-derived fuels within the existing transportation infrastructure. The strength of Colorado's biotechnology and brewing industries provides valuable expertise that can be leveraged in developing the biochemical pathways that produce bio-derived fuels and specialty chemicals. The state has been ranked among the top five for life science R&D, a sector with valuable expertise for microorganism strain development and other key skills for the bio-derived products industry."[62]

Transportation

In Colorado, transportation is the second largest consumer of energy behind the industrial sector. In 2011, 417 trillion British thermal units (Btu) were consumed for transportation purposes in the state.[63] Within the transportation sector of the Energy industry, there are multiple segments defined by fuel type. These include gasoline, diesel, biodiesel, electricity, ethanol, hydrogen, natural gas, and propane.

The use of AFV has begun to increase in Colorado. A 2012 analysis of car registration data showed 2.2% of all new electric vehicles sold in the U.S. during the year were registered in Colorado—ranking Colorado 14th in the nation.[64] AFV fleets and refueling stations are expanding in Colorado with support from Refuel Colorado Fleets—a pilot project that seeks to boost the use of alternative fuel vehicles in public and private sectors. The CEO, which relied partially on a grant from the U.S. Department of Energy (DOE), launched the project in nine counties to help fleet owners work together with auto dealers, fuel providers, business leaders, and local governments to pursue or expand the use of alternative fuels.[65] Counties selected for the year-long pilot are Routt, Larimer, Boulder, Jefferson, Adams, Garfield, Mesa, Montezuma and La Plata.[66] In recent years, businesses in Colorado have worked with the state and other partners to install 257 public AFV fueling stations, including 105 EV charging stations; 17 CNG fueling stations; 73 E85 fueling stations; and 12 biodiesel (b20 and above) fueling stations.[67] However, it became evident during the listening sessions that expanding the infrastructure for AFV fueling and charging stations and expanded public education initiatives are needed to grow AFV use to all regions of the state.

More than 130 organizations in Colorado participate in the Clean Cities program, which is an initiative carried out by the Vehicle Technologies Office within DOE's Office of Energy Efficiency and Renewable Energy. Participating organizations are part of a network of about 100 nationwide Clean Cities coalitions that bring together private companies, fuel suppliers, local governments, vehicle manufacturers, national laboratories, state and federal agencies, and other organizations to implement alternative transportation solutions in their communities; this includes developing public and private partnerships to promote alternative fuels, advanced vehicles, fuel blends, fuel economy, hybrid vehicles, and idle reduction. The Clean Cities program strives to advance the nation's economic, environmental, and energy security by supporting local decisions to adopt practices that contribute to the reduction of petroleum consumption. In 2012, the Metro Denver Clean Cities coalition reported that its programs resulted in more than 4.8 million gallons of gasoline equivalent reduced, with 80% of that reduction coming from the use of AFV and hybrid vehicles.[68] This was a significant increase from the coalition's reported savings of 2.3 million gallons in 2009.[69]

Energy Efficiency

Energy efficiency is a growing market sector in Colorado, with homes and businesses taking advantage of upgrades in efficiency to save money on energy and reduce air emissions associated with energy use. The rise in the energy efficiency industry in Colorado is reflected in the recent formation of the Energy Efficiency Business Coalition (EEBC) in Colorado in 2007. The EEBC was formed "to be the primary source of information, influence and interconnection for the numerous businesses that are involved in the manufacturing, distribution, installation, sales and marketing of energy efficiency technologies and services" and also seeks "to increase the business potential of the energy efficiency industry, at the local level."[70] The more than 100 members of the EEBC focus on end-user energy efficiency (or demand side management) opportunities that result in reductions in energy consumption through building improvements.

Colorado ranked 14th in the 2012 American Council for Energy-Efficient Economy's (ACEEE) State Energy Efficiency Scorecard for its energy efficiency program and policy efforts.[71] In 2007, Colorado enacted legislation requiring the Public Utilities Commission to establish energy savings goals for gas and electric utilities and to give investor-owned utilities a financial incentive for implementing cost-effective efficiency programs.[72] Both Xcel Energy and Black Hills Energy have demand-side management programs that are working toward meeting the PUC's energy savings goals. The EEBC reported in 2012 that Xcel Energy and Black Hills Energy since 2009 have spent $167.7 million in demand side management programs resulting in energy savings of 815 GWh per year and a peak reduction of 209.9 MW.[73]

In 2011, total energy consumption was 1,481 trillion Btu in Colorado, with more than $19 billion in energy expenditures.[74] This creates considerable potential for the energy efficiency market in the state. The energy efficiency sector is generally segmented by industrial, commercial, and residential energy users, with technologies and energy efficiency best practices tailored for each. Colorado's Industrial Energy Challenge has been working with more than 30 companies in the industrial sector to establish five year goals and plans for reducing their energy consumption and energy.[75] The state's commercial sector is increasingly seeking Leadership in Energy and Environmental Design (LEED) certification. Colorado is ranked third (behind Washington, D.C., and Virginia) on the U.S. Green Building Council's list of the top 10 states for LEED certifications in 2012.[76]

Research and Development

Colorado is uniquely positioned as a leader in energy technology research. The state is home to world-class research facilities, such as NREL—the only federal laboratory in the United States solely dedicated to the research, development, commercialization, and deployment of renewable energy and energy efficiency technologies; SolarTAC; which is a venue for researching, demonstrating, testing, and validating a broad range of solar technologies at the early commercial or near-commercial stage of development; and the Colorado Energy Research Collaboratory, a research partnership consisting of the Colorado School of Mines, the University of Colorado, Colorado State University, and NREL. The Collaboratory provides a mechanism for research collaboration and information sharing between researchers and provides training for careers in the Energy industry. In addition to NREL, Colorado has more than 20 federally funded scientific research centers that include the National Oceanic and Atmospheric Administration's Central Region Headquarters, National Center for Atmospheric Research, and National Institute of Standards and Technology. These federally supported labs are involved in a number of energy related research initiatives and offer the Energy industry access to opportunities for basic research and technology deployment.

Pathway to Economic Development of the Energy Sector

Energy industry stakeholders who participated in the listening sessions provided their insights, observations, and numerous opportunities for advancing the Energy industry in Colorado. They also voiced concerns and challenges that need to be overcome in order to effectively pursue the opportunities identified. The opportunities were based and built on the resources and strengths of Colorado, while the challenges were identified and framed around current weaknesses and barriers to advancement of the energy sector. The following sections summarize the strengths and opportunities, which will serve as the foundation for growth and innovation in Colorado; challenges to overcoming the state's weaknesses and threats to economic development of the Energy industry; and recommended strategies and actions—identified by the Energy KIN Steering Committee and Tactical Teams—to pursue collaboratively with industry and government organizations, academia, and other entities and stakeholders. These recommendations are categorized under the six Core Objectives outlined in the Colorado Blueprint.

COLORADO'S FOUNDATION FOR GROWTH AND INNOVATION: STRENGTHS AND OPPORTUNITIES

BRINGING THE INDUSTRY TOGETHER—DEVELOPMENT OF AN ENERGY VISION AND MISSION THAT WILL ADVANCE THE ENERGY INDUSTRY

A prominent strength of Colorado's Energy industry is its diversity of energy resources and the broad range of companies and human capital that develop those resources in the state. Industry leaders throughout Colorado have voiced that it is critical for industry and government leaders to better leverage this strength into initiatives that brings Colorado's diverse set of Energy industry segments into collaborative efforts. These efforts will allow for integrated approaches to position Colorado as a leader in creating innovations for energy production, renewable energy integration, smart grid deployment, and energy efficiency. A stronger Colorado Energy industry vision built on the integration of diverse energy resources will drive a set of strategies that supports the development of technologies and systems that can be exported nationally and globally to key markets seeking energy solutions.

FOSSIL FUEL PRODUCTION OPPORTUNITIES

Electric Generation from Natural Gas Compression Stations and Wells

With Colorado's substantial oil and gas production involving pipelines and wells, there are opportunities to capture waste heat from natural gas compressor stations and to use natural gas that may otherwise be flared or vented from oil wells in the region. Highline Electric Association, a rural electric association in Northeast Colorado contracted for the sale of electricity generated from a 4 MW Ormat Recovered Energy Generation power plant that was constructed at an existing natural gas compression station north of Crook.[77] The compression station is part of the Trailblazer natural gas pipeline. The facility was commissioned in 2009 and converts waste heat from the exhaust of the natural gas-fueled compressor to generate electricity. In addition, the energy produced is used for compliance with the state's renewable energy standard. Ormat owns and operates the facility and sales the power to Highline under the terms of a power purchase agreement. In Colorado there may be several other natural gas-fueled compression stations that are suitable for similar projects.

Environmental concerns exist in Colorado from the flaring and venting of natural gas from oil extraction processes at wells. The Colorado based company BluBox has identified hundreds of wellhead opportunities in the Denver-Julesburg Basin area of Northeast Colorado and determined their proximity to three phase power transmission lines and corridors.[78] The natural gas from these wells can be used to generate electricity from generators at the well site and interconnect with

a utility's distribution system. BluBox has recently established agreements with two rural electric stations in the northern Front Range region: United Power and Poudre Valley Rural Electric Association. United Power has signed five-year agreements that will provide two percent of its power needs with BluBox generators and will allow the retail distribution utility to buy power at lower rates than their wholesale supplier.[79] Poudre Valley Rural Electric Association has recently signed on for a five-year agreement that will provide 3 MW capacity from the BluBox generators.[80] There may be thousands of wells in Colorado with the potential to apply these natural gas generators for distributed generation.[81] However, the deployment of these generators may be limited by service requirements with the wholesale power provider Tri-State Generation and Transmission that allow REAs to generate only up to five percent of energy use from other sources.

Oil Shale

Colorado oil shale deposits, concentrated in the Piceance Basin in the Western part of the state, hold an estimated 1 trillion barrels of oil—as much oil as the entire world's proven oil reserves. However, oil shale development remains commercially not viable and faces several major obstacles involving technological feasibility, economic viability, resource ownership, and environmental considerations. Most recently, in September 2013, Shell abandoned its efforts to turn Western Slope oil shale into oil, indicating markets have changed since the project started in 1982 and the company no longer wants to continue this research project. Chevron had also stopped its oil shale research in Rio Blanco County in 2012. Shell spent an estimated $30 million to create a test subterranean wall to hold in the shale oil when it was heated, but full-scale production would probably have required building a large power plant. The new oil plays in North Dakota, Texas and along Colorado's Front Range have been producing large quantities of oil, which currently makes any investment in oil shale research unattractive due to economics.[82]

RENEWABLE ENERGY OPPORTUNITIES

Wind and Solar

Colorado offers a broad range of exceptional renewable energy resources for both utility-scale development and distributed generation installed directly at a facility. In 2008, CEO published the Report of Colorado Senate Bill 07-091's Renewable Resource Generation Development Areas Task Force, titled *Connecting Colorado's Renewable Resources to the Markets*. For wind energy and solar energy resources in Colorado, the report identified generation development areas (GDAs) that had high-quality resources to allow for at least 1 gigawatt (GW) of competitive, utility-scale project development. The report found that 96 GW of wind generation capacity could be developed in eight GDAs located in the eastern half of Colorado.[83] When comparing this to the existing installed capacity of 2,301 MW for wind in the state, the opportunity for future wind energy development is significant.

For central solar power technologies (encompassing both conventional photovoltaic systems and concentrating solar thermal power technologies), the report identified two GDAs extending over the San Luis Valley and southeastern Colorado that would allow for 26 GW of installed capacity, utilizing only 2% of the land area within the GDAs for development.[84] Currently, Colorado has more than 290 MW of installed solar electric capacity; a large portion of that development is distributed PV systems installed on rooftops of homes and businesses. Colorado has great potential to develop concentrated solar projects that include PV and concentrated solar

thermal technologies with capabilities for dispatchable power at all hours of the day. The San Luis Valley in southern Colorado offers one of the highest-quality solar resource areas in the world, but current development opportunities for central solar development are limited by transmission constraints in the region.

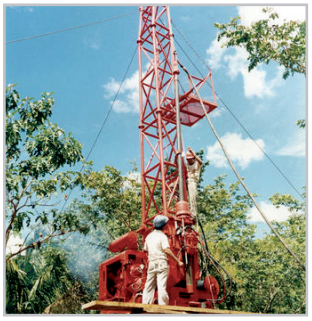
Additional Renewables

In addition to wind and solar generation, the Senate Bill 07-91 Report covered the opportunity for developing hydropower, geothermal, biomass, and biofuels resources in the state. These renewable energy resources do not allow for an assessment of any one particular area of the state to establish GDAs, but they provide opportunities throughout the state for energy production.

HYDROPOWER

In the case of hydropower, the Senate Bill 07-91 Report stated that there are 91 existing impoundments and other water diversion infrastructure features that could be developed to produce 782 MW of capacity.[85] The report also stated that "many of these sites can be developed with minimal environmental impact."[86] In addition the report found that among Colorado's 62 existing hydropower facilities with a total capacity of 1162 MW, there opportunities to improve their efficiency and production by as much as 25-30% in some cases.[87] A more recent report for the Colorado Department of Agriculture's Advancing Colorado's Renewable Energy (ACRE) program identified more than 250 irrigation entities in the state with potential water flows to evaluate for future development of low-head hydropower projects—with some projects having capacities as high as 500 kilowatts (kW) on utility distribution systems.[88] The ability to cost-effectively develop these hydropower opportunities in the future is dependent on their proximity to available transmission and distribution infrastructure and electric loads. Access to infrastructure challenges was highlighted in the ACRE report: "Electrical interconnection also presents both challenges and opportunities. Ideal hydropower site like ideal wind or photovoltaic sites are those with ready access to electrical service. Pulling new electrical service over any distance is often costprohibitive for small renewable systems. Conversations with one utility indicate that systems as large as 500 kW can be connected at the distribution level in modern distribution systems. However, on remote, rural feeders, sizes may be more restricted. Many utilities limit distributed generation to 10-15% of the peak load on a feeder line."[89]

The estimated costs of developing hydroelectric power plants in Colorado at existing impoundments or irrigation systems with reasonable access to distribution infrastructure ranges from under $2 per watt for projects close to 10 MW in capacity (hydropower projects with capacity up to 10 MW may qualify as renewable energy resources under Colorado's renewable energy standard) to $4-6 per watt for small 10 kW projects.[90]



GEOTHERMAL

Currently, Colorado does not have any large geothermal electric generation projects; however, a report produced by the Geopowering the West Colorado State Working Group in 2007 stated that "Colorado ranks fourth among western states in the number of potential sites for geothermal power generation, according to a 2006 Western Governors Association report."[91] Geothermal energy resources across the state are significant, with the Western Governors' Geothermal Task Force identifying Colorado as having the potential for 20 MW of power generation.[92] Although geothermal projects for electricity are not currently being developed in Colorado, geothermal heat pump technologies could potentially be installed in all regions of the state to provide constant temperatures of 50–60 degrees Fahrenheit through the seasons to support both heating and cooling of facilities. For example, United Power Rural Electric Association has installed a geothermal heat pump system at its headquarters in Brighton to demonstrate its application for commercial facilities. In 2012, the Swedish home furnishing company.

IKEA announced, its store in Centennial, CO, will be installing a geothermal heating and cooling system. This system is one of the larger geothermal heat pump installations in the United States. IKEA, along with NREL, has agreed to make the project information available to the public in an attempt to set a precedent for geothermal heat pump installations.[93]

California has implemented a geothermal funding program that supports geothermal electricity, direct use, and geothermal heat pump technologies.[94] This program has provided funding to more than 160 geothermal projects since 1980. The funding for the program has come from revenues paid to the U.S. government by geothermal developers for leases on federal land in California. Colorado has the potential to provide funding using the same approach as California; however, there are currently no geothermal leases on Colorado's federal lands to provide revenue for a program.[95]

BIOMASS

The increased opportunity in recent years for biomass energy development comes as a result of beetle infestations in Colorado's mountain forests. Since 1996, approximately 4 million acres of forests in Colorado and southern Wyoming have been impacted by the Rocky Mountain pine beetle alone.[96] Nearly 1 million additional acres in southern Colorado have been infested by the spruce beetle.[97] In many cases, these impacted forests are at high risk for forest fires. Removing the biomass from forests impacted by beetles for energy projects could reduce the threat of forest fires for mountain communities and provide a local feedstock for electricity generation and heating projects. The recent Colorado Forest Biomass Use Work Group, established through SB11-267, completed a report in 2012 that described several key challenges to overcome in using forest biomass which included among others, accessing federally managed forest resources, road weight limits for transporting biomass in Colorado, restricted investment opportunities due to federal forest stewardship agreements that are limited to 10 years, and a lack of incentives for forest biomass-to-heat projects.[98]

Current biomass-to-power projects under development in the state include a 10 MW project in Gypsum that will provide power to Holy Cross Energy under a power purchase agreement.[99] The Senate Bill 07-91 Report estimated that most biomass electric generation projects will be less than 30 MW in capacity. Additional opportunities exist in the state's forest to remove biomass from overgrown forests to maintain their future health. A number of other biomass-to-energy opportunities exist throughout the state, including anaerobic digestion technologies to create methane gas from agricultural animal waste and municipal solid waste projects for both heat and power uses.

Colorado also produces more than 120 million gallons of ethanol annually at four facilities that are supplied in part from the state's annual corn production of about 140 million bushels annually.[100, 101] In addition to corn feedstock for ethanol, Colorado has the potential to produce cellulosic ethanol from agricultural residues (e.g., wheat straw) and woody biomass resources, including forests impacted by pine beetles.

Distributed Renewable Energy Generation

Colorado is well-positioned for the deployment of distributed renewable energy technologies that can take advantage of the statewide interconnection and net metering standards, which apply to all three types of retail electric utilities in the state: IOUs, rural electric associations (REAs), and municipal utilities. The deployment of net-metered distributed energy technologies under the standards allow for a broad range of renewable energy technologies that include solar PV, small wind, and small and micro hydropower. In the case of IOUs, these can be sized to match

120% of a customer's load (standards for REAs and municipal electric utilities allow for projects up to 10 kW for residential and 25 kW for commercial properties). Other opportunities for distributed generation are being expanded through recent state legislation (HB 10-1342) that allows for the creation of community solar gardens up to 2 MW, which involve multiple customers owning or subscribing to a solar project in proximity to their home or business.

INNOVATIVE TECHNOLOGY DEVELOPMENT OPPORTUNITIES

Colorado's diversity of energy resources, (combined with its human talent, access to markets, and industry base) places the state in a competitive position relative to other states. A growing segment of the state's economy includes renewable energy generation technologies and technologies that allow for cleaner and more efficient use of traditional energy and natural resources. In its 2012 state index of the U.S. clean technology sector, Clean Edge ranks Colorado fifth among all states in terms of measures for technology, policy and capital.[102] Leading clean technology companies located in Colorado include global companies, such as Vestas, Cool Planet Energy Systems, Abengoa, RES Americas, and SMA Solar. Other energy technology companies that started in Colorado include Spirae, Solix Biosystems, and Advanced Energy Industries.

Colorado has unique opportunities in several sectors of the renewable and advanced technology industry, including wind, solar, smart grid, AFVs, and biofuels and bio-derived products.

Smart Grid

The development of smart grid technologies will allow for more efficient production of energy, enable a more advanced distribution system, with power flowing among central power stations, large renewable energy centers, small distributed energy generation centers, and smart homes and buildings. Three smart grid pilot projects—SmartGridCity, FortZED, and Black Hills Power Smart Grid Project—and other smart grid technology installations by several utilities have placed Colorado communities among the top 10 for adopting smart grid technology.[103] The SmartGridCity project, launched in 2008 by Xcel Energy in the city of Boulder, involved the installation of a digital, high-speed broadband communication system; upgraded substations, feeders and transformers; smart meters; and Web-based tools.[104] The project provided valuable insight for the smart grid sector into both the opportunities and challenges for future projects. A key challenge for future smart grid projects to address involves the difficulty in identifying and defining consumer stakeholders and understanding their needs. Overcoming this challenge involves effectively communicating the anticipated benefits of a project to stakeholders.[105]

FortZED has been initiated through a three-way collaboration between Fort Collins Utilities, the Colorado Clean Energy Cluster (previously named the Northern Colorado Clean Energy Cluster), and UniverCity Connections. In 2011 FortZED launched Phase I of the Renewable and Distributed Systems Integration (RDSI) project that included nine demonstration projects and resulted in a 20-30 percent peak electric demand load reduction in the project area.[106] The second phase of RDSI was scheduled to be completed in September 2013 will provide information on the operation of a micro- grid and use of advance cyber security safeguards to protect the micro-grid control communications network.[107]

The Black Hills project was co-funded by DOE with $6.1 million under the *American Recovery and Reinvestment*

Act of 2009. The project completed the system-wide deployment of customer smart meters (42,000 installed during the project), along with installations of communication infrastructure, and a meter data management system. The project is seeking to provide the utility and its customers such benefits as reduced meter reading costs, improved electric service reliability, reduced ancillary service cost, reduced truck fleet fuel usage, and reduced greenhouse gas and criteria pollutant emissions, In addition to the projects already described, NREL's newly dedicated (September 2013) Energy Systems Integration Facility will enable testing of a variety of smart grid technologies. The Colorado Cleantech Action Plan outlined the advanced energy technologies involved in developing the smart grid: "The smart grid sector is comprised of a variety of different technology types that seek to enhance the utilities' ability to operate the grid and the end users' ability to make informed decisions about their energy use. The key types of technology included in the smart grid sector can be characterized as follows:

- *Transmission and Distribution Automation*: Deploying technologies such as sensors and actuators on transmission and distribution infrastructure to achieve results, including integrating distributed and centralized renewables, enabling self-healing functionality of the grid, and improving the efficiency of the electricity delivery system.
- *Advanced Metering Infrastructure (AMI)*: Deploying smart meters, two-way communications infrastructure, and data management systems to provide greater information to utilities and their customers around energy usage and pricing, and to provide utilities with better outage detection and power restoration capabilities.
- *Home Area Network (HAN)*: Deploying smart appliances, in-home energy displays, and controls to enable utility customers to have greater and more transparent control over their energy usage."[108]

Colorado companies like Spirae, based in Fort Collins, are pioneering these smart grid advancements to the nation's grid infrastructure and helping to make Colorado a global leader in optimized grid technologies.

