UTAH ENERGY INITIATIVE
GOVERNOR HERBERT'S 10-YEAR STRATEGIC ENERGY PLAN
NOVEMBER 3, 2010 DRAFT

I. INTRODUCTION

In his State of the State address, Governor Gary R. Herbert announced his intent to create the Utah Energy Initiative – a 10-year strategic energy plan that combines Utah's rich abundance of diverse natural resources with our innovative and entrepreneurial spirit to ensure that Utah is at the forefront of solving the world's energy challenges.[1] Utah will excel in job creation, innovation, entrepreneurship, global business, and quality workforce and have a stable and sustainable business friendly environment. Under the Governor's leadership, the State has received several awards and accolades. Most recently, *Forbes Magazine* named Utah the #1 State for business and careers. One key factor in their decision was our low cost of doing business, especially our low energy costs.

Energy forms a strong foundation for Utah's economic growth. The energy industry is the second largest component of state gross domestic product. Utah's vast supply of energy fosters job creation and economic development through exploration, development, production, and manufacturing. The revenue from a vibrant economy funds education, developing the scientists and technicians, entrepreneurs, and workforce to match the opportunities of a vibrant economy and quality of life. The development of a long-term strategic energy plan must engage all stakeholders in Utah's energy future – producers and consumers, academia, industry, environmental advocates, cities and counties – especially those communities that have the very most at stake. As the Governor emphasized, "Through the Utah Energy Initiative, Utah will lead the way to a bright economic future."[2] The Governor established a Task Force (Appendix A) to develop a 10-Year Strategic Energy Plan to:

1. Ensure Utah's continued access to our own clean and low-cost energy resources.
2. Develop the best new cutting-edge technologies, particularly those that enable us to utilize precious natural resources with an elevated environmental consciousness, and deploy them in Utah, nationwide and worldwide.
3. Create new energy-related manufacturing opportunities and jobs in Utah.
4. Modernize the regulatory environment to implement sustainable power generation, energy transmission solutions and energy conservation.
5. Promote energy efficiency.
6. Expand and facilitate responsible development of Utah's energy resources, including traditional fuels, alternative fuels, and renewable fuels.
7. Expand opportunities for Utah to both market and export fuels, electricity and technologies to regional and global markets.
8. Enhance and further integrate partnerships between industry, universities, state government and local communities—especially those in energy-rich rural communities—to address future energy challenges and opportunities.[3]

9. Collaborate with other western states to present a strong and unified voice to federal regulatory agencies on energy and public land issues.

This Energy Plan has been developed by the Task Force,[4] through its Subcommittees[5] and with input from numerous organizations and individuals and during four public hearings.[6]

II. ECONOMIC DEVELOPMENT AND ENERGY JOBS

Utah has abundant conventional energy resources, including three of the nation's 100 largest oil fields with an estimated 286 million barrels in oil reserves. Utah is also home to two of the 100 largest natural gas fields in the United States, and Utah's proven natural gas reserves total 6.7 trillion cubic feet.[7]

Conventional energy and mineral resources have historically served as the backbone of Utah's energy production. However, Utah also possesses an array of renewable resources. Most renewable resources are used to generate electricity. About 2.5% of the state's electricity generation comes from renewable, approximately 26% of which is from geothermal, 65% from hydroelectric, 3% from biomass, and 6% from wind, with a small fraction from solar.[8] New studies indicate substantial renewable capacity in the state.[9]

Protecting jobs, manufacturing strengths, and innovative entrepreneurial enterprises emanating from Utah's energy sector is critical to success in future employment and investment opportunities. Department of Labor employment numbers as of December 31, 2009, provide the following baseline for the Utah Energy and Natural Resource Industries.[10]

Total Employees	19,451
Percent Represented of Utah's Workforce	3.4%
Total Wages	$1,381,142,470
Average Monthly Wage	165% of State's average wage
Number of Companies/Firms	1,142
Total Patents (2005-2009)	162
Venture Capital Deals (2000-2008)	20
Public Deals (2000-2008)	11

Table 1. Employment Baseline for Utah Energy and Natural Resource Industries. Source: U.S. Department of Labor.

The energy sector contributes substantially to state tax revenues; thereby enhancing and stimulating various employment sectors of the state beyond energy. Also, a significant amount of energy development takes place on school and institutional trust lands generating direct revenues that support K-12 public education programs. A Headwaters Economic Study, *Energy Revenue in the Intermountain West*, identifies the following revenues from energy development for Utah.[11]

	Production Value	Production Taxes	Property Taxes	Royalties	Total Revenue
Utah	$3,751,395,980	$77,074,318	$39,786,879	$251,799,166	$368,660,363

Table 2. Revenue from Energy Development for Utah. Source: Headwaters Economics

In 2009, the estimated value of energy and mineral production in Utah was $6.8 billion, about $2.6 billion less than the record high of the $9.4 billion in 2008. With a Gross State Product (GSP) of approximately $109 billion, energy production and its overall influence accounts for 7-10% of Utah's GSP.[12]

Developing Utah's energy resources creates a demand for jobs. Energy development in Utah enables the state to attract new jobs and manufacturing and improve its economic development and employment landscape. The ability to attract jobs is directly related to energy costs and quality of life in Utah. We have the second lowest electrical and heating energy costs in the country. This competitive advantage over other states is one way Utah is able to recruit new and expand existing business. A September 2008 study, *Fossil Fuel Extraction as a County Economic Development Strategy*, compared 26 energy-focused counties in the West. Four Utah counties were included in the study: Carbon, Duchesne, Emery and Uintah. The study shows quite clearly that as energy production/development jobs surged, "the principal growth came from direct energy-related occupations and largely in occupations indirectly associated with energy development. Other sectors such as retail trade, health care and social assistance, and accommodation and food services also grew.[13]

The study raises both a concern and an opportunity: energy-focused counties, and by extension the state, need to have strategies in place to adequately balance their reliance on energy as an economic and employment driver. Utah can do much to attract future energy related jobs and manufacturing by taking specific actions to eliminate barriers and provide enhancements to companies locating or expanding in Utah. In general, development will broaden and diversify our energy economy. Energy development in Utah communities can become a strong stimulus to create vital and growing economic conditions.

Production of energy resources, whether used in-state or exported, creates jobs and revenue for local communities and the state.

- **Coal:** In 2008, Utah ranked as the 14th largest producer of coal in the United States. Coal made up about 50% of our total produced energy resources and 42% of our own energy consumption by resource.[14] There are estimated to be 1850 direct jobs in Utah's coal industry including direct, indirect and related support jobs.[15]
- **Electricity Generation:** Employment in electricity generation and supply totals 3,134 jobs, including hydroelectric power generation, fossil fuel electric power generation, other electric power, electric bulk power transmission, and electric power distribution.[16]

- **Crude Oil (Petroleum Products) & Natural Gas**: In 2008, Utah ranked as the 13th largest producer of crude oil in the United States. In Utah, crude oil makes up 11% of our total produced energy resources and 31% of our own consumption by resource.[17] In 2007, we ranked as the 8th largest onshore producer of natural gas in the country. Natural gas makes up 39.2% of our total produced energy resources and 26.6% of our own consumption by resource.[18] There are estimated to be 11,310 jobs in Utah's oil and gas industries including direct, indirect and related support jobs.[19] Utah has five refineries with over 150,000 barrels per day of refining capacity making gasoline, diesel, jet fuel and related products. The refineries monetize Utah crude oil production. They are a significant source of jobs both for full time employees and contractors. Refineries are regional businesses exporting products to adjoining states. Though they are also significant consumers of natural gas and electricity, they provide transportation fuel reliability and accessibility in Utah. The environment in which they work is competitive because of the number of individuals and firms involved in the industry. This industry needs the certainty of regulation and taxation to invite the investment of necessary capital to continually modernize and make their operations more efficient.
- **Unconventional Fuels**: Utah possesses unprecedented oil-shale and oil sands resources. There have been wide-ranging estimates of the volume of resources in the Uinta Basin. The Utah Geological Survey evaluation of oil shale in the Basin totals approximately 77 billion barrels.[20] Tar sands potential includes 14-15 billion barrels of measured in-place oil, with an additional estimated resource of 23-28 billion barrels.[21]
- **Uranium:** There are estimated to be less than 139 jobs in Utah's uranium industry including direct, indirect and related support jobs in uranium mining and milling.[22] Future job growth is dependent on the growth of the nuclear power industry, nationally and in Utah.
- **Hydroelectric:** In 2008, hydroelectric made up 0.5% of our total produced energy resources and 0.7% of our own consumption by resource.[23] Hydroelectric power comprises about 1.5% of electricity produced. There are estimated to be 26 jobs in Utah's hydroelectric industry including direct, indirect and related support jobs.[24]
- **Solar, Wind and Geothermal:** In 2008, geothermal made up 0.5% of our total produced energy resources and 0.7% of our own consumption by resource. Utah is one of only four states where electricity is generated from geothermal resources.[25] In 2009, there were 223 MW of wind generation and 47 MW of geothermal generation. There are estimated to be 2,450 jobs in Utah's solar, wind and geothermal industries including direct, indirect and related support jobs.[26] There is only a minimal renewables component of manufacturing taking place in Utah. About 35% of the estimated jobs are directly related to manufacturing and production of equipment/ supplies related to the industry. By comparison, for Utah-specific manufacturing jobs, average employment is 4,155jobs in plastics and rubber, 12,318 in fabricated metal, and 3,574 in composites.[27]
- **Bio-fuels and Biomass:** In 2008, biomass made up 0.5% of our total produced energy resources and 0.7% of our own consumption by resource.[28]

- **Energy Efficiency:** Energy efficiency, conservation and demand side management (DSM) are among the lowest-cost options for providing energy, through energy savings, to meeting the growth in the demand for electricity and natural gas. As such, both the electric and natural gas utilities have been actively working with customers to reduce energy consumption through the installation of higher efficiency appliance and equipment and through improvements in building retrofits and new construction. The demand for qualified energy efficiency engineers and contractors, third-party program administration, and consulting firms specializing in planning and evaluation of energy efficiency and demand response has increased significantly, due in part to increased utilization of utility DSM programs and in part due to reduced demand in other construction sectors during the economic slowdown. Energy efficiency and energy related activities create jobs in building and construction, including retrofitting, and energy-driven activities in the transportation sector, including mass transit and vehicle conversions.

