

GOVERNOR GARY R. HERBERT — March 2, 2011



ENERGY INITIATIVES & IMPERATIVES

Utah's 10-Year Strategic Energy Plan



TABLE OF CONTENTS

Executive Summary	2
I. Introduction	10
II. Current and Future Energy Demand	10
III. Background Information on Utah's Energy Resources	11
IV. Economic Development and Energy Jobs	18
V. Energy Development and Our Natural Resources	21
VI. Energy Efficiency, Conservation, and Demand-Response	27
VII. Transmission, Infrastructure, and Transportation	31
VIII. Developing and Applying Technology and Science	35
Task Force & Sub-Committee Members	41

EXECUTIVE SUMMARY

Governor Herbert's 10-Year Strategic Energy Plan

In his 2010 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 seek to 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 best state for business and careers. One key factor in their decision was our low cost of doing business, especially our competitive energy costs.

While rich in energy resources, Utah is also known for its National Parks, State Parks and unrivaled natural beauty. It is critical that while we strive for energy development that it be done in conjunction with preserving the quality of life that draws people to live and play in Utah.

This Energy Plan has been developed by a Task Force appointed by Governor Gary Herbert. In turn the Task Force relied upon Subcommittees² and input from numerous private and public individuals, officials and organizations. Four public hearings were held throughout the state and input was solicited from all residents interested in energy development, economic development, human health and environmental issues. Based on this input, the plan will be implemented in accordance with the following five guiding principles:



Governor Gary R. Herbert



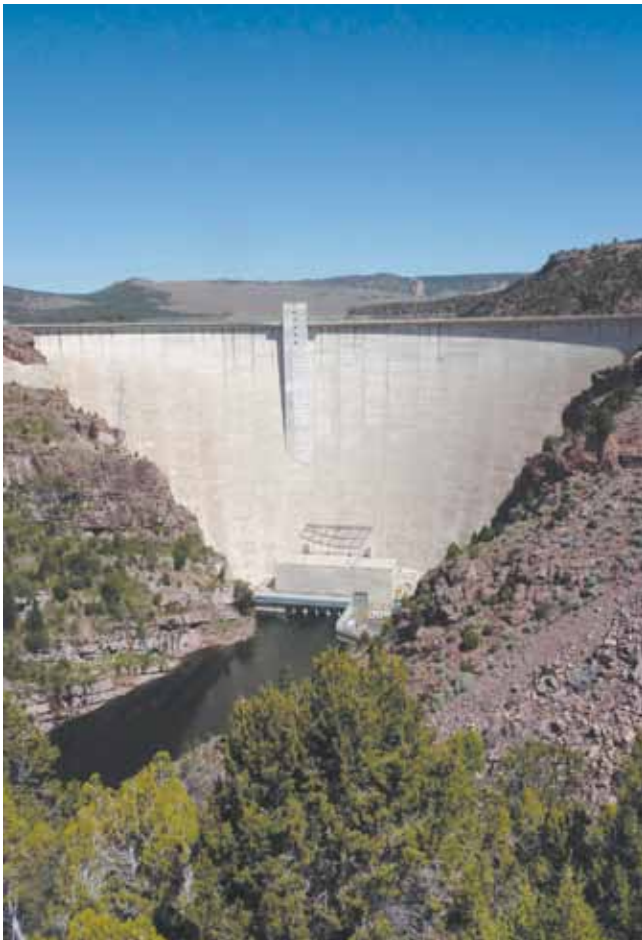
Guiding Principles

1. Utah's economy is dependent upon responsible energy development. Governor Herbert, his Cabinet and his energy policy task force will consider and thoroughly examine the potential for development of all energy resources—allowing the free market to drive while the state provides appropriate legislative and regulatory oversight.
2. Energy development in Utah will carefully consider the impacts on human health, environmental impacts and impacts on wildlife habitat. An effort to avoid, minimize, or mitigate these impacts will be made regardless of energy resource.
3. Governor Herbert's Energy Plan is not a static document; it ushers in an ongoing open and transparent public discussion about best practices. The Governor and his Cabinet will work hand-in-hand with local government, federal agencies, Native American Tribes, environmental organizations, energy producers and utilities, business, and the public to determine the best path forward.
4. Utah will work to keep utility costs low while recognizing that longer term price stability and relative affordability will require significant and ongoing investment in energy infrastructure.
5. Through expanding Utah's energy independence and providing export opportunity, Utah can stabilize its economy and provide for further economic expansion.

This document describes a 10-Year Strategic Energy Plan that seeks to strengthen Utah's economy by setting the following goals:

Goals:

1. Meet the projected energy growth demands over the next decade by making balanced use of fossil fuels and alternatives and renewable resources in a market-driven, cost effective, and environmentally responsible way.
2. Ensure Utah's continued economic development through access to our own clean and low-cost energy resources.
3. 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, the nation, and the world.
4. Create new and support existing energy related manufacturing opportunities and jobs in Utah.
5. Modernize the regulatory environment to support sustainable power generation, energy transmission solutions and energy conservation.
6. Promote energy efficiency, conservation and peak consumption reductions.
7. Facilitate the expansion of responsible development of Utah's energy resources, including traditional, alternative and renewable sources.
8. Pursue opportunities for Utah to export fuels, electricity and technologies to regional and global markets.
9. 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
10. Collaborate with other western regional states to present a strong and unified voice to federal regulatory agencies on energy and public land issues.



Modeling:

Given the vigorous nature of energy development resources, technology and potential impacts on human health and the environment, a key element of the Plan will be creating a methodology for evaluating resources, costs, and economic impact on a continuous basis. The PI+ model from Regional Economic Models, Inc. (the REMI model) is one tool identified that will be used to forecast economic impacts of resource development in a timely manner.

REMI is a dynamic model which generates annual predictions to 2050 and includes a detailed economic structure. While REMI has thousands of input variables, the change in energy prices resulting from various policies will be central. REMI includes the price of natural gas, electricity, and other energy for residential, commercial and industrial users as inputs. Other inputs that may be affected by different policies include home prices and industry production costs. In particular, REMI models the labor market as a process in which labor supply and labor demand are matched through wage adjustment. Employment by industry is determined in the labor market. Gross domestic product (GDP), personal income, and labor income are also estimated. REMI is an effective tool for energy scenario analysis precisely because it generates estimates of employment, GDP, and income resulting from different policy decisions.

This Executive Summary and Plan contain recommendations, next steps and additional investigations needed to achieve the ten goals above. This report does not contain answers to all of the challenges identified, but it provides a roadmap to accomplishing that objective. Over the next ten years, as Utah continues to develop a robust, diverse portfolio of energy resources and related economic development, there will surely be changes and additions to the 10-year Strategic Energy

Plan and opportunities for stakeholders to collaborate in building a stronger, more secure energy future.

Energy Resources and Demand

Utah's current energy resource consumption includes traditional fossil fuels and renewable resources, as summarized in Figure 1. In 2009, residents, businesses, and industries consumed approximately 27,411 gigawatt-hours (GWh) of electricity and 131 billion cubic feet of natural gas.

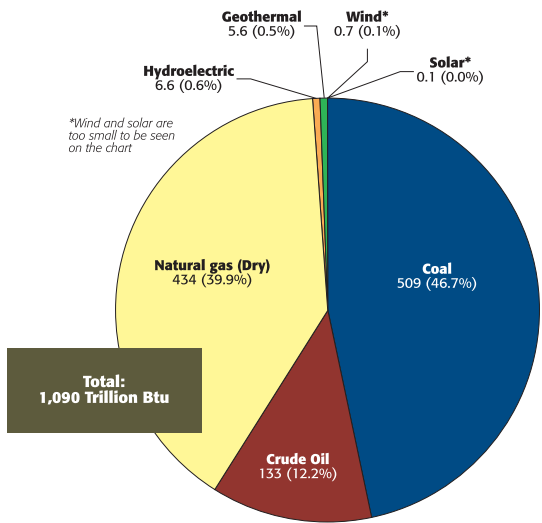


Figure 1. Energy production in Utah by source in 2009. Source: Utah Geological Survey.

The demand for energy in Utah is increasing. Rocky Mountain Power's total Utah load is expected to increase from approximately 4,700 megawatts (MW) in 2011 to approximately 5,600 MW in 2020. Questar projects that natural gas consumption in Utah in the residential, commercial, and industrial sectors will increase from 170 million Dth in 2011 to 200 million Dth in 2020. Based on

Table 1

Utah's Projected Fossil Fuel Energy Growth—Next 10 Years. Source: Rocky Mountain Power, Questar, Utah Geological Survey

	2011	2020	Percent Change	Annual Rate
Electricity Load (RMP) (MW)	4700	5600	19.1%	1.9%
Natural Gas (Questar) (million Dth)	170	200	17.6%	1.8%
Petroleum/Transportation (mbbl/yr)	45	52	15.56%	1.15%

Table 2**Utah's Current Annual Production Rates and Proven Reserves of Conventional Fossil Fuels**

(All values referenced elsewhere in this report.)

	<u>Petroleum</u>	<u>Natural Gas</u>	<u>Coal*</u>
Proven Reserves	286 mbbl	6.7 bcf	202 mt
Yearly Production Rates	45 mbbl	0.131 bcf	21 mt
Remaining Years of Reserve at Current Production Rates	6 years	51 years	10 years

mbbl = million of barrels, bcf = billions of cubic feet, mt = millions of tons

*including Kaiparowits (federal lands), 505 mt proven reserves, 25 years proven reserves at current production rates

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.⁴ These figures are summarized in Table 1.

Table 2 summarizes Utah's proven reserves and current consumption rates for petroleum, natural gas and coal. It also shows remaining years of proven reserves at current consumption rates. Several factors affect these values, including national policy, exportation of coal, unproven reserves, change in production rates (e.g., natural gas projected to increase, coal possibly to decline), new reserve discoveries, etc. Utah already imports a significant part of its consumed petroleum.

To meet future demand, Utah should continue to use existing fossil fuel resources while augmenting them with new, cost-effective energy efficiency measures and

alternative and renewable energy resources as they become more economically feasible.

How Utah Will Accomplish Its Energy Goals

The State of Utah should work to meet the energy demand of 2020 with a balanced use of Utah's abundant energy resources. Development of resources should be done thoughtfully through evaluation of resource potential, impact on economic development, the natural environment and human health and physical and regulatory constraints. Utah would be best served by pursuing development of all energy sources and focusing on strategies that do not favor one over the other. Success will come if the focus is on the following eight cross-cutting strategies that provide a solid basis to support development of all Utah's energy resources.



1

It is recommended that Utah establish an energy office, administered by the Governor's Energy Advisor, with an Advisory Committee to oversee the implementation of the Governor's Energy Plan. This structure will address the evolution of the state's energy policy and act as an advisory body to the Governor. The Committee will respond to emerging issues in the energy arena and make recommendations on any necessary changes in state policy in response to emerging issues. This committee will develop the next steps related to the energy policy recommendations, identify and evaluate scenarios to be evaluated using economic models, and oversee the action items identified by the Governor.