COLORADO NON-COAL MINING INPUTS FOR THE NATIONAL AND GLOBAL ENERGY MARKET

Uranium production in the region is of keen interest to the nation's nuclear energy sector. The United States is the world's largest generator of nuclear energy, with nuclear power making up about 20% of the total U.S. power generation mix. Currently, more than 90% of the uranium used for U.S. nuclear facilities is imported from outside the country.[109] U.S. nuclear energy demand in recent years has been for more than 19,000 tons of uranium, while U.S. total production has been less than 2,000 tons.[110] The future supply of imported uranium may not be reliable due to the future development of additional nuclear facilities in other countries. The latest uranium reserves data from DOE estimates that the combined region of Arizona, Colorado, and Utah has 31,500 tons of uranium (U308) at $50 per pound and 99,000 tons of uranium at $100 per pound.[111] The three-state region ranks third in the United States behind the nearby states of Wyoming and New Mexico. The market price for uranium has been volatile over the last decade, with prices ranging from $10 to $140 per pound. Currently, Colorado has no active uranium mining, but has an estimated 35 active uranium mining permits.[112] With greater worldwide demand for uranium and the subsequent shortage of imported supplies, there may be an opportunity to develop the state's uranium resources.

THE STATE'S EDUCATION AND WORKFORCE DEVELOPMENT SYSTEM

The Energy industry, like all of the state's advanced industries, needs a workforce proficient in science, technology, engineering, and math (STEM) skills. STEM skills are important for jobs across Colorado's Energy industry sectors—wind, solar, natural gas, coal, biofuels, and more—and all parts of the value chain from research and development to energy production and manufacturing. For example, a researcher working in the biofuels sector would need to have a solid background in chemistry and biology to understand how to work with certain feedstocks, as well as math and engineering skills to develop models, while a technician working in the wind sector or in a wind blade manufacturing setting would need strong math and technical skills to ensure that the blades are manufactured to specified tolerances.

Colorado's Energy industry benefits from a strong base of highly educated, skilled workers. Colorado ranks fifth in the nation in terms of the share of its workforce engaged in engineering occupations.[113] The state's research universities—Colorado School of Mines, Colorado State University, University of Colorado, and University of Denver—have outstanding engineering programs that work to meet the Energy industry's training needs. In 2010, an estimated 9,288 students graduated with an engineering degree or certificate from Colorado academic institution.[114]

Colorado energy companies also attract highly skilled workers from foreign countries through the U.S. Citizenship and Immigration Services (USCIS) H1B visa program. U.S. businesses can use H1B visas to employ foreign workers in specialty occupations—including scientists, engineers, or computer programmers—that require theoretical or technical expertise in specialized fields. Businesses petition for H1B visas to fill vacant positions they can't otherwise fill.

Colorado's energy industry has an opportunity to increase the number of "homegrown," highly educated, skilled workers. By partnering closely with education institutions in Colorado, industry can encourage the education of a workforce that meets its needs. This would include industry participation in curriculum development, internships, apprenticeships, and other learning opportunities. In the listening sessions, participants commented that there is a need to design programs that move people into the workforce faster than a four-year degree through programs that are designed for the specific knowledge and skills necessary to be successful in the Energy industry. For example, non-degree or credit courses work well for increasing skills and knowledge of workers already on the job, and educational programs that provide stackable certificates leading to an Associate of Applied Science (AAS) degree—similar to the program created by the Colorado Community College System (CCCS) for the utility industry—would be very beneficial for workers interested in seeking employment in the energy sector.

Colorado has several opportunities to build on existing STEM efforts. Most recently, the Colorado Legacy Foundation, Colorado Education Leadership Council, the Gill Foundation, the Colorado Department of Higher Education and OEDIT have been developing the Colorado STEM Education Roadmap and Action Plan (STEM Action Plan) to improve STEM skills. The Colorado STEM Action Plan is intended to improve STEM education in Colorado through identifying a common vision, mission, and goals to align, connect, and evaluate the individual and collective impact of the numerous STEM efforts, policies, and programs across the state. The STEM Action Plan is scheduled to be presented to Governor Hickenlooper as early as January 2014.[115]

In addition to monitoring and supporting the Colorado STEM Action Plan, the Tactical Team recommended developing stronger energy career pathways through partnerships between industry and education, establishing curriculum that provides STEM skills in an energy context, and updating and widely distributing existing career interest brochures.

Another opportunity is for Colorado to monitor the success of ongoing efforts by other states that are attempting to address the same issues. Where possible and practical, Colorado could consider developing similar programs and approaches. For example, several states have created "Energy Academies" to produce a skilled workforce for the energy industry. The California Department of Education and Pacific Gas and Electric are partnering to pilot the New Energy Academy in five high schools.[116] Based on the California Department of Education's Partnership Academy model, the New Energy Academy is a three-year program for students in grades 10–12. The Academy's focus on energy creates a "school within a school," as students participate in relevant STEM curriculum and are exposed to unique learning experiences, such as visiting an operational wind farm.

On a smaller scale, Rock Springs, Wyoming, has launched an Energy Academy in one high school for students in grades 10–12.[117] At Rock Springs, students take all of the required core high school courses for college admission, as well as a full complement of STEM courses focused on the energy theme through the Academy. Rock Springs offers specialized courses related to energy, many of which are taught together with the local community college, so students get dual credit. Every student of the Energy Academy is required to participate in an internship to acquire an understanding of the workplace and develop long-term connections in the industry.

COLLABORATIVE REGULATORY ENVIRONMENT

Each stakeholder in the regulatory process—regulatory bodies, industry, public, end users—has a role to play and can contribute to more consensus-based regulatory decision making. It is critical that regulations are clear and based on sound science, risk-based and cost effective, and developed collaboratively. There are opportunities for industry and regulators to work together for a balanced and more informed regulatory decision making process. It was mentioned in the listening sessions that industry should be consulted in the process of developing regulations, as they want to be involved and engaged in the process before a regulatory decision is made. Regulators are also expected to periodically review and modify requirements to reflect new information and technological advancements made. For example, technology advances over the last decade for oil and natural gas recovery from unconventional and geologically complex resources, particularly shale gas, have increased drilling activities nationally and resulted in significantly higher natural gas production. This increase also has raised environmental concerns and compelled states to reevaluate existing regulations or enact new regulations.

In an effort to address industry concerns about overregulation and address environmental and health protection issues in a balanced manner, many states are reviewing and overhauling regulatory processes. In this context, Governor Hickenlooper—through an Executive Order (D 2012-002, 1/19/2012)—directed all state agencies to conduct periodic reviews of all of their rules to determine their necessity, appropriateness, and effectiveness.[118] This process can help ensure that existing rules identify and use the best, most innovative, and the least burdensome tools for achieving their goals. Eliminating redundant, inconsistent, or unnecessary regulation without sacrificing safety and environmental quality has been the goal of regulatory reform proponents. Energy companies will also benefit from engaging with the public and local community, as well as maintaining transparency on issues that are important to the public. Listening to stakeholder concerns and addressing their issues can eliminate production delays, litigations, and potential regulatory actions. Industry and government entities should also work together toward achieving a regulatory environment that is performance-based and incorporates best practices for operations and safety programs.

CHALLENGES TO OVERCOME: WEAKNESSES AND THREATS

A "WINNERS" AND "LOSERS" MINDSET: COMPETITION OVER COLLABORATION AMONG INDUSTRY SECTORS

Colorado's abundant and diverse energy resources present not only an opportunity for the state to leverage, but also pose a challenge in developing a collaborative environment that can unite the Energy industry to work together in growing the industry. With recent policies establishing renewable energy standards for electric utilities and incentives for AFVs, a greater diversity of energy resources and technologies are being used within the state. However, a concern among some industry leaders is that policy makers are picking "winners" and "losers," which is preventing collaboration among key industry sectors to advance a larger vision for the state. A larger vision, built on Colorado being a global leader of innovation through its integration of a broad set of resources, will need to overcome the challenges of industry stakeholders seeking to maintain or grow production for local state sectors.

VOLATILE REGULATORY ENVIRONMENT

Heightened public awareness and concerns over impacts of energy resources production, transportation, and utilization on the environment and public safety led to regulations at the federal, state, and local levels. These regulations have helped to significantly improve environmental protection and public safety and health; however, the regulatory environment has become more complex and uncertain, and compliance by affected industries more expensive. Regulations at the federal, state, and local levels can lead to duplicative and conflicting requirements. While the interaction of these many layers of regulation is generally effective, regulation among jurisdictions at times can be uneven, and in some cases require strengthening of resources available for staffing and capacity to keep up with changes in the industry and provide enforcement.

A common concern raised in all of the listening sessions was regulatory volatility and uncertainty, including its impact on economic development. Within the same federal agencies, the process can vary between offices in different regions and states. This can become a barrier to developing an understanding of the different processes within each state. During the listening sessions, there was a range of views on whether regulatory issues are best addressed through state or federal regulatory action. It was expressed that in some cases federal regulations could be deferred to the state level; for example, industry stakeholders have stated that many state agencies have been involved in regulating oil and gas development for much longer than the federal government and that state agencies have unique knowledge and expertise relative to the local geological, hydrological, environmental, and land-use setting. These state agencies are responsible for regulation and development of private and state natural gas and oil resources, as well as for implementing certain federal laws and regulations.

Some small local jurisdictions may lack the capacity in terms of staff and resources to both deal with complex regulations on natural gas production and provide education to the community. County commissioners are facing many questions and concerns from residents about energy development, but do not always have adequate staff and funding to address the issues. It is important for the state to consider educational initiatives and funding for local governments to build more capacity to handle energy development issues. The participating representatives from industry desired regulatory stability, consistency across local areas, and streamlined procedures. Those representatives indicated that greater policy and regulatory certainty is needed to keep business operating costs predictable and manageable. Further, regulatory duplication and volatility across federal, state, and local governments can slow down projects and become a barrier to timely economic development. Regulatory uncertainty, as well as excessive delays in obtaining permits for development activities, can lead to the abandonment of initiatives and projects by industry. For example, a planned project that may be economically feasible at the time of a permit application may no longer be financially attractive when the permit is obtained after a lengthy delay that extends well beyond the anticipated or prescribed time frame.

LACK OF REGULATORY CONSISTENCY BETWEEN LOCAL-LEVEL JURISDICTIONS

At the local government level, Colorado is composed of 64 counties and 271 incorporated municipalities. Each of these local-level entities has significant authority in making planning decisions on matters of statewide interest. These planning decisions can impact the siting and development of key energy infrastructure, such as oil and gas pipelines and electric transmission lines, which are often required to cross multiple local jurisdictions. At each local jurisdiction in the planning process, a single project may face a different set of planning requirements. This authority by local governments over areas of statewide interest is referred to as "1041 powers" in Colorado. The Colorado Department of Local Affairs provides the following background on 1041 powers on its website:

In 1974, the Colorado General Assembly enacted measures to further define the authority of state and local governments in making planning decisions for matters of statewide interest. These powers are commonly referred to as "1041 powers", based on the number of the bill of the proposed legislation (HB 74-1041). These 1041 powers allow local governments to identify, designate, and regulate areas and activities of state interest through a local permitting process. The general intention of these powers is to allow for local governments to maintain their control over particular development projects even where the development project has statewide impacts. The statute concerning areas and activities of state interest can be found in Section 24-65.1-101.[119]

The areas and activities of state interest that local governments can permit include those that may directly impact energy development, such as:

- Mineral resource areas;
- Areas containing—or having a significant impact upon—historical, natural, or archaeological resources of statewide importance;
- Areas around key facilities in which development may have a material effect upon the key facility or the surrounding community;
- Site selection and construction of major facilities of a public utility;
- The use of geothermal resources for the commercial production of electricity; and
- Site selection of rapid or mass transit terminals, stations, and fixed guideways.

In addition to 1041 powers, many of Colorado's municipalities and counties have adopted a legal status of home rule to allow for greater local government decision-making power and flexibility over applying state laws. In matters of local and municipal concern, home rule jurisdictions are not required to follow state statutes and may establish their own local measures. Additionally, home rule municipalities and counties can respond more quickly to local issues and emergencies by enacting their own ordinances or charter amendments that do not require action by the state legislature. Out of Colorado's 271 incorporated municipalities, 100 are home rule municipalities. Out of Colorado's 64 counties, only 4 are categorized as home rule counties (City and County of Denver, Broomfield City and County, Pitkin County, and Weld County).[120] The history of home rule, according to a recent presentation by the Colorado Municipal League, dates back to the turn of the century and the expansion of Article XX in the Colorado Constitution:

> *In 1902, an amendment to the Colorado Constitution provided the right to citizens in cities… to adopt home rule, and in 1912, supporters of home rule initiated a clarifying and strengthening amendment that rewrote Section 6 of Article XX to specifically enumerate various municipal home rule powers with a powerful "catch-all" paragraph. Another important home rule amendment was approved by voters in 1970 which added a new Section 9 to Article XX to extend the right to adopt home rule to the citizens of each municipality, regardless of population or when incorporated. Article XX of the Colorado Constitution reserves both structural and functional home rule powers to municipalities and "the full right of self government in local and municipal matters" to citizens.*[121]

With all of Colorado's cities and counties granted 1041 powers, and more than one-third of municipalities adopting home rule status, the planning and regulatory framework for the Energy industry must confront the potential of a complicated and lengthy regulatory process for development of a pipeline or transmission line through multiple jurisdictions. In addition, the deployment of a standard energy technology, such as rooftop solar PV or solar thermal, may face a wide range of differing local permitting requirements across the state. For example, fire codes in different jurisdictions place different requirements on solar panel installation. Some of these jurisdictions are adopting codes that reduce the roof size available for solar panels to the point where PV systems are no longer cost effective.

LACK OF SKILLED WORKFORCE TO SUSTAIN FUTURE GROWTH OF THE INDUSTRY

Colorado ranks second highest in the country for the percentage of adults with college degrees, but ranks forty-seventh in high school graduates continuing to college.[122] This data indicates that Colorado businesses are recruiting talent from outside of the state. In addition, 46% of Colorado's first-time community college students coming out of high school need remediation in math at a cost of more than $16.7 million annually to the state.[123]

The annual number of STEM graduates has declined since 2001, which could produce a gap in the workforce when combined with the impending retirement of an aging technical workforce. This trend can be seen in the decline of Colorado's STEM workers younger than 34, a decrease of 2.6% annually from 2005 to 2010 to 55,640.[124]

In 2007, the Metro Denver Workforce Innovation in Regional Economic Development (WIRED) Initiative convened energy stakeholders to discuss workforce issues related to the Energy industry. According to industry representatives at that time, applicants for energy jobs often did not have the STEM skills needed to meet industry needs. Industry representatives participating in the Energy KIN continue to cite this as an unmet need.

Colorado stakeholders have been working to improve the STEM skills of K–12 students since 2007 through the WIRED grant from the U.S. Department of Labor. WIRED provided sub-grants to 26 programs or projects that worked to fill the pipeline of workers for four industries—aerospace, bioscience, energy, and information technology—including improving STEM skills in K–12 students. For example, a sub-grant was awarded to Colorado Mathematics, Engineering, and Science Achievement (MESA), whose mission is to increase the number of economically disadvantaged and underrepresented students in engineering, math, and science-based fields in college. WIRED funding supported Colorado MESA's annual competition for middle school students to test their STEM projects—structures such as bridges, model cars with different propulsion systems, etc.—against other students.

The WIRED initiative ended in January 2010, but stakeholders in industry, workforce development, and education have continued to expand programs supported by WIRED. Red Rocks Community College used WIRED funding to seed fund comprehensive technical training programs for wind, solar, and energy efficiency that are still being offered today. Although WIRED-funded activities were sustained after the end of the grant, industry representatives who participated in the Energy KIN said they continued to be challenged by the lack of a technically strong workforce. Technical jobs, such as mechanics and electricians, are in demand across the multiple energy sectors. In the wind sector, for example, mechanics and electricians are integral to the design, installation, and maintenance of nacelles—the housing for all of a wind turbine's generating components, including the generator, gearbox, drive train, and brake assembly.

While H1B visas are an option for recruiting engineering talent, there are challenges. The application process is competitive. For fiscal year 2014, H1B visas were capped at 65,000 for the entire nation. The U.S. Citizenship and Immigration Services received approximately 124,000 H1B petitions within the first week of the filing period in April 2013.[125] Additionally, H1B visas are not transferrable from one industry to another, creating challenges for the ever-evolving energy industry. Even though H-1B visas can be renewed, they cannot be renewed under a different industry sector because the H-1B petition for a visa is initiated by a specific company to meet its specific needs.

The Tactical Team agreed that businesses and students would benefit from strengthened partnerships to provide greater awareness of the Energy industry, advance career energy pathways, support programs to increase STEM skill achievement, and improve technical skills for the Energy industry. These parternships are among the Energy industry, the K–12 education system, colleges and universities, Career and Technical Education centers, community colleges, and other workforce development stakeholders.

ACCESS TO CAPITAL ISSUES

Capital Needed to Drive Energy Innovation from Proof of Concept to Commercialization

In 2010, the Colorado Cleantech Action Plan (the Action Plan) was commissioned by the Colorado Cleantech Industry Association (CCIA) to provide a set of key actions to advance the clean technology sector over a three to five year period. The Action Plan provided a succinct statement on the status of capital access to advancing the clean technology industry in Colorado: "Current levels of state, federal, and private funding for commercialization are insufficient to support an economy based on innovation and commercialization in the following areas…," which included proof-of-concept stage, seed stage, and venture capital stage.[126] That statement holds true for Colorado today, according to comments provided during the Energy KIN process. The Action Plan went on to state that:

> *"Because Colorado lacks significant on-the-ground investment capital for the cleantech industry, this perception is a barrier to obtaining the funding needed to move technologies beyond the lab. Several programs in the state provide training to bridge this gap (including CU-Denver's Global Energy Management Program, CSU's MBA in Global Social and Sustainable Enterprise, and the incubators throughout the state). The current capacity of the academic programs and funding for the incubators, however, are insufficient to support the type of training needed to secure outside funding."*[127]

Financing for the energy technology startups in Colorado has struggled to overcome several key challenges in recent years (see below for new state and public-private partnership programs that are showing promise to overcome challenges). There is currently a large gap in early-stage financing to develop energy technology prototypes from research coming out of the state's universities.[128] The development of prototypes is a critical step in the technology development process that would enable large corporations, or strategic investors, to provide additional capital for technology development.

Other challenges surround the fact that Colorado continues to lack a strong presence of venture capital firms in the state. Venture capital firms generally do not have their headquarters, a branch office, or staff assigned to the state that can rapidly identify investment opportunities.[129] Additionally, a large number of the venture capital firms that were pursuing investments in energy startups in recent years have pulled back from making investments in the energy sector. The reason for this decline in venture capital for energy technology includes a realization that investments in clean energy technology do not follow the same successful model for information technology investments—for energy startups, the cost for developing new energy technologies is higher and the length of time to commercialize is longer.[130] However, there are some areas of venture capital investment in clean technology that have grown or remained relatively stable. These areas include information technology (e.g., software platforms) for energy applications, energy efficiency technologies, and clean air and water technologies.[131]

Strategic investors, composed of large, established companies such as General Electric, have recently made some investments in energy startups to fill in the decline from venture capital. However, like with venture capital, Colorado does not have much of a strategic investor presence that can support the development of local startups.[132]

A sample of recent and current levels of investment for clean technology R&D and commercialization include the following funding activities:

- Nationally, venture capital funding in the clean technology sector was $3.3 billion in 2012, a 28% decline from 2011 investment levels; in addition, first-time funding in 2012 decreased 58% to $216 million, and follow-on funding declined 25% to $3.1 billion.[133]
- The Collaboratory received more than $6 million in state funds during 2006–2008, which have been leveraged to attract a total of $50 million in industry and federal funds through 2012 to conduct early-stage and basic science research.[134] The Collaboratory is a research consortium among four leading research institutions—the Colorado School of Mines, Colorado State University, NREL, and the University of Colorado at Boulder. It has been successful in attracting industry partnerships due to the research being pre-competitive and not at the commercialization stage.
- CEO has developed and currently manages two funding programs that provide financing for early-stage and commercialization projects. CEO's Revolving Loan Program was developed from a $17 million fund that is targeted for commercialization projects that are out of the R&D and demonstration phases. It provides critical bridge loans to access other forms of capital. The fund currently has $4 million available for companies to access and will seek to replenish the remaining funds from the projects that are currently being financed through the program. The Qualified Energy Conservation Bond (QECB) Program was established with $51.2 million in federal funds from the *American Recovery and Reinvestment Act of 2009*. The QECB Program has already allocated its entire fund for the state and is dependent on the federal government for additional funding.

The current environment is also difficult for financing mid-sized energy projects that may interconnect to electric distribution systems, or projects that provide energy improvements involving direct use by large commercial and industrial facilities. These mid-sized projects, in many cases, may be considered too large for local financial institutions and not large enough for large investors. Other challenges to overcome for mid-sized projects include a lack of short-term construction financing and a perception that utilities are not willing to work with small power producers to enable project investment.

New Opportunities for Capital Investments in Colorado

Recent activities provide optimism that a framework is being built to drive greater access to capital in the near future for the Energy industry. This framework would aid the commercialization of new technologies and support the growth of startups. These recent activities include state legislation, such as the 2013 Advanced Industries Accelerators Act, and a collaborative model led by Rocky Mountain Innosphere (RMI) in Fort Collins that is coordinating the resources of research institutions, private banks, venture capital, and the philanthropic community to match with innovative, early- to late-stage energy and water technology development. Below is a summary of these recent developments:

- *2013 Advanced Industries Accelerator Act* (House Bill 13-1001): The Accelerator Act is a 10-year grant program that provides funding for Colorado's Advanced Industries, which includes Energy and Natural Resources. Companies within an Advanced Industry are eligible to apply for grants from a current pool of $14.5 million per year in state funding. The program requires that a minimum portion of funding (approximately $2.0 million) be dedicated to clean technology. The Act provides for three types of grants beginning in late 2013:
    - Proof-of-concept grants for research performed at Colorado research institutions (grant size limited to $150,000 and requires a match of $1 from the institution for every $3 from the state)
    - Early-stage capital and retention grants for businesses with at least 50% of their employees based in Colorado (grant size limited to $250,000 and requires match of $2 from the company for every $1 from the state)
    - Infrastructure grants for programs or resources that will accelerate the growth of an Advanced Industry (grant size limited to $500,000 and requires match of $2 from private sources for every $1 from the state).
- Rocky Mountain Innosphere's Technology to Market (T2M) program: The T2M program was established in early 2013 under Innosphere, a Cleantech, Bioscience and Software technology incubator, to best assess the readiness of early-stage technologies. The program involves a partnership with the National Renewable Energy Laboratory, Colorado State University, Colorado University, and Colorado School of Mines to develop a pipeline of technological innovations and a team of researchers who can review projects to assess the readiness of a technology for company formation and possible funding. In addition to the T2M program, Innosphere has established the Access To Capital program. One key element of this financing program includes the creation of a community development venture capital fund that allows banking institutions to invest in a multi-purpose early-stage fund and receive Community Reinvestment Act credit and provides venture capital bridge funding to other sources of funding

The future framework being developed will require a substantial commitment among the key stakeholders involved to ensure the current available funding can expand in subsequent years to establish an economy to drive energy innovation technologies.

