



WESTERN GOVERNORS' ASSOCIATION

ENERGY PERSPECTIVES

WESTERN GOVERNORS AND PREMIERS
HIGHLIGHT THEIR ENERGY PRIORITIES

JUNE 2013



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GOVERNORS'
ASSOCIATION

ENERGY PERSPECTIVES

The views expressed herein do not reflect the views of any one Governor but rather the broad views of Western Governors.

The Western Governors' Association is an independent, nonprofit organization representing the Governors of 19 states and three US-Flag Pacific islands. Through their Association, the Governors identify and address key policy and governance issues that include natural resources, the environment, human services, economic development, intergovernmental relations and international relations.



GARY R. HERBERT
Utah Governor

WGA Chairman

Dear Friends of the West,

The Western United States play a critical role in meeting our nation's energy needs. From conventional fuels to renewable energy, the West's resources provide the majority of the United States' energy supply. These resources are good news for the West and its residents. They also present a challenge: Can the Western states create an approach to development that delivers energy in a way that is secure, affordable and respects the environment?

To address that concern, my colleagues and I at the Western Governors' Association (WGA) created *Energy Perspectives*, a collection of essays by Western governors and Canadian premiers on their specific energy plans. In addition to my essay on the challenges and opportunities of developing Utah and the West's oil shale and oil sand resources, other contributions include:

- Gov. John Hickenlooper on the important role natural gas plays in Colorado's achievement of an "all of the above" energy strategy;
- Gov. Butch Otter explaining Idaho's ability to develop policies that will enable nuclear research, development and commercialization;

- Gov. John Kitzhaber on Oregon's goal to meet 100 percent of electric load growth in the next decade through conservation measures and improved efficiency.

Energy Perspectives is one of three projects Western Governors created in relation to our year-long focus on energy. We have also published *10-Year Energy Vision*, a blueprint for the country to create an energy policy, and *The State of Energy in the West*, a survey of the region's vast energy resources.

We hope that Congress and the Obama Administration are able to follow this example of bipartisan cooperation in order to address energy on a national scale. Western Governors consider these efforts a first step toward a blueprint for the entire country to help create an energy policy that promotes economic growth while protecting our valued natural and environmental resources.

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SEAN PARNELL
Governor, State of Alaska

Achieving North American Energy Independence



An energy scholar based in the United Kingdom asked me recently why the United States, while so clearly capable of attaining North American energy independence, seemed to be avoiding that outcome.

He had studied our energy potential in such great detail that he knew the United States alone has the potential to become energy independent. He was mystified as to why U.S. policy makers were not actively pursuing an energy policy of which most other nations could only dream.

My answer was simple – failure in leadership, and a federal regulatory system literally tripping over itself to chase investment away to countries not burdened by the same two problems.

There's nothing like a little international perspective to help us focus on an economic and geopolitical fundamental principle – safe, secure, and affordable access to energy makes a nation great.

I know the President understands this energy fundamental – or at least that the fundamental is

good for Brazil. Early in his first term, President Obama committed billions of U.S. taxpayer dollars in loans to Petrobras, Brazil's state-owned oil company, to finance exploration and development of Brazil's offshore oil.

In March of 2011 the president told Brazil that U.S. taxpayers would bankroll more oil development for that country and will be its “best customer,” once it starts selling this newly developed oil.

Meanwhile, with 24 million people in this country unemployed, President Obama continues to lock down domestic oil and gas resources on federal lands in Western states and offshore of the United States, preventing thousands of private-sector jobs from being created for Americans.

Despite his abiding interest in buying Brazilian oil, he has called oil “yesterday's energy,” and said America must invest in alternatives. Further, he continues to propose new taxes on U.S. oil companies because, “They're doing fine on their own.”

Unemployed and underemployed Americans want to work. We need only look at a state like North Dakota, with unemployment under 4 percent,

to see our nation's way out of this long-term unemployment malaise. North Dakota's people are working, paying taxes, buying cars and homes, and not having to draw a government check. This economic activity is growing state revenue and will lead to infrastructure investment and a strong fiscal climate.

In the coming years, countries that can secure safe and affordable energy will move ahead, while those that cannot, or will not, will slip further behind. I am confident America will be in that first category, but only if our President understands the link between energy and prosperity, and acts quickly.

The President's ability to assert leadership on energy is relatively easy. The ability for our federal bureaucracy to reform its regulatory practices will be much harder.

Consider the history of my state – Alaska. In 1856, former New York Governor and then-U.S. Senator William Henry Seward, addressed his Senate colleagues: “To obtain empire is easy and common, to govern it well is difficult and rare indeed.”

Though spoken in a different context nearly 150 years ago, Seward had no idea how true his words would ring in the 21st Century in Alaska.

In fact, Alaskans would charitably say that the federal government has struggled to govern Alaska well.

The 49th State's relationship with the federal government has always been complicated, ever since Congress began debating the Alaska Purchase back in 1867. That was the same year the Civil War Reconstruction Act was passed, easing the South back into the union. It was the same year that most of Nebraska became a state. Some argued in favor of the Alaska Purchase because of the vast natural resources and strategic location.

Secretary of State Seward and President Andrew Johnson took some heat for acquiring “Seward's Folly.” Still, Seward reportedly said that the purchase of Alaska was his singular most

important accomplishment as a public servant. He was also smart enough to know it would be a while before many in America agreed with him. In its 92-year journey to statehood, Alaska was under the authority and rule of a distant federal government. The Department of Alaska, as it was called, was run for varying lengths of time by the Army, the Treasury, and the Navy.

By 1884, Alaska had become a judicial district as well as a civil one, with judges, clerks, marshals, and limited federal officials appointed to run the area. Alaska was established as a territory in 1912, and Alaskans had the voice of an elected legislature.

However, the federal government maintained control over Alaska's natural resources, and the President still appointed the territory's governor. By all accounts, the territorial governor had little authority. He was referred to as a “figurehead.”¹ The Department of the Interior, in fact, ruled Alaska.

By 1955 Alaskans were fed up with having no real voice in governing themselves or their resources. That year, Alaska's Democrat Territorial Governor Ernest Gruening delivered

a powerful speech at Alaska's Constitutional Convention. It was titled, “Let Us Now End American Colonialism.” He equated federal treatment of Alaskans to King George III's treatment of American colonists in the 1700s. Gruening aggressively made the case for what he called a “...universally applicable tenet of American faith – government by consent of the governed,” not by a distant crown or sovereign.

Statehood promised to “right the ship” of the complicated relationship between Alaska and Washington, D.C. Statehood promised to bring Alaskans a constitutional government originating with the people of this land, not along the bureaucratic banks of the Potomac River.

In the words of former Lieutenant Governor Jack Coghill, at statehood, “There was a big, big emphasis on our part to strip the Interior Department of every bit of influence that they had

The 49th State's relationship with the federal government has always been complicated, ever since Congress began debating the Alaska Purchase back in 1867.

on running our state of affairs.”²

With statehood, Alaskans also received a land grant of just over 103 million acres, an elected legislature, and a strong governor. Things were starting to look up.

Indeed, in examining Alaska’s relationship to the federal government since statehood, we acknowledge the benefits of statehood. Since statehood many billions of federal dollars have flowed to the benefit of the entire state. We know that federally funded infrastructure across our state creates opportunities, while congressional clearance for the Trans Alaska Pipeline System still allows Alaskans to reap benefits from producing oil from State lands. And we all know that a strong military presence protects us and fuels our economy.

Alaskans are thankful to be part of this great Republic. Yet, we have reason to be concerned that the federal government is reverting to its old territorial ways. You see, at statehood, the federal government and Alaskans recognized that our vast space, our Arctic climate, our sparse population, and our distance from larger markets all would make growing an economy and funding government services difficult without access to the bountiful resources of this state. Thus, Congress granted Alaska a 90/10 split of royalties from resource production on most federal lands.

However, if you can’t develop on federal lands, 90 percent of zero is still zero. The federal government owns about 240 million acres of the 371 million acres of Alaska’s land. Much of the federal land is restricted as national parks, refuges, and wilderness. These lands are now locked up with zero potential for dollars or jobs for Alaskans in the foreseeable future.

I believe – and many who study the history of Alaska agree – that the lack of reasonable and responsible development disappoints an expectation that Congress had, which was clearly embodied in the Statehood Act. Congress provided a revenue sharing formula for federal lands and just over 103 million acres of land to the State to ensure that Alaska would not become a ward of the federal government, a fear expressed by some statehood opponents.

Lately, we’ve seen the resurgence of influence and control by the Department of the Interior, and new federal agencies never dreamed of at the time of statehood, to lock up more of our resources. Many old timers in Alaska are reminded of the struggles from territorial days.

For example, readers will be interested to know that Alaska has three highly prospective, yet dormant, oil and gas basins that could contribute in a meaningful way to the energy independence of the United States. All three happen to be owned and operated by the federal government, and all three are designated by Congress as areas to be studied, and possibly developed, due to the significant potential for oil and gas.

The first is the coastal plain of the Arctic National Wildlife Refuge (ANWR), described in Section 1002 of the Alaska National Interest Lands and Conservation Act (ANILCA). A very conservative United States Geological Survey (USGS) estimates 10 billion barrels of recoverable oil lie beneath the coastal plain.

A few hundred miles to the west you find the nation’s single largest land holding, the National Petroleum Reserve - Alaska (NPR-A). As the name aptly describes, this 23 million acre swath of land contains an estimated billion barrels of oil, and more than 50 trillion cubic feet of gas.

Those two federal units border the super-giant oil fields currently producing on State lands, Prudhoe Bay and Kuparuk, which have supplied, depending on the year, 10 to 20 percent of U.S. oil production since 1977. To give you an idea of what conservative estimates mean, Prudhoe was originally estimated to contain 10 billion recoverable barrels of oil, and yet that field has already yielded 12 billion barrels, and is now estimated to contain 16 billion more recoverable barrels.

Finally, the Outer Continental Shelf (OCS) of Alaska – in particular, the shallow-water lease areas underneath the Beaufort and Chukchi Seas – is estimated to contain up to 23 billion barrels of oil and 100 trillion cubic feet of natural gas.

These regions, when combined with the energy

renaissance occurring in the Continental U.S., as well as the energy bounty found in Canada, are why the U.K. energy expert approached me with such a puzzled look on his face about the mystifying lack of a rational U.S. energy policy.

Other than leadership failures, what regulatory issues might be holding us back from energy independence? Since we rely on private investors to develop energy resources in the United States, and dramatically improving technology, combined with new hydrocarbon basins throughout the world being discovered at a rapid rate, private energy investors can weigh opportunities all over the globe. Knowing this, consider how the private investment in developing the oil and gas prospects outlined above might be impacted by these federal regulatory actions:

- In the first year of the Obama Administration, Interior announced delays and more studies on Alaska OCS plans for exploration, despite the fact that private companies had paid the Treasury billions of dollars for the right to explore. Then – after the deep-water drilling accident in the Gulf of Mexico – the President imposed a moratorium on shallow-water exploration of Arctic leases. Then, Interior said there really was not a moratorium on OCS development, just some permitting delays. Then, the Environmental Appeals Board at the EPA imposed a whole new series of delays on issued air permits before the first exploration activity could occur.
- The U.S. Fish and Wildlife Service is nearing completion of a multi-year planning process for the ANWR, including the 1002 area. Over my administration's strenuous objections, this planning effort will likely lead to a recommendation that Congress move the 1002 area to wilderness designation, planting a giant, virtual "Keep Out" sign at one of the nation's most promising resource plays.
- The Bureau of Land Management recently completed a similar planning process for the NPR-A. Again, this was not an academic exercise. Then-Interior Secretary Ken Salazar approved a plan to remove more than half of the NPR-A from potential oil and gas development. Since it is a petroleum reserve, Interior's plan to

make it essentially a wilderness preserve defies explanation.

- The Obama Administration has started the planning phase to zone the oceans, exerting even more control over maritime activities and commerce, as well as the river drainages into those oceans. The breadth of this activity has created concern not only among oil and gas companies, but also with fisherman, farmers, and anyone else operating in or near an ocean or river. The oceans, the White House tells us, will be zoned for ecological purposes, among other uses.

There's nothing at all wrong with protecting an ecosystem, especially our oceans. The State of Alaska has done a great job of protecting and managing our ocean resources, and sustainability is written into our state constitution. But also in Alaska, we have seen firsthand what a mess the federal government can make of things.

If no action is taken to stop ocean zoning, we anticipate marine areas will become de facto off-shore wilderness, regardless of the health of the ecosystem. As many as 20 federal agencies already regulate ocean uses. Does anyone believe that after ocean zoning adds a new layer of regulations, these 20 agencies will stand down? They never do.

- Over the past decade, Endangered Species Act (ESA) rules have brought about land and activity restrictions regarding Steller sea lions, polar bears, beluga whales, and most recently, the bearded seal. Once a species is ruled threatened or endangered under the ESA, critical habitat MUST be set aside for it, no matter how little sense it makes. In the case of polar bears, we have more bears than we had in the 1970s, and their habitat is nearly undisturbed. Yet, our federal government has designated an area larger than the state of California as critical habitat for polar bears.

Similar bountiful numbers of bearded seals have also been recorded, but a statistical model was used to generate the ESA endangered listing. This model was run out 100 years into the future, and at that far-flung date, the bearded seal was predicted to be endangered.

Regulation upon regulation – 145,000 pages of them³ – create liberty-eroding, job-killing requirements. For our economy, it is a death by a thousand cuts.

Let me relay one last story about federal regulatory activity, this time at Priest Lake, Idaho, involving one single family's struggle to build a home.

When I first heard about Mike and Chantell Sackett's situation, I was outraged. Their experience could easily be visited upon any private property owner in this country. The Sacketts own a \$23,000 piece of property, and they started work on a house when a single federal EPA agent walked on their small lot and declared it a wetland. The federal government threatened them with fines of up to \$75,000 a day if they did not remove the fill they had brought in and if they did not replant the native vegetation. The Sacketts bravely fought back, only to discover there was no viable judicial review process for them.

Fortunately, many more individuals and states rallied behind this American family, including the Pacific Legal Foundation. After a long and expensive legal process, the Sacketts persuaded the U.S. Supreme Court to rule unanimously against the EPA – a truly rare occurrence.

In the Sackett's case, it was never about whether an entity has a right to fill a wetland. It was always about whether – and when – a federal agency decision is subject to judicial review.

For U.S. citizens to be told that they cannot get judicial review of a federal ruling – that is unconstitutional. There is no question.

The Sackett case is an example of working together to protect our individual rights – rights that a heavy-handed government would trample, whether you are from Idaho, Alaska, or any other state.

In Alaska, we are fighting against federal overreach. And with good reason:

After the Sacketts won their case at the Supreme Court, I learned the EPA has not reformed its ways.

One official, the director of EPA's Water

Enforcement Division, told a legal forum of the American Bar Association that the EPA has no intention of changing its enforcement program just because of the Sackett case.

He said, "I don't see dramatic shifts in how administration enforcement authority is used, but I see continued evaluation."

We need a change. We don't need more studying or evaluation.

Additionally, he said, the pace of its Clean Water Act compliance orders will not change one iota because of the ruling.

"What it really changed is that [these] orders are now reviewable. It's pretty much the same game," he said.

There are many at that agency and others who see this as a game.

If so, then states must say, "Game on!"

We need more Americans willing to stand up, endure the stress and financial strain of taking their cases all the way to the highest court, if necessary. And states must stand strong against federal overreach.

I remain optimistic, because Americans will rise to the challenge. We are an exceptional nation based on an exceptional idea and the most profound governing document in history – our Constitution.

The regulatory purgatory that we often find ourselves trapped in will take far more concerted effort on behalf of the President, Congress, and every U.S. citizen. Fortunately there are many examples of success to be found right here in our United States. Many of my colleagues in Governors' Houses throughout the country are actively refining and improving their state regulatory regimes, all the while protecting the environment and improving the standard of living for their residents.

Access to safe, reliable, and affordable energy is a key to a nation's success. The United States has always been blessed with that access. Let's grow our nation's strength and create opportunity for Americans by growing our energy sector.





LOLO MATALASI MOLIGA
Governor, Territory of American Samoa

Moving Toward Energy Independence

Introduction



American Samoa became a territory of the United States via a Treaty called the “Deed of Cession of Tutuila” in April 1900. This was primarily at the convenience of the US Navy who found great value in the deep protected harbor now known globally as Pago Pago Harbor. The US Navy long ago pulled out leaving the harbor to be used mainly by the local tuna fishing fleet.

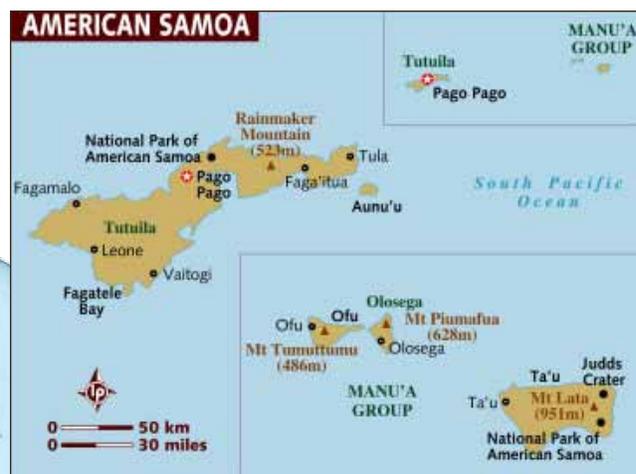
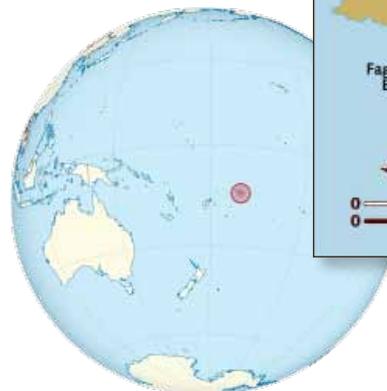
American Samoa is positioned 2600 miles south west of Hawaii, and as such is very isolated from main stream industry and commercial traffic as one may expect to see on any mainland continent. Made up of five inhabited islands, the combined population of American Samoa today is approximately 62,000 people with the bulk of residents on the main island of Tutuila at about 59,000.

Available Resources

American Samoa and its people are challenged in many ways because of our location. Located thousands of miles at sea, far from any major continent, the

dependability of regular ship deliveries of fuel to the island, the cost of freight, the availability of basic goods, national response time to emergencies and natural disasters etc ... all are major concerns and come at a high cost.

But for every great challenge the American Samoa people face, we find great blessings of equal magnitude. American Samoa is blessed with an abundance of natural energy resources that are yet basically untapped. The Island group sits on a volcanic area known regionally as “The Ring of Fire”. The area is a Geo-thermal “super energy” source.



Courtesy of Celebrating the World (above),
Courtesy Wikipedia (left)

This is a resource that has the solid potential to make American Samoa 100% energy independent from fossil fuels.

Another blessing is the Pacific Ocean which not only supports our main industry of fishing, but can also be considered the largest solar panel and energy storage unit in the world. The Pacific Ocean collects the sun's rays daily and stores them in the form of heat touching our shores each and every day. A naturally occurring situation is awaiting an OTEC (Ocean Thermal Energy Conversion) Power Station to tap its unlimited Solar Thermal energy resource.

While naturally occurring energy is abundant in American Samoa, the technology for tapping it is still quite expensive and beyond our reach without assistance. This has prevented large-scale advances towards our energy independence. However, we have made respectable strides towards reducing our dependence on fossil fuels. Recently, thanks to ARRA funding, we have installed a 1.8MW Solar Photo-Voltaic (PV) farm as well as several private sector PV's that equal about 600kw when totaled.