As Utah's energy portfolio is diversified, the demand for new energy sector employees will increase. Utah energy employment reflects its historic strength in conventional energy resources. In 2007, Utah ranked 34th in the Nation for the number of green jobs. The State of Utah has started to allocate funds through the State Department of Workforce Services, Salt Lake Community College and the Applied Technology Colleges in the State to establish curriculum, certification and degree programs to prepare Utah's workforce in green jobs. The Energy Cluster has established four pathways for green (sustainable energy, renewables and energy efficiency) job training – Green Construction, Alternative Fuels, Energy Management, and Renewable Transmission. The State is investing wisely to help train thousands to become certified solar installers, certified wind turbine maintenance workers, certified energy management workers, and alternative fuel vehicle technicians.

Efforts are underway to meet the demand for contemporary skill sets in power generation and transmission for the electric utility sector. Green job capacity-building in Utah has also not kept pace with contemporary skill sets for the state's traditional energy sectors, particularly in power generation and transmission. Over 42% of technician level workforce in sub-station management, metering, and line technology will retire within the next five years. The state should ensure that industry is engaged in developing, promoting, and assisting with contemporary skill training workshops and programs in conjunction with regional education centers to ensure a qualified pipeline of "work-ready" employees exist to fill the retirement gap.

As the cost of renewable energy continues to decline, regulatory reforms which encourage renewable energy development and use, once the cost tipping point is reached, will grow Utah's economy. For example, an optional renewable energy tariff could be introduced that would allow regulated utilities to consider specific renewable energy categories for pilot projects until market maturity realizes continued downward pressure on price. This option could be used as an economic development tool, to

facilitate companies that are looking to expand or relocate operations and have a desire to obtain their power from renewable sources.

Because of Utah's world-class conventional and unconventional fossil fuel resources, the state possesses unique opportunities for attracting job growth in the areas of research, development, demonstration and deployment of new technology innovation through business relocation and start-up companies. While the state is making great strides through its USTAR efforts in basic research and development, more investment and support is needed to take technology innovation to the next level using demonstration/pilot projects on the resources in Utah.

The state should attract significant domestic and international investment funding. Such funding provides essential opportunities to help supplement the extreme shortage of "seed" funding and second and third phase funding.

Utah can be a national leader in energy, resource management, environmental and technical training. Utah's expertise in resource and environmental management has great potential to attract high-skilled, high-paying jobs.

In summary, Utah's energy jobs are in the R&D, investment, technology, exploration, extraction, development, production, and manufacturing industries. As coal-fired generation and hydroelectric resources decline, new and expanded industry and jobs will be needed in these rural communities. State government should embrace continued State and federal support for exploration, extraction and production of crude oil and natural gas, invest in unconventional fuels technologies and development and the recruitment of manufacturing of renewable energy production components. Utah must show an unwavering commitment to the future energy economy that includes balancing fossil fuel development with development of renewable and alternative energy.

III. ENERGY DEVELOPMENT AND ENVIRONMENT

Utah has the resources necessary to diversify its energy portfolio to provide affordable, sustainable, and secure energy now and in the future. Utah's Energy Plan includes workable strategies to sustain our economy and protect our quality of life and environment.

Utah's energy portfolio should include fossil fuels, alternative fuels, renewable resources, and energy efficiency. Diversifying Utah's energy base not only provides jobs and revenues, but also critical resources and energy to fuel Utah's broader business and industrial sectors. Utah's energy resource base includes traditional fossil fuels, alternative fuels, and renewable resources, as summarized in Figure 1. Residents, businesses, and industries consumed approximately 27,411 gigawatt-hours of electricity and 131 billion cubic feet of natural gas for residential and commercial heating and industrial use in 2009.[29] With the exception of crude oil, Utah currently produces more energy (including electricity, transportation fuels, and fuel for residential, commercial, and industrial sectors) than we use. In 2008, Utah produced 29% more energy than it

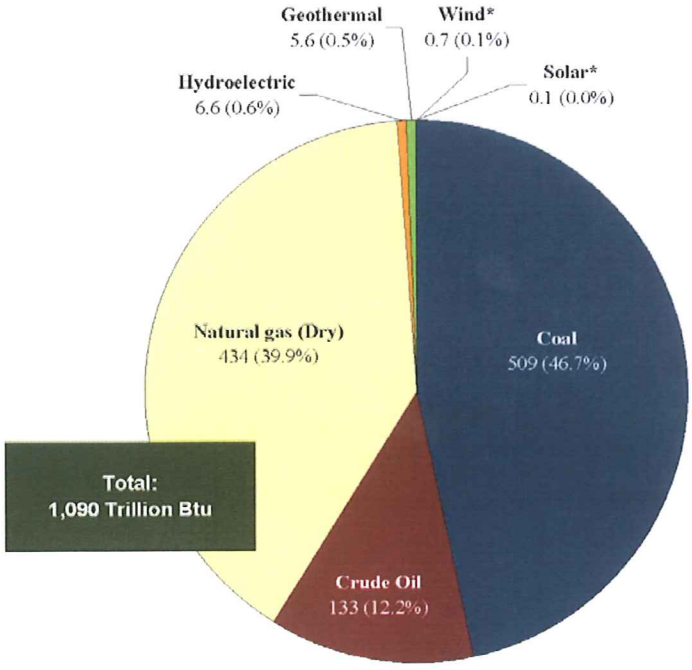

Figure 1. Energy production in Utah by source in 2009. Utah Geological Survey.

consumed.[30] Rocky Mountain Power's load growth is expected to increase from 4,725 megawatts (MW) in 2011 to 5,604 MW in 2020. Natural gas consumption in the residential, commercial, and industrial sectors is projected to increase from 137 billion cubic feet (mcf) in 2011 to 174 bcf in 2020. Based on increases in consumption over the last ten years, petroleum-based transportation fuel use is projected to increase from 45 million barrels/year to 52 million barrels/year during the same period.[31]

To meet future demand, Utah should continue to use existing fossil fuel resources and augment them with new, renewable energy resources.

Electricity generation in Utah is undergoing a transition from predominantly coal-fired generation to a more diverse portfolio of natural gas and renewable resources. This is not the first such transition. Prior to 1973, Utah generated only about 3,000 gigawatt-hours of electricity annually; approximately 30 percent of the electricity was coal-fired generation, and 30-35 percent was generated by renewable energy (hydroelectric power).[32] See Figure 2. From 1973 to 1988, electricity generation increased from approximately 3,000 gigawatt-hours to over 30,000 gigawatt-hours. Utah became a net exporter of electricity. Coal-fired power plants comprised about 95 percent of total net generation as the amount of hydroelectric generation declined. Today, approximately 82 percent of Utah's total net generation of electricity comes from coal-fired power plants, with 16 percent from natural gas, and 2 percent from hydroelectric, geothermal, landfill gas and biomass, wind, and solar.[33] Utah consumes about 60% of the electricity that is generated in the state. The resource mix consumed in Utah, as the Utah Geological Survey notes, is more accurately reflected in the fuel mix of Pacificorp, which serves 80% of the electricity (MWh) and 75% of the electric customers in Utah. That fuel mix includes approximately 58% coal, 17% natural gas, and 13% renewables (including hydroelectric).[34]

Utah's proven coal reserves adjacent to operating mines have been steadily decreasing, from a high of 429 million tons in 2000 to 202.5 million tons in 2009. During this same period, the number of mines decreased from 13 to 8.[35] Business-sector investments in

coal-fired generation, including carbon capture and sequestration, appear unlikely until there is certainty regarding federal carbon regulation. The cost of compliance with additional air pollution controls at existing plants is also under review. Furthermore, as some western states evaluate the generation and importation of electricity from cleaner sources (including renewables and natural gas), electricity portfolios may change.

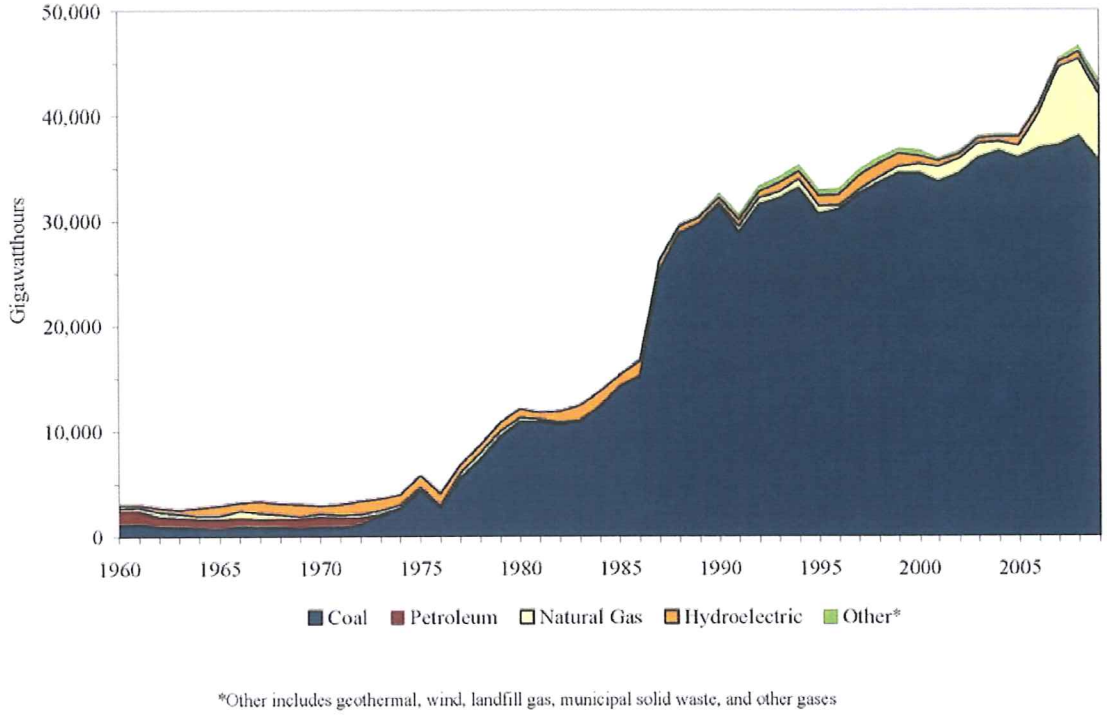

Figure 2. Net generation of electricity in Utah by energy source in 2009. Utah Geological Survey.