Recommendation:

Streamline government processes and policies for executing the Plan. A clear and predictable policy voice creates a business friendly environment and intergovernmental alignment yielding investment in energy development and job creation

- Create an energy office by consolidating existing energy functions currently fragmented throughout state government
- Form a State Energy Advisory Committee comprised of a diverse group of representatives of energy in Utah
- Shape policy discussions to make informed decisions
- Provide continuous policy analysis on resources, economic development, transmission and constraints on development
- Implement this Energy Plan and assure state government agencies are working seamlessly to accomplish goals as outlined

2

Utah should create an effective strategy for the legitimate use of Utah's public lands for energy development purposes by working with federal agencies to navigate the balance between economic and environmental sustainability. The federal government owns and manages approximately 60% of Utah's surface lands and a larger portion of the mineral estate. Many of these public lands include pristine air sheds, national parks and wilderness areas, important water resources that are essential to local communities, wildlife habitat and riparian zones, world-renowned archeological and culturally significant sites, nationally recognized scenic areas and prized recreational locations. Accordingly, Federal Land Management Agencies will play a central role in the state's ability to develop its traditional, alternative, and renewable energy resources.



Recommendation:

Act to keep Utah's Public Lands open for responsible energy development

- Continue to work directly with federal officials, Western Governors' Association, National Governor's Association and other groups to advocate for energy development on public lands
- Designate access to public lands for energy development as a priority for the Governor's Public Lands Policy Coordination Office
- Utilize the Governor's Balanced Resource Council to facilitate agreement on energy and environmental concerns
- Assure that state agencies are taking lead roles in developing plans and strategies on how to address impacted resources under state jurisdiction and regulation (e.g. air quality, wildlife, archeology)
- Coordinate efforts with local government, State and Institutional Trust Lands, state agencies and interest groups to identify potential issues and work towards solutions
- Partner in joint efforts to leverage regional support with other western states for land rights



3

Utah's research universities and regional colleges, the energy industry, and nearby national energy laboratories all contribute to development and deployment of energy technologies and work force capabilities. These efforts will be enhanced through greater coordination.

Recommendation:

Strengthen Utah's role in research and development of energy technology by making this a primary focus for the Governor's Energy Advisor with higher education, industry and other research partners

- Develop a "Research Triangle" of Utah's three research universities to expand interaction with regional technology leaders through collaborative efforts lead by the Governor's senior energy official and senior energy research officials from each of the universities
- Place emphasis on clean technology for fossil fuels (i.e. gasification, carbon capture and sequestration, unconventional fuel, etc.) and the interface with other energy forms
- Increase collaboration between the Research Triangle and nearby national laboratories, particularly the Idaho National Laboratory
- Continue to attract world class researchers to connect higher education to deployable technologies
- Collaborate with DOE Energy Commercialization Center and associated technology transfer or commercialization agencies within the Research Triangle and regional colleges

4

Government tax incentives are a powerful economic tool that can influence behavior and business decisions. Incentives should be used strategically in coordination with Utah's energy plan, and where they have the most beneficial impact on Utah's economy.

Recommendation:

Review the role of tax incentives for businesses to relocate to and expand in Utah and their potential impact on job creation, energy availability and the growth of energy production

- Assess how tax incentives may further foster energy production and the manufacturing sector connected to the energy industry
- Use economic modeling (REMI) to best determine the economic impacts of future development

5

Increase energy development through coordination and transparency in the regulatory and licensing process. Utah's regulatory framework and process should be reviewed and revised to accommodate future demand. Within various state agencies there are competing requirements and a lack of standard policies and regulations related to application processes, timelines and paperwork requirements.

Recommendation:

Align Utah's agencies to better meet and facilitate responsible energy development.

- Establish a single point of contact for energy developers for information on all state and local permit and ordinance requirements and regulations
- Empower a new coordinating council of state agencies to work on energy development issues and activities
- Instigate process improvement in state agencies that regulate the energy industry to assure greatest efficiency and protection to public health and environment
- Develop a Utah long-range transmission plan
- Strengthen the State's role in authorizing and facilitating transmission/infrastructure projects
- Adjust Utah's regulatory framework and process to address Utah's future energy demand and the role of emerging technology

6

Utah should have a state-wide program aimed at reducing energy consumption. Energy not consumed as a result of efficiency is a cost effective resource. Demand-side management (DSM) strategies reduce consumption during peak demand, resulting in lower costs because of avoided or delayed investment in new electrical generation and new natural gas supplies.

Recommendation:

Maximize Utah's commitment to energy efficiency and demand side management.

- Support education and communication programs that enhance public awareness of energy efficiency and promote energy code training for new and existing energy professionals

- Encourage utilities and regulators to expand energy efficiency and demand response programs through state policy
- Analyze financial incentives to enable investment in energy efficient construction and retrofitting

7

Utah should diversify transportation fuels and build a transportation infrastructure and a fleet to meet the needs and demands of future generations. Utah's dependence on out of state sources for crude oil—72% used for transportation from out of state sources—may create a future fuel crisis. It is critical to our economy, air quality and our quality of life that Utah diversifies our transportation model.

Recommendation:

Utah should pursue energy independence for transportation fuels by developing a framework for reducing its dependence on outside sources for transportation fuels and the inherent impacts this dependence has on economic development.

- Support augmentation of Utah's fuel supply with nontraditional fuels
- Promote research and commercialization of clean technology for nontraditional fuels and alternative fuel vehicles (USTAR and Research Triangle)
- Analyze current and future pipeline capacity for oil and gas



- Assure that the State of Utah is engaged in transportation planning that promotes non-motorized and public mass transit infrastructure

8

Utah should review the need for additional base load sources of energy to supply electrical needs for our future. Given future demand projections, current and projected environmental regulations and constraints, and Utah's unique mix of energy resources, the foundation for future base load growth should be laid now.

Recommendation:

Coordinate with major local and municipal utilities to develop a long term strategy to broaden Utah's supply of base load electricity

- Examine future coal supplies, the impacts of additional regulation on coal fired power plants and the potential of clean coal technology
- Assess Utah's natural gas resources and pipeline capacity in terms of delivering base load energy
- Facilitate dialogue regarding Utah's potential opportunity for nuclear power development

SUMMARY:

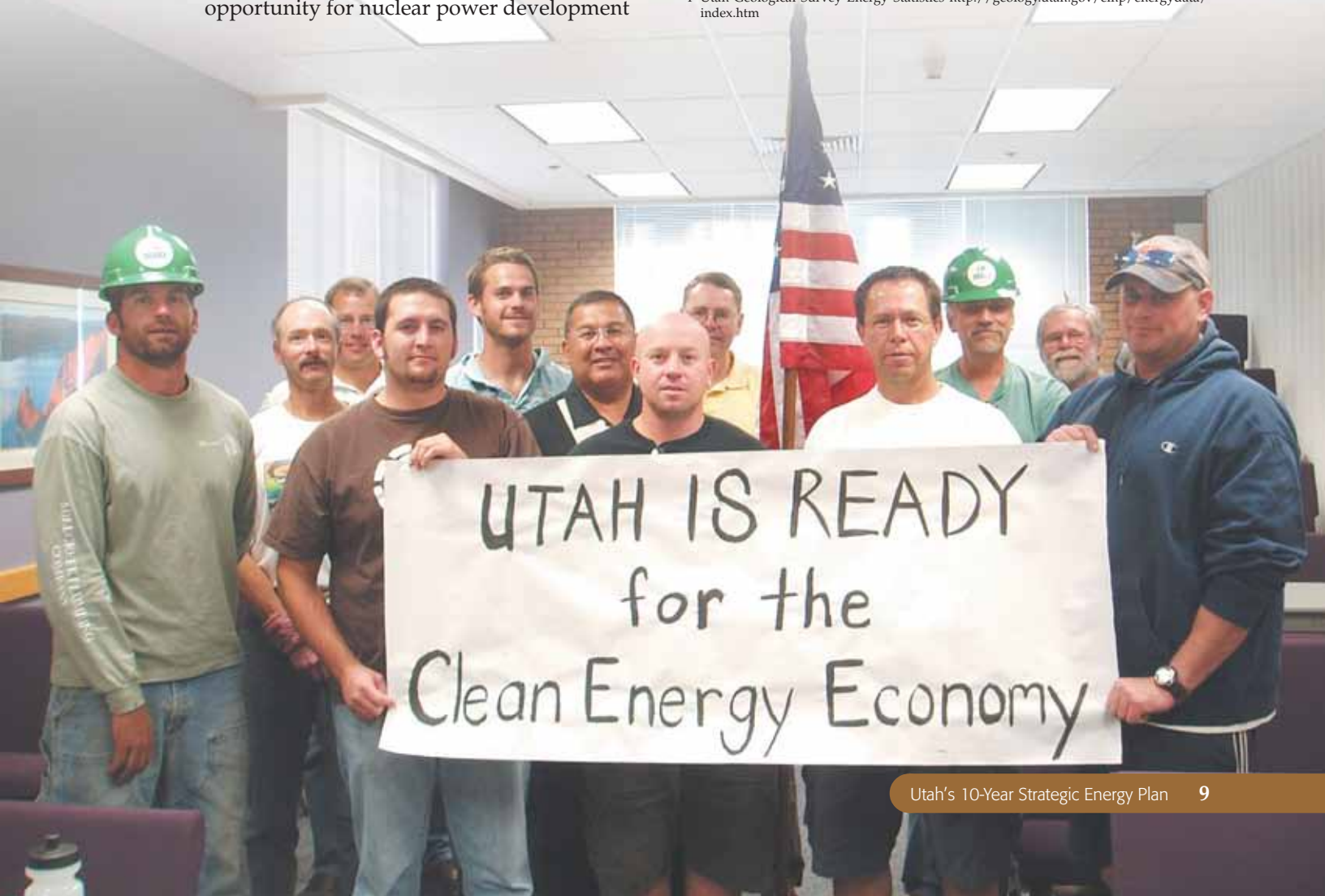
Energy is one of Governor Herbert's top priorities. The Utah Energy Task Force was appointed by the governor to develop a 10-year strategic energy plan. Eight recommendations have emerged from the comprehensive stakeholder driven process to help shape Utah's energy future. The plan takes into consideration our abundant natural resources, economic development objectives and the importance of environmental sustainability. It is intended to be a working document to which modifications will be made as new information is realized. Energy development is an essential component to the vitality and success of the state and Utah will strive to lead our nation in the development of traditional, alternative and renewable energy resources.

1 Governor Herbert, 2010, State of Utah, State of the State, reference Energy Initiatives and Imperatives—Utah's 10-Year Strategic Energy Plan, 6/10/10, <http://www.utah.gov/governor/docs/Energy-Initiatives-Imperatives.pdf>

2 <http://www.energy.utah.gov/governorsenergyplan/subcommittees.html>

3 Ibid

4 Utah Geological Survey Energy Statistics <http://geology.utah.gov/emp/energydata/index.htm>



UTAH ENERGY INITIATIVE

Governor Herbert's 10-Year Strategic Energy Plan

I. INTRODUCTION

The energy industry in Utah is the second largest component of state gross domestic product. Utah has a vast supply of diverse energy resources. These resources foster job creation and economic development through exploration, development, production, research and manufacturing. Additionally, Utah's low cost energy has been a driver in attracting businesses to locate in Utah. The revenue from energy development is the backbone of Utah's strong economy, providing funds for education to develop the scientists, engineers, technicians, entrepreneurs, and workforce that match the opportunities of a strong economy and a vibrant quality of life

II. CURRENT AND FUTURE ENERGY DEMAND IN UTAH

Utah's current energy resource production base includes traditional fossil fuels and renewable resources, as summarized in Figure 1.