RECOMMENDED STRATEGIES AND ACTIONS FOR THE ENERGY KEY INDUSTRY NETWORK

Based on the input and guidance received from the Energy KIN Steering Committee and Tactical Teams, the following 5 to 10 year Energy industry vision has been developed:

> *Colorado will continue to be a global energy leader by combining its diverse resources, talent, innovation, and capital to create energy production and efficiency solutions for state, national and world markets.*

This section of the report provides a compilation of recommendations to the state and Energy industry stakeholders to support this vision. They are provided in a framework of strategic actions and the associated steps for their implementation. The strategies and actions are an outcome of recommendations made by Energy KIN Tactical Teams based on the guidance provided by the Energy KIN Steering Committee. The Steering Committee was charged with reviewing the opportunities and barriers identified during the listening sessions; it was also responsible for assessing and prioritizing the issues and providing priority goals for each of the Core Objectives outlined in the Colorado Blueprint. Priority goals outlined in the Steering Committee meeting are thought to be achievable within a 6–18 month time frame and provide the industry with effective and tangible results. The Tactical Teams—organized around the six Core Objectives—reviewed the priority goals resulting from the Steering Committee meeting and developed a set of recommended strategies and actions to accomplish them. These recommendations provide a framework and/or foundation for the implementation of a strategic economic development plan for the energy sector in Colorado.

The recommended strategies and actions are grouped under the six Core Objectives of the Colorado Blueprint. Some strategies are relevant to more than one objective and aligned with other objectives as well. These correlations were shown in Table 1 of this report. Also provided below are the potential lead organizations and other entities that can further assess and formulate implementation of these actions, the time frame involved for each action, and the estimated cost ranges for planning purposes. The cost estimates are represented with "$" level symbol corresponding to the following ranges: $ = 0–$100,000; $$ = $100,000–$500,000; $$$ = $500,000–$1,000,000; and, $$$$ = greater than $1,000,000.

The recommended strategic actions may require programmatic, policy and legislative, or regulatory approaches in their implementation. The programmatic actions involve initiatives either by state government or collaboratively with the Energy industry stakeholders. Some of the actions are supported by and/or may be considered as part of current legislative initiatives; others are an extension of ongoing and planned programs by the state. Policy and legislative actions are those to be considered by the state legislature, as appropriate. Regulatory actions are those that will involve regulatory bodies at federal, state, and local governments, as well as collaborations with industry and other stakeholder organizations. Precedent examples of actions taken by other states and regional organizations and other countries as related to each strategic action are also provided.

CORE OBJECTIVE #1:
BUILD A BUSINESS-FRIENDLY ENVIRONMENT

1A. Strategic Recommendation	Identify duplicative (and conflicting) regulations and reporting for oil and gas production across multiple government agencies (federal, state, and local)
Background	Oil and gas developers in several regions of the state (particularly in areas with production on federal lands) face duplicative and sometimes conflicting regulatory and reporting requirements involving rules set by the federal government, state government, and local government. These regulations among multiple layers of government may impact the competiveness and efficiency of development in these regions compared to other regions of the country.
Strategic Actions	• Map the Energy industry value chain in Colorado to identify "pinch points" in permitting and regulation requirements. The map should consider regulation within both production and distribution (pipelines). • Develop a plan for the development of a central database for energy project information that could be used between different agencies at the state and local levels to expedite the permitting process. • Identify pilot project opportunities involving the local, state, and federal government agencies to address and minimize "pinch point" barriers.
Lead	Industry Trade Associations
Time Frame	12-18 months
Estimated Cost	$$
Precedent	Oklahoma's first energy plan (2011) calls for refining regulations to remain effective while not impairing business development in the state; attempting to reduce litigation between oil and gas operators, producers, mineral owners, and surface estate owners; promoting opportunities to enhance Oklahoma coal production and streamline state processes to create effective regulation; assisting industry in overcoming federal obstacles that stymie new mining permit evaluation processes; and ensuring the effectiveness of legislative and municipal efforts designed to promote energy efficiency planning and reporting.[135]
Precedent	STRONGER—State Review of Oil and Natural Gas Environmental Regulations—is a nonprofit, multi-stakeholder organization whose purpose is to assist states in documenting the environmental regulations associated with the exploration, development, and production of crude oil and natural gas. The state review process is a collaborative effort with teams composed of stakeholders from the oil and gas industry, state environmental regulatory programs, and members of the environmental/public interest communities. State oil and gas waste management programs are reviewed against a set of guidelines developed and agreed to by all the participating parties. The purpose of the state review process is to assist states in improving their oil and gas environmental regulatory programs.[136]

1B. Strategic Recommendation	Establish regulatory consistency between local jurisdictions for energy development
Background	In Colorado, the development energy infrastructure—such as transmission or pipelines—requires planning and construction across multiple local government jurisdictions. When each jurisdiction has its own unique permitting and siting requirements, this can result in a difficult and lengthy process. In addition, businesses installing distributed generation and energy efficiency technologies such as rooftop solar PV or solar thermal heating systems face a wide range of licensing and permitting requirements across Colorado's local jurisdictions.
Strategic Actions	• Identify innovative policy concepts in other home rule states for developing local government regulation that provides greater consistency. • Collaborate with local, state, and federal agencies to consider areas of local regulation that could allow for coordinated streamlining planning efforts for transmission and pipeline construction—including collaboration with the Western Governors'Association work on energy corridor designations with the federal government under Section 368 of Energy Policy Act of 2005.[137] • Identify opportunities to build capacity within local communities, including support from industry and federal and state agencies, which could be supported by a master database of energy project permitting data. • Certify additional municipalities and counties as a Solar-Friendly Community through 12 key steps that have been developed through a Colorado initiative funded by DOE's SunShot Initiative. • Identify and seek to modify local fire codes with roof setback requirements that restrict solar PV and solar thermal project development. • Support additional streamlining of regulations for small- and micro-hydro projects, including state electrical requirements for Underwriters Laboratories (UL)-listed equipment.
Lead	Industry Trade Associations and Colorado Energy Office in coordination with Local Government Associations
Time Frame	18+ months
Estimated Cost	$$
Precedent	Oregon's Regulation and Permitting Initiative for 2013 calls for creating and maintaining an efficient, simple, and streamlined regulatory and permitting system that makes it easier to start, expand, and operate businesses while protecting public regulatory goals. This initiative is an outcome of the August 2012 report from Governor John Kitzhaber's Regulatory Streamlining and Simplification Project, which provided a roadmap for a comprehensive overview of the often confusing and conflicting demands for regulatory relief and offered short-term and longer-term recommendations using both executive branch and legislative branch levers to effect change. One of the priorities is to adopt consistent management systems and permitting practices across state agencies and apply similar principles to the greatest extent possible across federal, state, and local governments.[138]

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Precedent	Germany: A study performed for the European Commission (Ecorys, 2008) on small rooftop PV installations showed that, at the time, Germany was the only country in the sample that had streamlined, "one-stop-shop" permitting procedures. It was also the only country in the study where waiting for permits did not consume more than 50% of the total project development time.[139] Germany has successfully scaled basic design and installation processes, driving down the cost and wait time associated with residential solar. Moreover, the country has successfully eliminated permitting for standard residential solar, which is part of the reason residential solar is so prominent in the country. In Germany, it's not uncommon for a person to contact a solar company and have a system on their roof in less than a week, sometimes in a few days.[140]

1C. Strategic Recommendation	Establish a clear long-term state energy plan
Background	A state energy plan supports government agencies and industry stakeholders as they move toward a shared goal of meeting future energy needs in a cost-effective and sustainable manner. A state energy plan may provide an assessment of current and future energy supply and demand, examine existing energy policies, and identify emerging energy challenges and opportunities. Several states near Colorado (e.g., Idaho, Oklahoma, Texas, and Wyoming) have created state energy plans developed with input from industry and other stakeholders; they also establish goals that support aligning policy and regulatory activities. In some cases, the plans are updated regularly to track progress and revise goals.
Strategic Actions	• Develop a state energy plan that is inclusive of all types of energy resources; encourages bipartisan collaboration on energy policy within the state; increases communication between industry and regulatory agencies; and accounts for export opportunities and mining of energy input minerals that will ensure growth opportunities in multiple sectors. • Establish a schedule for updating the plan.
Lead	Colorado Energy Office and Colorado Department of Natural Resources
Time Frame	12-18 months
Estimated Cost	$
Precedent	Per a recent report by the National Association of State Energy Officials (NASEO), 39 states had energy plans at the end of 2011. Of these, 21 were led by the state energy office, 14 by an advisory board, 3 by the governor, and 1 by the Public Utility Commission. By early 2013, at least 20 states were updating existing state energy plans or developing new plans. Per NASEO, at least 45 states will have state energy plans in 2013. Several states that began developing their state energy plans after 2010, including Florida, New Hampshire, North Dakota, and Utah, used the year 2025 as the timeline for their plans. Maine's state energy plan was developed in 2009, and it has taken the longest-term approach, using a 50-year planning horizon.[141]

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Precedent	Japan published its revised strategic energy plan in June 2012—originally formulated in 2003 and reviewed every three years by conference bodies, as well as various opinion polls. The latest revision includes a roadmap of energy-based economic growth and reformation of the energy infrastructure. The strategy is to ensure growth and encourage multi-faceted international trade by taking into account the social cost and price differences between nuclear, thermal, and renewable energy generation. The plan is to raise the energy independence ratio to 70% (self-sufficiency energy plus self-developed energy supply divided by total primary energy sources). Japan will also be expanding its feed-in tariff systems for renewables, as well as increasing support for R&D projects and local revitalization. The scheme required Japanese utilities to buy electricity from renewable sources at a rate of 42 yen (converted to $0.56 mid-2012) per kilowatt-hour (kWh) of solar-generated electricity for systems of 10 kW or more for up to 20 years. This, at that time, was double the tariff offered in Germany and more than three times that paid in China.[142]

1D. Strategic Recommendation	**Improve the air permitting review process within CDPHE's Air Pollution Control Division**
Background	Colorado's oil, natural gas, and mining industries have described lengthy time periods to acquire air permits from CDPHE. These delays can potentially result in lost production opportunities and reduce the state's competitiveness in production of energy resources. CDPHE's Air Pollution Control Division (APCD) has recently developed several General Permits that relate to oil and gas operations that are resulting in permits being issued immediately ("file and go"). These permits apply to categories where there are many identical sources that operate in a similar way. APCD is currently developing additional General Permits for the industry and making additional improvement to the air permitting process. This includes more efficient data management for reporting emissions and updating permits, and refinement of the permit priority list for the oil and gas industry.
Strategic Actions	• Provide comments to CDPHE on the General Permits under development for the oil and gas industry. • Facilitate a meeting to determine the status and development of permit streamlining for mining projects. • Evaluate the existing model used by the state's agriculture industry, where industry fees have helped to expedite the permitting process, to determine applicability to some areas of the Energy industry. • Evaluate the potential nexus between expedited permitting and enhanced environmental controls.
Lead	Colorado Department of Public Health and Environment and Industry Trade Associations
Time Frame	1-6 months
Estimated Cost	$

Precedent	Colorado Senate Bill 13-284, which was withdrawn by the sponsor, would have provided for streamlined environmental permitting of oil and gas development that meets enhanced environmental protection standards. Also, perthe requirements of Georgia's O.C.G.A. 12-2-2(c)(1)(A), Georgia's Environmental Protection Division (EPD), Air Protection Branch, developed and is implementing standard operating procedures for timely processing of certain permit applications, including but not limited to procedures for expedited review and granting of applications upon payment of a fee. Fees collected as part of the expedited permitting program will be used to offset the cost of expediting the permit applications. This provision of the law became effective on July 1, 2013.[143]

1E. Strategic Recommendation	**Establish replicable mechanisms for energy efficiency and distributed generation technologies to be integrated into new building construction**
Background	Maintaining an ongoing commitment and awareness of the application of energy efficiency and distributed energy technologies for new and existing buildings is important to ensuring future business success for energy improvement companies in the state. The energy efficiency and distributed generation sectors have technologies and applications that can be planned for in the early stages of new building design and construction to allow for increased development opportunities and enhanced efficiency of Colorado's new buildings.
Strategic Action	• Identify and provide input to local governments that are drafting new building codes following recent forest fires and floods. • Assess areas of improvements or needs for augmenting current energy efficiency standards and codes for new building construction.
Lead	Colorado Energy Office, Industry Trade Associations, and Local Government Associations
Time Frame	6-12 months
Estimated Cost	$
Precedent	Chandler, Arizona, adopted Resolution 4199 in June 2008 establishing expedited plan review for green building in the private sector. Permit applications for buildings registered with the US Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) for new construction, core and shell, commercial interiors or schools, which are pursuing a certification level of Silver or higher will be granted an expedited plan review from the city.[144]

1F. Strategic Recommendation	**Increase the use of memorandums of understanding (MOUs) between industry and local governments to support the use of specific/advanced technologies and to address potential impacts from oil and gas production within urban/suburban areas of the state**
Background	Several Colorado oil and gas operators and local governments have entered into MOUs, or established operator agreements, in order to determine mutually agreeable operating practices that account for local-level concerns. Where these agreements have been executed, the Colorado Oil and Gas Conservation Commission has included the principles in the state's permit requirements.
Strategic Actions	• Create and share sample MOUs/operator agreements. • Communicate the value of such agreements broadly with oil and gas operators and local governments.

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Lead	Industry and Local Government Trade Associations
Timeframe	12-18 months
Estimated Cost	$
Precedent	Encana Oil & Gas and the Town of Hudson, Colorado, entered into an agreement to address town concerns with traffic related to activities at existing horizontal wells. Executed in May 2013, the agreement requires Encana to seek approval for overweight trucks, and follow best management practices (BMPs) for traffic and road damage. The Town of Erie entered into separate agreements with Anadarko Petroleum Corporation and Encana Oil & Gas that institute BMPs for the operators in order to address town concerns about traffic and hydraulic fracturing, among other activities.(https://www.erieco.gov/index.aspx?nid=129).

1G. Strategic Recommendation	**Identify cost-benefit analysis approaches to evaluate the impact of regulation on industry**
Background	Several stakeholders of the Energy industry believe a regulatory- and policy-making approach should be required to consider the economic impacts on the industry before the new rules and legislation are approved. During the 2013 session the Colorado General Assembly passed SB 13-158 and it was signed into law in May 2013. The law extended and amended a section of the law scheduled to be sunset stipulating requirements by all state agencies conducting rule-making for informing regulated entities about new rules and conducting cost-benefit analysis. SB 13-158 also requires public involvement during a cost-benefit analysis. In addition, the Colorado General Assembly recently passed SB13-73, which provides a mechanism for evaluating the economic impacts from the permitting for water quality control. SB 13-73, signed into law in June 2013, establishes procedures for the development of General Permits by the Water Quality Control Division and requires the Division to allow a company to request and pay for a cost-benefit analysis of disputed requirements.
Strategic Action	• Monitor the actions taken under SB 13-158 that amended and extended the cost-benefit analysis requirements for state agencies that conduct rule-making. • Monitor the actions taken under SB 13-73 for water quality permitting to identify areas where it could be replicated within the Energy industry, and to identify technical changes that could be made to improve the statute.
Lead	Industry Trade Associations
Time Frame	12–18 months
Estimated Cost	$
Precedent	When conducting benefit-cost analysis, U.S. federal agencies must comply with federal guidelines outlined by various regulations and guidelines from the Office of Management and Budget (OMB), the White House, and Congress. The primary guidelines include OMB Circulars A-4, A-11, and A-94, and the White House's Executive Order 12866. Cost-benefit analysis approaches for regulatory impact assessment on industry are described in OMB Circular A-4 and the report of the Congressional Research Service, which can be found at the following links: http://www.whitehouse.gov/omb/circulars_a004_a-4 http://www.whitehouse.gov/sites/default/files/omb/inforeg/regpol/circular-a-4_regulatory-impact-analysis-a-primer.pdf http://www.fas.org/sgp/crs/misc/R41974.pdf

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Precedent	According to a PEW study (July 2013), states' use of cost-benefit analysis is growing—the number of states using cost-benefit analysis increased 48% between 2008 and 2011. Ten states led the way nationally in the production, scope, and use of cost-benefit analysis to support data-driven policymaking. Twenty-nine states reported that cost-benefit studies had directly influenced legislative or executive action, including decisions to fund or eliminate programs.[145]
International Precedents	The United Kingdom (UK) requires regulatory Compliance Cost Assessment (CCA) for each regulatory proposal affecting business. This covers primary and secondary government legislation, as well as Private Members bills; embraces new and amended regulations; and includes both UK and European Community-initiated legislation. CCAs are prepared and published by the department responsible for the regulatory proposal and completed before going out for public consultation. To further enhance the systematic assessment of the impact of regulatory proposals, the UK introduced a Regulatory Appraisal in May 1996. This provides a structured, and where possible, quantified assessment of the costs and benefits of regulatory proposals likely to affect business. It uses risk assessment techniques to identify the benefits of regulatory and other options, and aims to quantify and value those benefits so that they may be compared with the costs to business, consumers, and government.[146] Canada uses regulatory impact analysis as one component of its federal regulatory reform. Canada's Regulatory Impact Analysis (RIA) program complements other regulatory reform tools and is designed to encourage regulators to think through in a structured way the foundations for regulatory proposals. RIA provides a framework for answering questions such as: will the proposed regulation result in a reasonable balance of benefits and costs; who will pay the costs; and what will the impacts be on international competitiveness, small business, and other relevant factors?[147]

1H. Strategic Recommendation	**Establish more efficient ways to transport energy production feedstock and manufactured energy products**
Background	Biomass to energy projects may require transporting large loads of woody biomass material that are defined as divisible loads by the U.S. Department of Transportation (DOT). These divisible loads that are more than 80,000 pounds in Colorado are required to be split into separate carrier vehicles increasing costs and fuel use.[148] Other states have created permitting variances with DOT to allow for larger loads of biomass material. In developing these state permitting variances, the state cannot violate federal oversize and overweight permitting laws. Companies that manufacture large energy products, such as wind turbines, face delays in shipping the equipment due to unexpected road and highway improvements that do not allow them to plan. In addition, energy companies may have to administer thousands of individual permits with the Colorado Department of Transportation (CDOT) for the identical type of shipment that could be administered more efficiently under an umbrella permit.
Strategic Actions	• Determine the feasibility of obtaining a variance for higher weight limits with DOT on divisible loads to allow for more efficient shipment of energy feedstock, including woody biomass. • Identify biomass to energy project locations in close proximity to feedstock sources. • Establish a network of energy manufacturing companies that will receive email updates from CDOT about current and future road construction projects. • Facilitate a meeting between energy manufacturing companies and CDOT to develop an umbrella permit approach to shipments that are identical over a period of time.