Future energy projections place significant demands on natural gas production in Utah and may require the importation of additional natural gas supplies from neighboring states. Natural gas demand has historically come from the residential home heating, commercial, and industrial sectors. In 2008, those sectors consumed approximately 137 billion cubic feet (bcf) of natural gas.[36] Natural Gas vehicles consumed only approximately 240 million cubic feet. Even a doubling of transportation fuel use would have little impact on consumption. However, natural gas consumption for electricity generation has increased steadily since the late 1990's, totaling more than 55 bcf in 2008, while generating approximately 16 percent of Utah electricity production.[37] In 2020, Rocky Mountain Power's production of electricity from natural gas is projected to reach 15,700 gigawatt-hours, compared with production in 2009 of 8,576 gigawatt-hours.[38] Doubling Utah's natural gas-fired generation will require new natural gas production. However, the Bureau of Land Management is not conducting new natural gas lease sales in Utah, due to delays in the approval of federal Resource Management Plans, and permits to drill on existing federal leases are backlogged as much as 18 months. Also, high winter ozone levels in the Uinta Basin must be reduced if natural gas production levels are to be sustained or increased. These factors make the importation of additional natural gas supplies from neighboring states more likely. An

increased reliance on natural gas for electricity generation also means that the need for additional pipeline capacity should be considered.

Utah has vast untapped renewable energy potential, but policy, economic, and regulatory barriers currently impede widespread market adoption. Renewable energy represents a small, but growing, portion of Utah's energy generation portfolio, with a statewide installed renewable energy capacity, including hydroelectric generation, of 570 MW, with an additional 142 MW currently under contract or reserved.[39] Some of these resources are consumed in state, while others are exported to surrounding states. Utah's renewable energy resource potential varies by technology and location.

The Utah Renewable Energy Zone (UREZ) Phase I and Phase II studies, along with industry data and analyses, have estimated Utah's estimated technical renewable energy resource potential to be as follows: 15,000 MW of utility-scale solar located within 50 miles of transmission,[40] 7.8 GW of roof-top solar,[41] 1,830 MW of wind with expected gross capacity factors of at least 30%,[42] approximately 600 MW of discovered or known conventional geothermal,[43] and 200 MW of developable biomass resources (agricultural residues, forestry residues and urban wood waste).[44] Data and forecasts for new utility-scale hydroelectric dams are not readily available.[45]

The Utah Renewable Energy Zone (UREZ) Phase I and II reports represent a screening-level study that identifies geographical locations of renewable resources and estimates the theoretical potential of electric energy capacity. The reports do not provide project-level assessments of energy resource quality or project development potential.[46] The studies also represent a point-in-time review, and the model provided in Phase II is designed with the flexibility of revising resource and financial inputs, as conditions and data change, and depending on development and transmission objectives. More review is needed to identify the viable renewable energy projects, and potential barriers that may impede them. Given the current situation with coal as a primary fuel for base-load electric generation, Utah needs to develop every viable renewable energy project it can identify.

Nuclear power generation deserves additional evaluation, but will not be available for electricity generation in this 10-year strategic plan. The feasibility of future nuclear energy development in Utah will be impacted by the emerging role of nuclear energy nationally, as well as water, waste disposal, size of the plant, rail access, transportation of spent fuel, transmission costs, and available certified designs. Important impacts on the economic basis for developing new nuclear energy projects include future taxes or cap-and-trade programs to restrict carbon emissions, cost of compliance with regulations to control other air pollutants, and the instability of natural gas prices. Converting the current interest in building new nuclear energy plants in the United States into a series of new plant construction projects is dependent on public acceptance (this is particularly true in Utah), regulatory certainty, water availability, and the ability to finance. This new environment will provide a context for encouraging nuclear energy generation development in Utah. Furthermore, if environmental concerns or policies curtail the development of future coal and/or gas-fired plants, or increase their net generating costs, this would provide an additional incentive to consider nuclear as a

component of the state's base-load electrical generation. Because of size and complexity, the planning horizon for a nuclear plant currently requires 10-12 years, probably making it an impractical choice for the 10-year strategic plan. Consideration of the above-noted issues should be revisited, if the timeframe or conditions change.

Energy development can occur in concert with protection of our air, land, water, and wildlife resources.

Federal Lands – The federal government owns and manages approximately sixty percent of Utah's surface lands and a larger portion of the mineral estate. Accordingly, federal land management agencies will play a central role in the state's ability to develop its oil, gas, and renewable energy resources. It is also true that the state's public lands include pristine air sheds, national parks and wilderness areas, important water resources that are essential to local communities and wildlife habitat and riparian zones, world-renowned archeological and culturally significant sites, nationally recognized scenic areas and prized recreational locations. Because management of federal lands is prescribed by statue and administrative rule and attempts to balance competing uses, it is inherently difficult to achieve. Conflicts inevitably arise between industry, conservation organizations, and state and local leaders over how and where energy development should occur on Utah's public lands and what resources should be protected for their environmental and cultural values. These conflicts have triggered costly legal and administrative challenges that impact energy development in Utah. Energy development is a legitimate use of our public lands. To be successful in achieving the Governor's energy development objectives, Utah officials will need to develop strategies to work with the federal agencies and navigate the balance between economic and environmental sustainability.

Air Quality – Coal and natural gas plants typically emit a number of criteria air pollutants, those defined by the Clean Air Act as "harmful to public health and the environment and to cause property damage." Criteria air pollutants include particulate matter, sulfur dioxide, and oxides of nitrogen. The emissions are permitted and regulated consistent with the Clean Air Act.

Throughout the West, the energy production sectors have been viewed as major contributors to visibility impairment, especially in the national parks. Recent plans to address regional haze have resulted in substantial controls on emissions of sulfur dioxide. The full implementation of the regional haze plans will result in additional improvements as emissions from electrical generation are reduced.

Climate impacts associated with carbon dioxide and other greenhouse gases remain a contentious and politically-charged topic among some policymakers. However, a 2007 report authored by scientists from the University of Utah, Utah State University, Brigham Young University, and the U.S. Department of Agriculture, entitled *Climate Change and Utah: The Scientific Consensus*, states that, "[t]here is no longer any scientific doubt that the Earth's average surface temperature is increasing and that changes in ocean temperature, ice and snow cover, and sea level are consistent with ... global warming."[47] This 2007 report goes on to identify some of the environmental consequences predicted

as a result of climate change in Utah, including: fewer frost days, longer growing seasons, more heat waves, a decline in Utah's mountain snowpack, and the threat of severe and prolonged episodic drought in Utah. Assigning monetary values to these projected consequences is difficult. It is similarly difficult to predict whether Federal legislation will assign a tax to carbon dioxide and other greenhouse gases. If carbon regulation is imposed, the impact will likely be lower for natural gas-fired generation than for coal-fired generation, given that, on average, natural gas emits only about half a ton of carbon dioxide per megawatt-hour of electricity generated, whereas coal emit one ton. If a carbon regulation is enacted, it may be useful to monetize the impacts associated with different energy portfolios that can meet projected electricity demand over the next decade.

Oil and natural gas drilling and production may also impact air pollution. The Uinta Basin has recently recorded elevated levels of wintertime ozone. If these levels continue, they may impact attainment of national ambient air quality standards. It is likely that energy development contributes to the Uinta Basin's elevated ozone levels, although the causes of the high ozone readings are still being investigated. Monitoring from Vernal, Utah, indicates that fine particulate pollution may also be a problem in the winter with cold pool temperature inversions.[48]

Water Consumption and Quality – There is very little water available to appropriate for any new type of energy or other development in Utah. Most areas of the state are closed to new surface and ground water appropriations (especially new consumptive appropriations) and those that are still open are primarily for ground water in relatively small quantities. What little may be available currently will undoubtedly decline over the next decade. However, water currently used at other facilities along with technological and efficiency advances in the energy industry may provide additional water for power plants utilizing natural gas or nuclear, and other renewables.

Given Utah's population growth and projected economic growth over the next decade, the possibility of increasing drought, and with limited *new* water resources available, water consumption of energy resources should be given careful consideration. The State of Utah may wish to calculate the water consumption associated with different energy portfolios that can meet projected electricity demand over the next decade. An energy portfolio emphasizing renewable energy and energy efficiency could offer significant water savings relative to other energy portfolios.

Importantly, power plants located in water-scarce regions may rely on dry cooling systems, which use air to cool and condense steam, or hybrid wet-dry cooling systems. Dry or hybrid cooling is typically a less-efficient means of power plant cooling than water, and thus typically increases the cost per kilowatt-hour of electricity. Dry or hybrid cooling can be more or less cost-effective, depending upon the type of electrical generation (nuclear, solar, etc.), and is not the current baseline technology. The State of Utah may wish to consider examining the best opportunities for employing dry- and hybrid-cooling in new and existing power generation.