We have made plans to install another 1.8MW PV farm that will increase our total Solar output capability to 4.2MW. This number is significant because it is equal to 23% of our territory's base load power which currently is 18 MW.

By percentage of penetration, this number is noteworthy by any utility standards.

Thanks to a combined effort of our utility authority, the local energy office and US Department of Energy grants, we are close to completing a yearlong wind study that will identify the feasibility of wind farms, further enhancing our energy independence objectives. Tropical Pacific Trade winds are regular and consistent from 10-15 knots. The studies to determine the best location for capturing this wind energy were long but necessary steps towards successful implementation of this old technology with modern day engineering techniques.

Nuclear Power has long been a subject that was not

approachable on many levels. Recently, at the March 2013 Energy Summit in New Zealand sponsored by the European Union to include all Pacific Countries, four Pacific Island Nations endorsed the pursuit of a New Safer Nuclear Technology that may be ready for commercial production. The details were not readily available but the value of safe Nuclear Reactor Power cannot be ignored. We will be monitoring this alternative as information becomes more readily available.

Energy and the Economy

In an era of unprecedented high energy costs, we are seeing a dramatic impact on our economy as a result of our dependence on imported fossil fuels. Utility Electrical Power Generation, Government and Private sector basic transportation and services all under financial stress in large part due to increased cost of operations related to high cost of energy. Further to our dismay, while American Samoa is located in a beautiful and pristine Pacific Tropical Environment, we are always at risk of not

receiving a fuel shipment in time which would result in a complete collapse of all services in short order. A similar event happened less than a decade ago. We make no light of the fact that American Samoa is highly exposed to energy shortages due to our reliance on imported fossil fuels.

While American Samoa is taking steps towards energy conservation and implementing renewable options, we are very focused on complete energy independence due to its large impact on our economy and civil stability. If a 100% energy-independent status can be

achieved, we will have succeeded in boosting our economy by—at minimum— **20%** (in available cash flow), which will compound every year thereafter. We will also have succeeded in creating a highly competitive manufacturing environment for energy intensive processes. We will have taken a major step in securing our children's future and as an added benefit, brought our people self respect through ownership and proper utilization of our natural resources.

American Samoa is blessed with an abundance of natural energy resources that are yet basically untapped. The Island group sits on a volcanic area known regionally as "The Ring of Fire." The area is a Geo-thermal "super energy" source.

Failing this goal or failing to at minimum making large strides towards energy independence will leave American Samoa vulnerable to catastrophe such as interruption in fuel delivery would have. Or worse, an unexpected spike in fuel cost resulting in the inability of our Utility to pay for fuel. The results of either of those occurrences cannot be overly stated.

Challenges in Developing the Resources

Our challenges are most likely very similar to most others—“the funding” which is needed for capital improvements. Developing energy projects are not cheap. Before the project can even be started, studies must be done. Resource availability and options studies, technology availability research, feasibility studies, design and blue print costs, environmental impact studies, legal contracts, funding and financing solutions and the list goes on. Many good ideas for energy projects die along these path of unavoidable obstacles, as all have a large cost in both time and money. It is a cost (price and time) that kills most energy progress no matter how noble or valuable the project.

Financial institutions will fund smaller, low risk projects related to Solar and Wind but big projects like Geo-Thermal and OTEC projects are much larger and therefore risk assessment more thorough. Financial institutions are not lining up to fund these. Many renewable technologies are also fairly new. New Technologies do not have a proven track record and are quite often determined as high risk by financial institutions. That puts moving forward in the hands of Government and their level of desire to fund the “moving forward”. American Samoa sees OTEC and Geothermal as a very simple technology with abundant thermal energy at our shores which should be easily deployed.

Yet the OTEC technology is still in its infancy, because there are only a few places in the world that have the proper conditions to deploy it. (IE: Warm surface temperatures of 84F and very cold deep water currents (46F) close to shore). This has limited the development of OTEC and therefore hurt its industry credentials as being less solid, simply because it hasn't yet been implemented routinely around the world.

With lack of history on this technology, risk assessment is difficult. This makes financial institutions who rely on past industry performance to measure risk assessment, very uncomfortable towards investment. That leaves one option for funding—Government Guarantees or Grants. With recent cuts in the federal spending, it is unlikely American Samoa will realize the necessary funding to secure its energy sources and stabilize its economy by going 100% green anytime soon.

The energy resource is there, and the technology sound to extract and utilize it. The funding is not so available.

Implementing Strategies to Overcome Barriers

In the upcoming weeks, American Samoa will convene the American Samoa Renewable Energy Committee (ASREC) consisting of our territories most talented and best minds. An energy think tank working together comprised of both private sector and government Energy Professionals, business owners, financial organization people and political leaders. With this group of diversified backgrounds, IF they can find away to work together, their combined intelligence, experience and skill levels should be capable to overcome any obstacle we face in our energy goals.

Conclusion

We are in an era that recognizes the importance of energy and the value of developing renewable resources. Quote from the National Renewable Energy Laboratory (NREL) report. **“In short, energy security is critical to American Samoa’s future economic development and sustainability.”** While we move forward to try and tackle the challenges of energy and our goals of energy independence, the strong need for assistance from the US cannot be understated. The leaders that find ways to solve the problems of the development of sustainable and renewable resources for energy will not only have done the people who have empowered them a great service, but they will also have their names written in history as leaders with vision.



JAN BREWER
Governor, State of Arizona

Leading the Way on Solar Energy



Arizona has a long history of providing a balanced set of traditional resources to generate electricity, including nuclear, coal, natural gas and hydro power. We have the largest nuclear power

plant in the United States. Our tribal nations have large coal reserves, and our hydroelectric dams are the foundation upon which our state was built. However, over the past several years we have seen a transition from using traditional sources alone to also using a variety of newer energy technologies.

Arizona's solar resource not only has the potential to help us become more energy independent but also to provide enormous opportunity for economic growth. As we enter a new era in energy, Arizona is working toward developing a strong solar energy industry and infrastructure.

Since before statehood, Arizona has provided leadership in fostering solar energy research, development, manufacturing and deployment for the benefit not only of the people and the economy of Arizona, but the nation and the world. Since the 1800s, Arizona has utilized solar for heating and pumping water, and tested and certified solar products and new solar technologies. More recently, Arizona has enacted numerous solar tax incentive programs for both business owners and residents.

Under my leadership, solar energy has become a growing sector of our diverse energy portfolio, with Arizona being dubbed the "Solar King" by industry trackers due to our state's ideal climate and thriving environment for renewable-energy technologies and manufacturing.

Making Arizona the "Solar Capital of the World" is one of my commitments. It is supported by aggressive state financial incentives, which has created a climate perfectly suited to put Arizona on that path. Driven in part by Arizona's Renewable Energy Standard (RES), which requires that 15 percent of retail power production come from renewable sources by 2025, Arizona's solar installations grew by 250 percent in just 2010 alone – an unprecedented feat for any state.

One of my first acts as Governor of Arizona was to increase the number of renewable energy installations in Arizona. In 2009, 50 percent of the State Energy Program funding was leveraged for a total of \$104 million, and was dedicated to renewable energy projects. The results were 472 PV systems installed with 5,287 kilowatts of capacity and 168 solar hot water systems with over 23,000 gallons tank capacity. Included in these numbers receiving systems were 89 school districts, 51 nonprofit organizations, 41 ranches & farms and 9 state government facilities.

I also established the Solar Energy Task Force. This group, in keeping with my commitment to regulatory reform, helped us identify ways to streamline the solar permitting process and make installations easier and more affordable.

Arizona's rapidly expanding research and development resources for the renewable energy industry demonstrate a strong commitment to the industry's growth at the government, business and university levels.

Arizona is home to some of the world's most innovative renewable energy initiatives, including The Solar Zone research park in the University of Arizona's Science and Technology Park, which houses nearly 50 companies; 7,000 high-tech employees. It also includes the Arizona Center for Innovation, a business incubator for developing technology companies, which offers services to solar start-ups.

Arizona's world-renowned research universities and effective industry-university collaboration continue to drive solar advancements in the state. That helps deliver an exceptional workforce and secure Arizona's position as a global leader in the solar industry.

With approximately 61,000 students spread across four campuses, Arizona State University (ASU) is the state's largest university. Recently named one of the "greenest" universities in the country, ASU launched the nation's first School of Sustainability, offering graduate and undergraduate degrees in sustainability, with a focus on collaborative learning techniques designed to address challenges of the 21st century. ASU is also home to LightWorks, a multidisciplinary effort to leverage ASU's expertise in solar and other renewable energy fields to expedite the technology needed to make it affordable and mainstream; and to a number of research centers, including the Flexible Display Center and Photovoltaic Testing Laboratory.

The University of Arizona (UA) is Arizona's second largest university and ranked one of the top 20 public research universities in the country. UA is home to AzRISE, a global institute using powerful industry-education collaboration – supported by research and economic and public policy – to

drive innovative solar energy solutions; and to The Solar Zone, a pioneering solar research park spread across 222 acres in the University of Arizona Science and Technology Park. The Solar Zone's strategic location, synergistic environment, specialized talent pool, and access to quality research and resources give solar companies operating there a major competitive advantage.

Northern Arizona University (NAU) is home to the Center for Sustainable Environments (CSE), a national leader in the university-based "sustainable science." It offers programs that address the survival of humanity and other species on Earth. One area of emphasis is in the reduction of ecological impacts related to energy use. CSE is housed in NAU's College of Engineering and Natural Sciences and participates in many educational, research and outreach activities, including the Campus Sustainability Program and the Sustainable Economic Development Initiative.

Today, the solar industry is stabilizing from a frenzy of activity. Over the last two years, a number of high-profile solar firms have failed, restructured or scaled back investment in the solar market. While concerning, these setbacks are not uncommon for a relatively new technology still maturing in the global marketplace. With time and continued technological improvements, I'm confident the solar industry will emerge stronger.

Arizona remains focused on solar energy's still-promising future. This includes next-generation advances that will reduce manufacturing costs, increase energy retention with high-efficiency photovoltaic panels and improve utility with smaller, more efficient batteries.

Interest in Arizona among solar firms remains high.

Two years ago, I met with several such companies while on a trade mission in China. Similar discussions occurred last summer in Europe, during meetings in Berlin, Munich and Paris. This past fall, my Arizona Commerce Authority completed strategic outreach and company meetings during Solar Power International – the industry's largest global gathering.

Arizona has many unique renewable energy attributes, with solar energy being our most abundant. The Solar Energy Industries Association reports that our state:

- Ranks second nationally with 1,097 MW (distributed and utility-scale) of installed solar capacity, enough to power more than 267,561 homes;
- Is adding 426+ MW of utility-scale capacity;
- Creates electricity from 15,000 solar PV installations;
- Ranked second nationally for PV installations during 2012; and
- Boasts more than 265 solar companies, including 27 manufacturers.

With an “All of the Above” energy plan that takes advantage of all available resources, including traditional forms like coal and natural gas, we can ensure that Arizona has the energy necessary to power a growing economy. Renewable energies, such as solar, will continue to play an important role – and Arizona is positioned to benefit economically as these technologies mature. Tax incentives I have signed into law allow Arizona to compete globally, be more aggressive in attracting foreign direct investment, and secure quality jobs. It’s an investment in our future which will attract world-class renewable energy manufacturers and produce the jobs necessary to support our Arizona families.

We have seen significant investments and industry growth in Arizona. These include:

- **Faist Greentek** is a U.K.-based metal fabricator that opened a 56,000-square-foot manufacturing plant in Phoenix to support the Power-One manufacturing efforts. The plant employs 125 to 150 people.
- **First Solar**, headquartered in Tempe, Ariz., the world’s leading manufacturer of thin-film solar modules, is building a \$300 million, 600-employee solar-powered factory in Mesa, Ariz., that will produce an annual total generating capacity of 250 million watts. Fluidic Energy is commercializing

a revolutionary energy storage technology developed at ASU and will build a manufacturing plant in Maricopa County.

- **Gestamp Solar Steel** has a new manufacturing facility that will build steel structures for utility-scale, concentrated solar generation stations in its new 75,000-square-foot facility in Surprise, Ariz. It will house a steel fabrication factory and the U.S. headquarters for Gestamp, employing approximately 50 people.
- **Power-One Inc.**, a California-based solar and wind inverter manufacturer, opened a 120,000-square-foot manufacturing facility in Phoenix (its first in North America), citing Arizona’s strong workforce and the intellectual resources of ASU as reasons for choosing Arizona for its U.S. manufacturing base. It employs hundreds of Arizonans, and Power-One’s main suppliers are also expected to relocate to the Valley.
- **Rioglass Solar**, a Spanish company, is completing a glass reflector manufacturing plant in Surprise, Ariz., which supplies tempered-glass reflectors concentrated solar power (CSP) units.
- **Schletter Inc.** is a German-based company that built its first U.S.-based operation center in Tucson, Ariz., in 2008, after looking at cities across Arizona, Colorado and California. Schletter manufactures solar mounting systems for small- to utility-scale generating stations.
- **TÜV Rheinland** of Germany built its photovoltaic testing laboratory in Arizona, upgrading the technology and more than doubling the capacity of the former ASU photovoltaic lab. The new lab provides a unique one-stop source for clients to get full testing and certification for all safety and performance standards in use by the industry anywhere in the world.

I am proud to share that Arizona installed more utility-scale solar in 2012 than any other state, according to the Solar Energy Industries Association’s 2012 Solar Market Insight Report.

Installations totaled 710 mega-watts. Add to this significant projects already under development or recently completed.

- **Abengoa Solar** is building a 280-megawatt CSP plant (Solana) in Gila Bend, Ariz., which will generate enough energy to power 70,000 homes. The Solana generating station will create 1,500 construction jobs and when completed in 2013, it will employ 85 highly skilled technicians. The plant will also be the first large-scale solar plant in the nation to store the energy it generates for later use, enabling it to provide power at night and during cloudy weather.
- **APS/Luke Air Force Base Photovoltaic** includes 52,000 high-efficiency SunPower solar panels generating 15 megawatts across 100 underutilized acres on the base. It will be the largest solar installation on U.S. government property.
- **Sempra Gas and Energy** completed its Mesquite Solar Complex in Arlington on former agricultural land near existing transmission lines, commissioning Suntech Power to provide its solar modules, some of which were produced at its Goodyear facility. At build-out, the site could grow to 600 megawatts, becoming one of North America's largest photovoltaic solar generation plants. Phase one is now generating 150 megawatts with a capital investment estimated at \$500 million.
- **The Solar Zone**, on 250 acres in the heart of the University of Arizona's Science and Technology Park, was designed to enable utilities and developers to evaluate solar technologies side by side to determine the most efficient and economical systems. Supported by Tucson Electric Power, six projects by various solar companies are currently in the works, making The Solar Zone the largest multi-technology solar demonstration site in the U.S.

Quick Solar Facts:

9,800

Jobs in the solar industry in Arizona in 2012
(The Solar Foundation, 2012 Jobs Census Report).
This represents 8.2% of total U.S. solar industry jobs
and makes Arizona the second largest
solar employer in the country.

No.1

State in the Mountain Region (NM, CO, UT, ID, MT,
NV, WY, AZ) for number of solar establishments.
(The Solar Foundation, 2012)

\$590M

Amount invested in 2012 to install
solar on homes and businesses.
(Solar Energy Industries Association, 2013)

\$1.1B

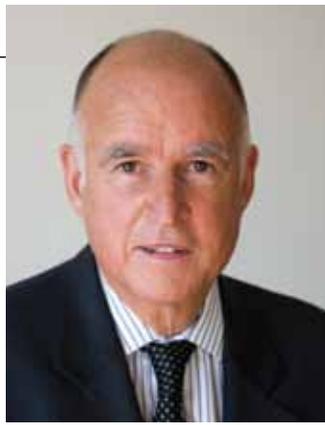
Estimated economic output of the renewable
industry in Arizona in 2011, produces more
than \$417 million in wages. (Elliott D. Pollack &
Company Economic Impact Analysis, Feb. 2012)

By focusing on renewable energy innovation, solar installation, and energy efficiency, Arizona will continue to lead the nation in the development and implementation of products that move the State of Arizona – and the world - toward energy independence. By continuing to foster a solar industry that will someday become an economic force of great significance, Arizona will diversify its economy, grow green jobs, and better the environment for the citizens of this great State.

My belief in solar energy isn't just lip service. I've used the Arizona sun to help power my own home since the 1970s, so I know from personal experience the potential of renewable energy in our state.

Engage in this statewide effort through my Arizona Commerce Authority.

Please visit www.azcommerce.com



EDMUND G. BROWN, JR.
Governor, State of California

State Energy Policy in the Era of Climate Change



Nothing poses a more serious threat to our region's long-term well-being than the buildup of carbon dioxide and other greenhouse gases (GHGs) in the atmosphere. Unchecked, GHG emissions will

lead to more severe droughts, heat waves, fires, and other extreme weather events. Most troubling, "tipping points" – those beyond which climate impacts become irreversible – can be reached before we even know we have passed them. Yet mobilizing the will to deal with climate change is especially difficult because the worst consequences are perhaps decades in the future.

The first step is to focus on our current energy and transportation systems. California policies offer a roadmap for how states can reduce GHG emissions while improving public health and fostering economic growth.

The Consensus on Climate Change

The scientific consensus on climate change has never been stronger. Every major scientific organization in the United States with relevant expertise and 198 scientific academies worldwide—including the national scientific academies of all

major industrialized countries – agree that the world is warming and that human activities such as burning coal, oil and gas are the primary cause. According to the latest report from the National Oceanic and Atmospheric Administration, carbon dioxide levels are at their highest levels in at least three million years.

The impacts of climate change are already occurring. Extreme heat is increasing, heavy downpours are more frequent, and droughts are becoming more persistent. The year 2012 was the hottest on record in the United States, and the past decade was the warmest globally. Arctic sea ice cover has reached its lowest level on record. The number of category 4 and 5 hurricanes in the Atlantic has doubled in the past century. Hurricane Sandy alone caused an estimated \$50 billion in damages, making it the second-most costly extreme weather event in U.S. history.

Our wildfire season is getting longer and burning more acres—it already lasts two-thirds longer in the West than it did two decades ago. Last year Colorado experienced its most destructive year for wildfires ever on record. Large fires also seared Nevada, Idaho, Wyoming and California. It now costs \$3 billion annually in the U.S. to fight wildfires – triple what it cost in the 1990s.

Future Impacts

At today's rate of emissions, the planet could warm by more than 7 degrees Fahrenheit by the end of the century, an event unknown in human experience. Unabated, climate change will pose serious risks for Western states.

- Climate change will reduce the productivity of timberlands and the value of harvested timber in the West, causing potential losses of tens of billions of dollars. The area burned by wildfires is expected to at least double over the next 25 years.
- Hotter temperatures will lead to more extreme heat days and more health-damaging smog. This will be acutely felt in the semi-arid regions of the West, as well as states like California that have serious air quality problems.
- Water in the West will become scarcer. Rising temperatures already have led to the snowpack melting up to 20 days earlier in the West, and by the end of the century, parts of the West could experience snowpack melt up to 60 days earlier. The Colorado River, which supplies water to seven states (Arizona, California, Colorado, New Mexico, Nevada, Utah, and Wyoming), will fall short of demand by 3.2 million acre-feet by 2060, more than five times the amount of water currently annually consumed by Los Angeles.
- Climate change will affect many of the diverse ecosystems and spectacular natural places that comprise the West. Plants and animals are already shifting their ranges and migratory patterns. Bark beetles are killing temperate and boreal conifer forests across areas greater than any in the last 125 years, and are thriving due to higher temperatures. Since 1997, tree mortality attributed to bark beetle infestation has harmed a total of 41.7 million acres, with California (5.5 million acres), Colorado (6.6 million acres), Idaho (5.2 million acres), and Montana (6.2 million acres) the hardest hit. Over 80% of California's 121 native freshwater fish species are at high risk of extinction as the climate changes; commercially important species, such as Coho salmon and Steelhead

trout, are particularly at risk because they require cold water below 72°F to survive. Almost half of trout habitat in the interior West could be lost by 2080. Glacier National Park has already lost more than 80% of its namesake ice fields present in 1850, and the last of its 26 remaining glaciers may be gone by 2030, according to the U.S. Geological Survey.