In 2009, residents, businesses, and industries consumed approximately 27,411 gigawatt hours (GWh) of electricity and 131 billion cubic feet of natural gas. With the exception of crude oil, Utah currently produces more energy (including electricity, transportation fuels, and fuel for residential, commercial, and industrial sectors) than it uses. In 2008, Utah produced 29% more energy than it consumed.¹ Rocky Mountain Power's (RMP) Utah load is expected to increase from approximately 4,700 megawatts (MW) in 2011 to approximately 5,600 MW in 2020. Questar projects that natural gas consumption in Utah in the residential, commercial, and industrial

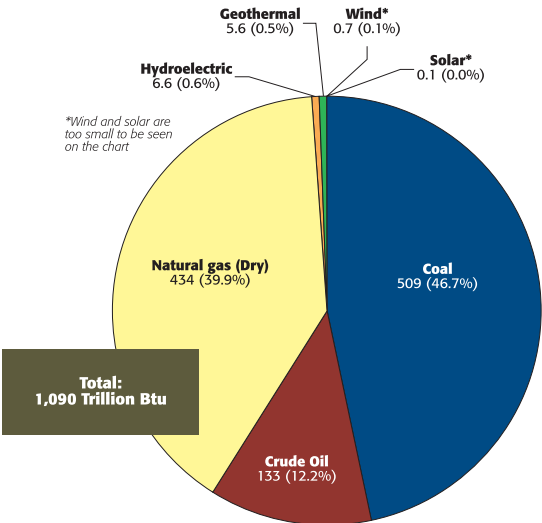


Figure 1. Energy production in Utah by source in 2009. Source: Utah Geological Survey.

sectors will increase from 170 million Dth in 2011 to 200 million Dth in 2020.² 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.³

Table 1 shows Utah's projected energy demand growth for three of the four fossil fuels (all but coal). Coal reserves are at least sufficient to last this coming decade; and in general, existing coal plants will likely continue to produce electricity through the decade. The coal use may remain about the same, but this energy is accounted for in the electricity.

Table 1

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Natural Gas (Questar) (million Dth)	170	200	17.6%	1.8%
Petroleum/Transportation (mbbl/yr)	45	52	15.56%	1.15%

This report notes that RMP provides about 80% of the State's electrical power, the balance coming principally from public municipals. Thus, the values in Table 1 will be low. Further, Utah is not self-sufficient in petroleum and imports about 72% of its petroleum consumed.

Figure 1 shows that currently, nearly 99% of Utah's energy production is from these three conventional fossil fuels. Renewable resources provide only 1.3% of the total.

While it is anticipated that renewable and alternative energy sources will likely grow at more rapid rates than the conventional fossil fuels, by 2020, Utah's energy will still be dominated by fossil fuels. To illustrate this, these 10-year projections for Utah can be compared to the federal government's energy plan which goes to 2035.⁴ The U.S. Energy Information Administration projects a 14% increase in consumption from 2008 to 2035, an annual growth rate of only 0.5%, significantly less than projected for Utah's growth rate (Table 1). The U.S. also projects a significant growth rate in renewables and biofuels. It also projects small increases in coal and natural gas with declining reliance on imported petroleum. Currently, the conventional fossil fuels provide 84% of the U.S. energy demand. By 2035, the U.S. projects the fossil fuel percentage will drop from 84% to 78%. This is an important observation for Utah's 10-year energy plan. The U.S. has an aggressive program to expand renewable and alternative energy sources. Yet, even by 2035, the U.S. will still be principally dependent on these three fossil fuels. It is very likely that, even with aggressive efforts toward renewable energy sources, Utah must continue to rely principally on fossil fuels over the next 10 years.

To meet future demand, Utah should continue to use existing fossil fuel resources and augment with new, cost-effective energy efficiency, renewable, and alternative energy resources to the extent it is technically and economically feasible, and continue the research and development of clean and secure energy through research centers around the State, e.g., the Bingham Entrepreneurship and Energy Research Center in Vernal.

Utah's dependence on imported transportation fuels is a concern over the next ten years. Utah currently imports about 72% of its petroleum to meet transportation needs. This is similar to U.S. imports of its petroleum which is considered to be a national crisis. As discussed elsewhere in this report, Utah has vast reserves of oil shale and oil sands in the Green River formation in eastern Utah.

Newer, cleaner technologies have been developed to produce liquid transportation fuels from these unconventional resources.⁵ Shale oil has been and is being commercially produced in Brazil, China and Estonia.⁶ A single small oil shale plant would have the capacity to produce 6,000 bbl/day of oil, which is about 11% of Utah's daily consumption of about 53,000 bbl/day.⁷

III. BACKGROUND INFORMATION ON UTAH'S ENERGY RESOURCES

A. Status of Utah's Energy Resources

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.

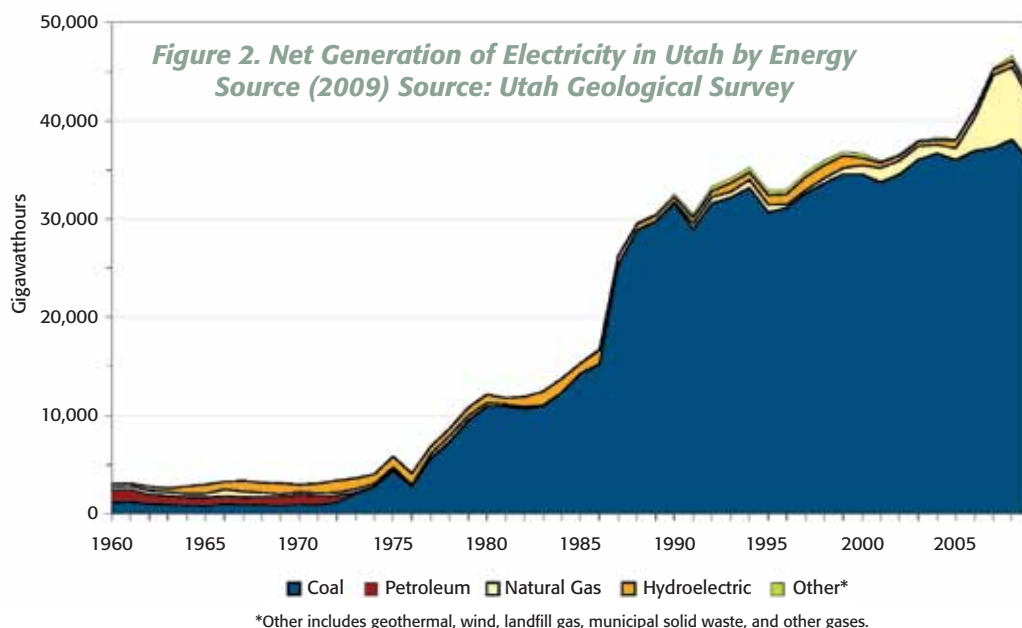
Coal: In 2008, Utah produced its one-billionth ton of coal. In 2009, Utah ranked 13th in the nation in the production of coal at 21.9 million tons and coal made up about 47% of Utah's total produced energy resources.

UTAH INGENUITY AT WORK

DESERET POWER

Deseret Power operates a coal fired power plant in northeastern Utah generating 458 MW of power for Utah. To address air quality concerns they are working towards two innovative ideas to both decrease emissions and reduce waste product. A new 110 MW coal fired unit will utilize waste byproduct eliminating the need to landfill and the best technology would be used to minimize emissions. Additionally Deseret is considering a 100 MW coal fired project that would capture 90% of CO₂ emissions and sequester CO₂ potentially for oil recovery.





Coal also accounts for 41% of the energy consumed by Utahns.⁸ There are estimated to be over 3,722 jobs in Utah's coal production industry, including direct and related support jobs (this figure does not include indirect jobs).⁹ Utah's most economic coal reserves are located in the three coal fields forming an inverted "U" primarily across Sevier, Emery, and Carbon Counties. Utah currently has about 202 million tons of coal reserves under lease at active mines, while state-wide recoverable coal resources total about 15 billion tons (this number does not take into account economic or land use constraints).¹⁰ Another estimate from the Bureau of Land Management Price Field Office resource management plan indicates statewide coal reserves at 14.3 billion tons or greater than 50 years at current production rates. The majority of Utah coal, 68% in 2009, was used in state, while 32% was shipped out of state. Foreign exports, mostly to Asia, peaked in 1996 when 5.5 million tons, or 19.7%, of Utah coal was shipped to foreign markets. This export market ceased to be economic as Australia and China increased production.¹¹ Utah's research universities are evaluating carbon capture and related technologies with direct application to Utah's coal-fired generation.¹²

From 1973 to 1988, electricity generation increased from approximately 3,000 GWh to over 30,000 GWh. Utah became a net exporter of electricity. Coal-fired power plants comprised about 95% of total net generation as the amount of hydroelectric generation declined. Today, approximately 82% of Utah's total net generation of electricity comes from coal-fired power plants,

with 16% from natural gas, and 2% from hydroelectric, geothermal, landfill gas and biomass, wind, and solar.¹³ 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 Rocky Mountain Power, 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).¹⁴ The remaining electricity customers are served by two municipal groups, UAMPS and UMPA, and by an association of rural electric cooperatives. They have a similar fuel mix as Rocky Mountain Power, but with a larger percentage from hydroelectric power.

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. There are three existing ways of estimating coal reserves. Reserves adjacent to active coal mines are the most conservative estimate, but also the most accurate estimate of readily available coal. During this same period, 2000 to 2009, the number of mines decreased from 13 to 8.¹⁵ 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. More restrictions are anticipated in the next few years, which will also decrease the probability of investment in new coal mines, or new coal-fired electric

generation. Furthermore, as some Western states evaluate the generation and importation of electricity from cleaner sources (including renewables and natural gas), electricity portfolios may change. The technology and cost of integrating intermittent, non-dispatchable renewable resources, as well as the need to ensure reserve generation to back-up intermittent generation, are factors in the diversification of electricity resources in Utah and across the Western Interconnect.

Crude Oil (Petroleum Products): In 2008, Utah ranked as the 13th largest producer of crude oil in the United States. In 2009, crude oil made up approximately 12% of Utah's total produced energy resources. Crude oil also accounts for 33% of the energy consumed by Utahns.¹⁶ Utah has five refineries with over 150,000 barrels per day of refining capacity making gasoline, diesel, jet fuel and related products. While Utah is a net exporter of energy, it imports approximately 72% of the crude oil that is processed in its refineries. Imports come principally from Canada, along with Wyoming and Colorado. 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 stability in regulation and taxation to invite the investment of necessary capital to continually modernize and make their operations more efficient.