The development of primary fuel sources such as oil, oil shale, tar sands, natural gas, and biofuels also consume water. Specific information on the water quantity and quality impacts of technology for developing many of these resources, particularly tar sands and oil shale, is limited. Additionally, the water used to develop biofuels can vary tremendously, depending on whether feedstocks are irrigated crops or waste products. In Utah, the primary water quality concern with oil shale is the potential release of leachates into the Colorado River drainage system from infiltration and runoff of meteoric waters on spent shale waste piles. Physical and chemical effects from mining and surface retorting such as fracturing, weathering, and redox changes can contribute to leachate generation. In addition to leaching of metals from spent shale waste piles, potential salinity increases may occur from leaching of evaporites that are disturbed and mobilized during mining operations. Appropriate management of spent shale waste piles using best available technology containment systems could help prevent potential surface water and ground water contamination during and after operations. However, the longevity of these containment systems and the need for long term monitoring may be a concern.

New regulations have been proposed by the US Environmental Protection Agency to regulate coal ash disposal after a disposal pond at a Tennessee coal plant failed, spilling 1 billion gallons of highly toxic coal ash slurry over 300 acres of adjacent river valley, destroying three homes and contaminating two nearby rivers.
Coal ash contains many heavy metals as well as arsenic, which is implicated with an increased incidence of cancer when ingested in groundwater. Under the Water Quality Act and Ground Water Quality Protection Rules (UAC R317-6), the Division of Water Quality has issued ground water discharge permits to 5 coal-fired power plants with coal ash management facilities. Potential contaminants of coal ash leachate that may impact ground water are boron, chloride, nitrate, sulfate, and total dissolved solids (TDS). Best available technology coupled with ground water monitoring is used to minimize the discharge of contaminants from the waste source by applying control and containment technologies such as liners, leak detection systems, leak collection systems, and pump-back systems.

In May 2009, the US DOE published a report titled "State Oil and Natural Gas Regulations Designed to Protect Water Resources" from a study by the Ground Water Protection Council. This report identified key messages and suggested actions for regulating oil and gas activities including hydraulic formation fracturing and coordination of state water quality protection and oil and gas agencies. Utah already has most of these water quality protection measures in place including an MOU between the DEQ Division of Water Quality and the DNR Division of Oil, Gas and Mining, which was established in 1984 and updated in 1986 and 2010.

Additionally, the U.S. Environmental Protection Agency has launched a Hydraulic Fracturing Study in order to assess potential impacts of this method of recovering natural gas on drinking water and human health. Study results should be released in 2012.
Nuclear wastes—including uranium mining, uranium milling, low-level, and high-level wastes—can impair surface and groundwater resources if they leak from impoundments

and disposal sites. As with other waste management units, best available technology combined with ground water monitoring is used to minimize the discharge of contaminants from the waste source by applying control and containment technologies such as liners, leak detection systems, leak collection systems, and pump-back systems. Finally, reactors at nearly a quarter of all U.S. nuclear plant sites have leaked tritium, with some leaks elevating the amount of tritium in groundwater to more than three times the federal safety standard.

Archaeology – Energy extraction and transportation generally require construction and ground disturbance, which can be damaging to historic and archaeological resources. Federal and state statutes require the responsible agencies (e.g., land owners and permitting agencies) to consider the effects of their actions on cultural resources, and to allow the State Historic Preservation Office (SHPO) to comment. With advance planning, use of the State's web-based GIS database of archaeological and historic resources, and consultation with interested parties, most of the potential conflicts can be avoided. Recent successes such as the West Tavaputs Programmatic Agreement and the Questar Pipeline Nine Mile Canyon Project demonstrate that energy development and transmission can occur without compromising fragile archaeological and historic resources. Advance planning, consideration of all affected resources using the best available data, and inclusion of all interested parties, are critical components of a successful strategy.

Wildlife – Energy development may negatively impact wildlife, critical wildlife habitats and migration corridors. The most acute problem occurs when an energy project negatively impacts a federally designated endangered, threatened and candidate species. One example is the potential for wind, solar, oil, gas, and coalbed methane development to negatively impact sage grouse and the sagebrush ecosystems they inhabit. Sage grouse inhabit numerous Utah energy development sites and were recently designated by the US Fish and Wildlife Service as "candidate species" for Endangered Species Act Protection. Extensive study indicates energy development related activities may negatively impact sage grouse and critical sage grouse habitat. These impacts include tall structure avoidance, habitat loss and fragmentation, predation, human disturbance, road networks, increased noise, reduced nesting success, effectiveness of vocalizations, lek attendance by males and females, shifts in nesting habitat selection away from energy development infrastructure, and reduced sage grouse breeding populations.

The State of Utah, partnering with the Western Governors Association, is developing a Decision Support System (DSS) that will make crucial habitat and wildlife corridors available in the form of maps.[49] The State of Utah is also engaged in developing Best Management Practices approaches to reviewing energy projects. Conservation groups are compiling a series of Best Management Practices to assist land managers, conservationists, utilities and developers in the process of zoning, siting, building, and operating renewable energy installations in a way to minimally impact wildlife and their habitats. They are also identifying the highest priority areas for conservation and ecosystem services in the region and then using a blend of land offsets and mitigation strategies to attain "no net loss" of biodiversity values. The analysis of the specific

impacts of new energy development on wildlife and critical wildlife habitats will need to be thoroughly assessed through science-based processes at the project site level. Once impacts are avoided and minimized, remaining impacts must be mitigated and long term wildlife monitoring implemented to measure mitigation success.

Carbon Management Risk – The question about what is to be done to curb carbon emissions continues to impact the national landscape, as well as future energy policy in Utah. The inability of Congress and the last four administrations to develop a policy on carbon emissions negatively impacts decisions at the state level, including Utah, where decisions on energy projects totaling several billions of dollars will be made during the next ten years. Local western utilities are including assumptions in their integrated resource plans on carbon emissions to help guarantee the plans reflect factors that may negatively impact the cost of energy. This is a risk management exercise for them, and not an endorsement of what scientific factors should, or will be used to establish a national policy on carbon. They further believe that a state policy on carbon emissions would not be useful until a national policy is implemented.

Next steps

Identify energy development issues and scenarios for further evaluation and modeling. Energy development drives economic development and sustainability in Utah. Questions that need to be answered include:

- How will energy resources be developed in Utah to meet electricity demand in the next 10 years? 20 years? 40 years?
- As Utah coal reserves decline, how will existing coal plants be fueled? At what cost, risk, and impact to the State?
- What combination of energy imports and exports will be the most beneficial to Utah's economy, ratepayers, and environment?
- Do adequate State policies and regulatory mechanisms exist to allow implementation of the State Energy Plan? If not, what policy and statutory changes are needed?
- How much energy savings can Utah generate from energy efficiency and conservation over the next 10 year? At what cost?
- How can Utah incentivize development of in-state renewable energy projects?

These questions could be evaluated and scenarios developed using economic modeling tools where appropriate, creating recommendations for the Governor and the Legislature to consider.

Designate an implementation and monitoring committee. A committee with expertise in energy, economic development, transmission, and related environmental issues should be designated to continue the work identified in the Energy Plan, including: identifying specific scenarios for evaluation using the modeling tool Regional Economic Models, Inc. (REMI) or similar model, verifying data input, overseeing model runs, and evaluating the results of energy policy throughout the duration of the 10-year Strategic Energy Plan.

Renewable energy development would benefit from a single point of "coordination" for permit application and approval among agencies. This is not a recommendation to consolidate functions in a single permitting process. However, having a point of contact for information about the permitting process, local ordinances, coordination of public comment, and similar functions would make the process more efficient.

A significant communication plan needs to be developed and implemented after the policy options are developed. The public and policymakers will continue to need information on the critical issues regarding Utah's energy development and utilization.

IV. ENERGY EFFICIENCY, CONSERVATION AND DEMAND-RESPONSE

The Governor and the Legislature have established energy efficiency as a priority resource and urged state and local governments and utilities to promote and encourage cost-effective energy efficiency and conservation.[50] Utah is making notable progress in energy-efficiency efforts and was recently recognized by the American Council for an Energy-Efficient Economy (ACEEE) as one of the "most improved" states and the highest-ranked in the region.[51]

Models and studies recognize energy efficiency as a cost-effective energy resource. Recent national studies conducted by the McKinsey Company and the National Academy of Sciences show, respectively, cost-effective energy-efficiency technologies and building practices could reduce energy consumption 23% by 2020[52] and 30% by 2030.[53] These studies align with Utah-based analysis. Rocky Mountain Power and Questar Gas have conducted studies to determine the maximum achievable cost-effective potential for energy efficiency in Utah. The results show that, if achieved, energy efficiency would reduce natural gas consumption by 20% (21.4 million dekatherms, Dth) by 2013[54] and electricity consumption by 1,641 gigawatt-hours (GWh) by 2020.[55]

Demand-side management (DSM) strategies enable energy users to reduce consumption during periods of peak demand. This results in lower costs because of avoided or delay investment in new electric generation and new natural gas supplies. Questar Gas's 2009 DSM programs confirm annual energy savings of 1,086,200 Dth. Rocky Mountain Power's DSM Programs saved 247.8 GWh per year or 1.2% of 2009 sales.[56]

Constructing buildings to current or above energy code standards reduces the occupant's energy costs and puts downward pressure on utility rates by deferring investment in new energy generation that would otherwise be needed to meet rising demand. Utah's commercial and residential buildings use 42% of our total energy, more than either the industrial or transportation sectors. Increasing energy efficiency in Utah's new buildings will potentially save $1.17 billion between 2001 and 2020.[57]

Building energy codes dictate minimum standards for the design and construction of all new and renovated buildings. The codes impact energy use for the life of the building. Utah's statewide building codes are adopted by the Legislature and enforced by local jurisdictions. The adoption process is usually triggered by the three-year publication cycle of an updated International Energy Conservation Code (IECC). The Legislature

must approve any local jurisdiction's request for more stringent building standards. The Subcommittee recommends that Utah adopt the most recent IECC. Doing so effectively ensures energy efficiency as a component of all new and retrofitted homes and buildings.

Adopting energy codes is not effective if those codes aren't properly implemented by the design and construction industry or enforced by local building departments. To effectively do their jobs, everyone involved in building design, construction, plan-review and on-site enforcement must be aware of the latest building-science technologies and codes. Compliance tools and training materials that support energy codes are available through the U.S. Department of Energy's Building Energy Codes Program. The Utah State Energy Program, supported by Rocky Mountain Power and Questar Gas, provides energy code training. However, qualitative observations in 2010 reveal Utah's compliance rate could be improved.