The economic costs are potentially staggering. In California alone, the costs of dealing with damage from climate could be between \$7.3 and \$46 billion annually.

California's Climate Policies

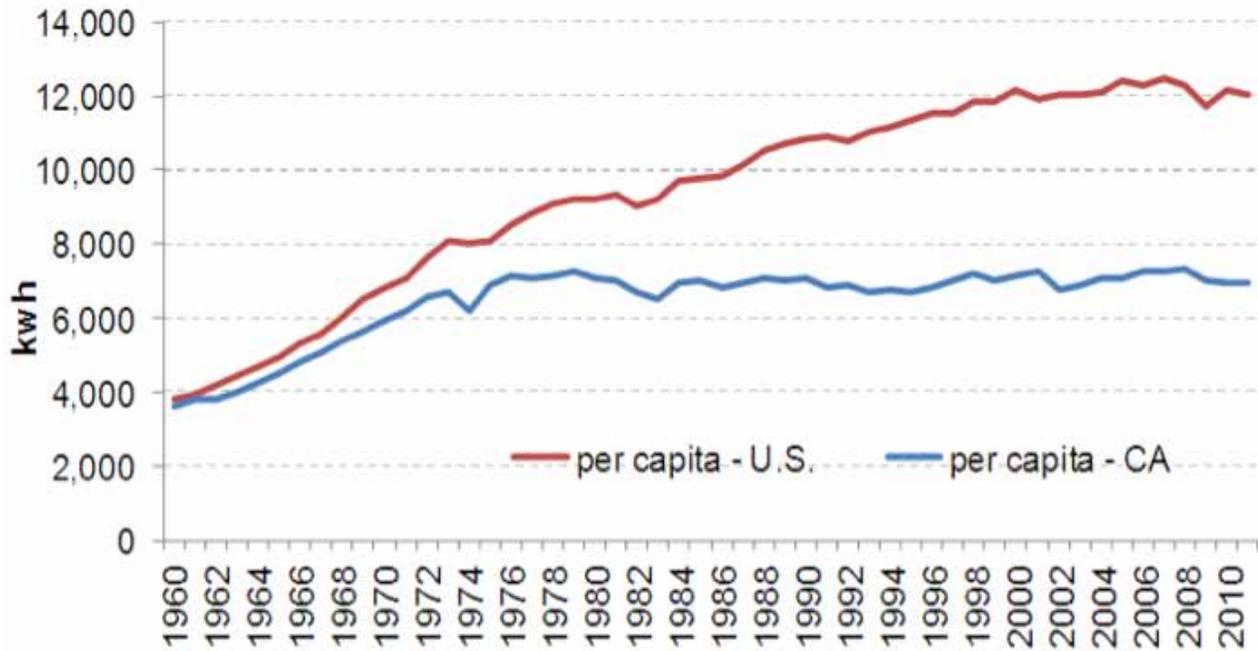
The centerpiece of California's approach to climate change is AB 32, which former Governor Schwarzenegger signed into law in 2006. It sets a goal of reducing greenhouse gas emissions in California to 1990 levels by 2020. We are pursuing a diversified approach to meet this target — relying on a combination of energy efficiency, renewable energy, clean cars, and efficient land use development, and putting a price on carbon emissions from the largest industrial facilities.

Along with climate benefits, these policies provide other important economic and environmental gains. The solar industry now employs over 44,000 people in California. Energy efficiency has a strong economic multiplier effect. Over the past three and a half decades, California's efficiency policies have created 1.5 million jobs and saved consumers \$74 billion, well over \$1,000 per household. Cleaner burning power plants and cars also reduce harmful air pollutants. And these policies help put us on a path toward long term energy self-sufficiency, with an energy and transportation system powered by home-grown wind, solar, biomass, geothermal and hydropower.

Energy Efficiency

Energy efficiency is the starting point for a clean energy economy. It is the fastest, most reliable and often cheapest source of energy, and it has zero impact on the environment. California's appliance and building efficiency standards, in place for the past three decades, have resulted in per capita electricity consumption in California

Figure 1: Federal vs. California Per Capita Electricity Consumption



California Energy Commission, based on U.S. Energy Information Administration & U.S Census Bureau data

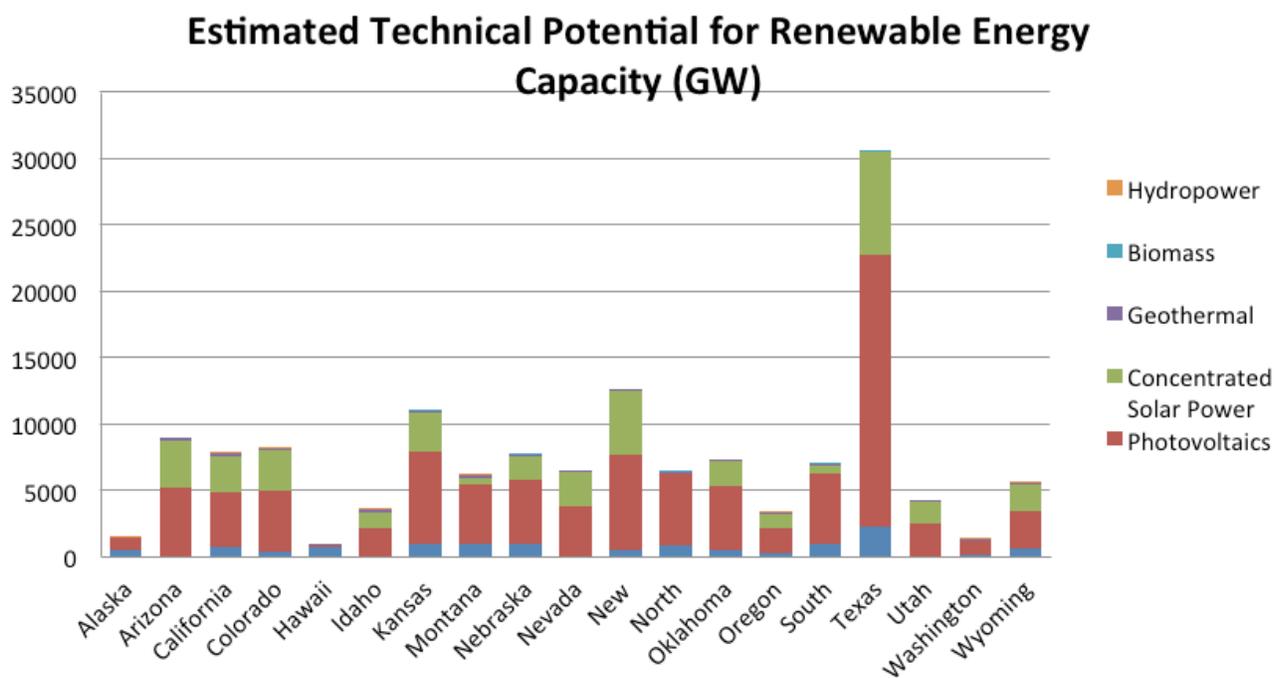
that has remained flat since 1980, even as consumption grew 50% nationally and California's economy expanded eightfold (See Figure 1). We anticipate further deep efficiency gains as we turn our attention to new lighting technologies and consumer electronic products (standards adopted in 2012 by California for battery chargers, for example, will save enough energy to power 350,000 homes, a city the size of Bakersfield).

Other Western states have made important strides in efficiency. Efficiency represents about 12% of electricity generation in the Northwest (Washington, Oregon, Idaho and Montana), compared to 1% nationally, and plans for these states call for meeting 85% of their new electricity load in 2030 through efficiency improvements (Governor Kitzhaber recently proposed meeting all of Oregon's new load growth through efficiency and conservation). Arizona, Colorado, Hawaii, New Mexico and Texas have energy efficiency resource standards requiring utilities to achieve efficiency savings. We will need all of these efforts and more to reduce GHG emissions.

Renewable Energy

A second pillar of our climate and energy policy is renewable energy. California law requires that 33% of electricity come from renewable sources by 2020. Ten years ago, when the standard was first set at 20%, many utility executives said it could not be met. Today, already, over 20% of our electricity comes from renewables, and we are on track to meet or exceed the 33% mandate by 2020, without any adverse impacts to grid reliability. Our success has come from consistent policy signals, strong coordination among state agencies and the federal government, and an ombudsman in the governor's office to speed project delays. And this is occurring at a reasonable cost to ratepayers. The average cost of renewable contracts signed last year was 9.6 cents/kilowatt hour, and prices have been steadily declining. The California Public Utilities Commission estimates that, of projected rate increases between now and 2020, only about 5-7% will be as a result of renewable energy costs.

Figure 2: Estimated Technical Potential for Renewable Energy Capacity in WGA States



Source: Adapted from National Renewable Energy Laboratory, "U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis." Lopez, A. et. al. July 2012.

Rooftop solar also is rapidly growing in popularity. Californians have installed over 1,300 megawatts in 127,000 homes and businesses. The three largest production homebuilders in the state, responsible for 25% of the market, have committed to making solar a standard feature on their new homes.

Many other states in the West have strong renewable policies; a total of 15 (including California) have a renewable portfolio standard or goal. Four of the five states with the most installed renewable energy are in the West – Washington, California, Texas, and Oregon. California leads the country in solar, Texas in wind, and Washington in hydroelectric power.

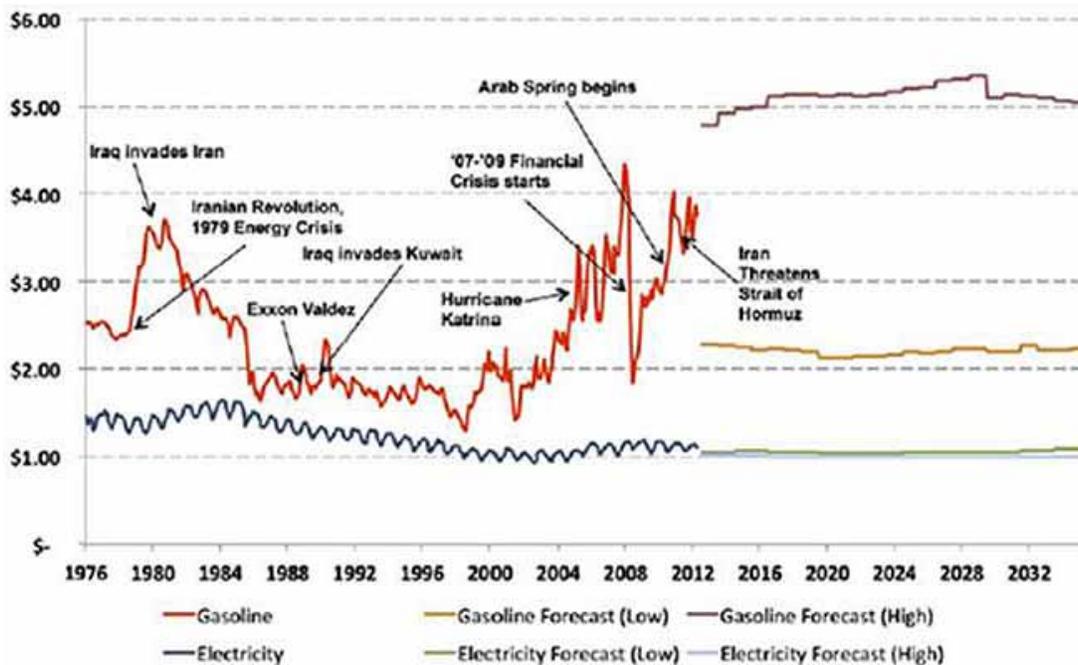
Over the long term, the West is blessed with extraordinary potential to meet our energy needs and export power elsewhere in the U.S. California alone has an estimated 8 million megawatts of renewable potential – and by some estimates over 18 million megawatts—more than 135 times our current peak load. The West leads the nation

in solar photovoltaic (PV), wind, geothermal, concentrating solar power, and hydropower resources, and has a potential of 139 million megawatts, according to the National Renewable Energy Laboratory (NREL) (see Figure 2). Prices will continue to decline as renewable technologies mature. Moreover, regional collaboration among states in the West offers the promise of reaching higher penetrations of renewables while keeping prices down and ensuring system reliability. The California Independent System Operator took a step in the direction of regional collaboration earlier this year, launching an “energy imbalance market” to help balance very short term deviations between energy supply and demand.

Clean Cars

A third component of our climate policy is clean cars. California has long been a pioneer in setting automobile emission standards that often have become national standards. In 2004, California set the nation’s first GHG emission standards

Figure 3: Electricity vs. Gasoline Prices (1976-2035)



Source: Adapted from Natural Resources Defense Council, based on data from U.S. Energy Information Administration.

from passenger vehicles, and subsequently strengthened them as part of national standards in cooperation with the federal government and the automobile industry. The rules require a doubling of passenger vehicle efficiency by 2025 and a reduction in GHG emissions of 34% compared to 2016 levels. The standards also will reduce smog-forming emissions from new vehicles by 75% and save consumers \$6,000 in fuel savings costs. And they will generate approximately 21,000 new jobs in California by 2025.

To meet our long term climate objectives, as well as the health-based requirements of the Clean Air Act, we will have to go beyond more fuel efficient cars that run on petroleum and make a major shift to zero emission vehicles (ZEVs)—especially electric vehicles. Last year, the California Air Resources Board adopted a mandate calling for 1.4 million vehicles—15% of our fleet—to be zero emission vehicles by 2025, and I signed an Executive Order calling for state agencies to help create the infrastructure to make this happen. Over 25,000 ZEVs were sold in California over the past two years (representing 40% of national market), and while they are still a small part of the

market, ZEVs are growing faster than hybrids did at a comparable stage when they were introduced in the mid 1990's.

ZEVs not only are cleaner burning than internal combustion engines, they also are an essential ingredient to long-term energy security. The price of gasoline historically has fluctuated quite substantially, and many experts believe it will continue to be highly volatile for at least the next 20 years. This will remain the case even if we increase our reliance on domestic sources, since oil is a global commodity. In contrast, as Figure 3 below highlights, electricity rates historically have remained relatively stable. And electricity fueled cars will be much cheaper to operate. With the right pricing policies (e.g., encouraging charging at night and other off-peak times), consumers should be able to fuel their cars for the equivalent of \$1.00 a gallon.

Sustainable Land Use Policies

Another key element in our climate strategy is promoting more efficient land use development. Up to 40% of California's GHG emissions come



from the transportation sector, much of this resulting from people commuting to work or school. As the State grows to 50 million people in the next two or three decades, we need to reduce the number of vehicle miles traveled. California enacted legislation in 2008, SB 375, that ties regional transportation funding to the development of sustainable land use plans that promote compact and efficient development, limit urban sprawl, and minimize the loss of natural resources and productive farmland. These policies will have very substantial health benefits as well, as people walk and bicycle more, have stronger neighborhood connections, and as traffic congestion and air pollution are reduced.

Cap and Trade Program

Finally, California has initiated a cap and trade program to obtain about 20% of the needed emissions reductions under AB 32. The program, championed by businesses as a means of more flexibly meeting their compliance obligations, imposes a declining cap on the state's 600 largest industrial facilities and emitters, and

lets individual companies meet their obligations through direct reductions or by purchasing allowances from other parties. A portion of allowances are being auctioned to companies, and the proceeds will be refunded to ratepayers and fund investment in clean energy technologies. A key feature of the program is the price it sets for carbon emissions, a clear signal to the market that carbon emissions have a cost to society. This in turn provides an incentive for businesses to switch to cleaner burning fuels.

Conclusion

California is making steady progress toward reaching our 2020 target for GHG reductions. In 2011, GHG emissions from the power sector declined by 22%, and by 5.8% overall. Our diversified approach allows us to build on existing programs, avoid undue costs to any one sector, and generate many other environmental and economic benefits. It can serve as an example for governments at all levels seeking to combat climate change.



JOHN HICKENLOOPER
Governor, State of Colorado

A Role for Natural Gas in Colorado's "All of the Above" Energy Future

Introduction

Colorado is pursuing an "all of the above" energy strategy across various resources and party lines. The state has abundant energy resources ranging from coal to wind to solar to oil and natural gas. Because all resources have drawbacks, Colorado is working hard to use all of our resources in the manner most suitable. The Western Governors' Association has asked for an essay on a specific energy topic of interest to the state, and the region. In Colorado, one major focus of energy development is natural gas, which makes it a relevant topic for contribution to this WGA report.

In Colorado, natural gas offers an impressive combination of affordability, abundance, environmental advantages, and flexibility. As an industry, it creates tens of thousands of jobs in Colorado alone and millions throughout the country. Colorado currently ranks fifth nationally in natural gas production, with diverse hydrocarbon resources encompassing shale, tight sand, coal bed methane, and traditional

formations across the state. Commercial production of shale gas has expanded the reach of the industry, creating important new economic activity for the state as a whole, and rural areas in particular. Natural gas also provides significant environmental advantages, reducing particulate pollutants that lead to respiratory ailments as well as greenhouse gas emissions. At the same time that natural gas provides jobs and directly reduces emissions, it paves the way for increased emissions reductions through the incorporation of more renewable energy because of its ability to cycle on and off efficiently.

Colorado's goal is to promote our energy resources for the benefit of the state and its citizens, while staying accountable for the highest ethical and environmental standards through regulations that are rational, fair, scientifically-based, and protective of public health and safety. Colorado has accomplished this through a series of rulemakings that have resulted in some of the most robust oil and gas regulations in the country, as well as through the establishment of other creative and innovative policy drivers. We are doing everything we can through policy, research, and regulation to promote safe

production of these resources, maximizing the benefits and minimizing the costs.

Natural Gas as an Economic Driver

Natural gas plays a major role in the nation's economy, and that role is even more prominent in Colorado and other western states. Gas fields create thousands of high-paying jobs, especially in rural areas, and the accompanying revenue fuels other sectors of the economy. Gas revenue provides tax support for schools and other vital services and infuses communities with funds spread across sectors. Natural gas discoveries have also reduced our reliance on foreign fuel and improved the country's trade deficit. All told, the natural gas market creates tremendous economic benefits for Colorado, the west, and the country as a whole.

Perhaps the most significant economic benefit that natural gas creates is employment on a large scale. In Colorado, the oil and gas industry and supply chain employ over 43,000 people. In Colorado, as in other western states recovering from a major recession, these jobs are indispensable. Furthermore, these jobs pay far better than average. In Colorado, the average salary for oil and gas employees is more than double the state average and exceeds \$72,000.¹ Many of these jobs are coming where they are most needed - in rural areas of the state. Much of the oil and gas development in Colorado comes in largely rural counties, and despite the overall economic downturn, rural income increased by 3.8% per person in real terms between 2007 and 2011.²

Beyond direct employment, there are indirect economic benefits related to the oil and gas industry. The industry indirectly supports an additional 63,000 jobs in the state.³ These are employees who provide goods and services to the industry itself as well as people who benefit from the money spent by industry employees, establishing a thriving, integrated local economy.

Landowners are another major group who benefit from drilling and production. In Colorado, \$1.2 billion in royalties were paid to mineral rights owners in a single year.⁴ While landowner payments

do not directly impact each citizen of Colorado, this is a significant infusion of cash into our economy and it drives other economic activity.