Lead	Industry Trade Associations in collaboration with Colorado Department of Transportation
Time Frame	12–18 months
Estimated Cost	$
Precedent	The State of New York allows operations to obtain a divisible load overweight permit that grants permission to operate a vehicle, or combination of vehicles, to haul a divisible load at weights exceeding the limitations of New York State's legal weight.[149]

CORE OBJECTIVE #2: RETAIN, GROW, AND RECRUIT COMPANIES

2A. Strategic Recommendation	**Establish greater communication on regulatory issues among industry, utilities, policy makers, and regulators to more effectively plan for future development opportunities**
Background	Through the development of communication initiatives between industry networks and other stakeholders, several key development issues can be evaluated for future opportunities. Greater communication and collaboration can lead to consensus-based regulatory decision making and eliminate or reduce disputes. Regulatory certainty is also important for economic growth and retaining businesses in the state. Predictability and certainty regarding rules at all levels is important to provide clarity as to what is expected and required for compliance.
Strategic Actions	• Evaluate current law for transmission development (including SB07-100) and identify new transmission development mechanisms that could support state and export markets. • Evaluate potential revisions to the Public Utilities Commissions' integrated resource planning process to model "Section 123" resources in energy resource plans. • Facilitate a meeting of stakeholders to seek recommendations to better define Section 123 resources and their consideration in resource planning. • Continue quarterly meetings of the Energy KIN Steering Committee.
Lead	Colorado Energy Office, Industry Trade Associations and Office of Economic Development and International Trade
Time Frame	6–12 months
Estimated Cost	$
Precedent	South Carolina's Energy Office partnered with the South Carolina Coordinating Council for Economic Development and the South Carolina Department of Commerce to launch a $2.1 million Clean Green Investment Incentive program under the SEP. The program aims to encourage manufacturers to locate, stay, and/or expand in South Carolina by providing funding for energy efficiency and renewable energy projects.[150] The State of California developed a memorandum of understanding (MOU) with U.S. Department of the Interior (DOI) to expedite the siting of renewable energy projects and their associated transmission across federal lands. The MOU has resulted in the siting of nine renewable energy projects totaling 4 GW of capacity and the transmission to connect the power to the grid.[151]

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2B. Strategic Recommendation	**Identify and assess the business incentives, tax policy and resources related to Colorado's Energy industry for maintaining and attracting energy companies**
Background	Colorado is in a competition regionally, nationally, and globally to attract and retain companies. An important consideration for Colorado's current and future business growth will be ensuring that incentives, tax policy, and other resources are competitive.
Strategic Actions	• Conduct a review of state tax policies, incentives, and business development resources for the Energy industry and compare with other states to assess competitiveness. • Develop a set of legislative recommendations for tax policy and incentives to support the growth of the Energy industry.
Lead	Industry Trade Associations, Office of Economic Development and International Trade, and Colorado Energy Office
Time Frame	6–18 months
Estimated Cost	$
Precedent	All states have some form of incentives and programs to promote economic development in the energy sector, especially for the energy industry to promote energy efficiency and renewable energy use and technologies. For example, a comprehensive listing and description of financial incentives for renewable energy and energy efficiency for each state can be found on the DSIRE website (the Database of State Incentives for Renewables & Efficiency).[152] These include tax incentives, rebates, grants, loans, industry support, bonds, and performance-based incentives. DOE's Advanced Manufacturing Office developed the State Incentives and Resource Database to help commercial and industrial managers seeking to make energy efficiency upgrades in their facilities find the financial and technical incentives, tools, and resources provided through federal, state, local, utility, and nonprofit resource providers. Search results can be filtered by program sponsor, resource type, industrial systems type, and/or energy type.[153]

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International Precedent	Renewable energy-based electricity generation policy options implemented in other countries include feed-in tariffs (FIT) and feed-in-premiums (FIPs). FITs guarantee the generator of renewable electricity a certain price per kWh at which electricity is purchased. FITs and FIPs are the dominant support policies for wind power and solar PV in several countries of the Organization for Economic Co-operation and Development (OECD). For example, in Victoria, Australia, FITs currently offer a minimum of ¢0.08 per kilowatt hour for 2013 for excess electricity fed back into the grid—the rate is based on the adjusted wholesale price of electricity. Some electricity retailers may offer a higher rate, but are not obligated to do so. To provide a basis for continued growth, FITs are available to solar and other eligible forms of renewable energy, such as wind, hydro, or biomass, with a system size less than 100 kW. Additional low-emissions technologies are also being made eligible under this scheme. All electricity retailers with more than 5,000 customers must offer a minimum ¢0.08 FIT in 2013, but they may offer different packages and terms and conditions. The introduction of FITs arrangement is in response to the recommendations of the Victorian Competition and Efficiency Commission's September 2012 report on distributed generation and FITs. The FITs rate will be reviewed and updated annually until 2016.[154] *(Note: FITs are more common internationally and used to a limited extent in the United States. FIT programs are similar to net metering programs that are more common in the United States. Their pros and cons would depend on project specifics, such as unique needs and circumstances, project design and technology, location of a particular project, and programs offered by utilities in a particular location or the state. In a net metering program, a utility customer is effectively paid the retail rate for any generation that is fed back into the grid. In a FIT program, the power generated by a utility customer's system is compensated at the rate set by the FIT rather than the retail electricity rate.)*[155]

2C. Strategic Recommendation	**Establish reasonable standards for the sharing of consumer utility data to third-party contractors to evaluate energy efficiency improvements and for development of energy tracking tools**
Background	An important activity of the energy efficiency sector is to establish a baseline of energy consumption among consumers and then be able to track the energy savings from the implementation of energy improvements. Through improved energy data sharing standards the energy efficiency sector will become more effective in the energy savings it can provide consumers and grow companies developing energy tracking tools, e.g., the Smart Grid industry. Currently, the process of obtaining consumer energy data from consumers, in some cases, does not seem clear and often varies from one utility to the next. Data privacy and security issues need to be considered and addressed as well.
Strategic Actions	• Energy efficiency companies should participate in the current Public Utilities Commission docket 13M-1052EG, examining standards for investor-owned utility sharing of consumer utility data among third parties. • Facilitate a meeting with the Colorado REA and Colorado Association of Municipal Utilities to develop a set of "best practices" for member utilities to implement for data-sharing requests. • Support energy benchmarking activities among commercial properties using the EPA's ENERGY STAR Portfolio Manager online tool.
Lead	Industry Trade Associations and Colorado Energy Office
Time Frame	6 months

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Estimated Cost	$
Precedent	DOE's Green Button initiative is an industry-led effort to provide utility customers with easy and secure access to their energy usage information in a consumer-friendly and computer-friendly format. Customers are able to securely download their own detailed energy usage with a simple click from the electric utilities' websites. Voluntary adoption of a consensus industry standard by utilities and companies has allowed software developers and other entrepreneurs to build innovative applications, products, and services that will help consumers to better manage their energy use.[156] In 2011, the North American Energy Standards Board (NAESB) issued a voluntary Model Business Practices for Third Party access to Smart Meter-based information. The model contemplates that such information would be made available to authorized third parties in a timely manner and that they would be responsible for protecting the consumer's privacy. The rules are intended to apply to utility disclosures to third parties, the use and retention of such information by the third party, and any discloser from the third party to another. The NAESB also encourages third parties that receive consumer-specific energy-usage data directly from the customer to adopt these "best practices." These voluntary standards are intended to be applied with some flexibility and to be subject to directives of appropriate regulatory authorities.[157]

2D. Strategic Recommendation	**Develop a regulatory and risk-sharing framework to allow for quicker deployment of new technologies**
Background	Companies that have developed new energy technologies may find it difficult to implement and commercialize due to lack of insurance, permitting issues, end-user uneasiness in deployment, skilled workforce that is able to work with such new technologies and other similar barriers to implementation.
Strategic Action	• Facilitate meeting with CDPHE and other state agencies to develop a framework for quicker permitting of new technology deployment. • Facilitate a meeting with CDPHE and other state agencies to develop a framework for new technology deployment that would allow insurance companies to provide affordable products that cover risks for those companies deploying the new technologies. • Collaborate with insurance companies to facilitate insurance products that would reduce risks for engineers when specifying innovative and new technologies. • Identify pilot program that will include pilot projects, regulatory task force and end-user collaboration that can access regulatory, insurance, permitting and other issues to test the ease with which certain technologies can be developed and commercialized.
Lead	Colorado Department of Public Health and Environment, American Council of Engineering Companies of Colorado, and Office of Economic Development and International Trade.
Time Frame	12–18 months
Estimated Cost	$
Precedent	Texas established a major cooperative wind power program to take advantage of its extensive wind resources. Texas Large Wind Turbine Research and Test Center was created under the auspices of the Lone Star Wind Alliance. The alliance is composed of NREL, several Texas universities, out-of-state universities, and energy firms with applicable technology and manufacturing expertise that can contribute to and profit from expanded use of wind energy. The center focuses on next generation turbine RD&D, testing and certification, and commercialization, creating a natural pathway for product development that draws on the strengths of alliance members. The state plan called for investing about $18 million through a combination of capital and loans to build the facility and cover start-up costs.[158]

2E. Strategic Recommendation	Market Foreign Trade Zones in Colorado to energy companies dealing with international vendors and customers
Background	Colorado currently has two general purpose foreign trade zones (FTZ) designated by U.S. Customs and Border Protection. These general purpose FTZs are managed by the City of Denver and City of Colorado Springs, respectively. Both entities are open to working with interested energy companies to establish sub-zones, as has been done in the past. Energy companies benefit from locating in, or establishing, an FTZ if they are currently importing products for the manufacture of technologies and then exporting the finished products to other nations. Manufacturing within an FTZ would allow companies in Colorado to pay duties on just the exported products rather than facing duties on both the imported and exported products.
Strategic Actions	• Compile and market a concise Colorado FTZ Toolkit to inform municipalities and energy companies of the value and administrative process associated with operating a general purpose, standalone FTZ or with establishing a sub-FTZ in partnership with the City of Denver or the City of Colorado Springs.
Lead	Office of Economic Development and International Trade and Industry Trade Associations
Time Frame	12–18 months
Estimated Cost	$
Precedent	Texas leads the nation with 32 FTZs, more than any other state, according to the U.S. Department of Commerce's International Trade Administration. The state has 70 firms assigned to subzones. In the United States, there are 250 FTZs and more than 500 subzones. Businesses operating in FTZs can reduce duty and tax costs, as well as streamline their production and processes. Authority for establishing these facilities is granted by the Foreign-Trade Zones Board (the Secretary of Commerce and the Secretary of the Treasury) under the Foreign-Trade Zones Act of 1934, as amended (19 U.S.C. 81a-81u), and the Board's regulations (15 C.F.R. Part 400).[159]

2F. Strategic Recommendation	Develop a coordinated planning effort for the deployment and promotion of alternative fuel vehicle infrastructure
Background	Colorado has a strong framework of existing initiatives for advancing AFVs throughout the state, involving many types that include natural gas vehicles, plug-in EVs, E-85 flex fuel, and propane. The AFV market in the state will grow with the expansion of the infrastructure for refueling and recharging stations, financial incentives, state and industry collaborations, and further public education.

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Strategic Actions	• Create an "application matchmaking resource" indicating the best-suited AFV types for particular applications and regions of the state to aid in the development of AFV infrastructure planning and market development. • Establish quarterly communication with NREL and AFV industry stakeholders to identify pilot projects for Colorado. • Facilitate quarterly meetings to establish a multi-fleet partnership that will create a critical mass for the installation of AFV fueling stations. • Conduct region-specific assessments to identify potential state and industry initiatives to increase AFV use, support infrastructure development, and remove barriers to AFV use. • Establish communication network with refueling/recharging providers to promote existing infrastructure and provide greater public awareness of refueling/recharging costs and benefits. • Communicate with DOE Alternative Fuels Data Center to list propane supply companies in western Colorado on the AFV refueling map.
Lead	Colorado Energy Office in collaboration with Clean Cities Coalitions, Drive Electric Northern Colorado, Clean Energy Economy for the Region, National Renewable Energy Laboratory, and other industry associations and companies
Time Frame	12–18 months
Estimated Cost	$$
Precedent	The California Hydrogen Highway program initiative, enacted in 2004 by an executive order, $19 million was appropriated for the construction of hydrogen fueling stations during 2005-2007. By the end of 2012, this program resulted in construction of 15 state-funded hydrogen fueling stations, with funding available for nine additional stations.[160] The Texas Commission on Environmental Quality (TCEQ) administers the Alternative Fueling Facilities Program as part of the Texas Emissions Reduction Plan. The Program provides grants for 50% of eligible costs, up to $500,000, to construct, reconstruct, or acquire a facility to store, compress, or dispense alternative fuels in Texas air quality nonattainment areas. Qualified alternative fuels include biodiesel, electricity, natural gas, hydrogen, propane, and fuel mixtures containing at least 85% methanol.[161]
International Precedents	In June 2013, the European Commission (EC) announced its proposed directive to meet a 60% target reduction in carbon dioxide (CO_2) emissions in the transport sector by 2050 by investing in an improved infrastructure for alternative fuels. EC has proposed a package of binding targets on member states for a minimum level of infrastructure for clean fuels, such as electricity, hydrogen, and natural gas, as well as common EU-wide standards for equipment needed. The directive includes measures to ensure the buildup of alternative fuel stations across Europe with common standards for their design and use. The proposed directive plans to introduce a common standard across all EU countries by 2015 with the alternative fuels infrastructure fully implemented by 2020. The plans include the development of a minimum number of recharging points for EVs and refueling points for hydrogen, liquefied natural gas (LNG), and CNG vehicles. EC has estimated that the alternative fuels infrastructure will cost €10 billion ($13.7 billion), but that it would generate saving of €18 billion ($24.7 billion) through benefits to the environment, improved energy security, and savings on oil.[162]

CORE OBJECTIVE #3: INCREASE ACCESS TO CAPITAL

3A. Strategic Recommendation	**Increase funding from private and government sources across the continuum of idea, seed, and early-stage business in order to increase the commercialization of new energy technologies**
Background	Building a state energy economy composed of greater innovative technology development will require strategic investment in R&D and commercialization initiatives to accelerate new technology development.

Strategic Actions	• Develop a "map" of different funding sources, incentives, and capital options for different energy development sectors and regions of the state to better inform startups of the pools of money that are currently available.
	• Conduct quarterly meeting among staff from CEO, OEDIT, and representatives from energy technology financing and accelerator programs to assess current opportunities and barriers to accessing capital.
	• Promote the Advanced Industries Accelerator Act (HB 13-1001), which provides proof-of-concept grants for research performed at Colorado research institutions (grant size limited to $150,000 and requires a match of $1 from the institution for every $3 from the state); Early Stage Capital and Retention Grants for businesses with at least 50% of their employees based in Colorado (grant size limited to $250,000 and requires match of $2 from the company for every $1 from the state); and Infrastructure Grants providing funding for programs and resources that can help support and grow the Energy industry (grant size limited to $500,000 and requires a match of $2 from private sources for every $1 from the state).
	• Utilize and seek to expand additional financing tools available for energy technology development from the state, including the Colorado Credit Reserve, Venture Capital Authority, and Community Development Block Grant Business Loan Funds.
	• Create platform to connect small energy technology developers to strategic corporate investors.
	• Lobby for and encourage continued funding of the Advanced Industries Acceleration Act.
	• Develop angel investor state tax credit legislation to encourage investment in emerging energy technologies.
	• Collaborate with the Rocky Mountain Innosphere to expand the Technology to Market (T2M) program and the Access to Capital program. The programs are demonstrating how incubators, universities, banking, venture capital, and community foundations can collaborate to develop a technology assessment pipeline, support technology R&D steps from research to commercialization, provide client technology solutions, identify funding sources and opportunities and create new jobs. Key elements of the financing program include the following:
	  ○ Rocky Mountain Innosphere (a 501(c)3 non-profit technology incubator located in a qualified Colorado Enterprise Zone) can receive donations to support an early stage seed fund at the Community Foundation of Northern Colorado to provide a bridge to early stage debt and venture funding.
	  ○ Banking institutions can invest into a Community Development Venture Capital Fund that provides reduced overall risk and compliance benefits under the Community Reinvestment Act.

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Strategic Actions	• Seek reallocation from the federal government of remaining funds that were authorized for the Qualified Energy Conservation Bonds program. The program provided $3.2 billion for states, but only $700 million has been used. Colorado has distributed all of its $51.2 million to finance a wide array of energy related applications. • Facilitate meetings with the Community Resource Center and University of Denver's Sustainable Finance Collaborative to establish program-related and mission-related investments from the philanthropic community. • Identify credible "crowd funding" tools to attract investment.
Lead	Office of Economic Development and International Trade, Colorado Energy Office, and Industry Stakeholders
Time Frame	6–18 months
Estimated Cost	$$$$
Precedent	In July 2008, Pennsylvania enacted a broad $650 million alternative energy bill designed to provide support for a variety of renewable energy and energy efficiency technologies. Included in this legislation was a provision authorizing the creation of a grant and loan program for alternative energy and clean energy production projects. The program is jointly administered by the Department of Community and Economic Development and the Department of Environmental Protection, under the direction of Commonwealth Finance Authority. The most recent Program Guidelines were issued in January 2013. Incentives are available to businesses, economic development organizations, and local governments, schools, etc.).[163]

3B. Strategic Recommendation	**Facilitate information sharing to strengthen financing for energy efficiency and distributed generation projects**
Background	With the sharp rise and then decline of *American Recovery and Reinvestment Act of 2009* funds available (along with changes in other state incentives—e.g., utility solar rebates), a more stable, long-term set of financing tools is needed to support the energy efficiency and distributed generation sectors.
Strategic Actions	• Provide information to consumers and banks on utilizing Small Business Administration and U.S. Department of Agriculture (USDA) Rural Development resources to guarantee loans from banking institutions for energy improvement projects. • Conduct outreach to all 64 Colorado counties and networks of commercial property owners for the Commercial Property Assessed Clean Energy established through recent state legislation (SB13-212). Enrollment in the program will begin in mid-2014. • Identify effective models for on-bill financing programs that can be implemented by the state's utilities. • Conduct workshops for the real estate industry, highlighting the value of energy efficiency improvements made by property owners. • Facilitate a meeting with the Colorado Water Resources and Power Development Authority to establish a model for using EPA's revolving loan funds for distributed generation projects. • Facilitate a meeting among solar energy installers to develop an aggregated loan fund to allow small installers to offer lease models to consumers.

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Lead	Colorado Energy Office and Office of Economic Development and International Trade in collaboration with Energy Efficiency Business Coalition, Southwest Energy Efficiency Project, Colorado Solar Energy Industries Association, Colorado Bankers Association, and Local Government Associations, and Banking Associations.
Time Frame	6–12 months
Estimated Cost	$$
Precedent	Tax incentives, rebates, grants, loans, and other incentives for renewable energy projects are common in all states at varying levels. For example, 42 states offer financial assistance programs—i.e., California's state loan program provides up to $3 million with 1% rate interest for energy efficiency improvements. Loans must be paid from energy cost savings within 15 years.[164]

CORE OBJECTIVE #4: CREATE AND MARKET A STRONGER COLORADO BRAND

4A. Strategic Recommendation	**Develop a cross-segment industry communication network that can promote the state's energy resources, strengths, and innovation climate**
Background	The Colorado Energy KIN engagement process under the Colorado Blueprint has established a network that engaged more than 400 industry contacts in 17 segments of the Energy industry that can be built upon to promote the state's energy resources. This network can continue to engage with each other through communication between trade associations and other forms of direct contact between organizations.
Strategic Actions	• Conduct quarterly meeting of Energy KIN Steering Committee. • Participate in monthly meeting of Advanced Industry leaders to discuss and collaborate on common challenges across industry sectors. • Conduct a survey of the Colorado Energy industry, including contacts from the Energy KIN process, to identify opportunities for co-benefits by combining marketing efforts. • Coordinate communication to local governments on energy decisions (e.g. purchase of new fleet vehicles or selection of street lights) that align with advancing innovation that can be promoted outside of the state. • Work with state and industry organizations and formulate strategies to promote Colorado's energy export potential to attract new companies.
Lead	Industry Trade Associations
Time Frame	1–6 months
Estimated Cost	$

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Precedent	In September 2008, the California Public Utilities Commission (CPUC) released the state's Long-Term Energy Efficiency Strategic Plan, which was developed through a collaborative process and communication network involving CPUC's regulated utilities—Pacific Gas and Electric Company, Southern California Edison Company, San Diego Gas & Electric Company, and Southern California Gas Company—and more than 500 individuals and organizations working together over an 11-month period. The plan provides a strategic roadmap for integrating energy efficiency efforts to achieve the aggressive goals the state has set for itself. It aims to bring together key participants beyond CPUC and the regulated utilities, including publicly owned utilities, the financial and building industries, cities and counties, other state agencies, and businesses and consumers, to work together toward common energy efficiency goals.[165] In 2011, the Connecticut General Assembly created the Clean Energy Finance and Investment Authority (CEFIA) with the mission to promote, develop and invest in clean energy and energy efficiency projects in order to strengthen its economy, protect community health, improve the environment, and promote a secure energy supply for the state. CEFIA is governed by an 11-member board of directors appointed by the governor and the leadership of the State Legislature. CEFIA, as the nation's first full-scale clean energy finance authority, will leverage public and private funds to drive investment and scale up clean energy deployment in Connecticut.[166] The New York State Energy Research and Development Agency (NYSERDA) developed programs to catalyze sustainable programs that will serve as the foundation for an innovation ecosystem across New York. For example, the Clean Energy Business Incubator program promotes successful partnerships between early-stage cleantech companies and regional incubators that provide guidance, technical assistance, and consultation to companies to help them develop and commercialize clean energy technologies. Since 2009, NYSERDA has established six cleantech incubators through the program. Each incubator receives up to $1.5 million over the course of four years, which is paid out according to milestones. By the third quarter of 2011, with just over two years of operation and $3.9 million in program expenditures, the Clean Energy Business Incubator program has already achieved significant results. The six incubators have nurtured the creation of several hundred net new jobs at client startup companies and the introduction of 33 new products to serve the clean energy market. These incubators have assisted client companies in raising $41 million in private capital and attracting $11 million in federal funding, and significantly leveraging state expenditures. NYSERDA's efforts to help cleantech businesses develop and commercialize new energy technologies has been critical in helping New York create and retain the types of companies that form a foundation for a clean energy economy.[167]

CORE OBJECTIVE #5:
EDUCATE AND TRAIN THE FUTURE WORKFORCE

5A. Strategic Recommendation	Increase industry engagement among current science and engineering students to increase their interest in pursuing Energy industry careers
Background	The Energy industry has the potential to play an outreach role to engineering and science students in order to attract and grow the number of students seeking to enter into energy careers.
Strategic Actions	• Update the energy career interest brochure that was developed by the Colorado Department of Labor using WIRE funds. • Leverage regional efforts of the Colorado Workforce Development Council Sector Partnerships. • Promote and facilitate career fairs in the energy sector and encourage energy company participation.
Lead	Industry Trade Association in collaboration with Colorado Workforce Development Council and Local Workforce Centers
Time Frame	12–18 months
Estimated Cost	$$
Precedent	The mission of the Institute for Sustainable Energy, located at Eastern Connecticut State University, is to identify, develop and become an objective energy and educational resource regarding the means for achieving a sustainable energy future. The Institute is involved in four types of sustainable energy education initiatives: (1) educational outreach to K-12 schools/ universities and professional development for individuals in the Energy industry, (2) maintaining a clearinghouse of energy sustainability information, (3) developing energy solutions for communities, and (4) helping with public policy on energy issues throughout Connecticut. The Institute is involved in a variety of K-12 energy education curriculum development and implementation initiatives, while providing seminars, workshops and symposiums for professional development to the Energy industry. The Institute is also assisting Connecticut communities in the development of sustainable energy plans.[168] The Pennsylvania STEM Initiative, established in 2007, is a statewide effort to create the foundation for the state's future competitiveness by establishing a network of partners and programs that support the development and deployment of science, technology, engineering, and mathematics education and workforce development. This initiative is implemented with support of leaders from multiple Commonwealth agencies, as well as business, secondary education, and higher education partners.[169]

5B. Strategic Recommendation	Expand science, technology, engineering, and mathematics (STEM) education programs for the Energy industry
Background	The State of Colorado is participating in an initiative with several organizations to develop a Colorado STEM Education Roadmap and Action Plan. The plan is in the final stages of development through an initiative led by the Colorado Legacy foundation and involving the Colorado Education Leadership Council, Gil foundation, the Colorado Department of Higher Education and OEDIT. The plan is scheduled to be presented to the governor as early as January 2014.
Strategic Actions	• Identify the role of the Energy industry to support the Colorado STEM Education Roadmap and Action Plan, which will be finalized in early 2014. • Identify the role of the Energy industry to promote STEM education at the K-12 level.
Lead	Colorado Legacy Foundation, Colorado Workforce Development Council, and Industry Stakeholders
Time Frame	6 months
Estimated Cost	$$
Precedent	STEMx, currently with 19 member states, is a network for the states dedicated to improving STEM education. It provides a platform for states to share and spread practices aimed at increasing student achievement in STEM; expanding the capacity, number, and diversity of high-quality STEM educators; and mobilizing states and communities to advocate for STEM. For example, Michigan STEM Partnership is a public-private collaborative that includes educators, employers, legislators, and any others who are concerned about creating the new economy and addressing the current lack of STEM skills in school children and job applicants.[170] National Governors' Association: NGA Center STEM Activities: Over the last two years, the NGA Center has supported six states (Colorado, Hawaii, Minnesota, Ohio, Pennsylvania, and Virginia) in advancing state STEM education policy agendas. A central premise of this work is the implementation of a STEM Center model connected to a regional and state-level infrastructure. The NGA Center expanded the STEM network to include a total of 33 states. Participation is open to all states. Through this network, governors' key policy staff share best practices, lessons learned, and have access to a number of NGA Center resources, including the NGA Center STEM E-Portal, sponsorship to attend national and state meetings focused on strengthening STEM education, grants, and a STEM Communications Toolkit.[171]

5C. Strategic Recommendation	Develop technical training programs for Energy industry workers
Background	A large number of energy employment opportunities can be made available through programs that provide skills through certificate or apprenticeship programs. The Energy industry should seek ways to support these programs, in addition to four-year degree programs.
Strategic Actions	• Leverage regional efforts of the Colorado Workforce Development Council Sector Partnerships to support executive industry advisory groups to provide updates on workforce and skill needs. • Identify small business employment needs in the Energy industry. • Develop greater coordination of employment opportunities for three primary career pathways into the Energy industry: students seeking employment after secondary school, students entering community colleges and four-year colleges, and individuals seeking career changes. • Explore developing educational programs that provide stackable certificates leading to an Associate of Applied Science degree—similar to the program created by Colorado Community College System for the utility industry. Such programs need to be a clear, concise suite of study that is supported by the industry and recognized by human resource departments when hiring.
Lead	Industry Trade Associations in collaboration with Colorado Department of Education, Colorado Department of Higher Education, Colorado Community College System and Colorado Workforce Development Council
Time Frame	6–18 months
Estimated Cost	$$$
Precedent	The Florida Solar Energy Center (FSEC) offers a wide range of courses covering renewable energy and building energy technology topics. Most courses include both classroom instruction and hands-on field experience. In many cases, attendees can receive continuing education units (CEUs), and some courses are approved for Florida professional license renewals.[174] The New York State Energy Research and Development Authority (NYSERDA) developed a statewide network of training programs in clean energy. The network has more than 70 training organizations offering a wide variety of clean energy courses with programs ranging from basic technical training to advanced levels.[173]

5D. Strategic Recommendation	Develop energy career pathways through the state education and workforce development systems
Background	The state's education and workforce development systems could support the future energy workforce pipeline through the use of energy concepts and curriculum within existing programs, or considering the development of new programs.