Since local jurisdictions implement and enforce energy codes, municipal leaders and building officials need to commit to and insist on enforcement. Potential areas for consideration include, but are not limited to:

- Adopting the most current energy code for both residential and commercial construction;
- Providing funding and other incentives to local building departments for well-trained staff educated specifically in the science of building energy demands, controls and efficiency;
- Providing education for building inspectors and contractors in code implementation and enforcement;
- Requiring energy-code education as part of continuing-education credits for building officials, contractors, and trades;
- Increasing the minimum hiring standards for building-plan reviewers and inspectors to include energy-management degrees, certificates, IECC training or equivalent;
- Providing tax incentives to builders who build or renovate using above-code standards;
- Enacting legislation to allow local municipalities to adopt energy codes above the minimum standard;
- Improving and clarifying the administrative feedback loop for code enforcement professionals between local jurisdictions and the Uniform Building Code Council, and developing a resolution process for consensus-based code enforcement disputes; and
- Approving development fees or allocating a portion of the DOPL's fund created from surcharges associated with construction as a funding source for energy-efficiency code enforcement at the local level.

A barrier to widespread adoption of energy efficiency and conservation is the lack of public awareness and understanding about energy, energy-efficiency technologies, practices and programs. Rocky Mountain Power and Questar Gas have excellent energy-efficiency and demand-side management programs and effective marketing campaigns. Other energy education efforts underway in Utah include some by

municipal and cooperative utilities, the State Energy Program, the Utah Building Energy Efficiency Strategies (UBEES) partnership, and nonprofits such as Utah Clean Energy.

Potential areas for consideration include:

- Developing and implementing a state-sponsored, Governor-led, single-messaging communication program, modeled after the Slow the Flow program, that would collaborate, support and complement the existing utility efforts, and raise public awareness and understanding about the importance and cost-effectiveness of energy efficiency, and thereby accelerate the deployment of energy efficiency and conservation.
- Developing and implementing statewide and community-based social-marketing strategies;
- With the Governor's leadership, educate industry and the commercial sector that energy-efficient improvements are also a risk-management opportunity;
- Recognizing excellence in energy efficiency, conservation and demand response through a state-sponsored program;
- Approving additional state support for K-12 energy education currently funded by the utilities and the State Energy Program; and
- Educating home buyers regarding the importance of energy efficiency in general and providing specific information about the energy efficiency of homes they are building or buying.

In many situations, incentives are sufficient to encourage businesses and residential consumers to pursue individual energy-efficiency measures, but barriers remain for obtaining significant energy savings on a whole-house or whole-building basis. Utah businesses and residential consumers used 13,944 GWh of electricity[58] and 103.8 million Dth of natural gas in 2009.[59] The utilities, as well as the state, offer incentives to customers who retrofit or purchase high-efficiency appliances, motors, lighting and other equipment. Potential areas the state should consider for working with existing stakeholders (i.e. utilities and non-profits), include but are not limited to:

- Encouraging utilities and their regulators to continue developing and expanding cost-effective energy-efficiency retrofit programs;
- Encouraging and funding programs that provide whole-house and building systems energy analysis and significant whole-house or whole-building retrofits.
- Encouraging banks to develop low-interest loan services for energy-efficient retrofits;
- Providing tax credits, tax deductions and/or rebates to home owners, landlords, condominium associations and businesses who invest in energy-efficient retrofits;
- Encouraging government and non-government organizations to utilize Energy Service Companies as a financing mechanism for energy-efficient retrofits, recommissioning, and ongoing commissioning; and
- Creating a market for energy-efficient retrofits by encouraging banks to include evaluating energy costs as part of the mortgage application and by requiring a home energy rating for all homes listed for sale or rent.

New home and new commercial building design and construction should be energy efficient. Utah is one of the fastest growing states in the nation. As such, more than 198,000 residential building permits[60] and an estimated 22,000 commercial building permits have been issued over the last ten years, and construction continues even during the economic downturn. These new homes and buildings will be part of the Utah landscape for decades to come. It is critical that steps be taken to ensure these buildings incorporate cost-effective energy-efficiency measures at the time of construction rather than burdening owners and utilities with the cost of retrofits. The state can work with the utilities to leverage existing utility programs by:

- Encouraging utilities and their regulators to continue to offer and develop cost-effective above-energy-code programs to support the new construction market;
- Creating a market for energy-efficient new homes and commercial properties by encouraging banks to include an evaluation of energy costs as part of the mortgage application or by requiring a home energy rating for all homes listed for sale or rent; and
- Providing tax credits, tax deductions and/or rebates to home owners, landlords, condominium associations and businesses who invest in energy efficient for new homes and commercial buildings.

Strategies are needed to advance energy efficiency in Utah's industrial sector. Utah industries are the backbone of the state's economy. Their competitiveness lies in the quality and cost of the Utah workforce and access to and the cost of critical components needed for manufacturing – including electricity and natural gas. Utah industries currently have access to energy at prices among the lowest in the nation. While these prices have helped make the industries cost competitive, they also create a barrier for investment in energy efficiency, i.e., multi-state industries receive a higher return for investments made where energy prices are higher. Strategies to advance energy efficiency in Utah's industrial sector need to address the two major resource constraints: limited financial resources and limited staff resources. Utility demand-side resource programs address these to some extent, but do not address all opportunities or resource needs; nor are all of Utah's industrial end users eligible for these programs. The state could work with the utilities and other stakeholders to:

- Encouraging utilities and their regulators to continue or begin offering cost-effective programs to support industries' energy efficiency investments;
- Providing tax credits, tax deductions and/or rebates to industries for investments made in energy efficient equipment, processes, etc.;
- A well-designed and integrated technical assistance program, addressing both electrical and natural gas energy efficiency should be created. It should leverage existing resources and new energy-efficiency/green-workforce training programs to include industrial energy management.
- Considering a job-creation tax incentive for hiring resource efficiency/energy managers at industrial facilities;
- Increasing efforts to pursue energy-efficiency opportunities that involve recovering wasted energy to generate power. These opportunities could be evaluated for capturing energy otherwise unused in industrial processes.

- Creating a no/low-interest loan program for industrial energy-efficiency capital projects, such as that provided by the Colorado Governor's Energy Office, or providing a volume cap allocation for tax-exempt funding from the Olene Walker fund;
- Requiring a portion of any incentive funds extended to recruit an industry be invested in energy efficiency and include information on these resources in economic-development marketing and outreach programs;
- Include energy-efficiency and conservation requirements in state/local tax incentives for new businesses; and
- Providing public recognition for industrial energy efficiency accomplishments.

For close to a decade, Rocky Mountain Power has worked with its customers reduce electricity use through demand-response (load control) programs. By actively controlling specific equipment such as residential and small commercial air-conditioning and irrigation pumps, the utility is able to reduce the long-term need for new electricity generation. Rocky Mountain Power in 2010 has about 100,000 customers (roughly 25 - 28 percent of qualifying homes and businesses) representing over 112 megawatts under direct load control. The company also has about 43 megawatts of irrigation pumps under direct load control. Customers participating in these programs allow, under terms and conditions approved by the Public Service Commission of Utah, Rocky Mountain Power to leverage the existing infrastructure by operating their equipment. The state continues to encourage utilities and their regulators to:

- Identify innovative demand-response programs and to remove barriers that limit participation in these programs; and
- Design demand-response programs that have been shown to increase participation significantly.

Utah's regulatory framework is most effective in focusing its efforts on reducing overall energy consumption, managing peak loads through best practices, and supporting energy-efficiency and demand-response programs, consumer education, and utility rate design to promote energy efficiency and conservation. Utah's regulatory environment, consistent with Utah statutes governing its operations, has provided support and recovery of costs directly incurred by public utilities associated with cost-effective energy-efficiency and demand-response programs. Both Questar Gas and Rocky Mountain Power have robust and active advisory groups, established within Public Service Commission processes, to provide recommendations on program design, scope, and implementation. This collaborative effort is an important ingredient to the ongoing success and achievement of these programs. Ongoing work should:

- Continue encouraging all customers and suppliers to pursue all cost-effective energy efficiency through its current regulatory culture;
- Examine potential new mechanisms for augmenting these efforts, always ensuring that programs are in the public interest;
- Make greater efforts to ensure all system and environmental benefits provided by energy efficiency are fully valued in the planning, acquisition and regulatory decisions;

- Consider establishing energy-efficiency targets and/or utility incentive programs for successful management of energy-efficiency and demand-side response programs;
- Pursue additional analysis and evaluation of utility and ratepayer impacts of high-efficiency scenarios; and
- Consider rate recovery mechanisms that balance the first-year costs of energy-efficiency programs while benefits are accrued across many years. Alternative rate recovery mechanisms may be necessary to give energy-efficiency resources comparable treatment to supply-side generation resources that are amortized over multiple years.

V. TRANSPORTATION AND AIR QUALITY

Transportation accounts for more than half of the air pollution along the Wasatch Front.[61] The combined criteria pollutant inventory for Davis, Salt Lake, Utah and Weber Counties in 2009 indicates that 51.9% of total annual emissions of criteria pollutants originated from the on-road mobile sector (cars, trucks and busses). Transportation is also the largest consumer of energy in Utah at 31%.[62] Saving energy and cleaning our air will improve public health, thereby reducing costs. It will also bolster economic-development efforts by helping to attract new companies and jobs; reduce our dependence on foreign energy sources; and generally improve the quality of life of all Utahns. This can be accomplished through strategies that consider the vehicles we use or eliminate, the energy we use to power those vehicles; the way we manage vehicle traffic with technology, engineering and community design; and finally, our personal actions and business decisions. Implementation of these strategies should also include meaningful metrics for success, such reducing particulate matter (PM2.5) and ozone levels in the air.