In addition to these ripple effects, Colorado citizens benefit from government revenue generated by oil and gas operations. Our local communities receive a portion of state revenues from oil and gas development, generated through a severance tax. Over \$26.5 million severance tax dollars and over \$32 million federal mineral lease revenues went directly to local Colorado communities last year.⁵ Beyond direct distributions, local jurisdictions in Colorado will receive grant funds totaling \$60 million from severance tax dollars to help address local impacts from oil & gas development. These grants are used to build the types of projects that provide immediate, positive impacts to Colorado communities - roads, community centers, water treatment, and other similar projects. Annually, over \$25 million in severance tax dollars goes to support projects that address high priority needs including water supply, endangered and threatened species, low income energy assistance, forestry projects related to bark beetle and protecting Colorado's water and water infrastructure from invasive species such as zebra mussels.⁶ Additionally natural gas development contributes hundreds of millions of dollars in property taxes to local governments.

Natural gas has the potential to benefit the country on an international scale as well. At this point, energy represents half of all U.S. imports, and most of that comes in the form of petroleum. Although our electricity sector is largely sourced domestically, petroleum products represent the bulk of our transportation fuel. Natural gas has the potential to displace petroleum as a transportation fuel. The benefits to energy security from using natural gas to fuel vehicles are clear: cleaner fuel produced domestically avoids reliance on foreign regimes, many of which are unfriendly to the United States.

The economic benefits from natural gas have grown recently, thanks to development of shale and tight gas in areas like Colorado's Niobrara shale formation, and are projected to continue to do so. A recent study forecasts that shale energy production will support 50% more jobs in Colorado

by 2020 compared to 2011.⁷ While such projections are inherently uncertain, numerous studies suggest that shale's impact on the economy will continue to grow into the future. This is a positive development for people across Colorado, not only those involved in industry. The benefits are felt throughout the state, throughout the west, and throughout the country.

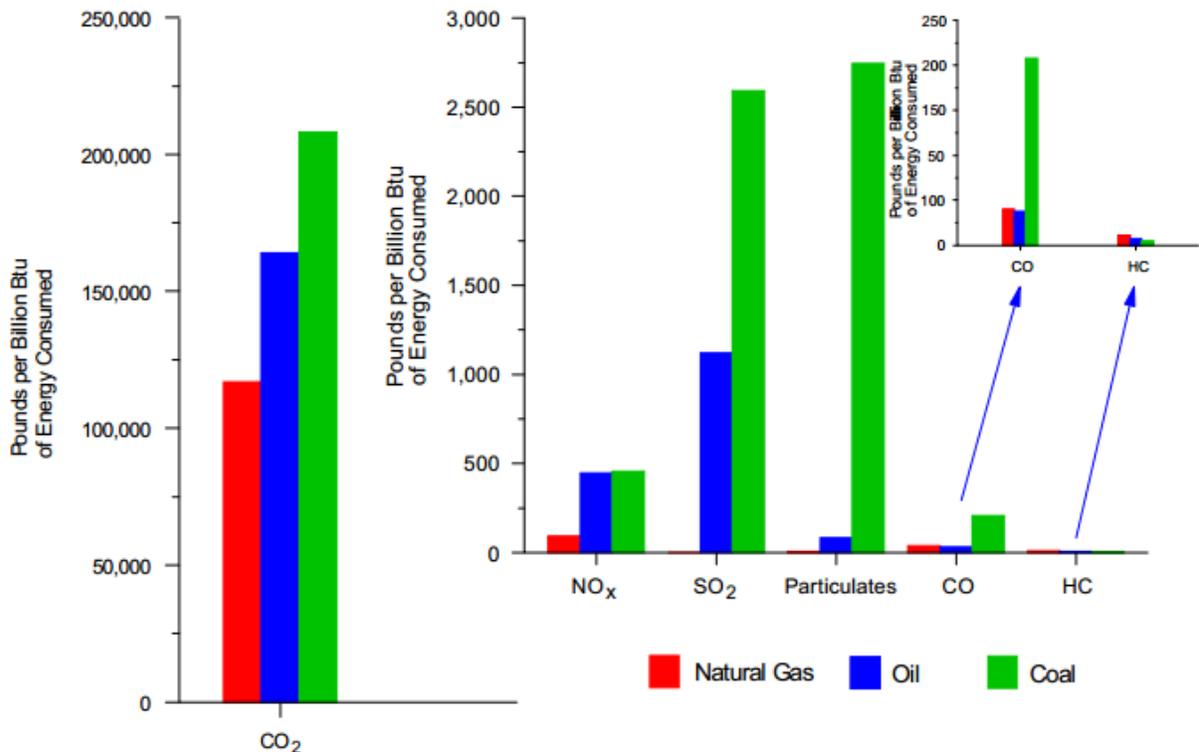
The economic benefits of natural gas are clear. Expanded natural gas production in Colorado can aid in the reduction of national energy imports and provide a more stable and secure energy supply. High paying jobs and large infusions of royalty and tax dollars come with development of these resources in our communities.

Environmental Benefits of Natural Gas

In addition to the many economic benefits of natural gas, the fuel creates environmental benefits in two major ways. First, it directly reduces emissions of air pollutants and greenhouse gases. Second, the flexibility of natural gas turbines allows the state to incorporate more renewable energy into its "all of the above"

energy strategy and continue to have one of the most aggressive renewable portfolio standards in the country.

From a long term perspective, one of the greatest environmental advantages of natural gas is its enabling effect for other technologies. Natural gas can easily cycle on and off, unlike generators like nuclear which run much more efficiently if kept on constantly. For many years, natural gas has been used to accommodate large shifts in consumer demand from minute to minute and throughout the day. Now, natural gas's flexibility can serve an extra purpose as well: regulating the variability of wind and solar power. Wind turbines depend on wind speed and solar panels depend on sunshine, and thus both require measures to mitigate their intermittency. For the time being, natural gas is the most viable alternative to compensate when renewable power is not available. Due in part to Colorado's great natural gas resources, Xcel was able to set a record for percentage of electricity in an hour from wind at nearly 57% in 2012.⁸ One of the biggest emission improvements due to natural gas usage is in sulfur oxides, the largest contributors to acid rain. The sulfur compounds



emitted by natural gas are essentially negligible compared to coal, diesel fuel, or gasoline. Colorado coal is naturally very low in sulfur, but it still cannot compare in purity to natural gas. Nitrous oxide is the other major contributor to acid rain as well as a major cause of smog. Natural gas emits about one-third of the nitrous oxide emitted by coal or oil combustion. It also emits far less carbon monoxide, another major contributor to smog. Lastly, because natural gas burns so cleanly, it barely emits any particulate matter, known for aggravating respiratory ailments. The graphs on the right from the EIA place these environmental benefits into perspective.⁹

At the same time, greenhouse gas emissions have been significantly reduced in Colorado due to widespread adoption of natural gas. Natural gas emits a little over half as many greenhouse gas emissions as coal and nearly a third as many as oil. Due largely to increased reliance on natural gas, carbon emissions from the energy sector hit a 20-year low in absolute terms in 2012.¹⁰

Colorado's Clean Air Clean Jobs Act, passed in 2010, has been a major driver of conversion to natural gas. The Act itself is responsible for CO₂ reductions of 28%, NO_x reductions of 88%, SO_x reductions exceeding 80%, and mercury reductions of 50%.¹¹ In terms of greenhouse gases, a UC - San Diego professor estimates that increased reliance on natural gas throughout the US has reduced carbon emissions by double the total effect of the Kyoto Protocol.¹²

Addressing Impacts from Natural Gas

The recent increase in natural gas development has raised concerns in Colorado and nationally regarding public health, the environment and impacts to nearby communities. This public concern is real and is resulting in national and state-level discussions about how to ensure public health and natural resources like air and water are protected as natural gas resources are developed. Any type of energy development is an industrial process, and those processes come with impacts, but we believe in Colorado the impacts can be

managed. Our goal is to be accountable for the highest ethical and environmental standards through a regulatory structure that is rational, fair, scientifically-based, and protective of health and safety.

The state regulates oil and gas activities through the Colorado Oil and Gas Conservation Commission (COGCC). The COGCC's mission is to foster the responsible development of Colorado's oil and gas resources in a manner consistent with protection of public health, safety, and welfare, including protection of the environment and wildlife resources. In the last five years, the COGCC has enacted some of the most stringent oil and gas regulations in the country to balance the development of our energy resources with protection of public health and the environment. In 2008, Governor Bill Ritter secured legislative support for restructuring the composition of Colorado's Oil and Gas Conservation Commission (COGCC), reducing industry representation and diversifying membership. This revamped commission embarked on a sweeping 18-month overhaul of regulations that produced new protections for the environment.

In order to minimize adverse impacts to wildlife resources and ensure proper mitigation of wildlife habitat, the 2008 rules developed a timely and efficient consultation process with the Colorado Division of Parks and Wildlife (then the Division of Wildlife) requiring operators to notify and consult with the state during their planning, and incentivizing the development of wildlife mitigation plans for operations. The rules also encourage operators to utilize comprehensive drilling plans and geographic area analysis strategies to provide for orderly development of oil and gas fields and minimize surface disturbance and fragmentation in important wildlife habitat by incorporating appropriate best management practices. To date, these rules have resulted in the development of 12 wildlife mitigation plans between the Division of Parks and Wildlife and energy operators, conserving 580,000 acres of important wildlife habitat in the state.

Colorado is also exploring creative and innovative policy solutions to increase habitat protection

across the state, not just in response to impacts from natural gas development. The state is a lead participant, along with environmental groups, energy industry, and landowners, in developing a market-based credit trading system to stimulate private investment in habitat conservation. The program, referred to as the Colorado Habitat Exchange, is currently in design phase and is expected to begin a pilot phase later this year.

While the use of hydraulic fracturing has raised concerns over the potential increase in water consumption, particularly in light of current drought conditions in the state, natural gas development uses a relatively modest amount of water compared to other water-intense energy types, like nuclear and coal. In 2010, water used for fracking was estimated to be 13,900 acre feet annually, slightly less than one-tenth of one percent of the total water used in the state. State regulators project that by 2015 that amount may increase to slightly more than one-tenth of one percent of the total water used in the state.¹³ Emerging technologies are proving useful to reduce demands on water from natural gas development. For example, the use of water recycling for fracking is growing quickly in Colorado.

National and state-wide debate has accelerated recently around concerns that chemicals used in the process of hydraulic fracturing might contaminate groundwater and drinking water supplies. In 2012, working with such diverse partners as the Environmental Defense Fund and Halliburton, the COGCC responded to these concerns by passing regulations requiring disclosure of chemicals in hydraulic fracturing fluid. This information will help to give a clearer picture about the chemicals present at drilling sites, as well as what chemicals might come into contact with humans and the environment in the case of an accident. As described in a recent edition of *The Economist*, these rules suggest an international model for disclosure.

In order to reassure the public that water quality is

not being impacted, and to better understand if a connection exists between natural gas drilling and deteriorated water quality, Colorado now requires mandatory water testing by operators near drilling and completion sites both before and after their activities. We are one of just three states in the country that has rules for mandatory groundwater sampling and the only state that requires post-drilling sampling.

Another area of recent concern comes from the increasing interaction of drilling with urban and suburban communities. In January 2013, Colorado finalized rules to reduce the impacts of drilling near communities. These rules increase the minimum distances between drilling sites and occupied buildings and require the most stringent mitigation

requirements in the country to ensure work occurs with the least disturbance to nearby residents.

Operations must be setback 1,000 feet from a “high occupancy building,” such as a hospital, school, nursing home, or place of worship in both rural and urban areas.

What had originally been a 150 foot setback in rural areas and 350 foot setback in urban areas was increased to a standard 500 foot setback from any dwelling, statewide. State of the art mitigation measures required for all permits within 1,000

feet include verified green completions to reduce odors, emissions closed loop drilling to eliminate pits, and documented plans for noise, dust, light, waste management, reclamation, and leak detection and repair to address nuisance impacts.

The 2013 rules also include extensive notice and outreach requirements on the part of operators, both to local government representatives and citizens directly. This has resulted in greater collaboration between our state regulators and officials at the local level, reinforcing what we know to be true about most difficult problems, namely, that conversation at the front-end reduces problems at the back-end.

Finally, in partnership with local universities, the state is launching a comprehensive study of the

Colorado is also exploring creative and innovative policy solutions to increase habitat protection across the state, not just in response to impacts from natural gas development.

impacts of natural gas drilling on air quality and public health. This comes after several steps in recent years to reduce the pollutants that originate at oil and gas facilities, including requirements for emission-control devices and “green completions” to capture the emissions that can otherwise escape prior to a pipeline connection.

Increased communication between industry, government and the public is central to our regulatory reform. The COGCC has two staff members dedicated exclusively to local government outreach, and other staff members have devoted significant time working with local government officials. A task force has been formed to develop protocols for local government outreach that will help to further understand and address the impacts of natural gas development on local communities. As patterns and the extent of oil and gas activities change due to constantly evolving technologies and economic demands, our regulatory approach must adapt.

Colorado’s Framework for a Successful Natural Gas Market

While focusing on protecting public health and the environment, Colorado has been working to maximize advantages realized through the use of our natural gas resources. The state is creating policies that remove barriers to the use of natural gas as a transportation fuel and is using our own fleet to set an example for the public in the alternative vehicle market. Colorado also has several publicly funded research institutions that promote innovation in energy technology and have helped the breakthroughs in natural gas extraction and methane capture. As these advantages come together, natural gas will crack new markets in Colorado while continuing to provide low-cost energy in existing markets.

Natural gas has long been the preferred source of heating in Colorado with $\frac{3}{4}$ of houses using it as their primary heating fuel.¹⁴ It has also fallen in price to become a lowest cost electricity resource at around \$0.05/kWh. In Colorado, natural gas enjoys particular advantages in existing markets due to prices sitting at the second lowest in the U.S.¹⁵

The transportation sector, however, remains a huge untapped market for natural gas. A number of state initiatives have been established to respond by removing barriers to using natural gas as a transportation fuel.

In order to allow natural gas vehicles (NGVs) to compete on their own merit, Colorado has had to overcome several regulatory barriers. For example, previous vehicle fuel taxes were based on the volume of gas dispensed into a vehicle. This places a financial bias against natural gas due to its lower energy content per unit of volume.¹⁶ Colorado stakeholders came together to support legislation removing this tax penalty and base alternative fuel taxes on energy content, rather than volume.¹⁷ A 2012 piece of legislation further clarified that groups selling natural gas as a transportation fuel do not need to be regulated as utilities.

Another way that Colorado’s government has been leading the nation in promotion of NGVs is through state fleet purchases. Colorado and Oklahoma led other states in establishing a Memorandum of Understanding (MOU) in 2011 where states agreed to increase the use of NGVs in their respective fleets. The MOU created a request for proposal (RFP) that aggregates fleet procurements across all the states involved, encouraging automakers to offer more NGVs at a cheaper price. The MOU now includes as signatories governors from sixteen states, making their combined buying power even stronger.

Aggregating state vehicle procurement has created huge benefits for all the states involved; even some states that had not signed onto the MOU participated in the RFP. Auto dealers in 28 states submitted more than 100 bids. Those dealers have made notable price concessions and are offering several more vehicles in their bids as interest continues to grow. Of particular significance in this process is the way in which states are leading by example rather than dictating results. They are taking advantage of their combined purchasing power and working with businesses in the free market that want to maximize their own benefits by giving the states a better deal. Colorado is quickly moving forward with plans to take

advantage of these prices by incorporating NGVs into our state fleet.

As previously discussed, the 2010 Clean Air Clean Jobs Act provided significant emissions benefits to Colorado, partially due to the conversion of over 400 MW of coal generation to natural gas. The Act also provided significant economic benefits and demonstrated the way that successful partnerships between natural gas and other energy industries can benefit the state as a whole. By guaranteeing that gas used as a result of this Act would be produced in Colorado, our citizens and businesses benefited from increased jobs and tax revenues. By establishing a larger fleet of natural gas generation in Colorado, Clean Air Clean Jobs also enabled Colorado's leading renewable energy standard, providing needed dispatch flexibility to partner with intermittent renewable resources. This has helped maintain the state's leadership in all areas of energy innovation and business development.

Beyond regulatory and communication efforts, the state of Colorado is working hard to minimize the environmental impacts of natural gas production through innovation and research. Colorado has several major research institutions that are making advances in energy technologies, including the Colorado School of Mines, University of Colorado, Colorado State University, and National Renewable Energy Laboratory. All four have teamed up in various ways throughout the years to explore technological aspects of oil and gas, the regulatory framework, and policy developments.

Among these collaborations are the Renewable and Sustainable Energy Alliance, which includes natural gas among other sustainable energies, and the Joint Institute for Strategic Energy Analysis (JISEA). The latter includes all of the aforementioned Colorado research institutions as well as Stanford and MIT. A recent JISEA publication entitled "Natural gas and the Transformation of the U.S. Energy Sector: Electricity" focuses on the shale gas contribution to the energy market. Among findings about carbon reductions and how demand will double between 2010 and 2050, the study explores how

various policy decisions could impact the market and the environment. These academic studies are crucial to good policy, and Colorado has benefitted from their input.

Colorado State University's Natural Gas Initiative has made giant strides in natural gas technology over the years. One of its biggest initiatives has been to improve the compression of natural gas to minimize fuel use and reduce pollution. According to CSU's Dr. Bryan Willson, CSU had a hand in developing almost every engine on the natural gas pipeline. Going forward, the lab will focus more on integrating natural gas and renewable resources like wind and solar.

At the same time, students at these institutions are creating technological solutions to remaining oil and gas inefficiencies. One such inefficiency is the loss of fugitive emissions in production, especially from holding tanks. A student at the Colorado School of Mines, Hans Mueller, used his education to create a cost-effective capture technology for these fumes called EcoVapor.¹⁸ The technology stops fugitive emissions from escaping into the atmosphere and processes those emissions into profitable natural gas fuel. School of Mines graduates like Mueller are adding significant value to the natural gas industry in Colorado while making environmental advancements at the same time.

Conclusion

Natural gas plays an important role in Colorado's achievement of an "all of the above" energy strategy. It provides significant economic benefits to the citizens of the state, and also allows for more aggressive reductions in air pollutants including greenhouse gas emissions. Colorado's goal is to promote our energy resources for the benefit of the state and its citizens, while staying accountable for the highest ethical and environmental standards. We have made great strides to date, but we understand that energy is dynamic. The state will continue to adapt through regulations and creative policy solutions, as well as our promotion of all of our energy resources, as energy technology evolves.



EDDIE CLAVO
Governor, Territory of Guam

Towards a Sustainable Energy Future

I. Background



Guam's dependency on oil is highlighted by Guam's largest export . . . Cash! The annual Guam consumption of electricity is greater than 2.75 million Barrels of Oil (BOE) equivalent projected through 2026. Guam is expected to spend over \$350 million this year alone to import fossil fuel. Just like members of Oceania we import most if not all of our goods. Guam's population is expected to climb to over 180,000 with a projected 1.5 million visitors annually. Furthermore, Guam hosts over 15,000 military personnel and their families and with the expected Marine buildup on the way, our island will add another 10 to 15 thousand to our island population. Due to Guam's progressive and modern way of life with its desire for continued growth fuels Guam demand for more sustained electrical energy.

Energy hasn't always been about oil. In the past, our culture was all about sustainability and the frequent exchanges of goods via seafaring canoes. What you didn't grow, collect, hunt or fish, you traded. However, after World War II our demand for fossil fuel grew. Modern modes of transportation and the variety of available electronic goods grew our appetite for energy intensive products and services. With the island-

wide availability of reliable electricity, our lives went from sustainment to downright unrestrained indulgence with the guise that our quality of life has improved. Fossil fuels became the engine of our economy as it remains today.