Natural Gas: In 2007, Utah ranked as the 8th largest onshore producer of natural gas in the country. In 2008, Utah's natural gas was mostly used for home heating (nearly 29%) and by the electric utility sector (nearly 25%). Natural gas makes up approximately 40% of Utah's total produced energy resources. Natural gas also accounts for 24% of the energy consumed by Utahns.¹⁷ There are estimated to be over 13,222 jobs in Utah's oil and gas industries, including direct and related support jobs of extraction, wells operations, distribution, transportation, refining, construction and manufacturing (this figure does not include indirect jobs).¹⁸

Future energy projections place significant demands on natural gas production in Utah. 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.¹⁹ 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 1990s, totaling more than 55 bcf from all utilities in 2008, generating approximately 16% of Utah electricity production.²⁰ Rocky Mountain Power currently estimates that its Utah natural gas plants will consume approximately 62 bcf in 2020 for electricity generation, an increase of over 45 % from the approximately 42 bcf consumed by RMP plants in 2009.²¹ In 2020, Rocky Mountain Power's production of electricity from natural gas in Utah is projected to reach 9,000 GWh, compared with production in Utah in 2009 of 5,300 GWh.²² Doubling Utah's natural gas-fired generation will require new natural gas production, which will require more efficient lease sales and permitting of natural gas exploration. Delays related to Resource Management Plan approvals must be resolved, and the approximate 18-month backlog on federal drilling permits must be reduced. State and federal agencies are already working together with industry to identify and reduce ozone and fine-particulate pollution that has been identified

UTAH INGENUITY AT WORK

WEST TAVAPUTS PLATEAU

Bill Barrett Corporation, working with the BLM, state, and local partners was able to reach an agreement with the Southern Utah Wilderness Alliance on an acceptable plan to extract vital natural gas resources from one of Utah's most spectacular landscapes. This win-win was brought about by a shared desire to keep lands appropriate for development open, while allowing that some areas should be maintained for their scenic and wild attributes.



in some regions of oil and natural gas development. Future considerations should include recognition that renewables, particularly wind and solar generation, do not completely replace fossil fuels in the fuel mix, but usually rely on natural gas as a backup and peak-day contingency. Additional natural gas will also be needed should significant wind generation be developed in Utah. Wind's unpredictable nature means grid operators and planners must construct a shadow grid, particularly gas-peaking units, to stand as a reserve generator for those times when wind resources are not delivering their potential capacity. An increased reliance on natural gas for electricity generation also means that there is a need for additional pipeline capacity.

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's 2009 evaluation estimates that a continuous oil-shale interval that averages 35 gallons per ton contains an in-place resource of 76 billion barrels of shale oil.²³ Tar sands potential includes 14-15 billion barrels of measured in-place oil, with an additional estimated resource of 23-28 billion barrels.²⁴ The 2005 Rand Corporation Report indicates that, "the largest known oil shale deposits in the world are in the Green River Formation, which covers portions of Colorado, Utah, and Wyoming. Potentially recoverable oil shale resources include 500 billion bar-

rels to 1.1 trillion barrels of oil. For policy planning purposes, it is enough to know that any amount in this range is very high. Present U.S. demand for petroleum products is about 20 million barrels per day.²⁵ The largest volume of deposits of bitumen is in Utah, which has measured reserves of 8 billion to 12 billion bbl and total resources in place, including speculative ones, of 23 billion to 32 billion bbl."²⁶ The 2008 Rand Corporation Report on oil sands notes that "U.S. resources of bitumen have not been heavily exploited and are not characterized as thoroughly as resources in Canada (USGS, 2006). Major deposits of bitumen (i.e., larger than 100 million barrels) in the United States can be found in Alabama, Alaska, California, Kentucky, New Mexico, Oklahoma, Texas, Utah, and Wyoming."

Uranium: Utah's San Juan County has a history of uranium mining dating back to the 1950s. Currently the Nation's only licensed and operating uranium mill, the White Mesa Mill, is located south of the community of Blanding, Utah. Uranium mined in Utah, in addition to Uranium mined in the Arizona Strip, is being transported to White Mesa for processing. There is the potential nuclear power plant project in Utah that would depend on this ore, additionally a market exists currently and may grow as additional plants are brought on line around the country.

There are more than 150 jobs in Utah's uranium industry, including direct and related support jobs in uranium mining and milling (this figure does not include indirect jobs).²⁷ Future job growth in Utah is dependent on the growth of the nuclear power industry, nationally and in Utah. Additionally, job growth in Utah is dependant on the area known as the Arizona Strip remaining open for uranium mining. Currently the Bureau of Land Management is proposing to withdraw over 1 million acres from development.

Hydroelectric: In 2008, hydroelectric made up 0.5% of Utah's total produced energy resources. Hydroelectric also accounts for 0.7% of the energy consumed by Utahns.²⁸ Hydroelectric power comprises about 1.5% of electricity produced. There are estimated to be 1,142 jobs in Utah's hydroelectric industry, including direct and related support jobs (this figure does not include indirect jobs).²⁹

Geothermal, Solar, Wind and Biomass: In 2008, geothermal made up 0.5% of Utah's total produced energy resources. Geothermal also accounts for 0.8% of the energy consumed by Utahns. Utah is one of only six states where electricity is generated from geothermal resources.³⁰ In 2010, Utah's wind generation capacity was

UTAH INGENUITY AT WORK

MILFORD WIND FARM

First Wind is an independent wind energy company that operates a 204 MW wind project in Beaver and Millard Counties. The company recently started construction of a second phase of the project that will add another 102 MW of generation capacity.



224 megawatts (MW), most of which is exported to California. In 2009, only 0.1% of Utah's electricity need was met by wind power. Solar energy generation makes up 0.1% of total produced energy in Utah and 0.01% of the energy consumed by Utahns. In 2009, biomass made up 0.5% of Utah's total produced energy resources. Biomass also accounts for 0.8 % of the energy consumed by Utahns. In 2008, Utah ranked 45th in the nation in percent of total net electricity generation from renewable resources.³¹ Currently, there is only a minimal renewables manufacturing component 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 4,155 jobs in plastics and rubber, 12,318 in fabricated metal, and 3,574 in composites.³²

While Utah may possess considerable renewable energy potential, many legitimate challenges currently impact the development of these resources. Among these challenges are the substantial investments in transmission infrastructure to connect these widespread resources to the grid, as well as policy, economic, technological and regulatory considerations. Combined, these challenges render many renewable energy projects in Utah not cost effective when compared to other resource options. Nevertheless, 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.³³ 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 numbers found in the Utah Renewable Energy Zone Task Force Report (UREZ) represent the upper boundary of what is theoretically possible, but does not identify what is reasonably probable and economic. Ongoing efforts by members of the Committee support the premise that commercially viable renewable energy projects exist and should be developed in Utah as they are demonstrated to be cost effective. Utah's policy-making authorities, public demand, cost, the utility regulatory and planning arenas, and continued coordination among stakeholders should collaborate to identify pathways to address existing challenges to renewable energy development. Given growing energy demand and constraints on current energy supply, renewable energy could play an important role in Utah's

energy future if these challenges are sufficiently addressed, though not likely having a major impact in the next 10 years.

It should be noted regarding Utah's renewable energy resources that to date, Rocky Mountain Power (RMP) has found potential renewable energy projects in Utah to be less cost-effective than projects in surrounding states. Current regulatory policy in the State applies a least-cost risk adjusted standard to RMP in providing electric service to its Utah customers. Under this standard, RMP has directed the majority of its investment in renewable energy generation facilities to areas located out of state, with the bulk of investment being directed to wind facilities in Wyoming. Under the current least-cost standard, RMP will invest in renewable energy facilities located in Utah (such as the Blundell geothermal facility located in Beaver County) to the extent they are found competitive from a cost effectiveness standpoint.

Also worthy of note regarding renewable energy facilities in general are the operational challenges of implementing renewable energy resources into an electrical system. By their very nature, energy production from renewable facilities is intermittent and can be random and unpredictable. Solar facility production is impacted by cloud cover and shading from nearby structures, while production from wind facilities can drop

UTAH INGENUITY AT WORK

RASER TECHNOLOGY GEOTHERMAL

Raser is a Provo-based environmental energy technology company focused on geothermal power development and technology licensing. Raser operates a 10 MW geothermal plant in Beaver County and plans to develop plants at two other Utah sites.



UTAH INGENUITY AT WORK

BIOFUELS CENTER AT USU

Utah State University's Biofuels Center has evolved into a dynamic research facility, designed to maximize the production of biofuels to meet the growing demand of energy in America's dynamic economy for the next generation. It's mission is to lead the R&D of Biofuels, with an emphasis on algae, giving America a reliable cost effective source of energy for the next generation.



off in a matter of minutes as the wind ceases to blow. Also, production from renewable energy facilities may or may not occur at the time it is most needed - when demand on the electrical system peaks. Because electric utilities are expected to provide service on a continuous basis, renewable energy facilities need to be backed up by production resources which can be dispatched 1) in a short period of time; and 2) at the time the energy is needed. Presently, RMP backs up its wind resources primarily with natural gas-fired generation and power purchases from the market, both of which add cost to the provision of electric service. The development of battery storage technologies, which is not a mature technology on a utility scale at this time, will improve the ability of renewable energy facilities to deliver energy at the time it is needed.

Compressed Air Energy Storage (CAES) as a Renewable Energy Resource. The 2010 Legislature, through SB 104, designated air that is compressed and stored using renewable energy to be classified as a renewable energy resource under certain conditions. While there are no operating CAES facilities in Utah, the legislation was based on the potential for compressed air storage in proximity to potential renewable energy

resources. A compressed natural gas storage facility, using storage in salt domes, is being permitted in Millard County. The CAES process uses stored compressed air, with the addition of natural gas combustion, to run turbines to generate electricity. This approach will not likely have a significant impact on Utah's energy production in the next 10 years.

Biofuels: There are currently approximately 75 direct jobs in Utah's biofuels industry at 9 project sites. The projects include both start-up and operational status, and the jobs types are R&D, manufacturing, engineering and operations.