Improve vehicle technology/efficiency and alternative fuels (refueling) infrastructure. Utah can reduce emissions and non-attainment air-quality days by providing incentives for adoption of emission-reducing technologies. A barrier to increased alternative-fuel vehicle use is inadequate refueling infrastructure. The state should strengthen current tax credits for alternative-fuel vehicles and explore incentives to make refueling infrastructure more accessible.

Alternative-fuel vehicles proven to reduce vehicle emissions and increase fuel economy include electric, electric hybrids, bio-fuels, bio-diesel, propane, hydrogen, compressed and liquefied natural gas (CNG and LNG), and hydraulic hybrids. New technology continues to expand this list. Even gasoline- and diesel-powered vehicles are producing fewer emissions due to improving technology.

The state should continue its support of results-driven solutions and not favor one technology over others. However, reducing emissions and eliminating non-attainment days will depend on adoption of new technologies. Incentives should be based on full-fuel-cycle efficiency since those technologies are the ones most likely to be developed and receive market support. To qualify, adopters' emissions reductions must be validated through the U.S. Environmental Protection Agency (EPA).

Incentives should be prorated on a sliding scale, with higher amounts for larger vehicles. The current tax credit incentives should be modified to provide lower amounts for passenger cars and higher amounts for delivery and freight vehicles. The same principal applies to refueling infrastructure: higher-capacity facilities should receive more incentives.

More state programs such as incentives, grants, or loans for alternative-fuel vehicles and infrastructure would help encourage more use of cleaner more efficient fuels. At the very least, the Utah Department of Environmental Quality's current grant and loan program should be expanded beyond a one-time allocation. Without incentives, payback periods for these vehicles average two to 10 years. With state help this could be cut in half.

Fuel consumption and air pollution can be reduced through more efficient traffic flow, using engineering and technology to effectively manage all modes of traffic and maximizing the effectiveness of our transportation systems. This includes continued implementation of proven ideas such as HOV/HOT lanes, reversible lanes, innovative intersection design, transit-vehicle signal pre-emption and signal coordination -- especially during peak hours.

The plan should include strategic introduction of ideas such as dynamic speed control, peak-hour use of shoulders, and increasing Park-and-Ride lots (both private and public). All traffic-operation plans should include a thorough evaluation of the proven energy-saving, air-quality and safety benefits of reduced speed limits.

Maximizing the efficiency of existing infrastructure has the added benefit of reducing demand for and costs of new infrastructure.

Changing behavior is difficult, but communication strategies and tactics that provide awareness and education, supported by incentives, marketing and promotions can succeed in reducing unnecessary travel, particularly the number and duration of solo-driver trips. Existing programs like TravelWise, Rideshare and Idle-free, along with events like the Clear- the-Air-Challenge, Bike Month and Free-Fare Day are beginning to show effectiveness in promoting, encouraging, and ultimately increasing alternative-transportation use. Programs such as Safe Routes to Schools, Student Neighborhood Access Program (SNAP), and Walking School Bus, all of which encourage walking or pooling to schools, need more resources to increase awareness. It is critical to educate and promote the benefits of more energy-efficient transportation with such tools as the TravelWise Tracker[63]. The tracker allows people to measure the money, emissions, and energy saved by using TravelWise strategies.

The state could help reinforce and encourage behavior change by more public education about air-quality indicators and using electronic signage as triggers to promote transportation alternatives such as using public transit, telecommuting, flexible work hours, trip chaining, biking, walking, carpooling, and vanpooling.

Many of the traffic-reducing strategies listed can be enhanced by business practices in the private and public sectors. Managers should implement policies that encourage and even coordinate ride sharing, telecommuting and flexible work schedules. Parking subsidies can be eliminated and given to employees as cash or transit passes. Above all, educational and promotional material should feature Utah's leaders at every level of state government and private business as examples of smart travel.

Assist communities in choosing land-use options that reduce per-capita energy consumption, improved air quality, and make it easier for people to get from one place to another. Utah's population is projected to double over the next 30 years, with vehicular travel increasing at twice that rate. As the population and economy grow we have an opportunity and responsibility to design communities in ways that support energy-efficient transportation and commerce, reduce congestion and long commutes, and remove physical barriers to using public transportation.

We should entice people to walk and cycle more often by designing accessible, safe and interesting paths and destinations. Government services should be located in neighborhood centers that draw people by offering a variety of public services and private businesses. Neighborhood economic centers should reduce commutes by bringing jobs and housing closer together, with the added benefits of community cohesion and vitality. Seamless connections should be made from these neighborhoods to mass/public transit.

Transportation costs can be further reduced by emphasizing new building construction in already-developed areas. Collectively known as walkable neighborhoods, transit-oriented development, and the "Envision Utah 3 Percent Strategy," these strategies are thoroughly examined in the summary document for Wasatch Choices 2040 project[64] and are designed to respond to changing demographics, increasing energy use and market demand for more residential choices.

Changes in fuel pricing can change behavior. As the past several years' trends indicate, the market is the strongest determinant of demand for (mostly foreign) petroleum used to power vehicles. When American gasoline prices rose to record levels in 2008, miles traveled dropped dramatically and drivers switched to more efficient vehicles and public transit. These changes in driving habits, which began in 2004, continue today and show that fuel price can be a powerful tool to help change transportation habits.

Through Utah's Clean Fuel Tax provision, tax rates for clean fuels are lower than those of petroleum-based fuels. This provision applies to CNG vehicles, and those powered by propane and electricity. However it does not apply to LNG. This provision needs to be changed so that all clean fuels are taxed at a lower rate, to encourage use of cleaner, more efficient fuels.

Increasing gasoline taxes will, of course, discourage driving; however current economic concerns may dictate that this option be postponed. The revenues from higher gas taxes

could be used to magnify the use of alternative sources; one such example would be to supplement free transit passes for low-income riders.

A better balance of regional travel choices between auto, public transit, bicycling and walking is imperative. Transportation's share of growing oil-consumption is a concern. Transportation accounts for approximately 25 percent of total energy demand worldwide (32% for Utah) and for 81% of Utah's petroleum consumption.[65] Approximately 81% of petroleum products in Utah are consumed in the transportation sector.[66] Better load share among the available energy sources will be part of the solution.

In the process of allocating public funds for transportation, the priority should be projects that demonstrate the greatest science-based long-term benefit. Mass transit should always be given at least equal consideration. Providing more convenient, reliable and affordable travel options and infrastructure that supports biking and walking will reduce the amount of time people spend in their cars, saving energy and reducing air pollution.

As we provide a more balanced transportation system, we need to expand pricing and land-use policies, well connected bikeways, and vehicle miles traveled (VMT) reduction strategies, throughout the region to support this system.

VI. TRANSMISSION, INFRASTRUCTURE AND TRANSPORTATION

Historically energy producers have focused on low costs while balancing other factors and risks. Increasingly other requirements and public policy objectives have become more predominant in thinking about the new energy economy and climate change. Infrastructure providers find themselves caught between customers who have become accustomed to low energy costs and continue to demand low costs, and those policies that promote renewable energy, conservation and the green economy with the potential for incrementally higher energy costs.

In Utah, peak demand for electricity rose steadily through the 1990s, with significant increases in the years prior to 2008 and the resulting economic recession. While growth has slowed significantly, consumer demand for electricity is still growing. The demand for natural gas has also followed a similar path as electricity and faces the same challenges.

Electric and natural gas transmission is a key part of any state's overall energy policy, but it is the most difficult component of the energy delivery system to construct. Long planning timelines, large geographic footprint, complex permitting from multiple jurisdictions and huge capital costs make transmission the most complex and highest risk enterprise an utility can undertake. Regardless of the energy policy selected, the mix of generating resources utilized—fossil fuels, nuclear, wind, solar or geothermal—all require robust transmission capacity to move electricity and natural gas to where customers need it.

The last major additions to the electric transmission network in the Western U.S. were made some 20-30 years ago. While some companies have begun major transmission additions or proposed major projects, the huge capital cost of transmission is a barrier to new investment. Because state policies still require that most transmission construction costs be borne by the retail customers of the load serving entity that construct them, few investor- or consumer-owned utilities have committed the large capital investment required for such projects, despite a pressing need. Likewise, private investors have been reluctant to propose projects of their own or commit funding to projects proposed by others.

During the summer of 2009 Rocky Mountain Power served approximately 85% of the total electrical peak demand in the State of Utah.[67] The peak demand in the Wasatch Front of Utah (Ogden area to Spanish Fork area) is 80% of the peak electrical demand for the entire state. This area is PacifiCorp's largest and highest density urban load center. It also represents some of the Company's greatest challenges in providing safe, adequate and reliable transmission service due large population and established communities, land use (both existing and future planned), and the limited geography available to site and construct transportation facilities.

There are approximately 150 electrical interconnection points to PacifiCorp's transmission system alone. The Company provides transmission services to more than eight other transmission owners and load serving entities. There are eight major electrical transmission paths that interconnect the State of Utah to bordering states. All of these existing paths are currently fully subscribed for transmission usage and have constraints and limits regarding their ability to serve the State long term.