However, our demand for fossil fuel has led us into ever increasing dependency on resources outside of our small island. Electricity development for island-wide power, local transportation and cost related to the ever growing import of goods and services continues to rise with no foreseeable end without drastic changes. Presently our oil and gas products are shipped in from Singapore and most of our goods are from the Asia, mainly China, via the Continental United States (CONUS). This dependency requires a large portion of our cash revenues to be spent on these outside resources. As emphasis, even our primary source of revenue, tourism, is dependent on air travel.

II. The Role of Energy on Guam

Given Guam's dependency on fossil fuel, our people have benefited with a quality of life matched with the most modern conveniences in CONUS and Japan. No longer toiling in the fields all day or hunting and fishing to feed the family, today, we are at the job for eight (8) hours and then off to take the kids to practice or rehearsal. We no longer live to work, but

work to play, as more and more activities and a greater range of leisure products are offered for our enjoyment. Every house has cable television with DVD and numerous games available. Nine (9) in 10 homes have air conditioning and all our public schools require that all classrooms are air conditioned with an air temperature no greater than “78 degrees Fahrenheit” under Public Law 28-45 (Every Child is Entitled to an Adequate Public Education Act) amounting to a \$14.46 million power bill payment in fiscal 2012. Most households own more than one (1) vehicle. Life is good on Guam with available energy affordable, continuous, and ready to use.

With an economy fueled by ready fossil fuels, jobs are available in almost all sectors. A total of 60,350 jobs were recorded in 2007 with the private sector the largest employer at 45,320 jobs. The government of Guam is the second largest employer with nearly 15,000 workers. With the economy driven by mostly military and tourism, most jobs are directly related or in support of these industries. Tourism accounted for direct spending of \$1.2 billion dollars in 2007.

III. The Challenges of Developing the “Resource”

Associated with the convenience of ready energy are the pitfalls of complacency and entitlement. We expect our alarm to wake us in the morning and our lights to turn on when we flip the switch. While our car is running low on gas, we have no problem stopping by to refuel. As the busses take our children to school, we race by heavy trucks to avoid getting caught behind them. Our kids bring jackets to school because they know the air conditioner has been on since at least 6:00 a.m. We have come to expect energy to be there whenever we need it. This has led to an attitude of entitlement as more people apply and receive welfare benefits. Even families receiving financial assistance enjoy Cable TV, have at least one (2) automobile, and an air conditioned house.

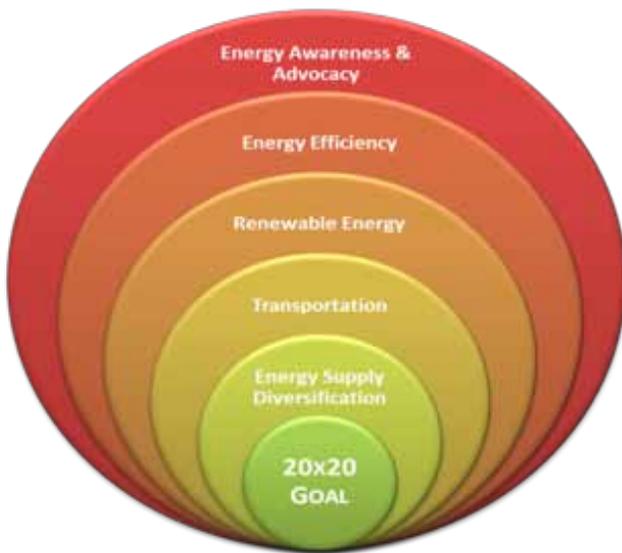
The cost alone of providing all the expected privileges and amenities are significant, yet associated with these are direct and indirect

cost are our peoples overall mental, physical and environmental health. We seem to melt when we are out in our beautiful sunlight. Our kids hesitate to go out to play and prefer to watch TV or play video games. This need to stay cool has kept our activity outdoors to a bare minimum, leading to serious health conditions. Guam has the highest per capital individuals with diabetes (Type 2 and Childhood), heart disease, stroke and cancer. Our kids are no better off as obesity has led to many of the same conditions. It has been said that this generation may be dying before their parents. Healthcare cost has been an indirect benefactor of reliable and affordable fossil fuel energy.

Our natural environment has taken a hit as well. Guam continues to develop from a rural setting into urban clusters. Our continual modernization places stress on our natural resources requiring that Guam use the appropriate smart growth tools to improve our various communities and villages. Correspondingly, our local statutes and the U.S. Federal Court’s injunction for the Guam Layon Sanitary Landfill limit our ability to maximize our waste to energy options such as thermal (gasification) and non-thermal (bio-gas rich in methane) technologies.

IV. Strategies to Overcome Challenges

Coupled with across the board frontal attack on health issues and maintaining ecological balance, our energy sustainment strategies are also becoming more dynamic and robust. At all levels of the Guam community, a greater awareness of energy needs have spurred serious discussions on costs, approaches, products and available alternatives. From the consumer, to government and the private sector is actively engaging in energy savings strategies at their respective level to reduce cost, diversify production, and seek a balance for a sustainable quality of life. Guam has already embarked on implementing several different energy strategies that are available to islands in our pursuit of diversifying fuel sources and reducing fossil energy consumption 20% by 2020 (20x20).



Ratification by the Guam Legislature is the next step in reaching the 20x20 goal. To accomplish this, the Guam Energy Task Force has determined the most appropriate course of action through sustainable and reachable objectives. The prioritization of these strategies will help facilitate the development of an action plan and the selection of appropriate strategies for meeting Guam's 20x20 goals. The strategies that will be used in reaching the 20x20 goal are broken down into five energy sectors. The energy sectors are shown below.

The Guam Power Authority, as the biggest producer of power, has stepped up their effort and has recently highlighted significant projects aimed at diversifying production and managing efficiency and conservation. As a full service utility serving over 46,000 customers, GPA owns and manages over 663 miles of transmission and distribution lines and 29 substations. With a generating capacity of 552 MW and the highest peak system demand of 281.5 MW, GPA is poised to make a difference. Having introduced net metering and allowing some study time to work out a suitable mutually beneficial solution, has the average consumer considering alternatives to take advantage of this opportunity. Additionally, GPA is moving quickly to establish a robust smart grid and smart meters to better manage existing energy production. While these steps are quite the undertaking, it is only a fraction of GPA's new vision to interact with the consumer and have a

The Energy Strategic Goals for Guam Are:

1. Implement efficiency programs to reduce demand on the island.
2. Seek alternatives to oil/diesel to mitigate risks.
3. Quantify and implement renewable energy at manageable and cost-effective levels.
4. Implement transportation and water strategies to reduce fuel consumption.

While the Short Term Objectives and Actionable Strategies Are:

1. To Promote Energy Efficiency and a Conservation Marketing Campaign Through Branding
2. To Establish Demand Side Loan Revolving Program Through Weatherization plus Renewable Technologies
3. To Provide a Waste to Energy Study for Policy Making
4. To Implement Transportation Initiatives such as linking MPG & idle time to the Vehicle Registration Fee, Hub Bussing with Car Parks around the island.

greater capability to manage power and send it precisely to where it is needed. Recently, GPA has announced the contract to provide 10 MW of photovoltaic solar energy and is working to close the site for 20 MW of wind turbine power generation in the Cotal site east of Mt. Alifan. While these represent a mere fraction of the total power requirement, it is a positive

Description	2020 Transportation Goal	% of Total Reduction
Miles Reduction	Light Density Vehicles (LDV's) travel 10% less	38.3%
Fuel Economy Improvements	Fuel Economy of new LDV's improves 6% each year	36.7%
Idle Time Reduced	Idle time by 45 minutes per weekday for each High Density Vehicles (HDV)	9.5%
Electric Vehicles	10% of new LDV's to be electric	7.7%
Biodiesel	All diesel fuels contains 5% biodiesel	5.4%
Traffic Flow Improvement	Coordinate all 84 traffic signals	2.5%

step in meeting the Renewable Portfolio Standard required by Guam Public Law 29-62, which set Renewable Portfolio Standards as follows:

- a. **5%** of its net electricity sales by December 31, 2015
- b. **8%** of its net electricity sales by December 31, 2020;
- c. **10%** of its net electricity sales by December 31, 2025;
- d. **15%** of its net electricity sales by December 31, 2030;
- e. **25%** of its net electricity sales by December 31, 2035;

GPA is also diversifying its present fossil fuel source and hopes to complete a conversion to liquid natural gas in the near future. With residual fuel oil (RFO) as GPA's primary electricity generation fuel source, and the cost continuing to rise, a cheaper alternative is desired to keep power cost affordable. This conversion is hoped to bring the fuel cost outlay down, thus bringing the cost to the customer down as well.

Fueled by the American Recovery and Reinvestment Act (ARRA) from the Department of Energy (DOE), the Guam Energy Office (GEO) managed to distribute over \$30 million in stimulus funds aimed at energy conservation, efficiency and outreach. Working together with great partners within the Government of Guam, and the private sector, the funds benefited the entire community. The biggest bulk of over \$19 million from the State Energy Program ARRA,

went to retrofitting 50 government buildings with efficient lighting, air conditioning, cool roofs, faucet aerators and much more. In addition, nine (9) other departments received funds to improve efficiency within their facilities and two (2) government and two (2) non-profit organizations received funds for their energy needs. Another \$9 million from the Energy Efficiency Conservation Block Grant ARRA, US DOE, went to additional government retrofits and a number of non-profit facilities. Of significant notice was the LED streetlight retrofits headed up by the Department of Public Works and the Guam Power Authority. The change in lighting was greatly appreciated by the community, and GPA is looking to find funding to retrofit all remaining streetlights to LED. The Weatherization Assistance Program (WAP), ARRA funds of nearly \$1.5 million went into the Guam Housing and Urban Renewal Authority for both public and private low income family homes. The Guam Building Code Council (GBCC) established by Guam Public Law 31-17 had completed its review of the Guam Tropical Energy Codes to complement the adoption of the 2009 International Energy Conservation Codes and submitted it to the Guam Legislature for introduction. The last approved energy codes were 12 years before and the newly formed GBCC is not waiting around and has begun the review of the 2012 IBC. These codes are sure to affect the very nature in the way we build and our ability to meet the Guam Strategic Energy Plan of 20% fossil fuel reduction by the year 2020.

Even before the Guam Tropical Energy Codes were considered, the Guam Community College planned and constructed the first public Gold LEED building. Since then others have followed including private companies like Coast 360 Federal Credit Union that established Platinum LEED. Indeed, even the private schools and churches are taking notice as two major photovoltaic projects were recently completed. Additionally, a proposed bill recently heard by the Guam Legislature to allow all public schools to engage PV alternatives is picking up momentum as the call to expand it to include all public buildings was frequently part of the testimonies. While the codes will make it a requirement, it appears architects and engineers are designing energy saving concepts into all activities, repair, renovation and new construction.

The Guam Energy Task Force (GETF), established by Executive Order 10-15 and co-chaired by both the University of Guam President and the Guam Energy Office Director, has taken the task seriously, and is moving quickly to establish a Strategic Energy Plan for Guam. With the support from the Department of Interior, Office of Insular Affairs and the National Renewable Energy Laboratory (NREL), has produced with the GETF the Guam Initial Technical Assessment Report, the Guam Transportation Petroleum Reduction Plan, the Guam Strategic Energy Plan, and the Guam Energy Action Plan. All documents are being finalized for the Governor's submittal to the Planning Council to be included in the comprehensive plan.

Of significance, the GETF has considered the Guam Energy Action Plan as an initial four actionable strategies and is preparing to apply for grant funding and identifying other sources to fund these activities. Realizing an ongoing requirement to remain aware of the ever changing situations, the GETF has initiated four actionable strategies that will surely impact all sectors immediately and through the long haul. Of course outreach will always be necessary to promote efficiency and conservation, but will be a required tool in changing attitudes and

highlighting new technologies. An ambitious strategy is the implementation of a revolving loan fund for residential consumers, but it will ensure a continual source of funding for those requiring the assistance of a small cash infusion to become more self sustaining. Waste on an island has few options and on Guam has been further complicated by our local interpretations of waste to energy activities. Studying present conditions, impact and technology will allow us to better evaluate our options. Finally, as nearly 30% of the 20% by the year 2020 equation, the transportation initiatives will allow for a quick overhaul in our transportation culture.

On Guam, the U.S. Navy has invested and begun testing the various energy technologies available to reduce fossil fuel cost within its area of control. In many ways, they are leading the island sustainability effort as there are many renewable projects completed, planned and presently being tested. Conversely, this will have a direct impact on the Guam Power Authorities customer base portfolio.

V. Regional or National Approaches

With the support of the Department of Interior and the U.S. Department of Energy, Guam has become more collaborative and synergistic in its approach to green technologies. Guam has adopted the Tropical Energy Code, island-wide conservation and energy efficiency retrofit of all government of Guam facilities and facilities housing non-governmental organizations (NGO's); rebates to first 50+ households for solar water-heater; net-metering of households using renewal technologies. Lastly, on March 2012, a regional round table discussion was held on Guam with the Micronesian Chief Executive Summit to collaborate and agree upon energy efficiency and renewal technologies. Indeed, we need to share our successes and failures so that our experiences can be a learning tool to prepare our islands for the Pacific future. The support we have received from the U.S. Federal entities has been greatly

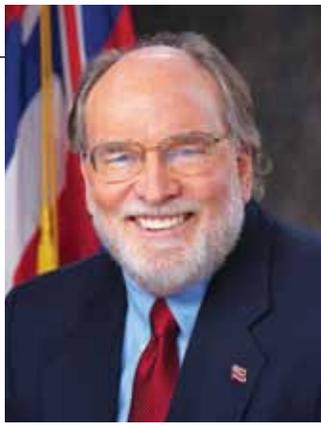
beneficial, but must continue to allow our island communities to prepare for the unthinkable possibility of isolation from required resources.

VI. Conclusion

Guam has taken a bold step to increase its energy security, reduce fossil fuels, and strengthen its economy. In doing so, it has also seized an opportunity to lead, charting a course for the Micronesian region to follow as we journey toward sustainable energy transformation. Guam is envisioning ways to change how consumers buy based on habit, cultural norms, and old ways of thinking. Creating new realities in which utilities make decisions based on a new green economy and “three generation thinking;” setting out on implementing policy strategies for policy makers to transcend traditional practices and

invest in our island and regions’ future. Guam is already transforming its citizenry to expand their knowledge of green energy technologies and make informed, sustainable choices; that Guam Power Authority and Guam Waterworks Authority transform from fossil fuel use to efficient and renewable proven technologies; that Government of Guam facilities are weatherized, become energy efficient and earnestly begin the transformation to wind and solar technologies. However, we are acutely aware that we have a long way to go to become truly sustainable. Then again our drive is to make sure a sincere effort to lessen the impact of dependency on outside resources for our children and grandchildren. The vision is a secure, sustainable, and economically prosperous future for Guam. That every household, business, public building, mode of transportation, and energy use concepts incorporate a mix of renewable energy.





NEIL ABERCROMBIE
Governor, State of Hawaii

Transitioning Swiftly and Safely To a Clean Energy Future

Introduction



Like our fellow western states, Hawaii is rich in energy resources. A full menu of clean, renewable energy options including solar, wind, and geothermal energy is available in one of the world's most beautiful and accommodating natural environments. Hawaii's geographic isolation and continued dependence on fossil fuels for generating approximately three-quarters of electric power has resulted in extreme energy prices. Hence, it is the collective mission of our island state to cultivate our abundant energy resources in order to achieve one of the nation's most aggressive sets of clean energy portfolio standards.

Our State has set a goal to reach 40 percent renewable energy generation and 30 percent energy end use reductions by 2030, resulting in a major transformation that has fundamentally altered Hawaii's approach and operations of its various isolated power systems. A new set of energy issues have arisen in the course of that transformation as a result of aggressively pursuing high levels of clean energy as part of

the State's overall energy mix. Hawaii's success or failure in achieving true energy independence will depend on forward thinking and innovative solutions, such as those we are currently pursuing in the areas of renewable energy integration and financing.

While Hawaii has been very successful in meeting the demand for renewable energy resources at both the individual consumer level and the large-scale utility level, we are now dealing with renewable energy-focused challenges arising from the widespread adoption of clean energy technology, particularly in the area of distributed generation of solar photovoltaic (PV) systems. These challenges have created opportunities for the State to reexamine and refocus its efforts on the technological and regulatory difficulties of bringing large amounts of renewable energy on to a set of small, isolated island grid systems. We have worked to ensure that these changes are made in a way that does not compromise the reliability of our energy systems, and in a fashion that fairly distributes the costs and benefits of clean energy across all sectors of the population.

At the same time, the State is mindful of the fact that the progress we have made in encouraging the

exponential growth of local renewable energy usage must continue to be supported. We know that we must respond to the needs of a maturing market environment and industry with innovative ideas that continue to make clean energy use a smart and economical choice. Hawaii's electric utilities, the private energy industry, interested community organizations, and the general public together with all levels of government have each stepped up to the plate to offer solutions to overcome the host of challenges we face in breaking Hawaii's dependence on imported fossil fuel.

Technical Challenges and Innovative Solutions

Each of Hawaii's grids stands alone and comprise a collection of unique island systems that must be self-reliant for power generation and backup. For the better part of the last century, those systems have been dependent on fossil fuel shipped from abroad and refined locally. The consequence has been electricity rates that are roughly three times more than the national average. I am proud that Hawaii responded to the momentous challenge of reducing its high fossil fuel-based electricity costs by committing to one of the country's most aggressive clean energy policies. As such, we are well on our way toward reaching a Renewable Portfolio Standard (RPS) and an equally ambitious Energy Efficiency Portfolio Standard (EEPS) that together require that 70 percent of Hawaii's electrical energy come from clean sources by the year 2030.

Hawaii's electric utilities are actively procuring renewable-sourced generation through programs such as net energy metering (NEM), feed-in tariff (FIT), and competitive bidding in an effort to meet our aggressive RPS requirements and to stabilize the high cost of electricity. As a result of these efforts, Hawaii is experiencing exponential growth in solar PV systems and significant wind resource additions on the collective statewide grid system of roughly just 2,300 megawatts in size in terms of available capacity. The total amount of customers in the State enrolling in NEM during 2012 alone was greater than the combined total for NEM enrollees over all of the program's previous years.

In addition, Hawaii is a hotbed for renewable energy testing and development in the areas of solar thermal technology, biofuels, ocean-based energy resources, and more. Change at such a pace and on such a scale, however, requires forward thinking about our grids and a collection of steps to modernize the current electrical systems.

System Reliability Efforts

Power system demand and supply must be balanced at all times. One of the inherent challenges in bringing on high levels of intermittent renewable energy is the unpredictability of those resources for the purpose of precisely balancing system supply and demand. While the sun will shine and the trade winds will blow in Hawaii the vast majority of the time, it can be challenging to plan for and smoothly operate isolated grids utilizing heavy amounts of such intermittent renewable energy resources. As a state composed of multiple islands, each one separated from the next by long, deep stretches of the Pacific Ocean, each island's grid system has had to be completely self-reliant. Because Hawaii does not have grid interconnection like the vast interconnections of the continental United States, the ability to pull backup power from across state lines to immediately stabilize a dip in local power supply is not an option to keep the Hawaii systems operating reliably. Thus, Hawaii has had to seek solutions to overcome the many technical challenges of integrating variable renewable energy at the levels required by the State's RPS, including the deployment of renewable energy enabling technologies, such as battery storage facilities on the islands of Hawaii, Lanai, Oahu, and Kauai, as well as through the implementation of regulatory initiatives.