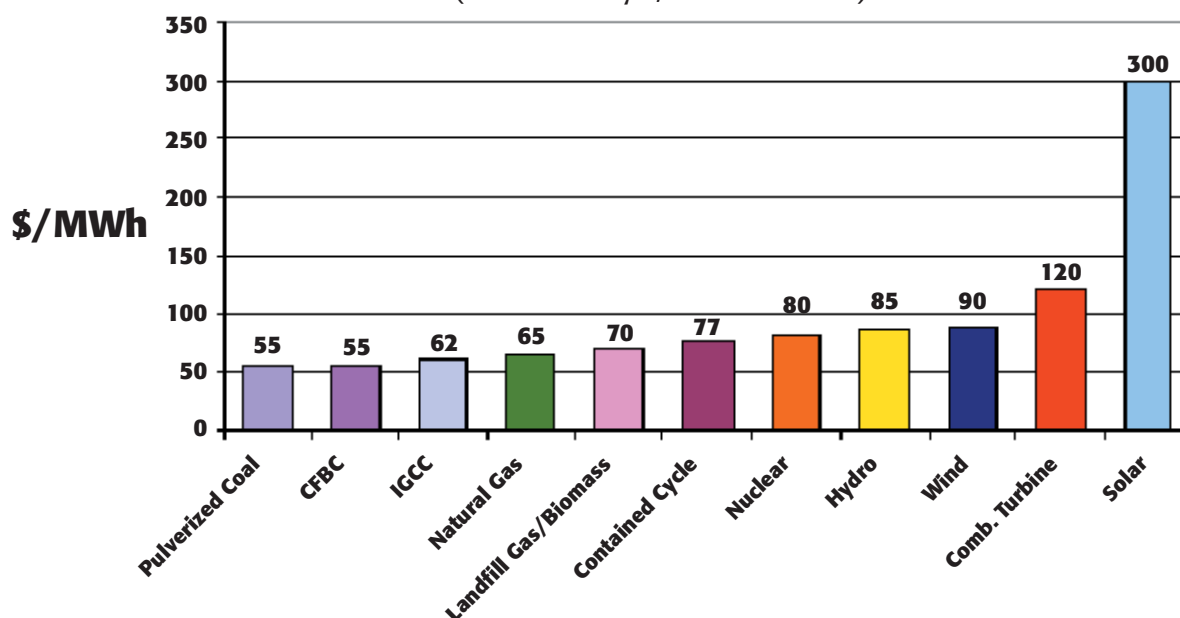
Biomass Utilization. Utah's biomass energy potential is only partly realized at this time. Currently, landfill gas, municipal solid waste combustion, and some experimental algae and anaerobic digestion processes constitute biomass energy utilization. The numerous national forests and wide expanse of public domain produce an excess of wood, beetle kill waste, and forest undergrowth waste. The web-based Coordinated Resource Offering Protocol (CROP) provides potential wood users with information on wood fiber available within economical haul distances from federal and non-federal lands. Additionally, crop residue and animal waste associated with agricultural operations provide a potential resource that can be used for direct combustion or gasification, though significant contribution to Utah's energy needs by 2020 is not likely.

The Algae Biofuels Program at Utah State University is designing new ways to grow algae without needing fertile soil or rain. The approach uses sunlight to its fullest potential, conserves water, produces oil 50 times faster than regular crops, and can co-produce electricity.³⁴

Nuclear Power Generation. This resource deserves additional evaluation, but will likely 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 the possibility of forthcoming taxes or cap-and-trade programs to restrict carbon emissions, cost of compliance with regulations to control other air pollutants, the instability of natural gas prices, and the possible reduction in the use of coal as a base-load electric generation fuel. Converting the current interest in building new nuclear energy plants in the United States into a

New Generation Cost (2012\$) March 2010, UMPA Conference

(D. Gruenemeyer, Sawvel & Assoc.)



*Figure 3. Estimated Costs of Energy Generation.
Source: D. Gruenemeyer, Sawvel and Associates.³⁵*

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 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. Nuclear has the potential to become a re-emergent industry within the United States. Utah should assess and develop its capacity to serve and supply the development of this industry, including the state's manufacturing capability and uranium ore reserves. There are proposals to develop nuclear power in Utah, but there is not a proposal that has moved through the permitting process.

B. The Cost of Energy

It has been noted above that Utah has enjoyed low energy costs and that these low energy costs have been important in Utah's economic development. As Utah's energy portfolio changes over this next decade, cost of

power will be a vital factor in maintaining Utah's economy.

Over the next decade, it is likely that Utah's energy cost will rise. Increases have/are occurring in some energy sectors such as motor fuels and electricity. Causes include costs of feedstock fossil fuels, costs of increasing regulation, impacts of supply and demand, the economic climate in the U.S. and other costs. Government expenditures through incentives, loans, tax credits and grants, several of which are mentioned in this report relating to development of renewable energy, will also impact energy cost. As larger fractions of Utah's energy are produced from alternative and renewable resources in the years to come, energy costs will rise. Figure 3 shows current typical generation costs for several energy resources, with pulverized coal plants being the least costly and solar energy the most costly.

Differences in costs among the various resources are dependent on the time period, the location, federal subsidy, pending regulations and other factors. But the comparisons of Figure 3 are current, realistic estimates for the State of Utah. As Utah implements its 10-year plan, implications of energy cost increase for various alternatives can be evaluated with the REMI Model.

IV. ECONOMIC DEVELOPMENT AND ENERGY JOBS

Utah has abundant conventional energy resources, including three large oil fields with an estimated 286 million barrels in oil reserves. Utah is home to two large natural gas fields, and Utah’s proven natural gas reserves total 6.7 trillion cubic feet (tcf).³⁶ In 2009, the State ranked 13th in the nation in the production of coal at 21.9 million tons. Utah currently has about 202 million tons of coal reserves under lease at active mines, while state-wide recoverable coal resources total about 15 billion tons (this number does not take into account economic or land use constraints).³⁷ Another estimate from the Bureau of Land Management Price Field Office resource management plan indicates statewide coal reserves at 14.3 billion tons or greater than 50 years at current production rates.

Table 2 summarizes Utah’s proven reserves and current consumption rates for petroleum, natural gas, and coal. It also shows remaining years of proven reserves at current consumption rates. Several factors affect these values, including unproven reserves, change in production rates (e.g., natural gas projected to increase, coal possibly to decline), new reserve discoveries, etc. Utah already imports a significant part of its consumed petroleum.

Conventional energy and mineral resources have historically served as the backbone of Utah’s energy production. For example, in 2009, over 96% of electricity generated in Utah was fueled by coal and natural gas, 82% of which was coal and 14% natural gas.³⁸ Of the electricity generated in Utah in 2009, approximately 37% was exported out of state.³⁹ That is not to say, how-

ever, that the State’s electricity needs are served only by the in-state coal and gas fired plants. Rocky Mountain Power, the State’s largest electric utility provider, supplies electricity to the State through a diverse portfolio that includes coal, natural gas, hydro, geothermal, wind, wholesale market purchases and other generation resources. For example, in 2009, Rocky Mountain Power-owned wind plants produced over 2,000 GWh of electricity. Generation resources located in Utah contribute to Rocky Mountain Power’s portfolio, including some Utah renewable resources, primarily from geothermal and hydro resources. Utah 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 resources, approximately 26% of which is from geothermal, 65% from hydroelectric, 3% from biomass, and 6% from wind, with a small fraction from solar.⁴⁰ New studies indicate meaningful renewable resource capacity in the State.⁴¹

Fostering 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 June 30, 2010, provide the following baseline (Table 3) for Utah’s energy and natural resource industries.⁴²

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 State School and Institutional Trust Lands generating direct revenues that support K-12 public

Table 2

Utah’s Current Annual Production Rates and Proven Reserves of Conventional Fossil Fuels
(All values referenced elsewhere in this report.)

	<u>Petroleum</u>	<u>Natural Gas</u>	<u>Coal*</u>
Proven Reserves	286 mbbl	6.7 bcf	202 mt
Yearly Production Rates	45 mbbl	0.131 bcf	21 mt
Remaining Years of Reserve at Current Production Rates	6 years	51 years	10 years

mbbl = million of barrels, bcf = billions of cubic feet, mt = millions of tons

*including Kaiparowits (federal lands), 505 mt proven reserves, 25 years proven reserves at current production rates

Table 3

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

Total Employees	22,926
Percentage of Utah's Total Workforce	1.9%
Total Wages (2009)	\$1,381,142,470
Percent of Utah's Total Wages	3.1%
Percent of State's Average Monthly Wage	157.6%
Number of Companies/Firms	1,109
Total Patents (2005-2009)	162
Venture Capital Deals (2000-2008)	20
Public Deals (2000-2008)	11

Table 4

**Revenue from Energy Development for Utah.
Source: Headwaters Economics (2008)**

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

education programs. A Headwaters Economic Study, *Energy Revenue in the Intermountain West*, identifies the following revenues (Table 4) from energy development for Utah.⁴³

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.⁴⁴

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, availability of resources, and quality of life in Utah. According to the U.S. Energy Information Administration, Utah consistently has the second lowest electrical and heating energy costs in the country, due in large part to the low costs of coal-fired electricity generation and natural gas. This competitive advantage over other states is one way Utah is able to recruit new and expand existing business, particularly high-tech

manufacturing. 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."⁴⁵

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 Utah's energy economy. Energy development in Utah communities can become a strong stimulus to create vital and growing economic conditions.

As Utah's energy portfolio is diversified, the demand for new energy-sector employees will increase. Utah's

energy employment reflects its historic strength in conventional energy resources. Efforts are underway to meet the demand for contemporary skill sets in power generation and transmission for the electric utility sector. Over 42% of the 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 in order to provide qualified “work-ready” employees to fill the retirement gap.

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 to establish curriculum, certification and degree programs to prepare Utah’s workforce in green jobs. The Utah Cluster Acceleration Partnership 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 of Utah opened the Intermountain Weatherization Training Center in Clearfield for training and certifications of staff from public agencies and private companies. The State is investing to help train thousands to become certified solar installers, certified wind-turbine maintenance workers, certified energy management workers, and alternative-fuel vehicle technicians.

Until renewable energy becomes cost-effective, the State should carefully consider whether or not to subsidize renewable energy development in an effort to grow Utah’s renewable energy sector. The committee needs to evaluate the renewable energy potential in Utah based on technological and economic feasibility. Any subsidies warranted to incentivize renewable energy development should be approved by State policy makers, i.e. the legislature and the governor. To the extent the state wants to encourage renewable energy development without mandates or incentives, legislation should be developed which enables utilities to offer renewable energy tariffs to their customers who want a greater share of renewable energy as part of their usage mix than is provided by the utility. Rocky Mountain Power is supportive of this concept and supports a thorough, holistic review of potential renewable tariffs for customers who want them. Currently, under its Blue Sky program, Rocky Mountain Power encourages custom-

ers to voluntarily purchase renewable energy certificates (“RECs”) that represent the environmental attributes of electric power produced from renewable energy projects.

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 Utah Science, Technology, and Research (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.

UTAH INGENUITY AT WORK

RED LEAF RESOURCES, INC.

Red Leaf Resources, Inc. has developed the EcoShale™ In-Capsule Technology to economically and environmentally produce high quality liquid transportation fuels from oil shale, oil sands, coal, lignite, and bio-mass. This revolutionary technology rises above other processes in that it does not require water. Additionally, the EcoShale™ In-Capsule technology protects groundwater and vegetation, allows for rapid site reclamation, and supports a favorable emissions profile. The EcoShale™ In-Capsule Technology uses low temperature heating resulting in a high quality feedstock with an average 34 gravity API with no fines or bottoms. The process also produces synthetic natural gas, which allows for energy self-sufficiency.



The State should continue to attract significant domestic and international investment funding. Such funding provides essential opportunities to help supplement the 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 research and development, investment, technology, exploration,

extraction, development, production, transmission, distribution and manufacturing industries, as well as professional support services. These jobs help to support Utah’s position of being one of three states in the United States that is a net exporter of energy. If coal-fired generation and hydroelectric resources decline, new and expanded industry and jobs will be needed in these rural communities. State government should promote continued state and federal land access for exploration, extraction and production of crude oil and natural gas, investment 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.