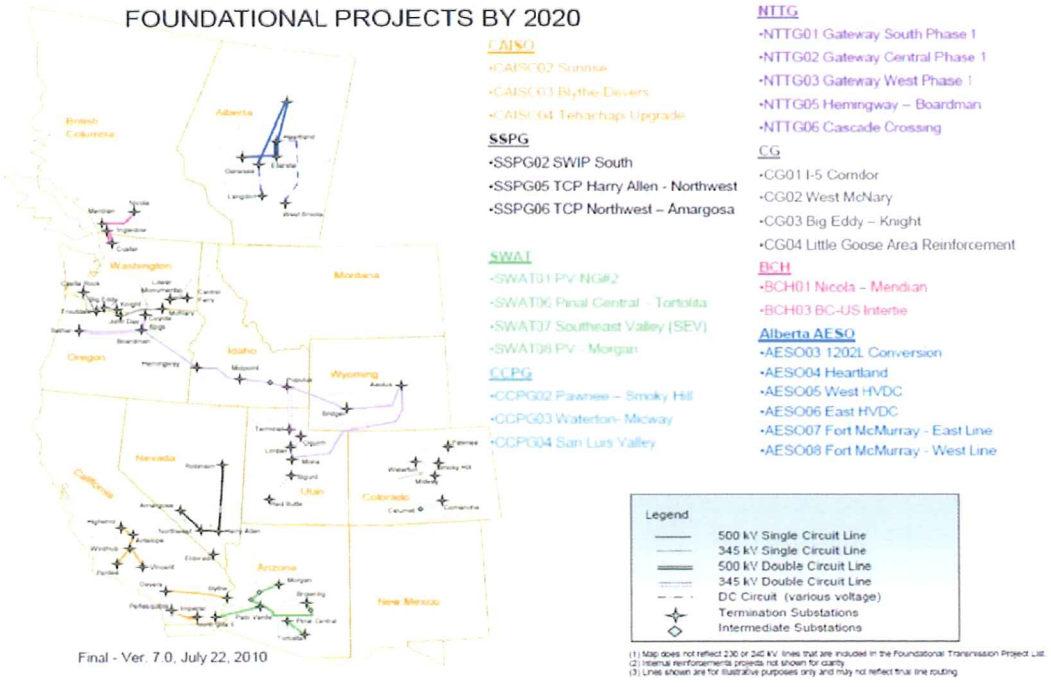

Figure 3. Proposed western foundational transmission projects by 2020. Western Electricity Coordinating Council.

Figure 3 is a map of planned projects (Foundational Projects) currently in the Regional planning review process within the Western Electricity Coordinating Council (WECC) and projected to be developed over the next 10 years. These projects are being proposed by a number of sponsors including electric utilities and independent power producers and private investors.

Natural gas transmission, on the other hand, has seen dramatic growth in the last 30 years. Natural gas export capacity from the Rockies has increased from 1.8 MMcf/day in 1980 to 8.1 MMcf/day in 2010. With the addition of the Ruby Pipeline and the Kern River expansion which are scheduled to be completed in 2011, export capacity in the Rockies will be 10.4 MMcf/day. Transmission capacity inside Utah has dramatically increased as well, with new transmission capacity from Questar Pipeline and Kern River Pipeline. Questar Gas is also spending significant capital to replace and expand intrastate high-pressure feeder lines. The following tables provide more detailed information.

Pipeline	Miles of Gas Transmission Pipeline	Miles of Gas Distribution Pipeline	Total Miles of Gas Pipeline	Utah Interstate Pipeline Interconnections
Kern River	712	0	712	1
Northwest Pipeline			-	
Questar Pipeline	2500		2,500	2
Questar Gas*	1,029	15,909	16,938	11
	4,241	15,909	20,150	
Total Customer Interconnections				14
State Tax Commission Est.**	1,957			

Table 3. Natural gas transmission and distribution pipelines in Utah. Source: Questar Gas.

Pipeline	Project Name	Miles of Gas Transmission Pipeline	Pipe Diameter	In-Service Date	Description
Kern River	Apex Expansion Project	28	36 inch	11/1/2011	This project will close the currently unlooped section of Kern River's pipeline in the Wasatch mountains.
Questar Pipeline	ML 104 Extension	23.5	24-inch	11/1/2011	This project extends QPC's mainline to the east to receive gas from the processing hubs in the Uinta Basin of Utah .
El Paso Natural Gas	Ruby Pipeline	181.5	42-inch	Spring 2011	This project transports Rocky Mountain natural gas to end users in California, Nevada and the Pacific Northwest.

Table 4. Proposed transmission pipelines in Utah. Source: Questar Gas.

The current lack of transmission capacity in Utah could prevent the state from reaping the economic and environmental advantages of developing renewable energy projects within our borders. To build its clean energy economy, gain more energy independence and promote development and jobs, Utah may desire to develop its own large-scale renewable energy projects. A major obstacle to getting these sources on the grid and powering western homes and businesses is the availability of transmission.

To address this shortfall, state and local government, resource managers and the public should work together to develop the transmission network needed to link Utah's wind, solar and geothermal energy development zones to existing grids. Potential barriers to transmission infrastructure development include financing, integrated planning across all levels of government and permitting procedures. Funding methods, sources, and options need to be explored and implemented, while building on previous state-based efforts. To facilitate the development of large-scale renewable energy projects in the state, a Utah transmission plan should be developed. Such a plan would include significant stakeholder input up-front. Substantial public and private sector participation, combined with the utilization of natural and cultural resource data early in planning and budgeting can help secure as much public support as possible. This in turn will reduce the probabilities of suits against the projects, facilitate permitting, and produce more efficient siting and mitigation practices, thereby saving time and resources.

With the projected increased in travel and population, there is a need to expand the state transportation system, as defined in the Utah Long Range Plan. The Utah Department of Transportation (UDOT) maintains over 6,000 miles of highway infrastructure and 35,000 miles of road within the State of Utah. Currently there are 1.6 million drivers; this number is expected to grow 65% to 2.6 million by 2030. Population is expected to grow from 2.5 million residents to 4.1 million residents by 2030. See Figure 4. The amount of travel has increased faster than the rate of growth of the population. UDOT estimates that it will require $10.2 billion between now and 2030 to maintain the physical condition of the highway system at its current level.

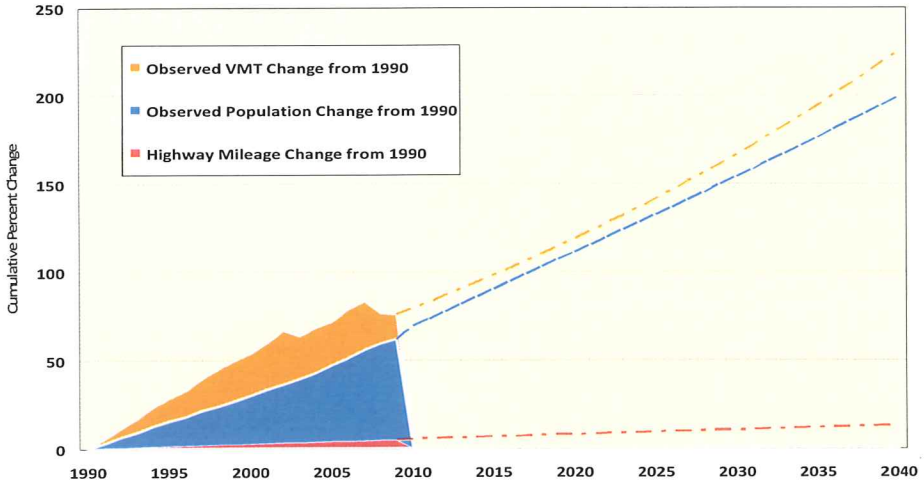

Figure 4. Comparison of population growth, increase in vehicle miles traveled, highway mileage change in Utah. Utah Department of Transportation.

There may be opportunities to both improve the energy transmission network and the transportation system that offers both overall efficiencies and reduced impacts through better coordination and planning.

Develop a state level position to propose alternatives to current regulation and funding sources to encourage transmission line and pipeline construction in areas that promote economic development or renewable resource development. State economic regulation requires that investments be prudently made, lowest cost (risk adjusted) and used and useful for existing and future customers. Federal and state regulation requires non-discriminatory application of all tariffs to transmission users. If stakeholders decide it is in Utah's best interest, legislation could be developed that creates a state authority and funding vehicle that would be granted to transmission companies or developers to build lines that are found to be not economic by state utility regulators.

The state needs a clear process for siting and permitting transmission infrastructure projects as part of its State Energy Plan. Local opposition can impede the development of infrastructure projects, which are critical and vital for the economic health of the state and its communities but have a direct impact on a limited number of citizens. Review the authority for the Utility Facility Siting Board that would specifically address local zoning and conditional use requirements and determine modified language that would allow the board to review proposed permitting requirements.

Inadequate coordination among state agencies involved in siting and permitting activities. There are competing requirements and lack of standard policies relating to linear facilities within various state agencies. Strengthen the state infrastructure departments mission and support, review all state agencies' roles in successfully completing facilities development, and consider options for better coordination among State and federal agencies.

Various linear infrastructure projects create competition for scarce corridors that creates a greater impact on citizens. There is a lack of joint strategic planning for multiple demands on scarce resources. Create a forum that would support joint planning and risk assessment for a multi-infrastructure corridor. This would reduce societal impacts. Create a subcommittee to review future linear infrastructure plans with providers that looks at Utah's long term needs. Compare these potential corridors with U.S. Department of Energy's national interest corridors.

Public interest multiple infrastructure corridors cannot be secured without funding and right-of-way acquisition. Infrastructure providers do not generally have mechanisms to acquire future rights-of-way that meet state law and provide a return on that long term investment. Develop funding methods to acquire long-term multiple infrastructure corridors. Review the statutory framework to identify options to provide funding to acquire Utah interest in joint corridors.

Infrastructure should be built in a way to minimize environmental and social impacts. Federal, State and Private land owners often prefer impacts to be located elsewhere. Work with the Governor's office to create a forum to balance infrastructure and the environment in the management of public and private lands. Create a team to

develop specific language and recommendations that the state can take to federal land managers.

Encourage strong energy efficiency, demand-side management measures and distributed generation to minimize the need to build additional transmission. Fixed cost recovery is a problem and stakeholders disagree on the appropriate level of spending on demand side management measures. Create a multi-dimensional stakeholder group to further discuss the issues. Utilities work with stakeholders to develop policies that encourage demand reduction and energy efficiency participation is at optimal levels. Consider policy changes recommended by the stakeholder group.

VII. DEVELOPING AND APPLYING TECHNOLOGY AND SCIENCE

Utah's heavy reliance on fossil fuels coupled with rapid growth in the demand for energy and new environmental regulations calls for a strategic energy plan to secure Utah's energy future. To stimulate economic growth, protect the environment, and develop the state's vast energy resources, Utah must invest in its energy research and development infrastructure and improve coordination of the state's research universities, national energy laboratories, energy research and development industry, energy-related university spin-off companies and other key partners to collectively contribute to the development and deployment of energy technologies and work force capabilities.