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Strategic Actions	• Develop partnerships with education and workforce systems to conduct gaps analyses for skills needed in the industry. • Develop partnerships with the education and workforce systems to identify core competency courses that will result in energy employment opportunities. • Develop and/or identify curriculum that provides math and science in the context of energy and provides contextual-based learning ("real-world settings").
Lead	Industry Trade Associations in collaboration with Colorado Department of Higher Education, Colorado Community College System, Colorado Workforce Development Council, and Colorado Legacy Foundation
Time Frame	12–18 months
Estimated Cost	$$
Precedent	The New York State Energy Research and Development Authority, through the Green Jobs-Green New York program, is offering energy-efficiency and renewable energy training courses to help current workers move ahead in clean-energy careers and unemployed workers or those entering the workforce for the first time gain clean-energy skills and professional credentials. Workforce development and training initiatives, funded by the Green Jobs-Green New York program and other sources, include basic and advanced technical training, career pathways, on-the-job training, internships and apprenticeships. NYSERDA-supported training is designed to meet the needs of utilities, energy service companies, contractors, installers, builders, architects, designers and engineers, inspectors and local officials, across residential, multifamily, commercial and industrial sectors through a network of more than 70 clean-energy training providers across the state, including community colleges, State University of New York campuses, City University of New York campuses, Boards of Cooperative Educational Services, and non-profit training organizations.[174] Massachusetts created its Clean Energy Technology Center under the Green Jobs Act (H.B. 5018), signed into law in 2008, which provided $43 million in funding to support the emerging green economy in Massachusetts. The center's goals include creating clean energy jobs; promoting research and workforce training in clean energy technology in the state's public colleges and universities; supporting the expansion of existing clean energy companies; and fostering collaboration between industry, state government, research universities, and the financial sector to advance clean energy technology in Massachusetts.[175]

5E. Strategic Recommendation	**Establish energy career academies for high schools in areas of the state with strong energy resources**
Background	Several states have established career academies within existing schools that demonstrate effective models for supporting the Energy industry with a skilled workforce that meets the current and future employment needs.
Strategic Actions	• Identify regions of the state and education partners for the development of energy career academies within existing education institutions.

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Lead	Industry Trade Associations in collaboration with School Districts and Colorado Department of Education
Time Frame	12–18+ months
Estimated Cost	$$
Precedent	The California Department of Education and Pacific Gas and Electric are partnering to pilot the New Energy Academy in five high schools. Based on the California Department of Education's Partnership Academy model, the New Energy Academy is a three-year program for students in grades 10–12. The Academy's focus on energy creates a "school within a school," as students participate in relevant STEM curriculum and are exposed to unique learning experiences, such as visiting an operational wind farm. On a smaller scale, Rock Springs, Wyoming, launched an Energy Academy in September 2012 in one high school for students in grades 10–12. At Rock Springs, students take all of the required core high school courses for college admission, as well as a full complement of STEM courses focused on the energy theme through the Academy. Rock Springs offers specialized courses related to energy, many of which are taught together with the local community college, so students get dual credit. Every student of the Energy Academy is required to participate in an internship to acquire and understanding of the workplace and develop long-term connections in the industry.

5F. Strategic Recommendation	**Collaborate to address work visas and H1B issues for the Energy industry**
Background	Colorado's Energy industry includes international companies with employees not only in Colorado, but also in other parts of the world. These companies face challenges in bringing foreign employees to work in the United States; in some cases, these employees support the training of Colorado employees. Other Colorado companies are in need of highly skilled foreign workers that would support their growth in the state.
Strategic Actions	• Track and monitor federal immigration and work visas legislation.
Lead	Colorado Department of Labor and Employment and Industry Trade Associations
Time Frame	12–18 months
Estimated Cost	$

CORE OBJECTIVE #6:
CULTIVATE INNOVATION AND TECHNOLOGY

6A. Strategic Recommendation	Establish greater industry and research alliances for the integrated and regional research and development approach
Background	Colorado and its surrounding states have a strong and vibrant community of businesses pursuing advanced energy technologies and leading research institutions. The R&D ecosystem of Colorado will be strengthened by greater regional and business collaboration on R&D initiatives.
Strategic Actions	• Establish a semi-annual regional energy R&D forum of university technology transfer offices that meets quarterly for the region (Colorado and surrounding states) to share research activities. • Identify future DOE projects to develop regional clusters for advanced technology development. • Hire state-wide experts in science, technology and entrepreneurship that will connect research and entrepreneurial assets across the state and identify best practices across the nation. • Establish industry collaboration with state-wide experts. • Develop a state portal of current and past research occurring at universities and federal labs across the state in order to connect business to specific research expertise. • Establish a semi-annual business R&D forum for energy companies new to the R&D field to communicate more effectively business–to-business and with the regions' R&D contacts; the forum would result in entry points for businesses to contact to pursue R&D opportunities. • Conduct peer review of appropriate state-funded energy projects to receive input and feedback on project merit, findings, and future direction. • Establish a partnership among geothermal developers, the Colorado School of Mines, and potentially other Colorado research universities to conduct primary research on the geology of geothermal electricity generation resources to reduce associated costs and risk to developers.
Lead	Research Institutions and Industry Trade Associations
Time Frame	12–18 months
Estimated Cost	$$$$
Precedent	Colorado State University leads a bioenergy consortium of industry, academic, and government stakeholders that is studying the major challenges to the use of beetle-kill wood for renewable energy projects. The Bioenergy Alliance Network of the Rockies was awarded a $10 million grant from the USDA in November 2013 to address the challenges and demonstrate solutions. The project will involve collaboration with partners across four states including Colorado, Idaho, Montana, and Wyoming. Colorado based members of the USDA supported project include NREL, Colorado Forest Service, and industry partner Cool Planet Energy Systems.[176]

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Precedent	DOE's National Energy Technology Laboratory (NETL) established the NETL-Regional University Alliance (RUA) in 2010 with the mission of accelerating development and deployment of energy and environmental technologies to ensure a robust energy future. NETL-RUA is a partnership of academic, industry, and federal researchers. The Alliance combines NETL's technology development and demonstration expertise with the diverse capabilities of industry member URS Corporation and five nationally recognized regional research universities: Carnegie Mellon University, the Pennsylvania State University, the University of Pittsburgh, Virginia Polytechnic Institute and State University, and West Virginia University. Programs conducted by NETL's Office of Research and Development coordinate the expertise and talents of hundreds of public- and private-sector scientists, engineers, technicians, and other professionals. By bringing together diverse viewpoints and resources, RUA is focused on developing the next generation of energy technologies that will invigorate the economy, create high-tech jobs, and transform the energy sector.[177]
International Precedents	Finland: Cluster for Energy and Environment (CLEEN)—a Finnish limited liability company with €2.5 million in equity—was funded in 2008 through a consortium with 44 shareholders consisting of the major companies and research institutes that have significant energy- and environmental-related R&D activities in Finland. The aim was to create cooperative "clusters" or networks around key strategic clean energy and environmental technologies. Its main goal is to stimulate and accelerate innovation through a detailed research agenda that facilitates long-term co-operation among industry, subject matter experts, and academia. Research work is typically resourced and executed 50/50 by industry and academia. The requirement for industry to generate 50% of the overall cost elicited stronger commitment to planning and execution of the CLEEN programs.[178] The Netherlands: The Research and Development Promotion Act (WBSO) was implemented in 1994 to encourage private R&D investment in the Netherlands and is regarded as the single most important R&D policy instrument in the country. WBSO is a fairly traditional tax credit scheme, which reduces a company's tax on wages by calculating the number of R&D hours worked and the hourly wages of R&D staff. WBSO offers different incentives depending on the type of taxpayer. For companies that pay taxes on staff wages, WBSO reduces contributions. In 2010, there was a reduction of 50% of the first €220,000 of the total R&D wage bill and 18% of the remaining R&D wages capped at EUR 14 million per year.[179]

6B. Strategic Recommendation	**Increase industry involvement in research efforts that advance clean energy technologies**
Background	Several segments of the Energy industry are seeking greater involvement and collaboration with research institutions and other industry sectors that they can support through the development of new technologies.

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Strategic Actions	• Conduct a survey of technology developers to identify commercialization priorities and testing needs. • Develop and update a list of key R&D research contacts to provide to industry at multiple touch points to increase awareness. • Identify incentives for industrial and commercial sectors to establish technology testing opportunities for developers. • Identify areas for greater flexibility at R&D institutions for "real-life cases" of energy uses in the industry. • Identify areas where university intellectual property requirements can be lowered to incentivize industry to work with university research centers and staff. • Simplify future state grant application processes and reporting requirements for funding opportunities under $100,000 using the Colorado Department of Agriculture's Advancing Colorado's Renewable Energy (ACRE) program as a model. • Establish a cross-sector industry stakeholders committee to evaluate new technologies and assess value for their operations.
Lead	Industry Trade Associations, Research Institutions, and Colorado Energy Office
Time Frame	12–18 months
Estimated Cost	$$
Precedent	The Georgia Energy Innovation Center is dedicated to the development of Georgia-based clean energy technologies and businesses by attracting and linking academic research, commercialization and business development services, including the "One-Stop Shop" that streamlines business start-up services and facilities' access to available state funding and incentives.[180] Ohio's $2.3 billion Third Frontier technology-based economic development initiative supports existing industries and fosters the formation and attraction of new companies in emerging industry sectors. This program provides funding to Ohio technology-based companies, universities, nonprofit research institutions, and other organizations to create new technology-based products, companies, industries, and jobs.[181] The Iowa Energy Center provides grants for renewable energy and energy efficiency to Iowa's college and universities, Iowa-based non-profit organizations, and Iowa-based foundations for energy research on topics that have strong relevance to Iowa (private sector research partnerships are encouraged); the $100 million Iowa Power Fund supports research, development, commercialization, and deployment of biofuels, renewable energy technologies, and energy efficiency technologies, while seeking to reduce GHG emissions; participant in Powering the Plains multi-state initiative to address energy and agricultural issues through the development of an integrated energy strategy, policy recommendations, and demonstration projects.[182] The University of Nebraska maintains a Carbon Sequestration Program for research purposes in addition to conducting climate change workshop efforts; in addition, the Nebraska Center for Energy Sciences Research, a collaboration between the Nebraska Public Power District and the University of Nebraska-Lincoln, was established in April 2006 to conduct research on renewable energy sources, energy efficiency and energy conservation; and to expand economic opportunities and improve quality of life for Nebraska and the nation.[183]

CONCLUSION

Colorado Energy industry is critical to the state's economic success. The Energy industry involves a broad range of businesses, organizations, and government agencies that have an economic impact on other industries in the state, as well as across the country. Continued innovation in technology development, policy, and education is crucial to expanding and strengthening a robust Energy industry.

The report was prepared by BCS to provide a summary of recommendations from participating industry stakeholder to the following state agencies: OEDIT, CEO, DNR, and CDPHE. The purpose of this project, supported by BCS, was to transform the Colorado Blueprint into an actionable business plan for the state's Energy industry. From the input provided by Energy industry leaders and stakeholders throughout the state, it was made clear that Colorado has the following assets that establish the foundation to remain and strengthen the state as a global Energy industry leader:

- Rich in a diverse resource base of oil, natural gas, and coal;
- Renewable energy resources for utility-scale and distributed generation projects using wind, solar, hydropower, and biomass;
- Mineral resources to support the Energy industry, including uranium, molybdenum, gold, and silver;
- World-class energy research institutions, including NREL, Colorado University, Colorado State University, and the Colorado School of Mines; and
- Unique geographic regions and talented human capital to develop and demonstrate technologies for national and global markets.

Through the input of the Energy KIN Steering Committee and Tactical Teams a 5 to 10 year vision was created to advance the Energy industry: **Colorado will continue to be a global energy leader by combining its resources, talent, innovation and capital to create energy production and efficiency solutions for state, national and world markets.** The report indentifies a number of key strategies to support this vision, including:

- Develop a long-term energy plan that is inclusive of the diverse Energy industry sectors.
- Establish regulatory stability; consistency across local areas; and more efficient, streamlined regulatory procedures.
- Pursue opportunities for greater energy efficiency and distributed generation integration within new and existing and facilities.
- Improve access to capital for R&D, startups, small businesses, and mid-size energy efficiency and distributed generation projects.
- Develop business and government collaboration initiatives across Energy industry sectors to support technology innovation, business growth and recruitment, and public outreach.
- Play a more prominent role in attracting STEM students and in expanding STEM education opportunities across the state for the Energy industry.
- Work collaboratively with education and workforce systems to strengthen and develop career energy pathways.

Collectively, the recommended strategies and actions are designed to align ideas and resources of the Energy industry to create energy jobs in Colorado; attract new energy businesses to Colorado; increase the competitiveness of Colorado's energy businesses; and develop the state's energy resources—in a balanced and economically and environmentally responsible manner.

APPENDIX A – SURVEY QUESTIONS

The following online survey questions made available during the listening sessions using *SurveyGizmo:*

1. What is your relationship to the energy industry in Colorado?
2. If you work for an energy-related business, please describe your business. If you don't work for an energy-related business, please describe your primary interests and ideas to support the energy industry.
3. What are the most critical elements for sustaining and growing your business in Colorado? Please identify any elements of the business environment in Colorado that help or hurt your ability to be competitive in your target markets.
4. What market opportunities are you targeting for future expansion of your business?
5. What steps could Colorado take to attract more investment into your type of energy business? For example, are there any suppliers outside of Colorado that we should work together to bring to the state?
6. Please describe what technical assistance you have received in the past from state government and/or other organizations.
7. Please describe any assistance that your company needs in order to become more competitive with your national and international competitors. For example, do you need assistance finding local suppliers, training your workforce on specific skills, or developing new technologies?
8. Last Name:
9. Organization:
10. Phone:
11. Email:
12. Address:
13. City:
14. State:
15. Zip Code:

APPENDIX B – ENERGY KIN STEERING COMMITTEE

Richard Adams	Director, Innovation and Entrepreneurship Center, National Renewable Energy Laboratory
Cary Baird	Community Engagement Specialist, Chevron
John Benton	Vice President and General Manager, Black Hills Corporation
Angie Binder	Government Relations Advisor, Encana
John Bringenberg	President, HomeTalk SunTalk Solar
Jim Burness	Chief Executive Officer, National Car Charging
Beth Chacon	Manager, Environmental Policy Relations, Xcel Energy
Ralph Christie	Chairman of the Board, Merrick & Company
Tom Clark	Chief Executive Officer , Metro Denver Economic Development Corporation
Sherry Cobb	President, Colorado Propane Gas Association, JC Propane, Inc.
Carolyn Dunmire	Senior Project Manager, Ecosphere Environmental
Megan Gilman	President, Active Energies
Anna Giovinetto	Vice President, Corporate Affairs, RES Americas
Forbes Guthrie	Vice President, Marketing and Commercialization, Stewart Environmental
David Hiller	Executive Director, Colorado Energy Research Collaboratory
Katie Hoffner	Vice President, Marketing and Strategic Alliances, Prieto Battery
Susan Innis	Senior Manager, Public Affairs, Vestas
Dan Kelly	Vice President, DJ Basin, Noble Energy
Aimee Leatherman	Board Member, Conservation Colorado; Manager, Western Region Development, E.ON Climate & Renewables
Rich von Luhrte	President, RNL
Fred Menzer	Vice President, Colorado Operations, Freeport-McMoRan Copper & Gold Inc.
Dave Neumann	Founder, Neumann Systems
Paul Nelson	President, Ward Alternative Energy
Jerry Nettleton	Manager, Environmental Affairs, Twentymile Mine, Peabody Energy

Merilen Reimer	Executive Director, American Council of Engineering Companies of Colorado
Stuart Sanderson	President, Colorado Mining Association
Jackie Sargent	General Manager/Chief Executive Officer, Platte River Power Authority
Dave Schrock	Executive Vice President, Comfort Air Distributing, Inc.
Christine Shapard	Executive Director, Colorado Cleantech Industries Association
Kent Singer	Executive Director, Colorado Rural Electric Association
Sharon Sjostrom	Chief Technology Officer, ADA
Eddie Stern	Executive Director, Colorado Solar Energy Industries Association
Bonnie Trowbridge	Lightning Hybrids
Julie Zinn	Chief Operating Officer, Spirae, Inc.

APPENDIX C – TACTICAL TEAM MEMBERS

John Benton	Vice President/General Manager, BH Exploration & Production, Black Hills Corporation
Melody Bolton	Employment Specialist, Limon Workforce Center
Erin Bradley	Business Development, Abengoa Solar
Mark Buschenfeldt	Senior Project Manager, Global Site Simplification, Vestas
Shelly Curtiss	Manager, Marketing , Colorado Cleantech Industries Association
Dr. Dan Doherty	Academic Dean, Aims Community College
Janet Fritz	Vice President, Marketing/Technology, Metro Denver Economic Development Corporation
Luis Garcia	Business Development, Abengoa Solar
Ledy Garcia-Eckstein	Interim Director, Workforce Development Division, Denver Office of Economic Development
Forbes Guthrie	Vice President, Marketing and Commercialization, Stewart Environmental
Michael Hurowitz	Vice President, Product Development, AcroOptics
Doug Johnson	Vice President, Capital Access, Rocky Mountain Innosphere
Joe Kost	Regional Director, U.S. Department of Agriculture Rural Development
Catherine Jones	Senior Vice President, Wells Fargo
Aimee Leatherman	Board Member, Conservation Colorado; Manager, Western Region Development, E.ON Climate & Renewables
Alan Lemons	Senior Vice President, Wells Fargo
Heidi Loshbaugh	Dean, Math and Science Community, College of Denver
Ravi Malhotra	Executive Director, International Center for Appropriate and Sustainable Technologies
Leslie Martel Baer	President, Strategist Energy Intersections
Lorrie McAllister	Executive Director, Colorado Renewable Energy Society
Laurent Meillon	Director, Capitol Solar Energy
Tom Morgan	Colorado Department of Labor and Employment/Workforce Centers
Wendy Moser	Vice President, Regulatory Affairs and Resource Planning, Black Hills Corporation
Jeremy Musson	Manager, Facilities Group, Pinyon Environmental

Larry Osgood	Energy Advisor, Colorado Propane Gas Association
Puneet Pasrich	Program Manager, Colorado State University, Engines and Energy Conversion Lab
Scott Prestidge	Energy Industry Manager, Metro Denver Economic Development Corporation
Marilen Reimer	Executive Director, American Council of Engineering Companies of Colorado
David Rivera	Government Affairs, Freeport-McMoRan Copper & Gold Inc.
Kirsten Skeehan	Vice President, Operations, Pagosa Verde
Gully Stanford	Director of Partnerships, Colorado Department of Higher Education – College in Colorado
Emily Templin Lesh	Assistant Director, Colorado Workforce Development Council
Thomas Tuttle	Business Agent, Pipefitters Local 208
Lynn Vosler	Director of Workforce, Front Range Community College
Chris Votoupal	Deputy Director, Colorado Cleantech Industries Association
Jenifer Waller	Senior Vice President, Colorado Bankers Association
Michael Womochil	Project Manager, Colorado Community College System
Marshal Younglund	Manager, AmeriGas Propane

APPENDIX D – SUMMARY OF COMMENTS RECEIVED DURING LISTENING SESSIONS

This appendix provides a compilation of various comments received from the participants of the eight listening sessions. The comments are grouped under several topics, similar to the approach taken during the listening sessions to organize the discussions.

Advancements in Energy Production

Solar

- There is currently a largely untapped opportunity for the use of renewable energy, such as solar. While a significant amount of solar potential exists in the state, permitting is a challenge for solar installations.
- Solar systems have stabilized the rolling brownouts and instability in the grid. Solar thermal, with storage, can provide baseload and more stable energy to the grid than PV. The state needs to value that and use it to its advantage. Net metering policy is also important, and the state needs to be more supportive of this.
- Solar and wind programs have to be put in with an understanding of the net system costs before the policies get put in place. People who are not able to take advantage of them will end up subsidizing those using the programs.
- Solar projects on properties that are leased are very difficult to develop. The lessee currently lacks an incentive to implement any upgrades.