As the rate of customers enrolling in Hawaii's NEM program has more than doubled in each of the program's last 8 years, installed capacity has surged at a similar rate. The amount of currently installed distributed solar PV generation, while continuing to grow at a remarkable rate, makes up only a small portion of the potential rooftops in the State available to hold solar energy systems. The potential for continued growth in solar

systems at the distributed level in the State is great. However, as more homes and businesses are able to bring distributed solar energy systems online, the rapid growth in the use of these intermittent renewable energy resources have raised technical concerns related to the stability and reliability of the State's various island grids.

In response to concerns that per circuit penetration levels for distributed generation and larger projects have been exceeding the maximum levels for reliable operation of the various circuits, a number of steps have been taken over the last few years to better understand the capability of the system and the integration of renewable energy. The Hawaii Public Utilities Commission is concluding the first phase of an effort to overhaul the State's electric system reliability rules and processes. The Reliability Standards Working Group (RSWG), a consortium of electric utility personnel, industry association and individual power providers, and various affected state agencies recently wrapped up a two-year effort to create prototype reliability rules and procedures and to gather baseline system reliability information for the State of Hawaii, which has historically been outside the jurisdiction of those entities charged with oversight responsibility for the power systems of the greater continental United States and other parts of North America. The RSWG process is now in the technical review stage, with the Commission's final disposition on the first set of proposed reliability rules to follow.

Related to the RSWG efforts, the Hawaii State Legislature passed legislation in 2012 that would provide the Hawaii Public Utilities Commission with the explicit authority and the means to establish a new electric reliability oversight entity to further the RSWG's work, known as the Hawaii Electricity Reliability Administrator (HERA). Similar to those electric reliability organizations found on the continental United States such as the North American Electric Reliability Corporation and its regional entity affiliate, the Western Electricity Coordinating Council, HERA will be responsible for assisting the Commission with electric reliability oversight for the State through established electric reliability standards, as well as for performing independent monitoring and

studying the operations of the collective Hawaii electric system. The combination of these efforts will not only ensure reliability, but will also promote transparency and streamlined processes to help independent renewable generators connect to the grid.

Existing interconnection rules were modified in November 2011, and additional work has been done to further improve those rules as part of the RSWG's efforts. These modifications were designed to make the process of the majority of the State's utilities for solar PV integration more accommodating and streamlined. Rather than having all potential solar PV system adopters face an interconnection process and potential integration studies that would result in thousands of dollars on top of the underlying costs of any new system, the revised interconnection procedures will help to make the process much less burdensome for the majority of potential solar PV system owners. The State's electric utilities have also begun to increase the limits of circuit penetration for distributed generation and they have been finding that distribution circuits are, in many cases, quite capable of accommodating distributed generation in excess of the traditional 15 percent threshold. By working together to better understand the Hawaii systems, we are able to make technical and procedural adjustments to expand current system limitations.

Undersea Cable: Grid Tie, Reliability, and Resource Development

In recent years, the concept of using an interisland undersea electric transmission cable to serve as a grid-tie between islands has moved closer to becoming a reality. The system reliability and power sharing benefits for the State through the use of cable technology are potentially significant. Connecting the various island grids via a cable system provides the potential for increased system reliability throughout the State by feeding stabilizing power flows back and forth between islands to smooth out the variability in renewable energy generation and better protection against system emergencies or disturbances. It would

also enable the State to make more efficient use of firm renewable energy resources that are currently available or developed in the future. For example, the development and transmission of excess geothermal development from the State's eastern islands could be channeled via an undersea transmission cable to the western load centers in a way that would improve system reliability and reduce the level of fossil fuel-based power reserves currently needed to backup intermittent renewable energy power from solar and wind systems. Further, this same undersea cable system, one connecting the load center on Oahu with other islands, could provide a means to make full use of wind energy that is currently curtailed on the islands of Maui and Hawaii.

Hawaiian Electric Company, Inc., the utility serving the island of Oahu which carries nearly 95 percent of the State's electrical load demand, has sent out a request for proposals for 200 megawatts of renewable energy that may come from any island in the State for the purpose of serving the Oahu island grid and is subject to review and ultimate approval by the Hawaii Public Utilities Commission. The establishment of an undersea cable in Hawaii is seen as the first step toward interconnecting the State's currently isolated island grid systems, which will enable the most efficient use and sharing of renewable energy resources on the different islands and will enhance grid reliability across the State as more renewable energy resources are being connected to the system. As the State gets closer to its 40 percent renewable energy generation mandate for the year 2030, Hawaii needs the benefits that all available clean energy enabling technologies, such as an undersea cable system, can provide.

Financing Challenges and Innovative Solutions

Clean energy comes with a price, and making the necessary upfront capital investment for clean energy systems can be a challenge for both the small homeowner and the large-scale developer. In order for Hawaii to attain a 40 percent RPS by 2030, over \$15 billion in investments for new and improved systems and infrastructure may be needed, with most of that amount coming

from private sources. Minimizing the capital for required infrastructure investments is critical to managing the cost impacts for the State's ratepayers.

Every state faces the challenges of encouraging growth in key development areas through the availability of capital and incentives, and transforming Hawaii's clean energy ecosystem is no different. Hawaii has been fortunate that for the past several years the availability of federal and state tax incentives for renewable energy systems have helped to spur the growth of clean energy projects across the State. However, a challenge that Hawaii faces in reaching its clean energy policy goals is the availability of low-cost, affordable financing for the broadest portion of the Hawaii population to be able to invest in energy savings installations. Many of today's clean energy products only serve those who can afford the large upfront costs or who have the financial ability to access traditional credit, thus, creating an underserved and untapped portion of the Hawaii market. These market segments have yet to benefit directly and immediately from the availability of clean energy technology systems despite Hawaii's success in growing its clean energy economy.

In order for Hawaii to move closer toward reaching its clean energy mandates and to provide affordable energy options, the State is developing solutions to make clean energy installations more accessible to those who may not typically have the available financing or upfront capital to invest in distributed renewable energy and energy efficient systems. As such, Hawaii is pursuing programs specifically designed to enable the greater adoption of clean energy technology by hard-to-reach segments of the local population, which includes low- to moderate- income level homeowners, renters, and other utility customers that lack the adequate access to financing that will help to reduce their fossil fuel energy usage and lower their energy bills.

On-Bill Financing

The Hawaii Public Utilities Commission is currently developing an on-bill financing program for Hawaii

that is intended to increase the accessibility of clean energy systems by tying repayment of a clean energy or energy efficiency system by a utility customer to their bill. Successful on-bill financing programs have been established in multiple jurisdictions across the country for different types of energy technologies, but this is the first program of its kind for Hawaii, and the focus of this effort is making renewable energy available for renters and other underserved customer segments. With over 150,000 renters making up nearly 40 percent of the local residential electricity market, there is great potential for an on-bill program in Hawaii that focuses on these customer segments.

An assessment of the program's potential conducted at the beginning of this year on behalf of the Hawaii Public Utilities Commission determined that an on-bill financing program focusing on the State's residential market is viable and the Commission convened the On-bill Financing Working Group in April for the purpose of designing program specifics. When properly designed, Hawaii's on-bill program will work to ensure that energy savings from renewable energy systems will benefit individual customers directly through increased energy savings which are then used to recoup the cost of the projects over time. Electricity bills will be kept steady at or below the average amount that customers currently pay without any personal clean energy systems installed. Keeping in mind the varying experiences of other states across the country and specifically those in the west, the Hawaii On-bill Financing Working Group has drawn the participation of interested organizations from both the local and national level and Hawaii is positioned to launch its program in early 2014.

The increased adoption of clean energy technology will benefit the entire State as a result of increasing progress in collectively reaching its clean energy targets through reduced need for fossil fuel-based generation. Though on-bill financing and on-bill repayment programs are not new to the country, Hawaii is looking at a low-cost capital financing program as a means to boost the reach of the program through an innovative approach intended to considerably increase low-cost program funding.

Green Infrastructure Financing

Hawaii is also working on developing new, innovative financing options to further support the reach of clean energy technology across the islands, solutions which can serve as a model for other jurisdictions that are also striving to increase clean energy penetration by removing financing barriers through the availability of low-interest capital. When asked in a recent survey conducted in Fall 2012 by the research group OmniTrak, 70 percent of Hawaii respondents said they would likely make energy-savings improvements if low-interest loans were offered for such purposes.

In order to address some of these financing challenges, my Administration introduced legislation this year to establish a traditionally industrial financing structure that will directly benefit consumers. Building off the standard utility securitization model used in other states, the legislation enables the issuance of highly rated low-interest Green Infrastructure Bonds to generate a pool of low-cost capital that will be made available to the people of Hawaii through proven clean energy financing programs, such as on-bill financing. The bonds issued under the Program are to be secured with utility customer surcharges, and this securitization ensures a low-interest bond issuance.

With the enactment of this legislation, the Green Infrastructure Financing Program is expected to start with an estimated \$100 million issuance of low-cost capital that will be used to spread the adoption of clean energy technology, with a particular focus on the hard-to-reach segments of the market that have previously not been able to take advantage of these clean energy investments. The development of this exciting new Program has been a collaborative effort that has brought together my Administration, the Hawaii State Legislature, the State's electric utilities, and many other stakeholders each in full support of working together to seek and open new channels to acquire clean energy.

Conclusion

Hawaii is deeply committed to transition swiftly and safely to a clean energy future, and to move forward on all fronts in a cost-effective manner that equitably benefits the people of the State. Our State has undergone a great transformation in just the last decade, guided by an aggressive set of clean energy mandates. The State's isolated island systems and the way in which we approach and develop those systems has evolved, as have the steps we are taking to make clean energy available to every citizen who wants to directly benefit from such technology.

This essay describes just a sample of the new challenges that have begun to emerge. The Hawaii Public Utilities Commission has undertaken a review of current renewable energy procurement programs in the State to better facilitate other

issues, such as the effect of increasingly widespread renewable energy systems on those electric utility customers who do not have renewable energy systems. Hawaii must also make key decisions for the future beyond its 2030 targets, and determine how to best develop a diversified, low-cost fuel portfolio for the remaining portion of its electrical generation not covered by the RPS and EEPS. As many states in the west and across the rest of the nation consider the levels of their respective RPS and EEPS, it is my hope that the lessons learned and the steps taken by Hawaii in dealing with the challenges it has faced in promoting the adoption and integration of renewable energy systems serves other states striving to increase the use of clean energy.

Aloha, and good luck to you and your efforts in providing a better energy future for each of your respective home states.





C.L. "BUTCH" OTTER
Governor, State of Idaho

Nuclear Energy's Future Requires National Commitment to R&D

Nuclear energy is an essential part of the U.S. energy mix. It now generates nearly 20 percent of the nation's electricity, including nearly two-thirds of all low-carbon electricity.

That strengthens the case for making nuclear an important element of any effort to improve air quality and reduce the carbon footprint of electricity generation.

For these and other reasons – including the importance of baseload electricity supply and the impact U.S. leadership in nuclear energy can have in achieving economic and national security objectives – the U.S. government maintains a research, development and demonstration program focused on nuclear energy. This program is conducted primarily through the U.S. Department of Energy (DOE), with much of this work taking place at DOE's flagship nuclear research facility: the Idaho National Laboratory.

While the specifics of the Department of Energy program can vary from year to year, the focus in recent years has been on research and development of nuclear energy technologies for electricity generation, safety, waste storage and

management, and security technologies to help meet energy security, proliferation resistance and climate goals.

The United States has the largest number of operating nuclear power plants in the world; however, the low price of natural gas – and the relatively low capital burden associated with building natural gas-fired electric generation capacity – is having a negative impact on investment in any other technology for U.S. electricity production, including nuclear energy. Despite a brief resurgence of interest in nuclear energy in the mid- to late-2000s, when various companies considered building as many as 26 new commercial nuclear power reactors in the United States, it now appears that only the two new reactors now under construction in Georgia and two that have been proposed in South Carolina are likely to proceed this decade.

Other economic issues for nuclear energy include high construction costs, long construction timeframes, and the failure of the federal government to implement a workable loan guarantee program for nuclear power as established under the Energy Policy Act of 2005.

Another significant concern for nuclear energy development also presents a potential economic opportunity for willing businesses, communities and states – the nation’s failure to develop a long-term disposal solution for spent nuclear fuel.

While some have advocated reprocessing to extract reusable elements from spent nuclear fuel as is being done in France, Russia and Japan, the United States has rejected this option for economic, environmental and national security reasons. Instead, U.S. policy calls for the direct disposal of spent fuel in an underground repository. Under legislation passed in 1987, a single site at Nevada’s Yucca Mountain was considered for such a repository, but the Obama administration halted work on the project in 2010.

Instead, the administration tasked a Blue Ribbon Commission (BRC) with developing recommendations for reformulating and reinvigorating the U.S. nuclear waste management program. The BRC issued a report in January 2012, and while legislation to implement its recommendations has been put forward, no bill has advanced very far in Congress. The administration likewise has submitted a strategy for implementing the commission’s recommendations. At the state and local levels, communities in several states – most notably Eddy and Lea counties in southeastern New Mexico – have expressed interest in hosting nuclear waste management facilities and are gearing up to participate in a consent-based siting process.

Nonetheless, the decision to halt work on the Yucca Mountain repository – and the recommendations subsequently developed by the BRC – presents potential opportunities as well as risks for the State of Idaho, the West and the nation. For example, the Yucca Mountain decision means that spent fuel at locations across the country will remain in storage for much longer periods than initially anticipated; DOE’s latest plan calls for a spent fuel repository to be available in 2048, decades after the repository at Yucca Mountain was supposed to be open. Until new waste management or storage facilities are established, spent nuclear fuel and high-level waste now stored at nuclear facilities and

The United States has the largest number of operating nuclear power plants in the world; however, the low price of natural gas – and the relatively low capital burden associated with building natural gas-fired electric generation capacity – is having a negative impact on investment in any other technology for U.S. electricity production, including nuclear energy.

commercial nuclear plants has nowhere to go.

Without a long-term nuclear storage solution, research is needed to better understand the performance of today’s commercial reactor fuels in the conditions and configurations we have chosen for storage. The INL is ideally suited to host the new research efforts that will be needed to study the behavior of spent nuclear fuel.

Another facet of spent nuclear fuel storage is the landmark 1995 Settlement Agreement between the State of Idaho and the federal government. With this agreement, Idaho became the only state in the nation with a court order mandating that federal nuclear waste leave state boundaries by a specific date. Even today, no other state in the nation has such a legally binding commitment. The Settlement Agreement and the way that it has transformed the state-federal relationship between Idaho and DOE – from one based on mistrust to one based on partnership – represent a true paradigm shift.

Many of the concerns about long-term storage of waste and spent fuel can be overcome by developing new technologies and products that address the economic and other challenges facing nuclear technologies. That requires research, development and demonstration programs aimed at ensuring nuclear energy remains a viable technology for addressing energy demands and concerns about greenhouse gas emissions. Work at the Idaho National Laboratory has the potential to overcome many of these challenges.

One potentially promising option for capturing the advantages of nuclear energy while avoiding the high capital cost of new reactors involves developing and commercializing small modular

reactors (SMRs). SMR designs may be able to deliver power with a shorter construction timetable and with less upfront financial risk, but their overall economic viability is uncertain. If the U.S. nuclear manufacturing infrastructure and regulatory framework can be adjusted for SMR manufacturing, this could offer an economic development opportunity to states with a favorable business climate and established nuclear capabilities.

Recognizing the significance of nuclear energy research and development in Idaho, I established the Leadership in Nuclear Energy (LINE) Commission in 2012 to assess and quantify the opportunities and challenges associated with hosting the INL and a significant nuclear manufacturing and services sector that has emerged as a result of the DOE site.

After nine public meetings, dozens of presentations and several hundred comments from the public, the LINE Commission's final report outlined six broad recommendations to help nuclear energy development:

- **Continue to work cooperatively** with the U.S. Department of Energy and other impacted states to address remaining environmental risks and continue cleanup at the INL site.
- **Exercise leadership** as the U.S. government formulates federal energy and nuclear waste management policies.
- **Capitalize on Idaho's nuclear technology competencies** by supporting the growth of existing nuclear-related businesses, the corresponding infrastructure, and the



attraction of new nuclear-related enterprises.

- **Invest in infrastructure** to enable the INL and Idaho universities to successfully compete for U.S. and global research opportunities.
- **Develop and promote** the Center for Advanced Energy Studies (CAES) at the INL as a regional, national and global resource for nuclear energy research.
- **Strengthen and expand** nuclear education and workforce training offerings.

To continue the LINE Commission's work, I also established LINE 2.0 in early 2013. Its responsibilities also will include identifying and recommending appropriate actions on federal budget and policy decisions that could impact INL's long-term operations; identifying additional opportunities and investments that can be made in CAES, Idaho's universities and general research, transportation and communications infrastructure to advance the INL's mission; providing a means of continuing a robust and open dialogue with the public on the INL's future and Idaho's broader nuclear industries sector; and evaluating policy options for strengthening that sector.

Through the work of the LINE Commission and LINE 2.0, public involvement, the support of other impacted states, and utilizing the resource of the Idaho National Laboratory as a significant research and development tool, Idaho stands in a position to help develop policies that will enable nuclear research, development and commercialization in an energy field with the potential to significantly meet the demands of baseload power needs with low carbon emissions.



SAM BROWNBACK
Governor, State of Kansas

The Role of Wind Energy

Introduction



The state of Kansas inherited its name from the Kansa Indians, the “people of the south wind.” The Kansa Indians provided for their families by harvesting the natural riches provided by the vast prairies of the region. Generations of Kansans have followed in their footsteps since our state’s birth in 1861.

As the heart of America’s “breadbasket”, we are famous for our production of agricultural goods, such as wheat, corn, and soybeans. A lesser known fact is that Kansas also has played a key role in providing the energy resources necessary to power our regional and national economy. We are a strong example of a state that embraces a true “all of the above” approach to energy policy. From traditional sources of energy such as oil and natural gas to more modern technology such as nuclear, Kansans have benefited greatly from reliable and affordable energy. We also have served as leaders in the next generation of energy development, producing renewable energy resources such as ethanol, methane and wind. And we are just getting started.

As Governor of Kansas, my objective is to make this great state the best place in America to work, start and grow a business, and raise a family. Last

year, we enacted the biggest tax cut in the history of the state to provide a much needed boost to an economy struggling to recover from the Great Recession. Our tax policy now includes a 0% income tax rate on the small businesses that serve as the heart and soul of the Kansas economy. We are working hard to attract new business from high tax and high cost-of-living states. We have made strategic investments in areas where Kansas is well-known as a global leader such as aviation, the bio-agricultural sciences, and cancer research. These initiatives are now starting to bear fruit. Kansas saw a record number of new business filings in 2012 and has one of the lowest unemployment rates in the nation. For this momentum to continue, we must continue to press forward and seize opportunities that are unique to Kansas.

In my Road Map for Kansas, I describe my plan for promoting economic growth. A key component of this plan is to promote energy development and the growth of renewables. We have an unprecedented opportunity to transform our rural communities, breathe new life into our manufacturing sector, and provide reliable and affordable clean energy to our fellow Americans.

Background

Windmills have been a common sight in Kansas for many years. My dad had one on his family

farm near Parker while he was growing up. My grandmother used it to power a small vacuum cleaner, a truly wonderful innovation at the time. Today, Kansas wind generates enough electricity to power more than 800,000 homes. We have come a very long way.

Large scale commercial development of wind energy in Kansas began in 2001 when NextEra Energy Resources developed a 112 megawatts (MW) wind farm in Gray County and culminated in 2012 with the construction of BP Wind's Flat Ridge 2, a 470 MW wind farm that spans four counties in south central Kansas. To date, Flat Ridge 2 is the largest single build wind farm in the United States. Between these two historic benchmarks, more than a dozen other sites have been developed. Kansas now produces more than 2,700 MW of energy from wind. More than 1,400 MW of wind energy generation was constructed in 2012 alone, placing Kansas in the top three states in new construction in the nation!