Access to low-cost energy is a key incentive for businesses to expand in Utah and to locate in the state. However, Utah is facing a significant risk in the future due to its reliance on low-cost, coal-fired power plants to produce the majority of its electricity. Rapid growth in the demand for energy, coupled with new environmental regulations, will lead to higher costs for energy, which in turn could negatively impact the state's competitive position for job creation, as well as business attraction and retention. Utah's reliance on fossil fuels, accounting for 98 percent of Utah's total energy production in 2008, leaves the state vulnerable to the economic effects of federal regulation of carbon dioxide and other green-house gas emissions. Development of new energy resources is becoming increasingly costly and challenging while Utah's energy demand growth, competition for water resources and air quality issues place additional upward pressure on energy prices.

To address these challenges and take advantage of its vast energy resources and talented workforce, Utah will have to take several key steps:

- Enhance the state's energy research facilities and continue to attract world-class researchers to the state;
- Align the state's main research universities - University of Utah (U of U), Utah State (USU) and Brigham Young University (BYU) - into a powerful energy research and development triangle;
- Connect this "Research Triangle" with industry, national laboratories and regional universities to effectively commercialize new energy technologies and develop Utah's conventional, alternative and renewable energy resources; and
- Empower Utah's education system to expand its ability to train, attract and retain the skilled talent necessary to grow Utah's energy economy.

Utah's Research Triangle will optimize the role of the U of U, USU, and BYU as innovation leaders in energy economy. The faculty, staff, students, and facilities are engaged and respected on a global basis, and Utah's research universities are among the nation's leaders in many areas of energy research and development. Their separate capabilities are impressive, yet their efforts could be more effective, through increased collaboration. The research universities investment in developing and deploying energy technologies includes research faculty and programs; research labs and related infrastructure; commercialization offices; and coordination with industry, national labs and state commercialization and economic development agencies.

Utah's Research Triangle is well connected nationally and internationally and has access to regional energy industry technology leaders with a global reputation for implementing and commercializing technologies developed within the Research Triangle. Closer collaboration between Utah's research universities, industry, national labs and state agencies will help achieve even greater returns on Utah's investment in energy research and development. Improved collaboration will also improve deployment of technology to develop Utah's natural energy resources affordably with minimal environmental impact.

The University of Utah is Utah's largest research institution and is ranked among the top 30 public research universities in the nation. Best known for its health sciences research, the U of U has also established itself as a leader in energy research. The U of U is home to two of the nation's leading energy research institutions, the Energy & Geoscience Institute (EGI) and the Institute for Clean and Secure Energy (ICSE). EGI is a leader in fossil fuel, geothermal and carbon sequestration research. EGI research projects cover the globe and 70 of the world's leading energy companies support its research. EGI is continuing to expand both its applied research in hydrocarbons as well as geothermal and carbon management applications for both government and industry. ICSE is a leader in fossil fuel combustion, gasification and computer modeling research. ICSE utilizes its impressive off-campus pilot-scale research facilities, and partners with industry to commercialize new technologies for responsibly utilizing conventional and unconventional fossil fuel and biomass resources. ICSE's carbon mitigation program includes oxyfuel combustion, chemical looping and gasification. The University of Utah also has emerging energy research programs in such areas as solar power, renewable energy storage, biofuels and smart-grid technologies.

Utah State University is Utah's land-grant institution and is home to several world-class research, development, demonstration and deployment platforms. USU is proficient in the areas of natural resource management and mitigation, agricultural development, animal and veterinary science and water resource management. Further, the university plays host to Energy Dynamics Laboratory, Colleges of Engineering and Science which are national leaders in bio-fuels, environmental monitoring and sensing, waste-water treatment, hybrid energy systems, electrical engineering, nuclear, geothermal, and wind profiling. USU also has the ability to address environmental issues and socio-economic issues. Finally, USU is a world leader in the area of space sensing and imaging, with a 50

year history of designing, engineering, constructing, calibrating and deploying satellites and sensing equipment for NASA, JPL, and US Department of Defense. Much of this work is now being brought to bear on terrestrial efforts related to weather, environment and energy both in the academic and commercial areas. USU has just opened the Bingham Energy Research Center in the Uintah Basin; the center serves as a research center and to educate the workforce in energy-related careers.

Brigham Young University is a private university engaged in substantial research and commercialization activities regarding environmentally sound energy resources. Research is both applied and academic with considerable strength in combustion, biomass, gasification, clean coal, and carbon management. Central to BYU's capability is the Advanced Combustion Engineering Research Center (ACERC) and the Technology Transfer Office (TTO). The ACERC has a global reputation for modeling and experimental work on clean coal combustion and has expanded to focus on sustainable energy. The TTO is a national leader in commercializing technology and products efficiently. BYU also has numerous initiatives in hybrid energy technologies and carbon management with expertise and intellectual property in both carbon capture and storage.

Utah's research universities seek closer research collaboration with all of the Nation's laboratories. In particular, the Idaho National Laboratory (INL) is collaborating with the State's universities on numerous projects and has established a formal relationship with USU. The Research Triangle can benefit greatly by expanding this relationship with INL as well as pursuing collaboration with additional Department of Energy national assets in the region and energy space such as Los Alamos, National Renewable Energy Laboratory, Oakridge National Laboratory, National Energy Technology Laboratory, and others.

INL, with its headquarters in southeastern Idaho, is one of ten multi-program national laboratories and is a unique resource serving as one of America's premier energy research laboratories with a mission to develop and advance clean, smart and secure energy systems essential to national security, economic prosperity and environmental sustainability. INL has lead responsibilities for the Nation in nuclear energy research but also engages in research regarding development of fossil, renewable, and integrated energy systems. In particular, INL is conducting applied research and demonstration, helping to reduce the risks associated with deployment of innovative energy technology.

INL is dedicated to collaborating with regional research institutions, government, and industry in addressing current and anticipated energy challenges. As part of this effort, INL has been building key relationships in the Western Energy Corridor, a transnational region containing world-class energy resources strategic to North American energy security and regional economic development. Utah is key to the Corridor and hosts many of these resources.

Utah's energy industry research and development leads in such fields as geo-mechanics, new material technology and clean coal technologies. Examples of the leaders developing technology in the state include TerraTek, Ceramatec and Combustion

Resources. TerraTek is a global leader in geo-mechanics laboratory testing and analysis provides multidisciplinary expertise in geosciences and engineering. Its expertise lies in unconventional gas recovery, drilling and completions performance, core-log integration and rock mechanics. Ceramatec is a national leader in developing new materials technology for the energy industry. Its focus is energy and environmental (clean-tech) areas, including industrial applications of ionic conducting ceramics and electrochemistry and fuel reformation and synthesis. Regionally, Combustion Resources' clean coke demonstration plant converts regional carbonaceous materials such as coal, coke fines, and chars into high-grade metallurgical coke.

The eight Utah College of Applied Technology (UCAT) campuses, community colleges, and other higher education institutions offering energy-related technical training, fill an essential role in developing and maintaining a technically-trained Utah workforce. These institutions focus on the safety, regulatory, implementation, production and other technical certifications that energy employees must possess. Typically, several technically-trained employees function as support to each researcher and engineer in the energy industry occupations.

Convene the Utah Energy Triangle and its collaborators. An annual Utah Energy Symposium could be extremely helpful in encouraging individual research and development efforts to collaborate with other members of the Research Triangle and research community.

- The U of U, USU, and BYU should collaborate optimize research capabilities and efforts. Recognizing the accomplishments and addressing the challenges of this collaboration will be the focus of semi-annual meetings convened by the Governor's senior energy official and attended by each university's senior energy research official at the State Capitol.
- INL is invited to provide a senior staff member to participate in the Utah Research Triangle semi-annual meetings. Other national laboratories may be invited in the future.
- The Utah Research Triangle will review the report and conclusions of the Utah Cluster Acceleration Partnership and implement findings appropriate to optimizing the welfare of the State of Utah and regional partners. The Utah Cluster Acceleration Partnership has worked extensively with industry, academia, and government to accelerate and support the expansion of Utah's energy industry and to fashion a well-trained workforce possessing the critical skills needed by this industry.
- The Research Triangle will expand its interaction with regional technology leaders through collaborative efforts lead by the Governor's senior energy official and senior energy research official from each of the Universities towards commercialization and implementation of technology to meet Utah's energy challenges.
- Directed by the Governor's senior energy official and senior energy research official from each university, the team will collaborate with industry to form plausible solutions to energy challenges. The efforts include collaboration with Idaho National Laboratory and the Utah Cluster Acceleration Partnership to

encourage energy career trainings and skilled workforce. To implement this recommendation, on an annual basis, the research universities will alternately host a Utah Energy Symposium to present topics related to Utah energy resources, reserves, new developments, new installations and facilities, and other emerging topics.

- Funding that encourages collaborative efforts in the research and development community is currently insufficient to promote and enable significant collaborative research. The Governor's senior energy official and the senior research official associated with energy at each of the universities will propose appropriate budget items at the state and federal level specifically focused on promoting cooperation between the Research Triangle in energy research and technology.
- The Department of Energy national laboratories present significant opportunities to collaborate on critical research and development needs for the State, region, and Nation. The Research Triangle should expand its interaction with Department of Energy national laboratories and specific funding should be identified to promote opportunities for appropriate collaboration in the State and Nation's interest.
- Utah is positioned with natural resources, research institutions, capable industry, and regional support to conduct meaningful demonstration scale projects that can lead to cost effective commercial and environmentally sound energy development. Demonstration-scale research projects supported by the State of Utah should be conducted by unprecedented partnerships between the Research Triangle, national laboratories, industry, and the public sector to capitalize on the region's rich resources to meet the region's energy needs in an environmentally sensitive manner.

Implementation of these recommendations will significantly improve Utah's energy research, development and deployment performance and foster unprecedented collaboration between academia, government, laboratories, and industry.

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