UTAH INGENUITY AT WORK

BINGHAM ENTREPRENEURSHIP AND ENERGY RESEARCH CENTER

The Bingham Entrepreneurship and Energy Research Center brings real life solutions to environmental issues by working hand in hand with industry on emerging technologies like Pure Stream. Additionally, the center works in partnership with Department of Environmental Quality, Bureau of Land Management other stakeholders to monitor winter-time ozone in the Uinta Basin to assist in determining a path forward addressing air quality issues.



V. ENERGY DEVELOPMENT AND OUR NATURAL RESOURCES

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 its economy and protect its quality of life and environment.

A. Land Ownership

Federal Lands — The federal government owns and manages approximately 60% 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, coal 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; and, nationally recognized scenic areas and prized recreational locations. 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. Although some progress has been made in resolving conflicts on federal lands regarding energy exploration and development, many Utah officials who are active in this area believe that conflict resolution is still a long laborious process.

State Institutional Trust Lands Administration (SITLA)

— At statehood, Congress granted Utah millions of acres of land to be held in trust by the new state to provide financial support for public schools. These school trust lands are managed by the School and Institutional Trust Lands Administration (SITLA). SITLA manages approximately 3.4 million surface acres. In addition, SITLA manages another 1 million split estate oil and gas acres. Revenue from school trust lands is deposited into the Permanent School Fund, a perpetual endowment that distributes income annually to each K-12 public school in Utah.

Energy development is the largest component of SITLA's contribution to education funding. The SITLA's greatest source of existing revenue, accounting for over half the revenue to the trust, is natural gas production, followed by coal. SITLA has leased over 90,000 acres of trust lands for oil shale exploration, with initial development of commercial projects beginning. SITLA also has an expanding renewable energy portfolio. Over 100,000 acres of geothermal leases are in place, and the first new geothermal power plant built in Utah in the last 20 years was constructed on state trust lands in Beaver County. Leases for utility-scale wind and photovoltaic solar projects are also in place. Finally, the unique Western Energy Hub project near Delta will be wholly located on trust lands. This project will store massive quantities of natural gas in engineered underground salt caverns, providing energy flexibility to industrial and power generation customers throughout the West. The Western Energy Hub project also contemplates developing underground compressed air energy storage, an innovative technology that can largely solve problems of intermittency with other renewable energy sources, thus supporting further development of wind and solar projects in Utah.

One critical issue for SITLA is access to and through federal public lands. The millions of acres of proposed wilderness in Utah have trapped over 1 million acres of state trust lands - almost 1/3 of the entire trust portfolio - in areas that are restrictively managed by the federal government, and to which access is highly limited. In

the event that Congress and current and future administrations choose to continue managing federal public lands largely for wilderness, there needs to be an efficient legislative process for exchanging state trust lands out of proposed wilderness for consolidated blocks of federal land that can then be managed by SITLA for energy and economic development.

B. Air Quality

Much of Utah enjoys clean air for many days of the year. However, due to topography, weather patterns, and a highly urbanized population, Utah also suffers some of the worst air quality days in the Nation. It will be critical for human health and the environment and economic development to implement energy development in a way that takes this unique situation into account. Additionally, the Environmental Protection Agency (EPA), in implementing the Clean Air Act, is continuing to strengthen the Nation's air quality standards for most pollutants. This will result in higher costs for coal and natural gas plants.

The natural byproducts of burning coal and, to a lesser extent natural gas, include air pollutants permitted and regulated by the Clean Air Act: particulate matter, sulfur dioxide, and oxides of nitrogen. The emissions are permitted and regulated through 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.

Oil and natural gas drilling and production may 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 may be 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.⁴⁶

C. Transportation and Air Quality

Transportation accounts for more than half of the air pollution along the Wasatch Front.⁴⁷ The combined criteria pollutant inventory for Davis, Salt Lake, Utah and Weber Counties in 2009 indicates that 51.9% of total an-

nual emissions of criteria pollutants originated from the on-road mobile sector (cars, trucks and buses). Ozone and PM2.5 are responsible for acute spikes in air pollution and unhealthy air days in Utah as confirmed by the Utah Division of Air Quality's (UDAQ) monitoring network along the Wasatch Front. Both ozone and PM2.5 emissions are related to on-road mobile sources. Ozone and PM2.5 are respiratory irritants that can trigger asthmatic episodes and cause acute respiratory symptoms in sensitive individuals at concentrations that approach and exceed the National Ambient Air Quality Standards. Both pollutants are statistically confirmed risk factors for a number of respiratory and cardiovascular conditions. Since acute spikes in concentrations of air contaminants are predictable based on reasonably reliable weather forecasts, it is particularly beneficial to eliminate all nonessential driving to protect personal and public health when the UDAQ announces its yellow and red action alert days.

Transportation is also the largest consumer of energy in Utah at 31%.⁴⁸ Saving energy and cleaning Utah's air will improve public health, thereby reducing costs. It will also bolster economic development efforts by helping to attract new companies and jobs, reduce Utah's dependence on foreign energy sources, and generally improve the quality of life of all Utahns. This can be accomplished through strategies that include changing the vehicles used or eliminating the energy used to power those vehicles; managing vehicle traffic with technology, engineering and community design; and finally, individual actions and business decisions. Implementation of these strategies should also include meaningful metrics for success, such as reducing particulate matter (PM2.5) and ozone levels in the air.

Utah should seek to improve vehicle technology/efficiency and alternative fuels (refueling) infrastructure. Utah can reduce emissions and non-attainment air-quality days by encouraging adoption of emission-reducing technologies. A barrier to increased alternative-fuel vehicle use is inadequate refueling infrastructure. The State should consider ways to incentivize alternative-fuel vehicles and 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, often with increased transportation costs. New technology continues to expand this list. Even gasoline- and diesel-powered vehicles are produc-

ing fewer emissions due to improving technology.

The State should continue its support of results-driven economically sound solutions and not favor one technology over others. However, reducing emissions and eliminating non-attainment days will depend on adoption of new technologies. If incentives are appropriate, they should be based on full-fuel-cycle efficiency since those technologies are the ones most likely to be developed and receive market support.

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 Utah's 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.

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

UTAH INGENUITY AT WORK

ST. GEORGE CITY SOLAR

City of St. George Energy Services Department and Dixie Escalante Electric have built a large solar photovoltaic facility allowing residents to get solar power through a community solar farm. The program itself is simple, with no set-up, no maintenance and no risk to the purchaser. It is one of the many programs St. George offers its residents so they can take advantage of alternative energy.



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 Neighbor-

hood 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.⁴⁹ 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, vanpooling and work at home opportunities.

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.

The State should assist communities in choosing land-use options that reduce per-capita energy consumption, improve 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, Utah has 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. Vision Dixie⁵⁰ in Washington County and Envision Utah's Quality Growth Strategies⁵¹ along the Wasatch Front are good examples of community input in the development of alternatives for transportation, infrastructure, land use, planning, and zoning.

The State should work with local government to 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

UTAH INGENUITY AT WORK

VIRESCO GASIFICATION PLANT PROPOSED FOR KANAB

The Viresco Process is an innovative gasification technology based on a combination of steam hydrogasification and reforming. The carbonaceous feedstock (biosolids, coal and/or biomass) is first converted to a fuel gas, containing a significant quantity of methane. This is accomplished by means of steam hydrogasification, where the carbonaceous feed simultaneously reacts with steam and hydrogen. The fuel gas is then subjected to gas cleanup and then reformed to generate synthesis gas (carbon monoxide and hydrogen). In the third step, the synthesis gas is converted in to a synthetic fuel over a high- efficiency catalyst. Examples of such synthetic fuels are Fischer-Tropsch (FT) diesel, methanol and dimethyl ether (DME). The fuel gas can also be converted into electric power. The production of high energy density liquid fuels such as the FT diesel is the primary focus of Viresco Energy.



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 Project⁵² and are designed to respond to changing demographics, increasing energy use and market demand for more residential choices.

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% of total energy demand worldwide (32% for Utah) and 81% of Utah’s petroleum consumption.⁵³ 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 be given meaningful 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 Utah provide a more balanced transportation system, it will 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.

D. Water Consumption and Quality

Limited quantities of water may be available for new energy development. 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 currently available will undoubtedly decline over the next decade.⁵⁴ Water currently used at other facilities or by other water users may be purchased for use in energy development in the future. This is how water resources were developed for the Huntington, Hunter, and IPP power plants. Technology and efficiency advances in the energy industry may provide additional water for existing power plants or reduce the demand for water at new power plants in the future.

Given Utah’s population growth and projected economic growth over the next decade, the possibility of increased 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.

As an arid state, an energy portfolio that encourages low water-use technologies should be considered. 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 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 and the 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. There are currently a dozen or more different technologies under consideration for these fuel resources. It is unlikely that all technologies will be developed. Water issues, including water availability, water pollution effects of specific technologies, and potential pollution from spent shale waste sites, need to be evaluated as commercially viable technologies emerge and are developed.

In May 2009, the U.S. Department of Energy (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 EPA 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. These issues need to be reviewed regularly by DEQ, with remedial actions recommended if problems occur.

E. 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, along with on-the-ground survey, 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, using the best available data, and inclusion of all interested parties, are critical components of a successful strategy.

F. Wildlife

Energy development has the potential to 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 or candidate species. One example is the potential for wind, solar, oil, gas, and coal bed 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 im-

pacts 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.⁵⁵ 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.

G. Carbon Management

As the debate on climate change continues, Utah must participate in this discussion to represent Utah's energy mix and to assist in developing complementary policies to address environmental pollutants. Congress and the last four administrations have not developed a policy on carbon emissions, and it seems less likely to occur in the immediate coming years. Uncertainties in possible future legislation impact decisions at the state level, including Utah, where decisions on energy projects totaling several billions of dollars will be made during the next decade. 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.

The EPA is moving forward with regulating Greenhouse Gases (GHGs) through the Clean Air Act. This is

based on the Endangerment finding, which includes six gases (carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) - collective known GHGs. EPA's phased-in approach through the Tailoring Rule limits regulation initially to facilities already permitted and emitting at least 75,000 tons per year. The effect of this regulation will be increased cost to energy production and ultimately to the consumer - though cost estimates vary depending on source. Again, any such regulations should be accounted for when determining cost/benefit of future energy sources.

VI. ENERGY EFFICIENCY, CONSERVATION AND DEMAND-RESPONSE

The Governor and the Legislature have established energy efficiency as a priority and urged state and local governments and utilities to promote and encourage cost-effective energy efficiency and conservation.⁵⁶ 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.⁵⁷

Models and studies recognize energy that is not consumed as a result of energy efficiency as a cost-effective 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 2020⁵⁸ and 30% by 2030.⁵⁹ These studies align with Utah-based analysis. Rocky Mountain Power and Questar Gas studies show that the maximum achievable cost-effective potential for energy efficiency would reduce natural gas consumption by 20% (21.4 million decatherms, Dth) by 2013⁶⁰ and electricity consumption by 1,641 GWh by 2020.⁶¹

A. Education and Public Awareness

A barrier to widespread adoption of energy efficiency and conservation is the lack of public and building official 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 utilities and utility cooperatives, the State Energy Program, the Utah Building Energy Effi-

ciency Strategies (UBEES) partnership, Utah's Weatherization and HEAT programs, and nonprofits such as Utah Clean Energy.