The Role of Wind Energy in the Nation, Region, and State

At less than five percent, wind energy currently supplies only a small portion of the energy needed by the United States every year. However, recent growth points towards wind playing a much larger role in the nation's energy portfolio very soon. According to AWEA's 2012 Wind Energy Market Report, the wind industry had many historic achievements last year: more than 13,000 MW of new wind capacity was installed, an annual growth rate of 28%. The U.S. now has more than 60,000 MW of wind installed, enough electricity to power approximately 15 million homes. In 2012, wind energy was the number one source of new generating capacity with more than \$25 billion of new investments.

Regionally, the central U.S. continues to play a very prominent role in generating wind energy with Kansas, Texas, Oklahoma, Colorado, Iowa, Minnesota and Illinois each generating more than 2,300 MW. Four of the central states - Kansas, Texas, Oklahoma, and Illinois - are in the top five of new wind power capacity installations in 2012.

As the nation continues to invest in and expand our transmission capacity, wind energy can be moved more easily from the central region of the U.S. to high population centers, particularly in the south and east. The increased transmission will allow states like Kansas to shift our focus from developing wind for our own use to developing it for export.

According to the National Renewable Energy Laboratory, Kansas is ranked number two in raw wind resource. We have worked very hard to construct a business friendly tax and regulatory climate that will allow us to take full advantage of this unique economic development opportunity. In 1999, the state legislature passed legislation that exempted renewable energy equipment from property taxes. Transmission equipment also is exempt. In 2009, the legislature passed the Kansas Net Metering and Easy Connect Act. The act allows utility customers who are able to produce energy themselves to carry forward the net excess generation to the next month at the full retail rate. Also in 2009, the legislature passed the Kansas Renewable Energy Standards Act, which requires regulated public utilities to purchase a minimum threshold of their energy from renewable sources. The thresholds are: ten percent for 2011 through 2015, 15 percent for 2016 through 2019, and 20 percent for 2020 and beyond. Every regulated public utility in Kansas has met the requirement through 2015. Four of the six have already satisfied the requirement through 2019. Three have already met the 2020 requirement. It is important to note here the impact of the Renewable Energy Standard on Kansas ratepayers has been minimal.

Kansas also has worked closely with the Southwest Power Pool Electric Energy Network to expand transmission capacity both within the state and from the Midwest to the Southeast U.S. The SPP's "Y plan" will increase transmission capacity from western Kansas to eastern Kansas and will allow for the addition of 2,500 MW of wind development in Kansas, Oklahoma, and Texas. The northern Kansas portion of the "Y plan" will add more than 180 miles of transmission and is expected to be completed in 2014. Additionally, the Kansas Electric Transmission Authority

and ITC Great Plains recently completed work on a 227 mile high voltage transmission project known as the “KETA project.” I also have been working closely with Clean Line Energy in support of the company’s project known as the “Grain Belt Express.” This project would construct a high voltage direct current transmission line approximately 700 miles long from western Kansas to high population centers in states to our east. Once completed, the Clean Line project will add capacity of another 600 kV, opening the door for another large expansion of wind development in western Kansas.

The results of these combined efforts are clear. The AWEA report lists Kansas as number three in the nation in wind energy capacity installed in 2012 and one of only nine states that produce more than ten percent of their energy from wind. As mentioned previously, BP Wind’s Flat Ridge 2 is the largest single build wind development in the U.S. and is currently the ninth largest overall project in the country. The industry also has bolstered the manufacturing sector of the Kansas economy. Most notably, in 2010 Siemens Wind Energy opened a turbine manufacturing plant in Hutchinson, Kansas that typically employs around 300 people. Kansas also is home to many smaller manufacturers of wind energy related parts and equipment.

Wind energy has had a positive impact on the Kansas economy. A recent report published by Polsinelli Shughart and the Kansas Energy Information Network estimates wind generation has created more than 13,000 jobs, provides more than \$13 million in annual landowner lease payments, and more than \$10 million of payments to local governments and communities. Wind developers currently hold leases for hundreds of thousands of additional acres of land that have not yet been developed; therefore we look forward to a very bright future for wind energy in Kansas.

Challenges of Developing the Resource and Strategies to Overcome Them

Kansas’ efforts to take advantage of our wind resources the last 12 years have been very

successful. However, we have and continue to face some challenges:

When I took office a significant conflict was brewing between wind developers, conservationists, and landowners concerning the presence of commercial wind development in the Flint Hills. Of particular concern was the destruction of the ecologically sensitive area of east central Kansas known as the tallgrass prairie. Less than four percent of the once-vast tallgrass prairie remains and nearly 80% of what remains lies within the Flint Hills of Kansas and Oklahoma. Governor Kathleen Sebelius had previously designated a portion of the Flint Hills, known as the “Heart of the Flint Hills”, as an area that should remain free of commercial wind development. However, the boundaries of the protected area did not include approximately half of the tallgrass prairie in Kansas. I was approached by concerned landowners and conservationists who felt the entire tallgrass prairie region of Kansas should remain free of wind development. I also was approached by wind developers who were frustrated by the resistance they were facing despite the fact they were developing projects outside of the protected area. Fortunately, after many tough conversations with many of the different parties, an agreement was reached. The agreement allowed any project with a power purchase agreement in-hand to continue but protected the rest of the tallgrass prairie from additional commercial wind development. The expanded protected area is now known as the “Tallgrass Heartland.”

I believe strongly in the importance of maintaining the balance between the economy, energy, and the environment. The agreement reached on the tallgrass prairie is a wonderful example of working hard and finding common ground to achieve that balance.

Another challenge we face in further developing our wind resource is limited transmission. The three projects described above: the Y-plan, KETA project, and Grain Belt Express, all represent significant expansion in our transmission capability. We are working closely with the SPP to examine opportunities for additional projects in the future. Transmission lines allow us to

move this product to market. I am confident other states will start to look to states like Kansas as they attempt to diversify their own energy portfolios and keep their utilities rates low. They are likely to find Kansas wind to be more affordable and more reliable than their own wind resource. Those findings will create a larger demand for Kansas wind. A demand we must be ready to meet.

Finally, the federal government's Renewable Energy Production Tax Credit (PTC) plays a key role in incentivizing the significant investments that are required to develop large commercial wind sites. The PTC was scheduled to expire at the end of 2012 and the industry rushed to complete their projects in time to qualify. They also did not schedule the construction of additional projects in 2013 until they knew it would be extended. The credit was eventually extended by Congress. However, wind development in Kansas nearly ground to a halt because of the uncertainty of the federal tax climate. The Siemens plant had zero new orders for the first quarter of 2013 and had to layoff half of its workforce. I have called for the credit to be extended but phased out over a series of four years. This gradual approach will provide a level of predictability the industry needs to successfully transition away from relying on the incentive. I have no doubt this industry will be able to stand

on its own two feet and compete in the free market system as technology improves and the industry matures.

Conclusion

While the role renewable energy plays in our nation's future has been a topic of much political debate recently, the following factors remain clear: Reliable and affordable energy is a critical component of a thriving economy. Increasing our reliance on domestic sources of energy allows us to have greater confidence in the reliability and affordability of energy in the future. The American people are increasingly supportive of renewable energy because it achieves the proper balance between energy production and the environment. Energy that is reliable, affordable and clean will be in high demand.

As I said in the introduction, Kansas produces what the nation needs. Our farmers and ranchers produce food. Our plants in Wichita produce airplanes. Our universities produce doctors, nurses, and engineers. And the vast prairies of Kansas produce reliable, affordable, and clean wind energy. Soon, our state will not only be known as the Wheat State, but also the Renewable State.





STEVE BULLOCK
Governor, State of Montana

Montana's Energy Diversity a Regional Asset

Montana's lands have blessed us with an abundance of natural resources, allowing the state to be an exporter of energy products for decades. As Governor, I take great pride in using our state's energy resources to provide good-paying jobs for Montanans, strengthen our rural communities and support local schools, while safeguarding our quality of life.

Montanans expect that we will protect our environment, outdoor heritage, communities and agricultural producers. That's why my administration is committed to maintaining sustainable and responsible development of our energy resources for a net benefit to the state and its citizens. The state must promote energy development to foster growth in this important economic sector and put Montanans to work, and we can do it in a way that will protect those things we love about living here.

To this end, my administration will support and encourage responsible development of all Montana's energy resources. That means we will seek top dollar for our resources, support landowners and property rights, address the needs of our communities affected by booming energy

development, and protect Montana's clean air, pristine waters, and world-class wildlife.

I intend to make sure that state government does its part to encourage responsible energy development and provide economic opportunities for Montanans. This includes some obvious activities, like making sure that state permitting processes provide predictability and certainty, and coordinating with others to deliver appropriate assistance to industry, such as financing programs and tax incentives. It also includes supporting quality education opportunities for Montanans in energy-related fields of study that will encourage students to apply their knowledge here in the state.

And it includes bringing people together to solve problems. In Montana, we work best when we work together. As an example, I recently created a Sage Grouse Advisory Council to bring together conservationists and industry so we can protect this species and promote energy development.

I just concluded my first legislative session, and energy issues were front and center. I signed bills making it easier to move wide loads on our roads and permit new gravel pits – both of which should help our booming oil and gas development. We

expanded the scope of our Renewable Portfolio Standard, designed to encourage new renewable power production. New upgrades at existing hydroelectric facilities will now qualify for renewable energy incentives.

I also signed a bill that offers more protection for private landowners in their negotiations with companies and government agencies that want to acquire their land under the state's eminent domain laws. Montanans have a strong connection to the land, so it is important to find a fair balance between respect for private property and responsible development.

Over the next several pages, I will review the vast and diverse energy potential that Montana holds and discuss some of the challenges and opportunities we have as both a state and as a part of the western region.

To begin with, for the next four years, I have identified a number of priority goals where I will focus my efforts to write the next chapter in Montana's energy history. These are to:

Boost the responsible development of fossil fuels to meet current demand.

Fossil fuels will be essential for the foreseeable future and Montana holds vast resources. We will be even more productive and create more opportunities if we focus on developing technologies to make those fuels cleaner and more efficient.

Support continued development of pipeline and rail infrastructure to move fossil energy resources to market.

This infrastructure is important to securing our supply of affordable power. Pipelines represent generally the most efficient and safe means of transporting many energy commodities.

Advocate for regional transmission grid operation policies and build electrical transmission infrastructure to enhance market access for electric generators.

The North American electrical grid is arguably the largest and most complex machine ever assembled. We must exploit our opportunities to expand and improve the operation of the grid, and to make it more friendly and responsive to

evolving cleaner and more variable generation technologies.

Quantify and promote the benefits of increasing the geospatial diversity of renewable electrical generation in the West.

Geospatial diversity in renewable and variable energy generation is the future for balancing power supply and demand on the grid. A better understanding of these benefits is needed so that engineers can optimize generation and transmission facilities to provide a more reliable and balanced generation profile, while dispersing siting and environmental impacts.

Promote conservation and efficiency of energy.

There are countless ways we can use energy and energy resources in a smarter and more deliberative manner. Changing out inefficient lighting, upgrading energy-using equipment, and encouraging the use of the latest technologies in public and private buildings are just a few of the ways we can use our energy resources more efficiently.

Montana: Energy Diversity for Energy Security

Montana is currently taking advantage of its vast and diverse energy portfolio to create good-paying jobs and provide affordable energy. To date, coal, oil, gas and wind have accrued the majority of investment dollars and have undergone the largest levels of development. The state however has great potential in biomass, biofuel, solar and geothermal energy production, all of which currently have projects undergoing feasibility studies and pilot-scale development. The following is a brief synopsis of what Montana has recently experienced in various fields of energy development.

• Coal

Montana holds 28% of the nation's coal reserves, the majority of which - 73.5 billion tons - is low sulfur, sub-bituminous coal. This coal is in demand in domestic markets for its clean burning properties and is now being sought after by foreign markets as well. Montana coal is the closest

resource of high quality coal to Pacific ports with access to growing Asian markets.

These market factors have made Montana a prime location for new coal mining development. Operational mines are applying for expansions and applications have been submitted for what would be the state's largest coal mining operation. This activity in the coal sector contradicts the notion that the coal industry is on the verge of collapse due to low natural gas prices and increasingly stringent emission standards. Demand for Montana coal remains strong and this resource will continue to play a major role in the nation's energy supply (approximately 33%), and will increasingly be destined for international markets.

We are in the process of permitting one of the largest coal deposits in the state. The Otter Creek Project is complex and challenging, and it involves multiple state and federal agencies. Some estimates show it could have a \$200 million annual benefit in jobs and tax revenues. But some folks are concerned about the impacts of the project on the environment and local communities. This is an example of where I insist that our permitting processes must be transparent to the public, protective of our outdoor heritage and agricultural economy, predictable to industry, and based on credible science.

• Oil and Gas

Montana has a long history of oil and gas production, and is home to approximately 25% of the oil refining capacity in the Rocky Mountain region. Leasing, permitting, and production are again on the rise as exploration and infill drilling have taken place, primarily on the western edge of the Bakken formation, in eastern Montana.

Natural gas pipelines now cross the northeast and southeast corners of the state, along with a natural gas liquids (NGL) line which will deliver NGLs from Sidney, Montana to a pipeline in northeastern Colorado. The state is also staged to move crude oil via the Keystone XL pipeline when it is constructed. Successful negotiations by Montana and neighboring states resulted in the development of the Bakken Marketlink project, a \$140 million on-ramp to the Keystone XL pipeline that will move

100,000 barrels per day of Bakken area crude oil to refineries in the Gulf coast.

Natural gas production has declined as low gas prices have made drilling new natural gas wells uneconomical. Nonetheless, Montana's natural gas resource still exists for future development and co-production of natural gas continues as new oil wells are drilled. Infrastructure development to capture and move natural gas produced from oil wells has lagged behind the rapid development of oil in some parts of the Bakken, leading to an increase of gas that cannot be economically captured and moved to market. However, a number of small businesses have sprung up to offer producers the ability to gather, process, and compress natural gas on-site, giving operators an option to flaring.

In addition, Montana is home to innovative projects using CO₂ enhanced oil recovery to boost production from stranded oil reserves. With this technology, the life of an existing oil field can be extended by 25-30 years.

Communities in eastern Montana are facing both opportunities and challenges from impacts of development in the Bakken. Development of transloading facilities along Montana's rail system to bring pipe, proppant, and other necessary goods are creating jobs and new prospects for those communities. Diesel mechanics, truck drivers, contractors and other occupations are all in short supply and workers from across the state are finding opportunities in the region. At the same time, this influx of workers has strained municipal water and wastewater facilities, increased impacts to roads and created a lack of affordable housing. The state is taking an active role in assisting communities that are facing these challenges by providing technical and planning assistance, and investing in road and municipal facility upgrades. Montana has positioned itself well to remain a strong producer of petroleum resources and is working to develop the infrastructure needed to safely move these products to market.

• Wind

Montana has one of the strongest wind resources in the US and arguably the greatest opportunity for wind development among any state in the West.

The US Department of Energy's report "20% Wind by 2020" calls for Montana to develop 5,000 megawatts (MW) of wind power, but the state's resource could support the development of 10,000 MW in the medium term with the proper infrastructure in place. Since 2005, Montana has gone from under one MW of electric generation capacity from wind to nearly 650 MW to date.

The wind farms east of the Rockies in Montana have a unique characteristic that make them even more valuable to the Pacific Northwest. The wind regime in this area matches the peak demand for electricity throughout the Pacific Northwest's major population centers. These load centers experience peak demand for electricity during the winter months and during daytime hours, when Montana's wind provides the most power. Developers have recognized this advantage and built over 400 MW of wind generation for markets outside of Montana. California, Oregon, and Washington not only have large power needs but also some of the nation's strongest demand for renewable energy. Montana wind is well positioned to help states meet their energy demands and renewable portfolio requirements. However, transmission development remains a major hurdle for these wind resources to reach the load centers of the West.

In 2005, Montana adopted a Renewable Portfolio Standard (RPS), requiring many electricity suppliers to provide a percentage of their supply from renewable energy sources. Wind energy provides the vast majority of renewable energy in Montana and has been largely responsible for utilities meeting Montana's standard of 15% by 2015. Tax credits and production incentives are also available for wind generation and other



renewable sources as a way of leveling the playing field with traditional forms of electricity generation.

• Hydroelectric

Montana's mighty rivers have powered industry for over a century, and some of the hydroelectric infrastructure in use today was built well over a half a century ago. Montana is one of the top hydroelectric producers in the country and six of the state's ten largest electrical generating plants run on hydropower.

While this renewable resource provides immense power potential and carbon-free electricity, proposals for large-scale dam development have historically created significant public debate over the impacts of development. While fisheries have been harmed by hydropower development, states are now aggressively addressing these impacts. Montana has both removed dams and added fish ladders to existing dams to boost fisheries and ecosystem health.

Electric generation capacity is on the rise as upgrades to hydroelectric facilities are installed and small scale hydroelectric generators have been placed along drops of irrigation canals. Opportunities exist to add additional capacity

through further upgrades to existing facilities, and there are countless prospects for community development of small scale hydro along irrigation canals. These types of development have few environmental impacts and take advantage of existing infrastructure.

• Bioenergy, Geothermal, and Solar

Great potential exists in Montana's biomass, biofuel, geothermal and solar resources. The state has 16.5 million acres of crop land suitable for growing grain and/or oilseed crops for use in ethanol and biodiesel production. Montana also contains 19 million acres of non-reserved forest land with potential for bioenergy production and is second and third in the nation for safflower and canola production, respectively. Biomass is currently being used in community-scale heat and power operations throughout the state. It also provides electrical generation at lumber mills, both powering the mill and generating surplus power for sale to local co-ops or utilities. Montana's biofuel sector has made great strides in research and development through pilot contracts with both BNSF Railroad and the US Department of Defense.

Montana is home to a significant geothermal resource that remains largely untapped. Current uses of geothermal in the state are centered on direct-use facilities like recreational hot springs, green houses, and fish farms. The state does contain several high temperature sites that could provide clean, renewable base load power. There are at least two projects that are currently undergoing feasibility studies to determine if electrical generation projects can be economically developed.

Despite its nickname, the Big Sky State is not often thought of as a solar resource; however Montana has blue skies most of the year in the eastern two-thirds of the state. These areas provide an average of 4-5 kWh/m² per day of solar radiation, justifying solar development. While exporting this energy through distributed generation currently dominates solar development in the state, the potential exists for community-sized and utility

scale solar installations.

• Distributed Generation, Conservation, and Efficiency

Conservation remains the most cost-effective source of energy. Through representation on the Northwest Power Planning and Conservation Council, Montana is active in setting regional policies to acquire energy conservation as a priority resource. Montana state government has joined with NorthWestern Energy to demonstrate the effectiveness of smart grid technology on a large state office building in Helena, and leads by example with a self-funded energy conservation program for state-owned buildings that has reduced heating and cooling costs by \$1.8 million annually while providing jobs in the construction industry across the state.

Industrial, commercial and residential property owners are increasingly investing in a long term energy strategy by implementing conservation and efficiency measures as well as the installation of distributed generation. Montana has incentivized these types of investments, which can foster a more efficient energy society with diversified generation assets.

Net metering has also spurred the development of distributed generation throughout the state, primarily solar and wind with the occasional small hydro system. This industry continues to grow and develop in Montana as small businesses such as solar contractors, electricians, and hardware distributors respond to demand. Small-scale wind generation is also becoming a common sight, and Montana State University Billings has installed a 10 kilowatt vertical axis wind turbine that will both provide power to the campus and be used as a learning tool for faculty and students.