Wind

- There is limited wind data in the region for decision making to allow for wind development—some regions may have suitable wind resources. The geography of the region is difficult for wind development, and landowners do not have site-specific data.
- The biggest barrier to wind power is the location and necessary transmission to users not located near the load center. The future development of transmission lines will be important to wind development in the region.
- Northeast Colorado may currently be in a position that locks out any future wind developers from seeking projects without new transmission capacity in the region.
- For wind power, there are currently some issues with "pancaking" in the region—transmission through multiple lines and charge by each. A nodal (local market) pricing model may be a solution.
- Long-term stability of incentives is necessary in order to plan effectively for wind development projects.
- A wind integration study conducted on the Highline Electric Association's (HEA's) distribution system showed that approximately 100 MW of wind turbine capacity could be installed. However, at this time, it does not seem to be economically practical to develop a project that would be spread out across the entire HEA system.

Geothermal

- Geothermal electricity production from oil and gas wells could be a potential opportunity for the region, but land agreements are potential barriers. Mineral rights and land ownership is a complex subject, and the addition of another potential resource may be difficult to develop.
- Producers in the region may find it challenging to adjust the payment process to landowners to allow for the sale of electricity from a well. Currently, there are also capital issues for geothermal development that stem from the need to provide a proven resource.

Biomass

Biomass

- Barriers to biomass power include: lack of long-term purchasers/contracts; weaker project financing/ access to capital; reliable, long-term feedstock availability (may be required by financiers); mid-size projects may be too large for local financial institutions to handle and not large enough for major investors; and some utilities are not willing to work with small power producers.

Hydropower

- Micro-hydro is another potential resource. An existing challenge for micro-hydro development includes a complicated water rights process to navigate. It took a micro-hydro project more than two years to get through regulations to be able to operate the facility.
- A primary barrier for the development of hydropower on many creeks and canals in the Southwest region is that they only run six months out of the year and cannot produce power during the winter months.
- It is difficult to interconnect to a transmission/ distribution line from a ditch or canal that may not be in close proximity to a power systems infrastructure.
- Meeting state electrical inspector requirements for UL-listed equipment has been difficult. The emerging market of micro-hydro technologies are not likely UL-listed for hydro energy.
- Small-head hydro has the potential to be developed in the Eastern Plains region. There is interest in working with CEO to determine the most effective way to use power from canals and reservoirs in the region. The technology would be well-suited to water system infrastructure that is moving water before it reaches the farm. Systems that could be installed may have a capacity of 1 MW or less.
- One important aspect for small hydro power in the Eastern Plains region is that it would help match the seasonal load with high demand during irrigation season. The water power could be used at the same time irrigation power demand peaks in the summer. The region needs help identifying technology or policies that would advance small hydropower development.

Oil and Gas

- Higher prices for oil are stimulating more production in the state. In order to fully realize the market that Colorado has for oil production, it will be important to effectively export the product out of the state. There is a need for additional pipelines to support the export market.
- The oil and liquids plays have a higher market value on the Gulf Coast, and the region's oil could be more profitable with exports to that part of the country. The oil in eastern Colorado has valuable byproducts that can be sold in other markets.
- An important issue for oil and gas pipeline development is obtaining the right-of-way on private property. Right-of-way approval is becoming more difficult with local governments in the state for expansion of liquid petroleum pipelines.
- The effectiveness of future transmission and pipeline development will require maintaining transparency and open communication during the planning process. Landowners should be consulted during the process and not told what to do.
- Local governments may not have adequate permitting and zoning in place for alternative energy projects, which results in lengthy time delays for development.
- The state could work with counties and municipalities to get ahead of future development opportunities by providing local permitting templates.
- Some small communities also lack the capacity in terms of staff and resources to deal with complex regulations on natural gas production and provide education to the community.

Hydraulic Fracturing

- Hydraulic fracturing (HF) used in oil production is a major area of concern for the Northern Front region's urban areas. HF is currently an industrial use that cannot be permitted by local governments. There may be additional technologies to apply to HF activities in urban areas that would differ from rural areas. Local planning initiatives become very challenging to carry out in areas where oil wells are located.

- A well may result in a "dead zone" in a city's future planning efforts. There is an interest to work with oil producers to more effectively use available technologies that would locate HF wells away from homes and potentially capture 100% of volatile organic compounds within urban areas.

Coal

- There is a need to focus on sustaining the coal industry. Coal provides a large base of employment in Craig, Colorado. Coal currently provides more than 60% of Colorado's power, and it may be difficult to replace with other sources of energy.
- Colorado may be placing too much emphasis on natural gas and renewable energy sources to replace current coal power facilities. Price of electricity from coal power plants could be significantly lower than from some type of solar power plants.
- There is a need to look at impacts from legislation on other industry sectors that may affect coal production, as well as the impact on consumers.

Oil Shale

- Oil shale holds a vast amount of energy in the region, but there just is not a way to recover the oil in an environmentally clean and safe manner. CEO should be taking a closer look at this resource and how to develop it.
- Oil shale is a significant potential industry. The state is currently in a situation where it has essentially made rules that will undermine R&D of the oil shale resource.

Mining

- Mining is an important industry for renewable energy technologies—i.e., critical and rare-earth minerals. There are significant resources within the San Juan Mountains, such as tellurium. Currently, there is an effort to encourage more mining in this region, while doing it environmentally responsibly.
- Uranium resources should also be considered. One company was permitted to do a mining project in Montrose County, and then their permit for a uranium mill was taken away. This incident was a serious blow to the economies of Nucla, Norwood, and Nataria.

Market/Business Environment

- Energy efficiency saves money by not having to build a new power plant. The models need more research to identify accurately what the cost of different technologies would actually be.
- There are currently several barriers to attracting energy, manufacturing, and R&D facilities to the San Luis Valley region. These barriers include limitations in the region's transportation infrastructure, education system, and workforce.
- Attracting new manufacturing to the San Luis Valley region may be difficult due to transmission constraints and lack of reliable power to meet a new facility's energy demands. Impact of new production on energy rates will also influence businesses looking to locate to the region; higher energy prices would hurt the region's ability to attract these businesses.
- Any new transmission development in the San Luis Valley region will need to address the "rate stacking" issue—i.e., in some cases, carrying the energy to market will require going through multiple transmission lines, each with its own rate, which will increase cost.
- In Colorado, it is not the utilities' unilateral decision on what to invest in. The cost issues make it difficult for these technologies to be chosen as a long-term energy provider.
- There is a need to have an export corridor in Colorado. Prices are crashing at the Four Corners coal hub. This provides an opportunity to transform the hub into a renewable energy and natural gas hub.

Federal and State Regulations

- Regulatory volatility and uncertainty in regulation are an issue, especially for natural gas production. The delays and final decisions result in uncertainty for producers.
- Regulations and changes to policy impede production and investment in western Colorado; there needs to be a better integration of policies, as well as an awareness of and approach to state regulation.

- State-level regulations could be better suited for energy production than federal regulations. The state government is more in tune with local communities, the local geology, and the local economy.
- Many federal regulations could be deferred to the state-level rules for oil and gas development. In many cases, these federal regulations create confusion with state rules. The state is typically ahead of the federal government on the development of appropriate regulations.
- The regulatory process involving local, state, and federal entities for some regulated activities requires that the same information be collected and applied to multiple forms instead of submitting a single form—there is a need to reduce duplication.
- Each jurisdiction across the state currently has its own permitting process, which acts as a barrier for solar installation companies operating in multiple jurisdictions. In each jurisdiction, the company needs a license to operate. This can become expensive for a company to obtain and maintain multiple licenses.
- A more efficient permitting process that provides a greater regulatory certainty would improve business development efforts—e.g., "one-stop shop" for permitting that would help to coordinate and navigate through the regulatory landscape.
- There is duplication in permitting requirements for natural gas production. Local control has grown to include topics that are below ground (downhole) in nature, and the Colorado Oil and Gas Conservation Commission (COGCC) has primacy. La Plata County, as an example, could use the COGCC permit 2 or 2A and streamline the duplicative work required for permitting.
- Legislation and rulemaking should take a time out for a minimum of three years to give the oil and gas industry a chance to recover as a result of price points and workload associated with rulemaking and legislation.
- Duplicative federal and state regulations are becoming more difficult to navigate (being considered on federal lands) and are a challenge for natural gas producers on the Western Slope to remain competitive with other regions (e.g., Marcellus shale).
- Natural gas producers are seeing more regulation being presented at the local level (primarily among counties in the Southwest region) that may duplicate other rules at the state or federal levels. Increased coordination between COGCC and county governments may be necessary to avoid duplication of regulations.
- There are a number of key federal regulations that the state could engage in, including HF and sage grouse. Sage grouse regulations under the U.S. Fish and Wildlife Service could impact transmission and renewable energy development in the region.
- The federal-level Endangered Species Act is a barrier, and its effect on any future development project is not clear. There is currently much uncertainty about the animals listed, and more species are being added.
- There is a need to examine proposed regulations with a cost-benefit analysis before they are implemented or approved at the state level. Further, we should look at the long-term impacts and benefits of legislation, not just what will benefit us today.
- The MOU approach may be a productive, effective way to collaboratively address community concerns—e.g., MOUs developed with the oil and gas industry to establish some local control.
- Utilities should be consulted before proposing legislation. They want to be involved, and they need to be engaged in the process before a regulatory decision is made.
- More education is needed for the general public on regulations applied to the energy industry. In some cases, there may be an inaccurate perception that the energy industry is under-regulated.
- The state could be more actively engaging with federal agencies on oil and gas regulations. Oil and gas production companies active in the state have significant senior water rights. Several of these companies are being asked to give up their water rights by the federal government as part of their agreement to produce on federal lands.
- Counties in Colorado have "1041 powers" that can be applied to both pipeline and transmission development; this provides counties with the power to stop development of lines.

- There is a need for continuity of permitting within a multi-county region that respects each county's "1041 powers" and provides one standard form. The state could provide leadership to work with local governments on 1041 authority to find a better balance on transmission line siting. There has been an impasse with local governments versus the state versus utilities, and methods for removing some of the road blocks that stop projects would be useful.
- Oil and gas pipeline and/or new transmission line developers are facing challenges at the county level for future projects. County governments have permitting authority for pipelines and transmission lines and can delay or prevent development.
- There is concern that the recent passage of SB13-252 will take away the ability of REAs to implement creative distributed energy projects. Tri-State G&T is required to meet SB13-252's renewable energy requirement and not REAs in the region.
- There is concern that utility compliance with SB13-252 may occur from out-of-state renewable energy projects and by purchasing renewable energy credits rather than through development of new renewable energy projects in Colorado. Another concern in the region is that the SB13-252 bill defines "recycled energy" too narrowly by not allowing the capture of natural gas flaring from oil production to be a qualifying project.
- Local-level permitting may be the primary challenge to transmission development. Addressing local-level permitting will involve the Public Utilities Commissions, counties, and cities. SB07-100 could provide some solutions for permitting that would provide a more streamlined permitting process.
- The Colorado DOT oversees regulations that can impact the energy industry's growth in the Central Mountain region. Transporting wood feedstock on interstate highways faces costly regulations that could be addressed at the state level. Biomass facilities are currently unable to carry 250,000 pounds of wood in one load because it is considered a divisible load.
- An issue that relates to transportation infrastructure: there is a need for timely superload permits. This should be noted as a flag for economic development.
- The bonding authority is available for the state for construction of biomass projects, but it should also support biomass energy development by expanding bonding authority to private companies.
- Woody biomass resources should be explored further in the San Luis Valley region to determine costs on collecting the biomass feedstock, and to make for a more streamlined decision making process in the collection of the feedstock.
- Air permits are the number one obstacle for producing natural gas. Typically, these are regulations at the state level, with small challenges becoming big challenges. Air permitting rules for biomass projects are also perceived as difficult to navigate.
- Colorado's regulations discourage more mineral investment; although, it is still a leading mineral-producing state, according to international surveys. Certainty in regulation is necessary.
- Regulations must reflect fairness and avoid unnecessary requests for monitoring, testing, and the like without a clear objective in mind. Main issues are with air and water regulations; the Colorado Division of Reclamation Mining and Safety does an effective job permitting and working with industry.
- Regulatory agencies are very slow to react when permits and revisions are submitted. For the coal industry, only a limited expansion is anticipated in the near future. The remaining coal-fired power plants are under unnecessary scrutiny.
- It may take up to 10 years to get a mine permit in Colorado. Commodity prices may not be as favorable at the time when a permit is obtained; this creates uncertainty of the future markets.
- For the stone, sand, and gravel mining industry, there are companies that have waited 18 to 24 months for permit approval based solely on delays in the state agencies' review processes.
- State agencies are using part-time employees for processing air permitting. These air permit delays also apply to the mining industry. There is currently a national-level problem with permitting delays.

- CDPHE does not have sufficient staff for air permitting, but seem to have plenty of staff for regulation. Also, water quality permits for mining are difficult to gain approval through the system.
- Statewide solar permitting standards are being advanced in the state, but local permitting barriers persist in the region—e.g., structural permits may not be necessary for PV panels that weigh roughly 2.5 pounds per foot.
- For biofuel facilities, the U.S. Forest Service has to issue enough cutting permits to get enough trees to create energy. Getting tree permits is a challenge at the federal level. The foresters also face litigation for removing trees.
- Utilities may have to deal with lengthy EPA regulations and processes that continue beyond when an agreement is reached among stakeholders—e.g., Tri-State G&T's experience with the Craig Power Plant for regional haze improvements.
- The regulatory process lacks definition. So much goes into settling law suits with EPA, which needs to be reined in. The EPA regulations are litigated under the Equal Access to Justice Act, which was created to allow recreational activities for handicapped people and the elderly.
- The Equal Access to Justice Act should be reviewed and reformed in order to serve its original purpose so that Colorado can be more competitive. Many environmental groups are using this law to fund their causes, which takes money away from the agencies, as they seem to sue on any topic related to the National Environmental Policy Act, enforce land-use laws, the Clean Water and Clean Air Acts, and laws protecting endangered species.
- The industry needs state assistance in eliminating frivolous lawsuits by environmental groups that appeal every stage of permitting and leasing. These lawsuits delay permitting and leasing processes that the coal industry needs to complete for leasing and mining activities. This is for both the power generation and exportation sectors of the economy.
- The ability of utilities to retrofit or construct new coal-fired power plants to meet the requirements of EPA's Maximum Achievable Control Technology regulation is impossible. Therefore, our main market for coal would be export, and with environmental groups opposing export facilities, future expansion is going to be difficult on all fronts.
- Water quality and stream standards are an important issue for mining. The mining industry does not want to impact water quality, but some requirements currently being developed are very difficult to achieve.

Energy Efficiency Trends

- Energy efficiency is the fastest-growing clean technology sector in the state. There needs to be a test or demonstration facility for these technologies.
- Key drivers of energy efficiency projects include incentives (state, federal, and utility), utility engagement, and increased awareness.
- There is a need for using a life-cycle cost approach to energy comparisons. Not just the return on investment, but looking at externalities, economic impact, and environmental impact.
- Utilization of capital assets is important, and new investment for energy efficiency needs to be cost effective.
- Some programs do not align what customers are seeking for energy efficiency improvements and the more cost-effective improvements that would actually provide greater benefits for the utility and customers.
- Large agriculture operations in the San Luis Valley region may face very high upfront capital expenses to improve the efficiency of multiple center pivot irrigation systems. These high expenses are a barrier to making energy improvements.
- Incentives are what drive energy efficiency as opposed to mandates, which drive costs and not efficiencies. There is a concern that energy efficiency activity will begin tapering off in the near future without sustained effort to keep incentives funded.
- There are finite dollars available through the subsidies on energy. The marketplace needs to drive energy efficiency. The current system is not making the market drive energy efficiency, and there needs to be a change.

- It is challenging to access financing for some types of energy efficiency projects that are larger than residential energy efficiency improvements. The commercial Property Assessed Clean Energy program developed by the state will support projects currently lack financing.
- On-bill financing for energy efficiency improvements is an area of interest to REAs and municipal utilities in the region. There could be a role for the state and banks to support utility on-bill financing programs.
- The Metro Listing Service (MLS) for residential real estate sales currently does not provide accurate or valuable information on energy costs for most homes listed. Capturing a home's Home Energy Rating System (HERS) score in the MLS system is important.
- There are currently issues with appraisals. Appraisers are unable to capture the value of energy efficiency upgrades made by homeowners expecting an increase in the value of their homes when sold.
- Some real estate appraisers are learning how to value energy efficiency, but more expertise is needed in this area. MLS for marketing real estate should be examined for including a HERS score on a home.
- Education for accountants on energy efficiency tax incentives would support the market and provide benefits to their clients.
- Additional education to consumers is important to expand and appropriate energy efficiency improvements. Providing information to consumers is a key piece to understanding cost and making energy decisions.
- The creation of "energy coaches" is needed to support the Central Mountain region's homes and businesses to streamline the retrofit process and provide long-term follow up on projects.
- Small business owners that rent space in commercial buildings have difficulty connecting building owners to energy efficiency programs.
- Small businesses frequently lease their offices, and many are located in multi-use zoning areas that are composed of older houses. These small businesses present opportunities and challenges for energy efficiency projects.
- Programs that focus on income levels result in barriers for energy efficiency. Low-income customers may be renting and therefore not able to make energy efficiency improvements with incentive funds. In other cases, some customers have income that is slightly too high to qualify for incentives.
- Access to capital is a barrier for energy efficiency projects in the Southwest region involving both business and residential facilities. The banking industry could be engaged to better address this barrier.
- Higher income residents in the Southwest region are less interested in making energy efficiency improvements in their homes. There is a reluctance to conduct an energy assessment or audit that would expose areas of energy waste or needed upgrades.
- Landlords with tenants do not generally make energy-related improvements in the Northern Front region. In many cases, tenants are responsible for their utility bill, which prevents a landlord from calculating a payback on an investment.
- Low-income customers may generally use more electricity due to the fact that many are not homeowners, and the costs are barriers to making energy improvements.
- A "collaboration model" between a wholesale power provider and distribution utilities may be a better model for advancing energy efficiency than a "competition model" found in other regions of the country.
- There is a need for financing mechanisms for energy efficiency at the state level. This could potentially include a carbon tax and private capital.
- A sustained commitment to energy efficiency at the state and regional levels is very important for local initiatives and small businesses.
- There is a need for data aggregation and access to data for customers interested in energy efficiency to realize the impact of their work and improvements.
- There should be an effort to help existing energy structures to decouple and help utilities make the transition into allowing renewable energy. Decoupling refers to rate structures that separate energy sales from the recovery of fixed costs.

- Solar thermal systems fall into the category of energy efficiency, not generating energy but saving energy usage. This distinction has been an obstacle and has historically been overlooked in many energy initiatives at the state level. This is also true for geothermal heat pumps.
- Energy efficiency on the generator side is also important and it can have a significant effect. A significant amount of energy can be saved when improving infrastructure. There is a need to support the power providers when making plans and going through the regulatory approval process.
- Publications on energy efficiency provide a good amount of data. There is a need, however, to get this data to the contractors to help expand the information sharing in the industry.
- For an electric cooperative, there is difficulty in stimulating interest in energy efficiency upgrades. Only about 3%–5% of Western Slope business and residential customers are active in seeking energy efficiency opportunities. Cost savings represent only a small portion of total expenses of a customer.
- Residential energy consumption makes up a small portion of the northern Eastern Plains' load for REAs and should not be the focus of energy efficiency programs. Increased energy efficiency should target irrigation improvements in the region that would result in cost savings for farmers.
- The potential "game changer" technology for irrigation efficiency in the future could be low-cost drip irrigation systems. There is an interest in learning more about drip irrigation systems and their potential for energy savings.
- Irrigation pumps have become more efficient over time in the Eastern Plains region. Some wells are now using variable speed controls. Variable speed pumps are effective when the load output of the motor needs to change, which can occur frequently on wells running two sprinklers.
- Pumping water out of wells takes a lot more energy than pumping out of a ditch or a pond. A potential high-priority target for efficiency improvement in the region should be farms using wells for irrigation.
- There needs to be demand side management (DSM) program expansion. Cooperatives and municipalities do not have DSM programs but need them.
- The restaurant industry presents a good target market for energy efficiency in the region. It has many energy uses to consider for energy efficiency improvements. Tailoring an energy education program for this sector would be helpful.
- Rebate programs lag in technology and they do not encourage the most optimized way to improve efficiency. A more dynamic approach to incentivize through utilities would be preferred.
- Rebate programs are how the government picks winners and losers. There is a certain amount of displeasure about that. The best way to pick winners is in the marketplace.
- There is a boom and bust cycle with funding and rebates. Contractors do not like it. There are five utilities, all with different rebates, and they change at different times.

Business Development

- Colorado has a unique opportunity that not many other states do. Because the state is so strong in traditional energy resources and has many innovative cleantech companies that call it home, thought should be given to the state's position to bridge the gap between traditional and new energy sources by connecting the clean technologies in the state, including air and water, advanced engines, bio-based chemicals, etc., to the oil, gas, and mining companies located here.
- We need support in better explaining the scale and importance of energy development in Colorado. The state's projects are less known than those in California or the East Coast, but they are just as complex and important—especially oil and gas development where Colorado has some of the most stringent surface use laws. These laws, which should not block development, can demonstrate how oil and gas development can occur in environmentally or culturally sensitive areas, such as Canyons of the Ancients National Monument.