Public and building official's awareness could be increased through the following methods:

- Developing and implementing a State-sponsored, Governor-led, single-messaging communication program, modeled after the Slow the Flow and PowerForward programs, that works with existing utility efforts to raise public awareness and understanding about the importance, cost-effectiveness and risk management opportunities of energy efficiency and recognizes excellence in energy efficiency
- Requiring energy-code education as part of continuing-education credits for building officials, contractors, and trades; and providing funding and other incentives to local building departments

UTAH INGENUITY AT WORK

MAGNUM GAS STORAGE

The Magnum Gas Storage Project is a high-deliverability, multi-cycle, salt cavern natural gas storage facility located in Millard County, north of Delta at the crossroads of existing and developing electric, natural gas and petroleum liquids infrastructure in the West. Plans call for development of four caverns with capacities of up to 10 million barrels of natural gas or its equivalent. Natural gas will be stored in caverns 1,300-1,400 feet tall and 300-feet in diameter, located 3,500-4,000 feet below the ground surface in a naturally-occurring salt dome formation. The first cavern is expected to be available for natural gas storage beginning in early 2012.



to train staff in the science of building energy demands, controls and efficiency and in code implementation and enforcement

- Increasing the minimum hiring standards for building-plan reviewers and inspectors to include energy-management degrees, certificates, IECC training or equivalent
- 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
- Helping low income households to maximize energy efficiency and reduce energy impacts on household budgets

UTAH INGENUITY AT WORK

GORDON CREEK PILOT CO₂ SEQUESTRATION PROJECT

The Southwest Regional Partnership on Carbon Sequestration (SWP) includes the states of Arizona, Colorado, Kansas, New Mexico, Oklahoma, Texas, Utah, and Wyoming. SWP has selected Gordon Creek in Carbon County to accomplish a major sequestration deployment. This test will follow an injection schedule over 4 years, leading up to 900,000 tonnes (1 million U.S. tons) of CO₂ per year. Formations such as the one found at the Gordon Creek site are targets of potential commercial sequestration throughout the western United States. The SWP plans include a “dual completion” with injection in two different formations at the same time. By carrying out two tests in two different formations within the same stratigraphy, portability of science and engineering results can begin to be evaluated.



B. Demand Side Management and Load Control

While the impact energy efficiency can have is significant, it cannot entirely obviate the need for new production facilities, transmission lines, pipelines or transportation facilities. Each new customer added to a utility's system increases the demand on that system. In addition, demand is increasing as existing customers install high energy consumptive appliances, such as central air conditioners, large screen televisions and computer systems, etc. to their homes and businesses. Energy efficiency programs can contribute towards meeting this growth in demand.

Demand-side management (DSM) strategies enable energy users to reduce consumption during periods of peak demand. This reduces costs because of avoided or delayed 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, while Rocky Mountain Power's DSM Programs achieved 247.8 GWh of first year energy savings, or 1.2% of 2009 sales, in 2009.⁶² In 2009, Rocky Mountain Power spent \$45.6 million to acquire these savings. In addition, Rocky Mountain Power spent \$12.5 million in 2009 to acquire 155.9 MW of load control resources.

For close to a decade, Rocky Mountain Power has worked with its customers to 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. In 2010 Rocky Mountain Power had approximately 100,000 customers (roughly 25 - 28 percent of qualifying homes and businesses), representing over 112 megawatts, under direct load control. The company also had 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 curtailing usage of customers' equipment (irrigation pumps and air conditioners) at times when demand for electricity is high.

The state could enhance DSM and load control programs by:

- Identifying innovative demand-response programs and removing barriers that limit participation in these programs
- Designing demand-response programs that have been shown to increase participation significantly

- Supporting increased participation in cost effective distributed generation

C. Industrial Sector

Utah industries currently benefit from energy 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.

Possible strategies to advance energy efficiency in Utah's industrial sector include:

- Provide a well-designed and integrated technical assistance program, addressing both electrical and natural gas energy efficiency. It should leverage existing resources and new energy-efficiency/green-workforce training programs to include industrial energy management.
- Increase 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.
- Encourage utilities and their regulators to continue or begin offering cost-effective programs to support industries' energy efficiency investments.

D. Financial Incentives

In many situations, incentives are sufficient to encourage industries, businesses, and residential consumers to pursue individual energy-efficiency measures, but barriers remain for obtaining significant energy savings on a whole-plant, whole-building or whole-house basis. Utah businesses and residential consumers used 13,944 GWh of electricity⁶³ and 103.8 million Dth of natural gas in 2009.⁶⁴ The utilities, as well as the State, could offer incentives to customers who retrofit or purchase high-efficiency appliances, motors, lighting, increased insulation, more energy-efficient windows, and other equipment. Home energy retrofit programs offered by the State and Salt Lake County also provide homeowner financing. Financing programs try to match the loan payment with the energy bill savings; however this is difficult with Utah's low energy costs. The State's Utah Home Performance program is based on the contractor delivering a whole package energy analysis, home improvement, and financing program to the homeowner. Salt Lake County's Energy Smart program is

an interest rate subsidized loan program serviced by Community Development Corporation of Utah, a 501(c)(3) organization.

Additional financial incentives to be considered include:

- Provide tax credits, tax deductions and/or rebates to industries, businesses and home owners, landlords and condominium associations for investments made in energy efficient equipment, processes, retrofits, etc.
- Create 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
- Include energy-efficiency and conservation requirements in state/local tax incentives for new businesses
- Consider a job-creation tax incentive for hiring resource efficiency/energy managers at industrial facilities
- Encourage banks to include evaluating energy costs as part of the mortgage application and develop low-interest loan services for energy-efficient retrofits, such as DOE's PowerSaver Loan Program
- Require a home energy rating for all homes listed for sale or rent

E. New Construction

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 permits⁶⁵ 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 of Utah will continue to lead by example in energy efficiency. The Division of Facility Construction and Management (DFCM) established Leadership in Energy and Environmental Design (LEED) Silver certification as a minimum standard for all new

state-building construction. In 2010, DFCM also installed \$4 million in renewable energy projects (mostly solar) with American Recovery and Reinvestment Act economic stimulus funding; established private/public partnerships with energy service companies (ESCOs) and utilities to fund energy efficiency improvements in existing buildings; benchmarked or tracked energy use in over 90% of large buildings under their management through EnergyStar's Portfolio Manager; used a re-commissioning platform for tuning up buildings; established a \$2.5 million energy-efficiency revolving loan fund that is currently fully subscribed; established a statewide employee energy behavioral program "Think Energy" and employee E-teams; and continued to track the "Working 4 Utah" initiative that has shown a 10% energy use reduction.

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 its 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 2020.⁶⁶ The economic cost to builders to achieve such savings has not been determined and should be analyzed.

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. Many Utah builders are effectively ensuring energy efficiency is a component of all new and retrofitted homes and buildings.

Energy codes are 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.

The Task Force makes the following recommendations to improve energy efficiency in new construction:

- Encourage builders' participation in programs that encourage continued improvement. Voluntary programs that encourage more energy-efficient construction and renovation, such as EnergyStar for Homes, provide the opportunity for better-than-code products
- Use the most current Utah state energy code for both residential and commercial construction
- Improve and clarify the administrative feedback loop for code enforcement professionals between local jurisdictions and the Uniform Building Code Council, and develop a resolution process for consensus-based code enforcement disputes
- Approve 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
- Encourage and fund programs that provide whole-house and building systems energy analysis and significant whole-house or whole-building retrofits
- Encourage government and non-government organizations to utilize energy service companies as a financing mechanism for energy-efficient retrofits, re-commissioning, and ongoing commissioning

F. Regulatory Changes

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. It is also important to ensure that utilities are not disadvantaged or economically harmed as a result of state energy and economic policy decisions. 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
- Make greater efforts to ensure all system and environmental benefits provided by energy efficiency are fully and appropriately valued in the planning, acquisition and regulatory decisions. Likewise, the costs and challenges associated with energy efficiency should be fully and appropriately considered as well
- 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
- 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. Impacts this approach may have on a utility's financial condition should be considered as part of this effort.

VII. TRANSMISSION, INFRASTRUCTURE AND TRANSPORTATION

Historically, energy producers have focused on providing competitive 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. While growth has slowed significantly, consumer demand for electricity is still growing. The demand for natural gas has followed a similar path since natural gas is now increasingly being used for 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 energy transmission

UTAH INGENUITY AT WORK

INSTITUTE FOR CLEAN AND SECURE ENERGY

The Institute for Clean and Secure Energy (ICSE) grew from a long tradition of combustion research at the University of Utah beginning in the 1950s and continuing to today's level of over 120 faculty, staff, and students. ICSE formed from the combination of several strong research programs that focused on combustion simulation, analysis, and experiments. In 2004, the University of Utah officially recognized ICSE as a permanent institute. The mission of ICSE is education through interdisciplinary research on high-temperature fuel utilization processes for energy generation, and associated environmental, health, policy, and performance issues.

ICSE employs an integrated, multi-disciplinary approach to the study of energy, combustion and high-temperature fuel-utilization processes by combining hands-on experimental work with analytical tools and simulation. This approach enables ICSE to develop predictive tools for these highly complex processes, which span multiple scales of time and space. ICSE has the resources and expertise to address and improve the understanding of these processes, which are often associated with applied systems and industrial applications.



the most complex and highest risk enterprise an electric 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.

Electrical transmission is accomplished by above-ground high voltage lines. 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 Rocky Mountain Power'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 to 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 Rocky Mountain Power'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.

FOUNDATIONAL PROJECTS BY 2020

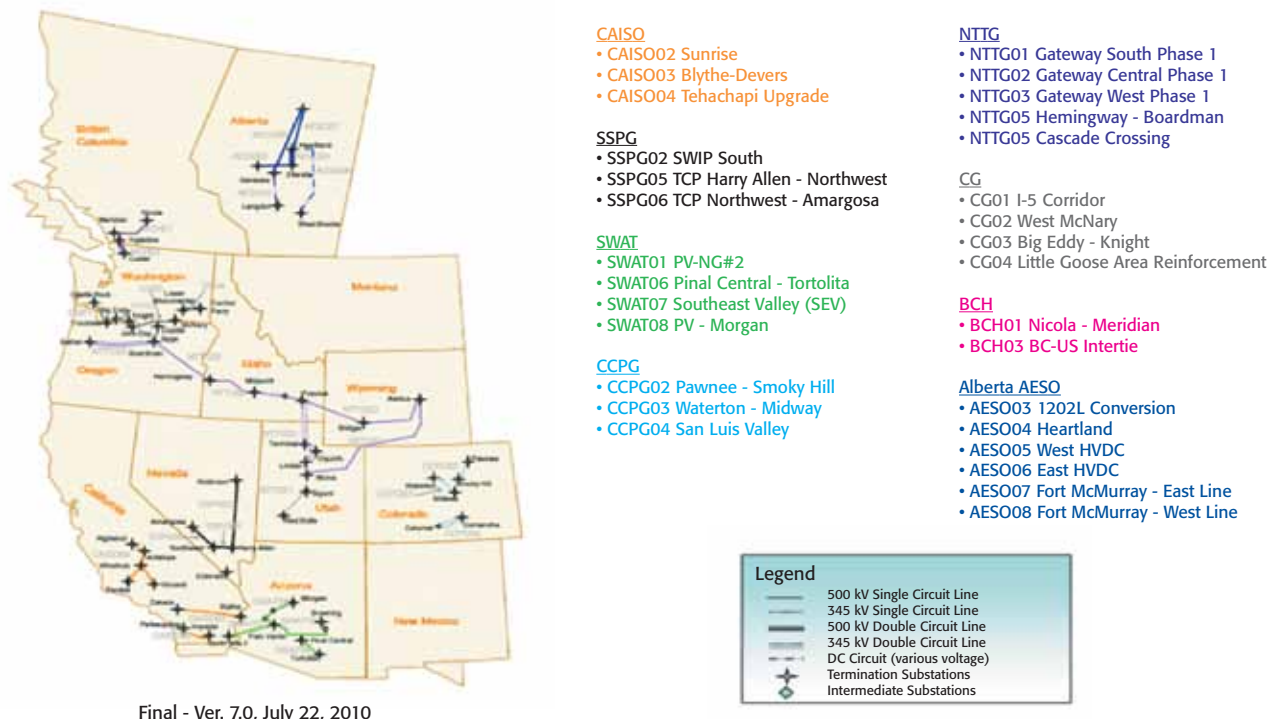


Figure 4. Proposed western foundational transmission projects by 2020.
Western Electricity Coordinating Council.

Figure 4 is a map of planned electrical transmission projects (Foundational Projects) currently in the Regional planning review process within the Western Electricity Coordinating Council (WECC)⁶⁸ 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. Utah's transmission plan should be developed in coordination with sub-regional and WECC transmission plans, and Utah should work with other states/provinces in the Western Interconnection to capitalize on synergies among transmission development in other states/provinces.

Natural gas transmission is accomplished by underground pipes, which have 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, pipeline export capacity in the Rockies will be 10.4 MMcf/day. Pipeline 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. Tables 5 and 6 provide more detailed information. Whether Utah is a net importer or exporter of natural gas in the future is dependent on development of resources in-state and regional and national market forces.

Transmission of coal and gasoline are typically by train or truck. Leaks in oil pipelines in the Salt Lake Valley have been of particular concern.

Table 5

Existing natural gas transmission and distribution pipelines in Utah. Source: Questar Gas.

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	2,500		2,500	2
Questar Gas*	1,029	15,909	16,938	11
Total Customer Interconnections	4,241	15,909	20,150	14
State Tax Commission Est.**	1,957			

Table 6

Proposed transmission 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	2.8	36 inch	11/1/2011	This project will close the currently unlooped of Kern River's pipeline in the Wasatch mount
Questar Pipeline	ML 104 Extension	23.5	24-inch	11/1/2011	This project extends QPC's mainline to the east receive gas from the processing hubs in the Uintah Basin of Utah.
El Paso Natural Gas	Ruby Pipeline	181.5	42-inch	Spring 2011	This project transports Rocky Mountain natural to end users in California, Nevada and the Pacific northwest

To develop renewable energy projects within the State's borders, additional transmission capacity would need to be built. To build a clean energy economy, gain more energy independence and promote development and jobs, Utah will need to develop its own large-scale renewable energy projects. A major obstacle to getting these sources on the grid is the availability of transmission to collect the output of these renewable resources from remote locations. Utah's regulatory framework is not currently set up to make this possible.

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. A long-range transmission feasibility study of a large-scale renewable energy projects in the state should be considered. Such a plan would include significant stakeholder input upfront. 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, would reduce the probabilities of suits against any future projects that may be built as a result of the plan, facilitate permitting, and produce more efficient siting and mitigation practices, thereby saving time and resources.

With the projected increase in travel and population, there is a need to expand the State transportation sys-

tem, 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 5. 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.

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.

RECOMMENDATIONS TO SUPPORT TRANSMISSION DEVELOPMENT:

Consider alternatives to current regulation and funding sources to encourage transmission line and pipeline construction in areas that promote economic development or renewable and alternative energy resource development. State economic regulation requires that investments be prudently made, competitive 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,

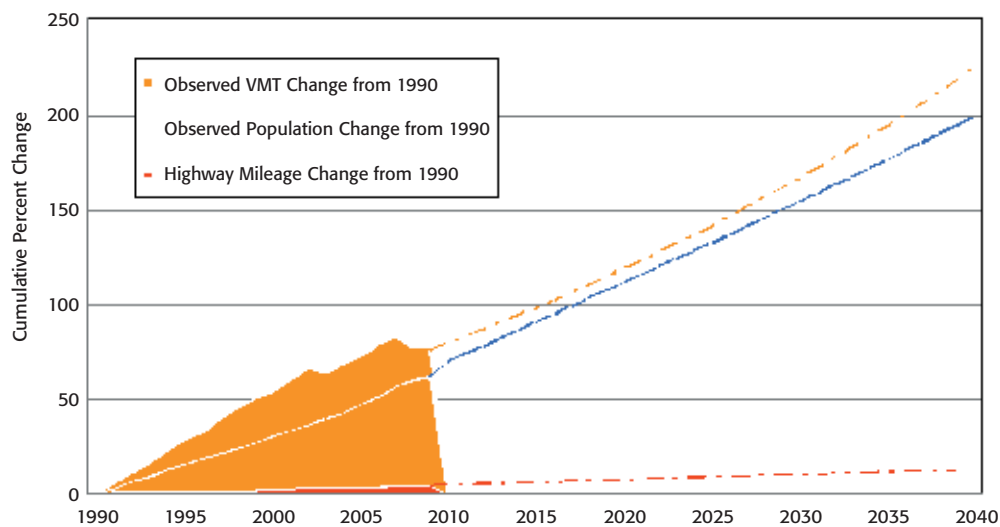


Figure 5. Comparison of population growth, increase in vehicle miles traveled, highway mileage change in Utah. Utah Department of Transportation.

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. Local opposition can impede the development of infrastructure projects, which are critical and vital for the economic health of the State and its communities. 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 can impede the development of infrastructure projects. 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.

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 par-

ticipation 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

UTAH INGENUITY AT WORK

AUXILIARY POWER UNIT GRANTS

Federal Department of Transportation regulations for semi truck drives require 10 hours of rest for every 11 hours of driving. When stopped, drivers often idle their engines to provide heat, light, and power. Idling burns fuel and puts wear on engines. The Utah Division of Air Quality obtained grants to fund the installation of Auxiliary Power Units (APUs) that reduce fuel consumption and diesel emissions by providing climate control and electrical power for the truck's sleeper cab and engine block heater during downtime on the road without running the truck's engine. It is estimated that each truck will save 6,450 gallons diesel fuel per year. As of February 1, 2011, 32 APUs have been installed and 49 more are planned to be installed in the next year. Below is a picture of an installed APU.



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 potential risk from carbon and green-house gas emission legislation on the cost of electricity in the state. 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.⁶⁹ While the electricity in Utah is primarily generated from fossil fuels, accounting for 96 percent of Utah's total energy production in 2009, a significant portion of this generation is exported to other states. Electric power providers serve the State with a portfolio of resources (coal, natural gas, hydroelectric, wind, geothermal, purchased power, etc.) that are included in customers' electricity prices and mitigate the exposure to economic effects of federal regulation of carbon dioxide and other greenhouse 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. While the state's energy costs will continue to increase, other states will likely also experience similar pressures.

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 global industry, national laboratories and regional universities to effectively commercialize new energy technologies and develop Utah's conventional, alternative and renewable energy resources
- 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, regional universities, and State commercialization and economic development agencies. The research universities will also work closely with Utah's other universities, such as Weber State University, Utah Valley University and Southern Utah University, where notable energy research initiatives have already been established.

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. Additional information regarding specific research at the universities is also available in the Subcommittee's full report.⁷⁰

A. The University of Utah

The University of Utah (U of U) 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. The Technology Commercialization Office at The University of Utah manages the commercialization of energy technologies produced at the university. The University of Utah will work closely with the Energy Commercialization Center to promote its successful model for bringing university-based renewable energy and energy efficiency technologies to market.

B. Utah State University

Utah State University (USU) is Utah's land-grant institution and 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. The USU Technology Commercialization Office is tasked with commercializing USU energy technologies. USU is uniquely equipped to test and deploy energy technologies in rural Utah through its rural partnerships and extension program. 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.

C. Brigham Young University

Brigham Young University (BYU) 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.



D. Research Partners

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. It 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, Ceramtec 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. Ceramtec 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.

Utah is blessed with regional universities and colleges that grant bachelor degrees in science, technology, engineering, math, and commercial subjects that support energy producers, users, and research with a skilled work force. These institutions provide for a full spectrum of training from high school through post-doctoral education.

The eight Utah College of Applied Technology (UCAT) campuses, Salt Lake Community College, and other institutions of higher education 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.

E. Research Initiatives

- The U of U, USU, and BYU should collaborate and 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 should be 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 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's 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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Selma Sierra, Utah State University Energy Dynamics Lab

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Christopher Thomas, HEAL Utah
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Ronald W. Daniels, Governor's Energy Advisor's Office, Staff
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Sarah Wright/Kevin Emerson, Utah Clean Energy
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Cheralyn Anderson, Governor's Energy Advisor's Office, Staff

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TRANSPORTATION AND AIR QUALITY (cont.)

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Robert Simmons, USTAR
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Spencer P. Eccles, Governor's Office of Economic Development, Staff
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Greg Hartley, Governor's Office of Economic Development, Staff

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Nancy Kelly/Joro Walker, Western Resource Advocates
Rob MacWhorter, U.S. Forest Service Dixie National Forest
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John Njord/Carol M. Bracer, Utah Department of Transportation
Juan Palma, U.S. Bureau of Land Management Utah Office
Mike Peterson, Utah Rural Electric Association
Philip J. Powlick, Utah Division of Public Utilities
Kimball Rasmussen/Jim Tucker, Deseret Power
Shelly Cordon Teuscher, First Wind
Yashoda Khandkar, Governor's Office of Economic Development, Staff
Doug Bennion, Rocky Mountain Power, Staff

DEVELOPING AND APPLYING TECHNOLOGY AND SCIENCE

Alan J. Walker, Utah Science Technology & Research Initiative (USTAR) and University of Utah, Chair
Robert T. Behunin, Utah State University
L. Douglas Smoot, Brigham Young University
Robert Brems, Utah College of Applied Technology
Michael Hagood, Idaho National Laboratory
Robert Simmons, USTAR, Staff
Vatsala Kaul, USTAR, Staff
Yogesh Mishra, USTAR, Staff

Public Awareness and Reporting
Bob Henrie, R&R Partners, Chair
Angie Welling, Governor's Office
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Ashlee Buchholz, Governor's Office, Staff

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Amanda Smith – Energy Policy Advisor
amandasmith@utah.gov

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801-536-4402