- There is not enough high-level planning with a large perspective for coordination and planning going forward to avoid issues between energy types. Currently, planning is too focused on specific elements.
- Communication with industry is needed to understand the long-term effects of regulations and laws prior to them being passed, including the need to assess the negative effects of laws and regulations and impact on commodity prices.
- Regulations increase the price and add complexity to operations. Increased electricity sector regulation in Colorado resulted in losing industrial customers to other states.
- Many rural areas are looking to have businesses locate to their region. The state could benefit from economic development opportunities occurring in areas outside of the major metro areas.
- The local economic development impact from projects will involve different factors, including agricultural acres out of production and property taxes.
- Colorado should take advantage of the fact that the mining industry alone contributes more than 50,000 jobs to the state's economy and that Denver is a leading international mining center. Colorado should fairly reflect the contributions of this industry. There are opportunities to work with OEDIT.
- The average pay of coal miners and power operators in the Northern Front area is around $100,000 per year. Jobs advertised for wind power plants are around $30,000–$35,000 per year. Difference in earning will hamper wind power development.
- Similar to the agriculture program, new legislation could develop a program that would allow CDPHE to collect a fee to fund a clearinghouse of permitting support to the energy industry.
- Establishing a market-based system for renewable energy development could help rural electric cooperatives to cost effectively bring renewable power online.
- There is currently a lack of financing options for energy projects and a need for a whole set of power generation options and financing models for different industries.
- Colorado doesn't have a mechanism to evaluate the economic impact of federal land projects and how much the delays cost. CEO is well-suited, from a statutory perspective, to conduct this analysis.
- Development of a rail system is important to the Southwest region for hauling both oil and coal. A rail system has the advantage of being able to carry multiple resources, whereas a pipeline can only carry one energy resource.
- There is a need to get different energy sectors working together. For example, renewable energy that supports traditional energy production, such as use of solar on natural gas well pads.
- A FTZ designation could encourage business expansion for companies, such as Vestas, that must deal with multiple vendors located in other countries. Some foreign suppliers appear to be hesitant entering the United States market due to wind energy incentive uncertainty—with a particular uncertainty surrounding the production tax credit.

Training and Education

- Colorado must talk about all energy—good leadership needs to be inclusive of all of the above. In the past, clean energy is the word used, which implies that all other energy is dirty. It is difficult to get a person to want to be an engineer and work for an oil and gas company because they are being led to believe that these resources are environmentally dirty. A standardized curriculum must be developed that prepares students with math and science and stays away from conditioning students against traditional energy, such as oil, gas, or coal.
- The area around Limon may be the only region in the state that does not currently have a main campus for higher education. Young residents must leave the community for higher education opportunities and may not return to the region for work.
- The energy industry in the region can work with local colleges to help commercialize new technologies. In some cases, new technologies can be adapted for use in the energy industry.

- Training and workforce development in a timely manner is important for the skills needed in the energy industry and other industries. The region may need to focus more on technical skills instead of high-end engineering degrees.
- Training programs do not have to come with college credit to be successful for workforce development. Certification programs may be very valuable to support the energy industry.
- There is a need to design programs that move people into the workforce faster than a four-year degree through programs that are designed for the specific knowledge and skills necessary to be successful in the energy industry. Offering courses that do not follow a plan of study toward some type of document at completion that the graduates can carry with them into the job application process is not the way to go.
- Non-degree/credit courses work well for increasing skills and knowledge for incumbent employees. They are already in the industry and in a position where a certificate of completion of a specific class can be valued by the human resources department and provide benefit to the employee. In this case, there is no need for a certificate or degree program completion because the employer knows of the training program/class that the employee is completing and most likely had pre-approved the program.
- The utility industry indicated it needs a degree/certificate program that it can recognize and value at the point of hiring. The stackable certificate program created by CCCS for the utility industry is an example of such a program. The industry played a vital role in putting this program together, so it knows what knowledge and skills a graduate of the program will have when they apply for employment, with either a certificate or the Associate of Applied Science degree. A same type of program is needed for the oil and gas industry.
- There needs to be a consistent statewide plan of study in the energy field (e.g., oil and gas) that provides students with the knowledge and skills needed for entry and advancement in the industry. This needs to be a program that provides stackable certificates leading to an Associate of Applied Science degree. This way, a student in the program will have certificates indicating the work completed, and it is recognized by the industry at the point of employment application. This needs to be a clear, concise program of study that is supported by the industry and recognized by the human resources department when hiring. A mix of non-credit courses will not provide this clarity.
- It is important to provide training for the maintenance of propane, natural gas, and other AFV infrastructure and refueling stations. The training may involve fire safety as it relates to CNG and propane infrastructure. In some cases, the training may be as short as 15 minutes to train local fire departments on the basics of fuel properties.
- Some companies do not believe they can find a drug-free workforce in the region and therefore seek to source a large portion of the workforce from outside the state.
- There is a need to create interest among kids for jobs related to energy. The energy industry needs to be presented in a manner that represents the whole system and does not divide it between clean energy and other energy sources.
- The state could provide additional support to STEM education programs to increase the interest among students and to facilitate an increase in engineering graduates.
- STEM education is an important issue. Students need to be prepared in K-12, but also need to be encouraged to go further and get advanced degrees.
- A concern for utilities is a lack of engineers available to hire. The oil and gas industry is in need of more skills in process safety management, as well as STEM.

Connecting Business to Research

- Evergreen Clean Energy has worked with Colorado State University on wood-burning biomass research issues. The Town of Vail and Eagle County have conducted emissions reduction studies with the University of Colorado at Denver.
- The San Luis Valley has had a series of partnerships with NREL, which have resulted in data collection on

- solar resources. Eagle County partners with NREL through the Energy Smart program—NREL provided energy efficiency modeling for the county that has been valuable.
- The City of Loveland currently has a Technology Acceleration and Advancement Program designed to develop relationships with the labs and other technology transfer institutions in Colorado. The program also identifies funding grants and opportunities. Program participants indicated that not having access to funding for R&D continues to be a barrier.
- Mesa University partners with Colorado University Boulder. There is a lot of research in the energy development field and it has been fairly successful. If CEO can do anything to promote those programs and reduce red tape to expand beyond the mechanical engineering fields, it would be beneficial to the Western Slope region.
- There is currently robust R&D taking place in the utility sector. There is a large global competition in this space, which is forcing utilities to look beyond Colorado and the West. There are many opportunities outside of this area, which need to be tapped into through the research institutions to stay competitive.
- When dealing with academic institutions and national laboratories, the major issue is intellectual property (IP) rights. This can be a barrier if companies hesitate to use their services because of the IP ownership rights.
- The most successful projects have rational expectations and are realistic. The more two organizations understand in advance, regarding who will pay for what and who will own what, the better the collaboration will be.
- The duration of research programs can be an issue. It can take a long time and may not be viable for an industrial company to make it cost effective. On the academic side, it depends on how long the research student will be there for and working on the project.
- Developing the workforce of the future and growing company employees is important. Curricula are changing fast and the state has a responsibility to lead that effort to be inclusive of today's markets and industries.
- The San Luis Valley region is currently lacking in science and technology training. The state entities that oversee educational curriculum development could be a resource to develop policies or guidelines on a new type of energy R&D curriculum.
- There is a need for community colleges and high schools to develop better programs that educate and encourage students to get into energy industry research, establish informative energy opinions, and change their perceptions. CEO needs to be more involved in advertising Colorado.
- There is an effort to try to grow employees through the research projects. If there were an incentive from the state that would entice an academic institution or company to hire students from the project, that could build a pipeline of employment.
- Workforce development for solar thermal is not just about research, but about other parts of the value chain. Technicians have constant turnover, and training and hiring are difficult. There is a need to have the tools to prepare the technicians.
- Design engineers that can work with complex systems are hard to find. They are typically from out of state, located out of state, or from out of the country; if so, they cannot be retained because of work visa issues.
- In oil and gas, there is a need for good technical minds with familiarity in the industry. In four to five years, 50% of the oil and gas industry workers will retire. Efforts are being made to partner with universities to look at technical programs for training. Looking at it regionally, western Colorado could use better programs.
- The oil and gas industry has had positive and negative experiences with studies on air emissions. An important element for research is to include private-sector stakeholders as part of the research effort. With the appropriate stakeholder involvement, the research can be transparent and ensure that stakeholder participation mechanisms exist for comments.

- A concern for the years ahead is attracting workers to this industry, as the aging miners are retiring. The state should recognize the opportunity to try to draw people to this state and encourage mining.
- There is a need to determine how to get campuses to Grand Junction. The city has much better cost of living than the Front Range cities. There needs to be a way to get people to go to college on the Western Slope and collaboration between the universities.
- In the Central Mountain region, when local organizations have contacted research institutions, the experience has been generally challenging to identify the appropriate staff person or team to work with.
- There needs to be more communication in the energy industry to "connect the dots" between the state's research laboratories and business needs.
- A number of farms in the Eastern Plains region have converted their diesel tractors to run on biodiesel. Farmers, in collaboration with researchers, have been successful in growing sunflowers and/or soy beans for feedstock.

Alternative Fuel Vehicles

EASTERN PLAINS - LIMON

- Currently, Limon and the surrounding region have no Compressed Natural Gas (CNG) or Liquefied Natural Gas (LNG) fueling infrastructure.
- The state's natural gas vehicle activities are perceived to be focused on the I-25 corridor. The I-70 corridor in the Eastern Plains' region may be a good region to expand the initiative. There may be approximately 1.2 million heavy trucks that travel through Limon annually, and about 10,000 vehicles that stop in Limon each day.
- The community would be interested in alternative fuel vehicles if they were confident in being able to use the vehicles as currently use traditional vehicles. Their use would require that they are able to travel long distances with access to fueling stations as well being able to travel over rough terrain in the region.
- Expanding Alternative Fuel Vehicles (AFVs) use would require that they are able to travel long distances with access to fueling stations, as well being able to travel over rough terrain in the region.

CENTRAL MOUNTAIN - EAGLE

- Local government fleets in the region are becoming highly aware of CNG vehicles. The region is planning for CNG stations to allow convenient refueling access from Denver to the state line along I-70.
- More than fueling stations are needed to increase the AFV market. Other important factors to advance the market include having auto dealers with AFV vehicles available in the region, trained mechanics who can service the vehicles, and customers with more knowledge of how the cars work. Some key education targets in the region for AFVs include customers, service technicians, and fleet managers on AFVs.
- A public–private partnership was the catalyst for the expanded CNG transportation options in the region.
- LNG trucks are important to consider when planning for an expanded AFV infrastructure in the region.

SAN LUIS VALLEY – MONTE VISTA

- AFVs are generally viewed as an urban opportunity. The region may not have the market scale in terms of population or cars traveling through the region to implement these systems. The opportunity exists for agriculture producers to use biodiesel in the region.

SOUTHWEST - DURANGO

- Utilization of CNG is an important opportunity for the region; however, there is currently no infrastructure to use the local natural gas product.
- The region should explore opportunities for converting cars and fleets to CNG. Additionally, the infrastructure needed to develop the market from local natural gas includes storage tanks, compressor stations, pipelines, and maintenance facilities.
- Education initiatives are also needed for CNG adoption. The state and natural gas producers are potential areas to explore for funding and sponsorship.
- The State of Oklahoma provides CNG rebates and subsidies that should be examined to expand the use of CNG stations.

- There is currently a disconnect among consumers in that natural gas is regarded as a safe resource for heating the home, but perceived as an unsafe resource for fueling vehicles.
- There is a need to develop partnerships in the Southwest region for the development of CNG and LNG infrastructure.
- There is a LNG plant in the region that transports fuel to Phoenix, Arizona; it should include LNG as an alternative fuel for the region.

NORTHERN FRONT RANGE - LOVELAND

- CNG fueling stations have a Return on Investment (ROI) of about four years in the region. CNG outreach efforts in the region are focused on corporate fleets, not individual commuters. Fleet vehicles tend to be driven more which create greater benefits for reducing air emissions.
- There is a concern that currently EVs do not generate enough tax revenue to support the state's road and highway infrastructure. EVs may consume no or less gasoline than traditional vehicles and therefore may not generate as much gasoline tax revenue as compared with gasoline and diesel vehicles.
- State legislation has recently passed that requires EVs provide a $50/year excise tax on registration. However, there may remain a large imbalance between what the EV excise tax generates than what the gasoline taxes generate.
- Additionally, increased CAFE standards will lead to significant reduction in gasoline use, which will also have an impact on the revenues collected for road infrastructure maintenance and development.
- Federal and state tax credits for EVs that would provide instant price reductions at the time of sale may increase the sale of EVs. The state should consider a tax rebate incentive that provides a benefit at time of sale to support the EV market.
- Cost is a big issue and a large barrier for EVs—cost to install the infrastructure is considerable. Usage is also an issue. There are quite a few vehicles in operation in the region, but there is no guarantee that they will be using the charging stations.
- Resale of electricity is a barrier. Some private entities in the Northern Front region cannot sell electricity. As the state pushes more EVs, this will be something that needs to be addressed.

FRONT RANGE - DENVER

- The CNG vehicle market would likely grow with refueling stations installed in building parking garages. There is also a need for increased education on CNG vehicles—consumers do not always understand how they work.
- The Western Governors' Association hosted a meeting on CNG financing and infrastructure. The report that was produced as an outcome of the meeting should be incorporated into this Energy Key Industry Network effort.
- CNG is a complex issue for deployment; however, there are other countries that have more CNG vehicles in use than the United States.
- Installing CNG refueling stations in the garage parking space of a building would incentivize people to buy the vehicles. Increased education and more knowledge about CNG vehicles will help people make a decision.
- There is a need to look at other types of vehicles—fuel cell vehicles, in particular. There is a need to understand how they compete with other vehicle technologies, how they can collaborate, and what are the benefits and impacts. The models need to evolve, and we need to be better at comparing them.
- The state should not define technologies as they are now because they are moving fast. Incentives should be based on performance, not strictly on the technology. This would allow for greater innovation and the advancement of new technologies.
- EVs have grown by 300%, with 80%–90% of charging occurring at home. Utilities are happy to handle the charging at homes, but they want to know where charging stations are being installed for system upgrade planning purposes.
- The method of charging EVs is an issue. Basing the cost of charging on time used (i.e., minutes/hours) is not equitable because different cars charge at different rates. Charging based on the kWh used is the best method.

- Charging EVs at night creates an opportunity to use excess capacity. From the utility perspective, EV owners should always charge at night and certainly not between 4:00 p.m. and 8:00 p.m.
- The two biggest opportunities for charging in the public sector are workplaces and multi-family housing. The challenge is getting the unit installed at either location. There is need for a tax incentive to encourage expansion of chargers in these markets.

WESTERN SLOPE – GRAND JUNCTION

- There is a concern that CNG refueling infrastructure is not being developed to meet the interest and market demand in the region. In Mesa County there are currently no CNG fueling stations in the region that have been developed solely by private entities driven by the market.
- Local government entities in Grand Junction and Glenwood Springs have each installed stations. A station located in downtown Rifle is owned by a private business, but was substantially funded by a grant from the State of Colorado. Recently, Encana opened a CNG station in the town of Parachute without public funding, the first fully-private CNG station in Garfield County and in all of western Colorado.
- Outside of the U.S. there are millions of CNG vehicles on the road, but companies and/or government in the U.S. have not developed CNG stations that link the key transportation corridors.
- Subsidizing two or three CNG stations in key towns along the I-70 corridor could make it possible to cross the entire state on CNG, boosting consumer confidence in the fuel and increasing vehicle purchases sufficiently to support additional private stations.
- The State of Utah has a funding model to facilitate installation of CNG fueling stations. Purchases of natural gas by homes and businesses include a tax that goes toward building CNG stations and subsidizing the CNG fuel cost.
- The Roaring Fork Transportation Authority (RFTA) built its own CNG station for refueling 22 new CNG transit buses. RFTA has offered several other government agencies the opportunity to use RFTA's CNG infrastructure to refuel government fleets until another station is built in Glenwood Springs.
- Propane safety standards are not well understood by the public. Building owners are having difficulty planning the costs of upgrades to a building that would provide fueling infrastructure.
- There is an interest in adding propane fuel vehicles to the list of primary AFVs to advance in the region and state. Propane vehicles have been in use since 1913 and the technology has improved a lot since then. This type of fuel does not require pipelines as it would be sourced locally. Refueling dispenser stations can be installed on site for users. Encana has a propane plant in Fruita, Colorado, and the infrastructure for propane production has been in this region for years.
- There are currently challenges with dealers not selling propane vehicles and there is a lack of service providers to maintain them.
- There is a need to clarify the propane price confusion (residential versus auto) and educate consumers, in general, on various alternative fuel options and their comparisons. Customers need to have the right information, including propane, which is 25% less efficient than gasoline.
- Propane vehicle fueling prices may be lower than residential propane prices, but that is not widely known, and so vehicle buyers balk when they see a price of over $3/gallon for propane fuel; clear pricing differentiation and publicity is needed.
- In Colorado, less than 25% of produced propane is used in the state—75% is sent out of state and overseas. Propane auto gas should be added to the list of viable alternative fuels. Original equipment manufacturers are coming out with more vehicles that can run on propane. Propane is best used in rural areas where travel distances are greater.
- Most propane supply companies in western Colorado are not currently listed on the DOE's Alternative Fuels data Center refueling map. Those stations that are listed in western Colorado are open for refueling on weekdays 8 am - 5 pm only, no nights, no weekends.

NORTHEASTERN PLAINS - STERLING

- In the 1970s, when gasoline prices reached historic highs, several farmers and contractors in the region had propane tanks in their trucks. There is not a large amount of propane fueling infrastructure in the region today.
- Propane buses are about the same cost as diesel buses, and the fuel equivalent for propane is currently about half the price. Propane fuel should be considered as a cost effective solution for fleets of vehicles.
- Local government permitting may cause barriers for compressed natural gas and propane stations in the region.
- There is a concern that incentives and mandates will inappropriately pick one technology winner over others. A fuel-neutral approach may be better for allowing multiple technologies to develop.
- There is concern that electric vehicles currently do not have the range to be a reliable vehicle for the region.
- The major growth in AFVs could come mainly from fleets that will require collaboration and partnerships.
- Air quality benefits from propane and natural gas vehicles are substantial compared to gasoline vehicles. There may be effective incentives to consider for those vehicles to address air quality issues. The requirements of current federal air emission rules today for off-road vehicles have not created the incentive to choose CNG or propane vehicles over diesel vehicles, because the requirements can still be met cost effectively by diesel engines

OTHER

- Colorado should provide loans or capital for renewable projects, or work with federal government to consider taxing renewable energy efforts on federal lands for a funding stream to pay for the CNG stations.
- The state needs a funding source other than the severance tax revenues received from the oil and gas industry for all energy projects requiring capital. CEO should find a permanent source of funding and then severance money could be used for grants for CNG stations throughout the state where there are large amounts of natural gas produced—e.g., La Plata County.

APPENDIX E – A LOOK AT OTHER STATES: PLANNING AND POLICY INITIATIVES OUTSIDE OF COLORADO

Several states across the country have undergone the process of developing statewide energy plans. In most cases, this planning effort has been motivated by the need for economic development (NASEO 2013). Such is the case for Colorado—examining each industry sector for opportunities to create jobs, expand markets, and strengthen the state's energy industry. Through the planning processes of other states, new and innovative policy and program approaches have been created in order to stimulate the energy industry, create jobs, reduce emissions, and bolster economic activity. The length of time a state energy plan has been in place affects the level of detail in these policy and program approaches, which range from broad mandates for research, into the development of new programs, to specific goals for specific sectors.

This section will review those key policies and initiatives in order to glean possible ideas for similar approaches that can be pursued in Colorado's energy industry.

CAPACITY DEVELOPMENT	
State	**Strategic Action**
Idaho	• Move toward a smart grid structure that allows interaction between consumers and utilities.
Nebraska	• Support programs that help landowners, businesses, and residents interested in investing in distributed generation of renewable technologies. • Improve municipal water and wastewater management strategies and water quality.
New York	• Encourage energy storage deployments. • Define energy storage technologies under Public Service Law, Section 2(2-b), in order to exempt energy storage facilities up to 80 MW from the jurisdiction of the Public Service Commission. • Facilitate the demonstration of carbon capture and storage technology. • Examine the transmission system to identify and evaluate bulk transmission system upgrades or expansions needed to allow for reliable delivery of the energy output from renewable energy systems. • Facilitate the interconnection of distributed generation to the electric grid. • Encourage public and private fleets to purchase AFVs.
Montana	• Increase the capacity of existing transmission lines in existing corridors and maximize the potential of existing transmission lines. • Strengthen Montana's level of participation in regional transmission efforts and organizations. • Promote the generation of low-cost electricity with large-scale, utility wind generation and small-scale distributed generation. • Use new and innovative technologies, such as compressed air energy storage, batteries, flywheels, hydrogen production, smart grid, smart garage, and intra-hour balancing services, to address wind integration.
Oklahoma	• Utilize smart grid technology and methods, such as net metering, to better manage demand peaks.
Oregon	• Continue testing smart grid technologies. • Site transmission lines to meet future electricity demand.
Texas	• Encourage utilities to deploy advanced metering infrastructure that can provide metering data at 15-minute intervals to help consumers understand their roles in energy efficiency.
Utah	• Create a forum to balance infrastructure and the environment. • Improve vehicle technology and AFV fueling infrastructure. • Implement HOV/HOT lanes, reversible lanes, innovative intersection design, and signal coordination. • Identify innovative demand-response programs and remove barriers that limit participation. • Support increased participation in cost-effective distributed generation. • Provide a well-designed and integrated technical assistance program for the industrial sector. • Increase efforts to recover wasted energy to generate power.
Wyoming	• Create an Energy Atlas Geographic Information System decision-support tool—a Web-based mapping tool that allows landowners, industry, and various agencies obtain spatial information on energy development. • Construct state-wide pipeline network corridors to transfer CO_2 to remote areas where it is needed to enhance oil recovery.

RESEARCH INTO NEW RESOURCES	
State	**Strategic Action**
California	• Identify regional renewable energy resources and prioritize areas for renewable energy development based on this information. • Promote incentives for renewable energy development, especially those that lead to in-state job creation.
Montana	• Diversify energy development to include both renewable and non-renewable local resources. • Develop biomass plants to generate heat for industrial use, electricity, or both, and as a means to manage Montana's forests.
Nebraska	• Fund analysis to better understand the feasibility of expanding nuclear power generation capacity. • Pursue policies that help optimize water resources for hydroelectric power. • Increase opportunities for waste-to-energy projects. • Work with local public land administrators to increase opportunities for woody biomass.
New York	• Develop in-state energy supplies, including renewable energy and natural gas facilities, to reduce reliance on higher carbon content fossil fuels. • Encourage the state's power authorities to procure diverse renewable electricity resource development, including solar, onshore and offshore wind, as well as hydrokinetic and sustainably managed biomass. • Encourage in-state renewable energy development through the Renewable Portfolio Standard (RPS), including expanding the RPS program to adopt the governor's goal to meet 30% of the state's electricity needs with renewable resources by 2015. • Complete the biofuels roadmap. • Analyze bioenergy options and identify strategies for promoting the most sustainable/highest value use of biomass as part of the Climate Action Plan.
Wyoming	• Utilize forest waste to produce energy and products.

ENHANCING EXISTING RESOURCES	
State	**Strategic Action**
Montana	• Increase use of vast coal reserves.
Nebraska	• Continue to provide support for the public power system and encourage public participation in local boards. • Maximize investment in coal plants. • Continue building wind energy through public-private partnerships. • Increase opportunities for methane recovery from agricultural and community biomass resources. • Increase ethanol production, blended and delivered across Nebraska and to markets outside the state. • Increase development and use of other alternative fuels. • Expand opportunities for renewable diesel by diversifying feedstock types grown in-state.

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New York	• Support private interest and investment in drilling in the Marcellus Shale natural gas reserves and natural gas pipeline expansions to improve supply and deliverability to markets. • Support bioenergy production from sustainably managed feedstocks. • Increase use of AFVs. • Determine the optimal fuels for the replacement of petroleum, while considering environmental, economic, and energy benefits.
Oklahoma	• Promote natural gas development through the creation of tax credits and exemptions—transitioning state vehicles to run on CNG—as well as the promotion of long-term contracts with power companies looking to use natural gas for generation. • Advance policies to lower the price of Oklahoma-produced crude oil, such as increasing outgoing pipeline capacity. • Integrate renewable energy with other generation methods to strengthen the state energy portfolio. • Develop state wind resources by keeping wind incentives competitive with neighboring states and pursuing a partnership between wind and natural gas industries to better integrate renewables.
Utah	• Maintain and expand production of natural resources.
Wyoming	• Undertake a surface water resource analysis that will help land owners and developers maintain water quality when developing local energy resources. • Develop a centralized groundwater database that agencies can use when planning.

EDUCATION EFFORTS	
State	**Strategic Action**
Idaho	• Create government-led initiatives that spread information about energy efficiency, especially in public buildings.
Oklahoma	• Create programs to educate consumers about their roles in energy management. • Educate utilities on the benefits of combined heat and power (CHP) systems for reducing peak demand.
Nebraska	• Work with utilities on education programs designed to increase the use of electric vehicles.
New York	• Educate end users on the economic and environmental benefits of alternative fuels. • Ensure that efficiency outreach, education, and marketing efforts conducted by state agencies, authority administrators, and utilities reflect best practices in terms of design and delivery. • Use targeted outreach to deliver energy efficiency programs and services to commercial and industrial customers.
Utah	• Increase education and public awareness of energy efficiency through a state-sponsored, single-message communication program. • Require energy-code education as part of continuing education credits for building officials. • Educate homebuyers on the importance of energy efficiency.
Wyoming	• Begin to increase awareness of the benefits of liquefied natural gas production and utilization through both technical studies and an educational summit.

MARKET AND ECONOMIC-BASED ENERGY INCENTIVES	
State	**Strategic Action**
California	• Coordinate state renewable funding opportunities so that they work in tandem with federal funding.
Idaho	• Promote investments in non-traditional sources of natural gas, including landfill methane, anaerobic digesters, and biomass methane. • Encourage investments in CHP systems and other renewable generation methods. • Research current rate designs and gather information on rate changes that can promote energy efficiency.
New York	• Support investments in smart grid and the efforts of the Smart Grid Consortium to identify opportunities for accelerating advancements and investments in smart grid technologies. • Use electricity price signals to help level load and reduce generation requirements. • Study potential requirements for electricity to be priced on a time-of-use basis for all customers. • Implement rate structures and metering requirements for non-residential customers that encourage shifting use of electricity to off-peak hours. • Enhance certainty in the renewable energy market by scheduling regular solicitations for Main Tier procurements. • Create a tracking and trading system for renewable energy credits (RECs) to foster the development of a robust voluntary market for REC purchases. • Continue to provide RPS incentives for environmentally beneficial, renewable distributed generation resources, including CHP, with specific targets determined by the Public Service Commission. • Complement the RPS program with bilateral contracts. • Encourage the Long Island Power Authority and New York Power Authority to continue with issuing an Request for Proposal for the private development of offshore wind resources in a manner protective of natural resources. • Establish a wood boiler change-out program to remove the high-emitting and poor-performing systems from the marketplace. • Provide financial and technical support to accelerate the market introduction of the top tier of bioheating systems. • Work with New York manufacturers to develop their capacity to deliver high-performance bioheating systems. • Provide training to ensure that New York has a skilled workforce to deliver services and products. • Extend the tax credit for bioheating. • Expand funding and implementation support for environmentally beneficial distributed energy resources. • Provide financial incentives for alternative fuel infrastructure development. • Support federal and state tax incentives for fleet and private individual AFV purchases, including infrastructure. • Invest in end-use energy efficiency as the most economical approach to expanding the state's clean energy economy. • Mitigate short-term impacts of rising energy costs on New York's low-income populations • Identify and implement alternative financing programs to fund energy efficiency projects, exploring all innovative financing mechanisms. • Directly implement cost-effective approaches and technologies that facilitate demand response.

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Texas	• Create a fund that can be used to incentivize research on commercial-scale energy storage methods. • Endorse a similar pattern of incentives and market forces that led to rapid investment in traditional wind power for offshore wind. • Provide a sales tax exemption for purchase and installation of solar system.
Utah	• Develop funding methods to acquire long-term, multiple-infrastructure corridors. • Support results-driven, economically sound solutions not favoring one technology over others. • Provide tax credits, tax deductions, or rebates to industries, businesses, and homeowners for investments made in energy efficiency upgrades. • Create a no- or low-interest loan program for industrial energy efficiency capital projects • Include energy efficiency requirements in state/local tax incentives for new businesses. • Consider a job creation tax incentive for hiring resource efficiency or energy managers at industrial facilities. • Encourage banks to include evaluating energy costs as part of the mortgage application and develop low-interest loan services for energy-efficient retrofits.
Wyoming	• Implement wind tax solutions.

MANDATING ENERGY DEVELOPMENT POLICIES	
State	**Strategic Action**
Idaho	• Research necessary steps for implementing a statewide goal for reducing peak electricity loads by 50%.
Nebraska	• Increase opportunities for demand-side energy management and energy efficiencies.
New York	• Establish final Department of Environmental Conservation regulatory requirements for drilling and pipeline construction. • Develop legislation that addresses CO_2 pipeline siting and CO_2 injection to facilitate the demonstration of carbon capture and storage technology. • Support the use of the repowering and replacement of existing nuclear power units with new facilities when such actions can be justified. • Assess the potential for siting renewable energy projects on state lands and waterways where development would not require constitutional amendment. • Develop regional performance standards to accelerate the market introduction of new, high-performance bioheating systems. • Reduce electricity use 15% below 2015 forecast levels. • Expand and enhance low-income efficiency programs. • Improve the energy conservation construction code. • Update the energy code every three years in response to updates to the International Energy Conservation Code for residential buildings and American Society of Heating, Refrigerating and Air Conditioning Engineers standard 90.1 for commercial buildings.

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MANDATING ENERGY DEVELOPMENT POLICIES	
State	**Strategic Action**
New York	• Enact energy efficiency standards for products. • Collaborate with other states to influence federal enactment of national standards. • Promulgate regulations to implement standards from 2005 legislation. • Adopt standards for other products not covered by national standards. • Supplement truth-in-heating law requirements to ensure that prospective purchasers of residential and commercial buildings are provided relevant information on energy efficiency attributes of buildings. • Explore energy-use benchmarking programs. • Expand the statewide Evaluation Advisory Group to include additional state agencies involved in energy efficiency programs. • Develop standard measurement reporting for statewide energy efficiency achievements. • Release specific energy program achievement data, including detailed evaluation reports. • Continue to develop and implement energy efficiency program coordination between state agencies. • All state agencies, authorities, and utilities that administer energy efficiency programs must consistently measure and report results of efficiency programs.
Oklahoma	• Support utility proposals aimed at increasing the amount of bioenergy, hydropower, and geothermal power used in production. • Work with industry to begin financing the transition of state vehicles to alternative fuels • Promote legislation that expands the reach of CNG and EV fueling stations.
Oregon	• Continue to balance energy demands with water supply conflicts, local air quality concerns, and cumulative impacts from multiple projects. • Create a state and federal agency collaborative partnership for regional policy opportunities and challenges associated with sage grouse conservation, sagebrush habitat protection, and renewable energy development.
Utah	• Consider alternative regulations for transmission line and pipeline construction. • Increase coordination between state agencies for project permitting. • Carefully consider subsidizing renewable energy projects before it becomes cost effective. • Increase minimum hiring standards for building-plan reviewers and inspectors. • Encourage utilities and their regulators to continue or begin offering cost-effective programs to support industries' energy efficiency investments. • Require a home energy rating system for all homes listed for sale or rent. • Help low-income households maximize energy efficiency and reduce energy impacts on household budgets.

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Wyoming	• Engage federal agency cooperation and coordination with the State of Wyoming and local governments in the NEPA process. • Gather a committee of oil and gas industry representatives, state environmental regulatory program managers, environmental stakeholders, and public interest groups to conduct a review of state oil and natural gas environmental regulations. • Exert state influence on Endangered Species Act issues. • Conduct a regulatory review and develop recommendations for flaring. • Pursue collaboration on energy planning between Western states. • Agreement status to Wyoming regulatory authority over radioactive materials. • State historic preservation office programmatic agreement. • Wyoming agency permitting processes and timeliness mapping project. • Update uranium reporting guidelines to prevent duplicative reporting. • Baseline pre-development water quality testing. • Develop a state program to track the performance of oil and gas operators, and reward those operators achieving consistently high environmental standards. • Review existing state policies to identify any barriers to increasing supply and demand for CNG.

APPENDIX F – COLORADO ENERGY INDUSTRY TOTAL REVENUE AND EXPORTS

The Colorado Energy Industry revenue and export data for this report is from OEDIT's selection of the NAICS codes in the table below and application of EMSI Data 2013.4 (released October 25, 2013). The EMSI Data 2013.4 is based on data from multiple sources including the Census Bureau's Current Population Survey and American Community Survey; as well as the Bureau of Economic Analysis' National Income and Product Accounts, Input-Output Make and Use Tables, and Gross State Product data. In addition EMSI uses state data from the Colorado Department of Labor and Employment.

NAICS CODE	DESCRIPTION	2012 REVENUE	2012 EXPORTS
211111	Crude Petroleum and Natural Gas Extraction	$12,748,234,642	$11,723,814,035
211112	Natural Gas Liquid Extraction	$125,048,922	$86,624,374
212111	Bituminous Coal and Lignite Surface Mining	$228,515,387	$195,464,683
212112	Bituminous Coal Underground Mining	$1,065,205,543	$844,213,134
212113	Anthracite Mining	$0	$0
212221	Gold Ore Mining	$590,645,512	$524,376,295
212291	Uranium-Radium-Vanadium Ore Mining	$66,671,876	$60,838,738
213111	Drilling Oil and Gas Wells	$1,375,432,506	$690,845,951
213112	Support Activities for Oil and Gas Operations	$3,956,353,891	$2,377,116,276
213113	Support Activities for Coal Mining	$343,546,258	$256,957,819
213114	Support Activities for Metal Mining	$603,724,030	$520,296,763
221111	Hydroelectric Power Generation	$17,990,176	$920,371
221112	Fossil Fuel Electric Power Generation	$357,443,702	$52,967,638
221113	Nuclear Electric Power Generation	$0	$0
221119	Other Electric Power Generation	$139,703,294	$56,184,084
221121	Electric Bulk Power Transmission and Control	$199,567,366	$30,712,051
221122	Electric Power Distribution	$3,068,747,848	$952,084,605
221210	Natural Gas Distribution	$1,902,892,963	$534,765,080
237120	Oil and Gas Pipeline and Related Structures Construction	$500,599,926	$224,496,735

NAICS CODE	DESCRIPTION	2012 REVENUE	2012 EXPORTS
237130	Power and Communication Line and Related Structures Construction	$551,814,939	$147,611,374
238220	Plumbing, Heating, and Air-Conditioning Contractors	$2,378,579,884	$303,948,642
324110	Petroleum Refineries	$5,043,638,401	$1,168,599,579
325110	Petrochemical Manufacturing	$0	$0
325181	Alkalies and Chlorine Manufacturing	$54,405,703	$47,008,182
325193	Ethyl Alcohol Manufacturing	$124,399,381	$83,427,063
333131	Mining Machinery and Equipment Manufacturing	$45,295,665	$37,376,403
333132	Oil and Gas Field Machinery and Equipment Manufacturing	$110,462,832	$74,067,209
333414	Heating Equipment (except Warm Air Furnaces) Manufacturing	$29,186,479	$16,958,698
333611	Turbine and Turbine Generator Set Units Manufacturing	$653,112,101	$526,041,029
334413	Semiconductor and Related Device Manufacturing	$799,952,555	$454,936,334
334512	Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use	$3,727,422	$1,305,883
334515	Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals	$386,682,546	$305,027,145
334519	Other Measuring and Controlling Device Manufacturing	$135,793,792	$96,056,061
335311	Power, Distribution, and Specialty Transformer Manufacturing	$36,147,570	$18,082,701
335312	Motor and Generator Manufacturing	$138,733,705	$108,200,364
335911	Storage Battery Manufacturing	$11,167,171	$6,098,755
335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing	$146,160,631	$103,271,651
336391	Motor Vehicle Air-Conditioning Manufacturing	$3,502,776	$2,777,259
336399	All Other Motor Vehicle Parts Manufacturing	$77,052,029	$60,723,810
423520	Coal and Other Mineral and Ore Merchant Wholesalers	$8,022,387	$685,549
423720	Plumbing and Heating Equipment and Supplies (Hydronics) Merchant Wholesalers	$323,755,473	$139,956,401
423810	Construction and Mining (except Oil Well) Machinery and Equipment Merchant Wholesalers	$452,536,795	$220,129,691
424710	Petroleum Bulk Stations and Terminals	$99,572,926	$23,251,472
424720	Petroleum and Petroleum Products Merchant Wholesalers (except Bulk Stations and Terminals)	$238,336,222	$61,167,175
486110	Pipeline Transportation of Crude Oil	$5,180,896	$596,549
486210	Pipeline Transportation of Natural Gas	$257,747,738	$91,151,646
486910	Pipeline Transportation of Refined Petroleum Products	$8,893,196	$4,981,915

NAICS CODE	DESCRIPTION	2012 REVENUE	2012 EXPORTS
486990	All Other Pipeline Transportation	$0	$0
523999	Miscellaneous Financial Investment Activities	$291,942,311	$103,138,307
532412	Construction, Mining, and Forestry Machinery and Equipment Rental and Leasing	$676,462,964	$264,834,296
541360	Geophysical Surveying and Mapping Services	$289,708,419	$225,198,175
541620	Environmental Consulting Services	$521,078,723	$246,851,721
562213	Solid Waste Combustors and Incinerators	$0	$0
	Total	**$41,193,377,474**	**$24,076,139,671**

APPENDIX G – COLORADO ENERGY INDUSTRY EMPLOYMENT

The Colorado Energy Industry employment data for this report is from OEDIT's selection of the NAICS codes in the table below and application of EMSI Data 2013.4 Data (released October 25, 2013). The source for the total number of full- and part-time jobs is from EMSI data based primarily on the Quarterly Census of Employment and Wages (QCEW) from the Bureau of Labor Statistics (BLS) and the Bureau of Economic Analysis (BEA). The average annual earnings for Colorado Energy Industry jobs is from EMSI's proprietary employment data that calculates earnings from wages, salaries, profits, benefits, and other compensation ("2013 Earnings" column in table on next page).

NAICS CODE	Description	2003 Jobs	2013 Jobs	Change	% Change	2013 Wages, Salaries, & Proprietor Earnings	2013 Supplements	2013 Earnings	2013 Establish-ments
211111	Crude Petroleum and Natural Gas Extraction	13,403	38,148	24,745	185%	$68,743	$6,790	$75,533	479
211112	Natural Gas Liquid Extraction	331	739	408	123%	$38,909	$810	$39,719	4
212111	Bituminous Coal and Lignite Surface Mining	660	448	(212)	(32%)	$76,315	$15,547	$91,862	4
212112	Bituminous Coal Underground Mining	1,482	1,992	510	34%	$82,861	$14,685	$97,546	10
212113	Anthracite Mining	0	0	0	0%	$0	$0	$0	0
212221	Gold Ore Mining	534	1,435	901	169%	$81,978	$11,556	$93,534	32
212291	Uranium-Radium-Vanadium Ore Mining	72	195	123	171%	$71,169	$11,073	$82,242	9
213111	Drilling Oil and Gas Wells	1,201	2,686	1,485	124%	$84,881	$10,691	$95,572	77
213112	Support Activities for Oil and Gas Operations	3,560	13,899	10,339	290%	$76,435	$9,344	$85,779	832
213113	Support Activities for Coal Mining	80	341	261	326%	$67,358	$7,507	$74,865	11

NAICS CODE	Description	2003 Jobs	2013 Jobs	Change	% Change	2013 Wages, Salaries, & Proprietor Earnings	2013 Supplements	2013 Earnings	2013 Establish-ments
213114	Support Activities for Metal Mining	143	476	333	233%	$114,476	$13,594	$128,070	29
221111	Hydroelectric Power Generation	44	38	(6)	(14%)	$85,482	$25,614	$111,096	9
221112	Fossil Fuel Electric Power Generation	636	600	(36)	(6%)	$89,800	$34,243	$124,043	18
221113	Nuclear Electric Power Generation	0	0	0	0%	$0	$0		0
221119	Other Electric Power Generation	<10	236	--	--	$90,562	$31,419	$121,981	19
221121	Electric Bulk Power Transmission and Control	147	330	183	124%	$82,577	$32,561	$115,138	3
221122	Electric Power Distribution	5,131	5,160	29	1%	$87,806	$34,847	$122,653	134
221210	Natural Gas Distribution	1,321	1,085	(236)	(18%)	$182,337	$70,289	$252,626	61
237120	Oil and Gas Pipeline and Related Structures Construction	1,771	3,111	1,340	76%	$64,015	$12,952	$76,967	94
237130	Power and Communication Line and Related Structures Construction	2,666	3,470	804	30%	$67,345	$13,588	$80,933	181
238220	Plumbing, Heating, and Air-Conditioning Contractors	22,845	21,659	(1,186)	(5%)	$46,562	$9,089	$55,651	2,156
324110	Petroleum Refineries	390	551	161	41%	$122,211	$101,302	$223,513	12
325110	Petrochemical Manufacturing	<10	0	--	--	$0	$0		0
325181	Alkalies and Chlorine Manufacturing	0	118	118	--	$75,354	$26,142	$101,496	2
325193	Ethyl Alcohol Manufacturing	12	90	78	650%	$60,573	$21,014	$81,587	4
333131	Mining Machinery and Equipment Manufacturing	195	216	21	11%	$61,632	$13,583	$75,215	8
333132	Oil and Gas Field Machinery and Equipment Manufacturing	103	329	226	219%	$101,729	$23,675	$125,404	8
333414	Heating Equipment (except Warm Air Furnaces) Manufacturing	30	109	79	263%	$55,169	$11,076	$66,245	4

NAICS CODE	Description	2003 Jobs	2013 Jobs	Change	% Change	2013 Wages, Salaries, & Proprietor Earnings	2013 Supplements	2013 Earnings	2013 Establish-ments
333611	Turbine and Turbine Generator Set Units Manufacturing	40	1,218	1,178	2945%	$57,477	$13,648	$71,125	4
334413	Semiconductor and Related Device Manufacturing	4,384	2,943	(1,441)	(33%)	$81,724	$16,490	$98,214	45
334512	Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use	51	45	(6)	(12%)	$38,778	$6,911	$45,689	5
334515	Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals	3,375	1,320	(2,055)	(61%)	$116,898	$23,878	$140,776	33
334519	Other Measuring and Controlling Device Manufacturing	316	688	372	118%	$66,776	$13,402	$80,178	34
335311	Power, Distribution, and Specialty Transformer Manufacturing	79	175	96	122%	$74,444	$28,620	$103,064	8
335312	Motor and Generator Manufacturing	216	296	80	37%	$99,645	$38,089	$137,734	5
335911	Storage Battery Manufacturing	133	65	(68)	(51%)	$39,281	$14,175	$53,456	2
335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing	273	435	162	59%	$54,691	$20,206	$74,897	24
336391	Motor Vehicle Air-Conditioning Manufacturing	85	17	(68)	(80%)	$31,613	$6,977	$38,590	1
336399	All Other Motor Vehicle Parts Manufacturing	923	203	(720)	(78%)	$49,355	$11,460	$60,815	19
423520	Coal and Other Mineral and Ore Merchant Wholesalers	32	34	2	6%	$99,740	$14,477	$114,217	8
423720	Plumbing and Heating Equipment and Supplies (Hydronics) Merchant Wholesalers	1,878	1,651	(227)	(12%)	$62,476	$10,097	$72,573	177

NAICS CODE	Description	2003 Jobs	2013 Jobs	Change	% Change	2013 Wages, Salaries, & Proprietor Earnings	2013 Supplements	2013 Earnings	2013 Establish-ments
423810	Construction and Mining (except Oil Well) Machinery and Equipment Merchant Wholesalers	1,802	2,036	234	13%	$70,472	$11,618	$82,090	103
424710	Petroleum Bulk Stations and Terminals	606	627	21	3%	$53,635	$7,187	$60,822	42
424720	Petroleum and Petroleum Products Merchant Wholesalers (except Bulk Stations and Terminals)	916	1,161	245	27%	$68,065	$10,215	$78,280	81
486110	Pipeline Transportation of Crude Oil	21	15	(6)	(29%)	$124,880	$13,311	$138,191	3
486210	Pipeline Transportation of Natural Gas	791	782	(9)	(1%)	$117,482	$19,944	$137,426	40
486910	Pipeline Transportation of Refined Petroleum Products	30	33	3	10%	$81,410	$12,390	$93,800	4
486990	All Other Pipeline Transportation	0	0	0	0%	$0	$0		0
523999	Miscellaneous Financial Investment Activities	575	2,263	1,688	294%	$67,596	$6,453	$74,049	35
532412	Construction, Mining, and Forestry Machinery and Equipment Rental and Leasing	1,337	2,284	947	71%	$60,961	$7,723	$68,684	128
541360	Geophysical Surveying and Mapping Services	600	1,732	1,132	189%	$97,542	$14,339	$111,881	92
541620	Environmental Consulting Services	3,165	4,966	1,801	57%	$55,510	$7,039	$62,549	518
562213	Solid Waste Combustors and Incinerators	<10	0	–	–	$0	$0		0
	TOTAL	**78,406**	**122,449**	**44,043**	**56%**	**$69,172**	**$11,720**	**$80,892**	**5,608**

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