Challenges and Opportunities for Montana and the Region

• Key Challenges Ahead

A 2010 study completed by Idaho National Laboratory inventoried the energy resources in

portions of the western US and Canada and found:

- Some of the most intense concentration of carbon based energy resources in the world including coal, conventional oil, natural gas, oil sands, oil shale and more.
- Huge renewable resources including solar, hydro, geothermal, bioenergy and the heartland of North American wind energy potential.

Currently, Montana exports three-fourths of its coal production to other states and about 15% overseas. Nearly 88% of the crude oil refined in Montana is piped in from Canada, while Montana crude flows elsewhere. Approximately 50% of the electricity generated in Montana is sold out of state. Yet, given the chance, Montana could do more, and there are specific challenges which must be addressed to realize the West's energy potential. Montana will work within the region to address infrastructure needs to facilitate the flow of energy products from areas of production to population centers where energy is needed. Central to many of these challenges will be the need to improve cooperation among federal, state, and local permitting agencies to streamline infrastructure permitting—including electric transmission lines, railroads and pipelines.

In addition, some state policies in the region effectively limit the ability of electricity generated out of state to reach areas of high demand, making the generation/transmission landscape even more complex. While it is important to recognize the prerogative of states to set these kinds of boundaries, these policies could lead to unnecessary social and environmental costs.

• Transmission

Perhaps the most significant and least understood issue facing American energy development today is transmission. We are dependent upon an antiquated and congested grid. The West is leading the nation in diversifying its sources of energy. Nevada, Arizona, and California are developing photovoltaic solar power; Texas, Wyoming, Montana and others in the Pacific Northwest are developing wind. While the development of these

resources is a worthy accomplishment and has happened in relatively short order, transmission improvement and development are critical to further advances in renewable development and diversification of our energy portfolio.

First, we should strive to do more with what we have. This means identifying ways to operate the transmission grid more effectively to get the most from our existing generation and transmission assets. This includes the elimination of inefficient rate pancakes and implementation of dynamic transfers, intra-hour scheduling and energy imbalance markets.

Second, the difficulty in siting linear infrastructure, particularly electric transmission lines, has become a major obstacle to achieving timely investment decisions for critical infrastructure. Landowner rights, fair compensation, eminent domain, and legal challenges to permits are all major issues that influence investment decisions on critical energy infrastructure in an increasingly complex social and regulatory environment.

Montana recognizes the need for investment in transmission infrastructure. Recently, the first major transmission line connecting the US and Alberta was built in coordination with a wind farm in Montana. The process of bringing such a line onto the grid is no simple task and took four times as long to energize than the wind farm to which it was attached. Linear projects, especially highly visible, overhead, high voltage transmission lines, undergo very high levels of scrutiny by landowners and the public. Siting and securing right of way can take years as the projects affect a multitude of landowners and jurisdictions. Existing policies and practices for the planning and siting of transmission infrastructure must be reviewed and modernized to be more responsive to this new paradigm.

• Infrastructure

Expansion and maintenance of rail and pipeline energy transport infrastructure will also continue to play a key role in meeting our energy needs. The Keystone XL pipeline project and coal port developments on the West Coast have grabbed headlines for the past several years, pitting

opposing parties in a battle over the future of energy development. Opponents of these projects argue that the world needs to switch to renewable forms of energy. Proponents say that we need this infrastructure to develop more North American energy resources, to drive economic development and become less dependent on energy imported from unfriendly or unstable world regions.

It seems that the solution lies in both of these arguments. Consider that renewable energy's share of our energy portfolio is climbing dramatically. For example, this country now boasts approximately 60,000 MW of installed wind energy capacity, with most of that installed in the last 10 years. Significant advances in energy conservation and efficiency improvements have helped to temper energy demand. At the same time, traditional fossil fuels are a mainstay of the economy and a big part of the future, and need to be part of our core energy strategy.

Opportunities

My administration is dedicated to the task of not only maintaining Montana's importance to the region and the nation as an energy leader; we also want to grow that position. We will accomplish this by looking into the needs of the future - and utilizing Montana's world class higher education system - to conduct energy research and development, and partner with the Tribal Nations and private sector to tackle such issues as:

- **Developing and deploying** advanced CO₂ sequestration technologies;
- **Improving wind turbine design** and composite materials;
- **Leading research** into algae-based fuels;
- **Training engineers and professionals** in a wide variety of energy-related disciplines, from petroleum engineers to environmental scientists, working to develop tomorrow's solutions for today's energy challenges; and
- **Seizing other opportunities** to help drive innovation, not just follow it.

New drilling techniques are opening up huge shale gas reserves of this cleaner burning traditional energy source, and these same advances in drilling technology have led to an increase in domestic oil production for the first time in 30 years. Montana is home to two CO₂ sequestration research projects aimed at finding solutions to carbon emissions from combustion of fossil fuels. Efforts like the BNSF biofuels pilot project, industry advancements in coal-to-liquids, and the rapid expansion of wind development are bringing dramatic changes to our world. I think all of these circumstances represent real hope for our energy future.

But above all, our highest priority must be developing our most valuable and precious resource - our children. I firmly believe that by giving our children the best education we can provide, that we can and will bring about the solutions to our energy challenges. We will see an energy future that is cleaner, more reliable and secure when we provide the educational opportunities to train our future scientists, technicians and business leaders.

Conclusion

People living in Montana and the West get to enjoy a great quality of life. Wide open spaces, an attractive mix of rural and urban amenities, and unmatched recreation opportunities have made the West a great place to live, work and raise a family. Again, affordable, abundant and environmentally friendly energy is and will continue to be hugely important to driving our Western economy and powering our communities. Our energy future is up to us and we must rise to the challenge and set out to commit, educate, improve, conserve, invest, expand, optimize and maybe most important, work together to make this future happen.

I look forward to working with the other Western Governors and the Western Governors' Association to build a regional energy future for the West that creates jobs, increases the tax base, keeps energy affordable, and protects our quality of life.



JACK DALRYMPLE
Governor, State of North Dakota

Fossil Fuels Play a Critical Role

Crude Oil and Natural Gas Production in North Dakota

• Background



North Dakota has seen a significant increase in energy production in recent years,

due in large part to innovative new horizontal drilling techniques, used in conjunction with hydraulic fracturing, that can harvest previously inaccessible pools of crude oil and natural gas. Over just the past two years, crude oil production has increased from 344,000 barrels per day to 768,850 barrels per day as of December, 2012. The North Dakota Industrial Commission currently estimates that there are 6.5 billion barrels of recoverable oil in the Bakken and Three Forks formation, with only 244 million barrels having been recovered so far. Other estimates have placed potentially recoverable crude oil in North Dakota as constituting up to 25 billion barrels.

A concurrent growth in natural gas production has been seen as well, increasing from 342,000 million cubic feet/day in December of 2010 to 805,705 million cubic feet/day as of December 2012. Natural gas production is expected to increase as oil

production increases, and as natural gas gathering and processing sites continued to be built by the energy industry.

The Beneficial Role Oil and Natural Gas Plays in the State and Federal Energy Strategy

Oil and natural gas development has a significant impact on the state of North Dakota, providing quality, high-paying jobs to our residents. According to a recent study, the value of oil and gas production, exploration, refining, payroll, and other activity was \$30.4 billion in 2011, compared to \$4.4 billion in 2005. According to the North Dakota Industrial Commission, a typical 2012 Bakken well has an expected production life of 45 years and will produce 615,000 barrels of oil. Over the course of their production, each of these wells is expected to produce \$20 million in net profit, pays \$4 million in taxes, \$7 million in royalties, \$2 million in wages, and \$2 million in operating expenses.

Natural gas has boosted our state economy, while serving as an affordable, clean-burning energy source. A 2012 study estimated that natural gas production in North Dakota could increase from production of 805,000 million cubic feet of gas per day to 3.1 billion cubic feet per day by 2025. This

energy source will be a valuable resource going into the future due to its many varying uses, including for fertilizer, natural gas-fired electricity, and in its liquid form as a valuable fuel source.

It is our hope that the efforts of states like North Dakota to promote responsible energy development can be a large part of working to secure United States and North American energy independence, and to reduce reliance on unstable foreign energy supplies.

To attempt to achieve this worthy goal, the State of North Dakota will continue to support responsible development of oil and gas resources within our borders. The state has taken a number of steps to address needs that support this rapid growth. The following segments detail the steps North Dakota is taking to address challenges to developing our crude oil and natural gas resources.

The Challenges of Developing Oil and Natural Gas Resources

There have been some challenges to developing the crude oil and natural gas resources that exist in North Dakota. With regard to development of crude oil resources, some of the main issues seen in our state include transportation logistics, impacts of rapid energy development on infrastructure and the environment, and federal regulatory issues. Crude oil transportation logistics is one area the state and industry have been working to address due to the significant distance North Dakota faces in transporting crude oil resources to hub markets. In the past, the distance and the difficulty in transporting crude oil resources to these markets have resulted in a significant markdown of price in Bakken crude oil, due to the significant costs of transportation to market. The industry has been working to address this issue, including development of significant pipeline and rail infrastructure to deliver crude oil to markets. In addition, the state has been working with industry to support development of feeder pipelines for intra-state transportation of crude oil to reduce impacts and traffic on our roads. These topics will be further discussed within Section IV.

With regard to natural gas resources, our main concern is developing infrastructure to collect natural gas at drilling sites to substantially reduce flaring. The state legislature is currently considering legislation that would provide mechanisms to reduce flaring, which will be detailed later in this report.

State and Industry Strategies to Overcome Challenges

• Infrastructure Development

Governor Dalrymple has played a key part in initiating legislative funding that addresses needed infrastructure required to sustain large-scale energy growth. During the 2011 legislative session, Governor Dalrymple proposed and the state legislature passed legislation that provided in funding for transportation infrastructure. For the 2013 legislative session, a record \$2.7 billion in road funding was proposed in Governor Dalrymple's budget for transportation infrastructure, with a significant portion of this total going to address needed repairs and additions on roads in oil and gas producing areas of the state.

One funding source that has already been used to target a wide variety of infrastructure needs in energy-producing areas is the Energy Infrastructure and Impact Grants proposed by Governor Dalrymple and approved in the 2011 Session. That legislation provided \$135 million in Energy Infrastructure and Impact Grants to help counties, cities, and other political subdivisions in oil and gas producing areas address such issues as critical street and water infrastructure upgrades, emergency service enhancements, law enforcement equipment and portable classrooms for schools that need extra space for students. Governor Dalrymple has proposed that for the 2013-15 biennium, \$214 million be included for this grant funding, to ensure that areas impacted by energy development receive the funding needed to maintain high-quality infrastructure. These funds will be in addition to the significant amount of funding that the state has spent to address roads in energy-impacted areas of North Dakota.

Another step North Dakota has taken to address local impacts is to encourage development of significant rail and pipeline infrastructure to transport crude oil produced in North Dakota. In addition to limiting wear and tear on our roads, pipelines and rail provide for a secure form of transportation of our oil resources, and as such we promote development of pipeline infrastructure to address the need to safely transport these products. Three years ago pipelines and rail capacity were major barriers to growth in oil production. At the start of 2010, crude oil takeaway capacity via pipeline and rail capacity was a little more than 450,000 barrels of oil per day, with 337,500 barrel per day pipeline capacity and 115,000 barrel per day rail capacity. As of the end of 2012, pipeline takeaway capacity had been increased to 463,000 barrels of oil per day and rail capacity had been increased to 670,000 barrels of oil per day, for total takeaway capacity of more than 1.1 million. Current estimates from state authorities project that the combined pipeline and rail takeaway capacity for North Dakota crude oil will reach over 1.5 million barrels per day by the end of 2013, and that by the end of 2016 that total capacity is projected to reach over 2.1 million barrels per day. This capacity will be needed to address future growth in oil production within the state.

The State is also working with the energy industry to support development of infrastructure used to collect and transport natural gas produced at our well sites. Daily natural gas production continues to increase slightly faster than oil production. This indicates that gas to oil ratios are increasing and confirms the need for more natural gas gathering and processing capacity. To deal with this, oil and natural gas producers in North Dakota have invested \$4 billion for natural gas gathering and processing capacity. In addition, the State of North Dakota, through the Oil and Gas Research Council and in partnership with private parties, has invested more than \$3 million researching new technologies to capture and utilize natural gas at well site. These technologies include generating electricity on-site from the gas, compressing the gas into cylinders for transportation by truck and using the natural gas instead of diesel to fuel drilling rigs. The state has also had in place since 2009 a sales and use tax exemption that is granted

for purchasing building materials, production equipment, and other property used in the construction of a natural gas processing facility.

The North Dakota State Legislature is currently considering legislation which would create a 2 year tax exemption from the time of first production if natural gas is collected and used at the well site to power an electrical generator that consumes at least 75% of the gas from the well; or collected at the well site by a system that intakes at least 75% of the gas and natural gas liquids volume from the well for beneficial consumption by means of compression to liquid for use as fuel, transport to a processing facility, production of petrochemicals or fertilizer, conversion to liquid fuels, separating and collecting over fifty percent of the propane and heavier hydrocarbons, or other value-added processes. These provisions would help to address flaring at locations that are so remote that developing pipeline infrastructure to gather and transport the natural gas is economically infeasible.

• Regulating Rapid Oil and Natural Gas Growth in North Dakota

The State of North Dakota, through the Oil and Gas Division of the North Dakota Department of Mineral Resources, has closely regulated oil and gas recovery processes in North Dakota to ensure that oil and gas drilling and hydraulic fracturing operations are conducted in an environmentally sound fashion. The North Dakota Industrial Commission approved rules in 2012 that provided greater transparency over the drilling process, including the requirement that energy companies disclose the contents of hydraulic fracturing fluids used at well sites. Due to the fact that the hydraulic fracturing process differs significantly from region to region based on the geology and location of the crude oil resources, a one-size-fits-all federal policy would not be the appropriate manner to resolve this issue. The North Dakota Industrial Commission, with Governor Dalrymple as a member, will continue to closely monitor hydraulic fracturing practices and will respond in a timely manner if changes are needed.



In order to ensure that rapid oil and gas growth in North Dakota continues to be properly regulated, Governor Dalrymple's budget proposal for the 2013-15 biennium includes about \$4 million for 23 new positions within the North Dakota Industrial Commission's Oil & Gas Division. These additional positions would include petroleum engineers and field inspectors to further ensure safety and environmental regulations are followed at drilling and well sites. These new positions will enhance our efforts to monitor water supplies and wastewater treatment, to enforce compliance of the state's laws and rules on wastewater handling, and to enhance protections against public health threats.

• **Workforce Development/Education**

Another challenge that North Dakota is actively addressing with regard to oil and gas development is developing a highly skilled workforce that can fill all needed positions in the energy field. One major development within this area was the recent founding of the "Harold Hamm School of Geology and Geological Engineering within the College of Engineering and Mines." Funding for this project

included \$4 million from the North Dakota Industrial Commission Oil and Gas research program; a \$5 million donation from Continental Resources President Harold Hamm; and another \$5 million from Continental Resources, Inc. This combination of public and private funding will create a program at the University of North Dakota that will help train future petroleum geologists and petroleum engineers who will be sought out as employees in North Dakota.

• **Conservation Efforts Funded With Oil Proceeds**

The challenges created by a growing population and expanding energy development include impacts on our outdoors; to address this issue Governor Dalrymple included within his budget a proposal to establish a permanent conservation fund to enhance the opportunities for hunting and all outdoor recreation experiences.

Governor Dalrymple's budget proposal for the 2013-15 Biennium proposed committing a portion of funds generated by oil production taxes to a

newly created conservation fund, with an annual funding cap of \$10 million. The legislature subsequently amended and passed the bill, which will now provide up to \$30 million per biennium for the conservation fund. These funds will be awarded to state agencies and non-profit groups to benefit statewide conservation practices, wildlife habitat, parks, and outdoor recreation.

• Crude Oil and Natural Gas Processing Capacity

North Dakota currently has one crude oil refinery located in the state, the Tesoro Refinery located in Mandan. This facility processes 68,000 barrels of crude oil daily. Three other entities are attempting to develop crude oil refineries in North Dakota.

First, MDU Resources Group has recently announced that they have partnered with Calumet Specialty Products Partners to begin construction late this spring on a refinery near Dickinson. This facility will help to refine Bakken crude oil in state, providing up to 7,000 barrels per day of diesel for use in North Dakota. Two additional crude oil processing facilities are also being considered, as Dakota Oil processing is trying to develop a diesel refinery near Trenton, and the Three Affiliated Tribes are working on a diesel refinery on their Fort Berthold Reservation. These new facilities would provide a significant supply of diesel fuel for North Dakota and other states in the region.

Natural gas processing capacity will also see a significant increase within the state over the coming years. As of the end of 2012, natural gas processing plants within the states could process about 900 million cubic feet per day, compared to the 500 million cubic feet per day capacity existing within the state as of the end of 2010. Processing capacity will continue to increase dramatically, with production capacity expected to reach approximately 1250 million cubic feet per day as of the end of 2013.

CHS Incorporated is also considering development of a nitrogen fertilizer plant in North Dakota that would use natural gas produced in the state. In late 2012, the company announced that it is taking steps to constructing a plant that would convert natural gas into fertilizers. The plant would

provide North Dakota farmers with a reliable, long-term supply of locally produced fertilizers, while also creating more jobs in North Dakota and utilizing natural gas that is being rapidly developed in our state.

Regional or National approaches

The State of North Dakota believes that the delayed portions of the Keystone XL Pipeline should be approved by the federal government as soon as possible, especially in light of the recent findings by the State Department that the project would have no significant impact on the environment. This pipeline will create a significant number of jobs, while providing for a safe and reliable transportation method for crude oil that is critical to our state and national economy.

We also want to note that we are encouraged by large domestic businesses that had previously been reliant upon foreign crude oil switching to crude oil produced by developing plays in the United States. One recent example of how North Dakota crude oil will be utilized in this manner is seen with Delta Air Lines beginning use of Bakken crude oil at its refinery in Trainer, Pennsylvania. The crude oil will be refined into jet fuel for Delta's fleet of airplanes. Delta's subsidiary, Monroe Energy LLC, was forced to slow production at the 185,000 barrels-per-day plant in November of last year. The company is now receiving crude shipments from the Bakken shale rather than importing foreign crude at a higher cost. The company is using Bakken crude as a way to improve profits and retain the 400 jobs at its refinery. This is just one example of how crude oil from North Dakota's Bakken Shale and other domestic plays will help to reduce our reliance upon foreign energy sources, to the benefit of our economy.

Conclusion

The State of North Dakota will continue to pursue policies that support responsible development of crude oil and natural gas resources within the state. We believe that energy development would be best served by a federal government policy

that allows states considerable input and control over the development of resources within their boundaries with respect to activities such as hydraulic fracturing, rather than a one-size-fits-all federal approach that doesn't match the realities present in each state. The State of North Dakota will also continue to provide a significant amount of funding to address infrastructure improvements and upgrades needed to address the energy growth currently present in our state.

Coal Production in North Dakota

• Background

In addition to the current boom in crude oil and natural gas production, coal remains a major source of energy in North Dakota. Western North Dakota contains an estimated 351 billion tons of lignite coal, the single largest deposit of lignite known in the world. Of this amount, an estimated 25 billion tons is economically feasible to produce, enough to last for over 800 years at the present rate of production.

Lignite coal is more accessible than most other forms of coal due to its close proximity to the surface, which allows this resource to be surface mined. There are currently four large-scale lignite mines in North Dakota.

• The Beneficial Role Coal Plays in the State and Federal Energy Strategy

Along with the dramatic increase in crude oil production that has been seen in North Dakota, coal remains significant as a major source of energy in North Dakota. Western North Dakota has over an 835 year supply of lignite that is currently accessible and economically feasible to recover. Approximately 30 million tons of coal is mined in North Dakota every year, resulting in annual economic impact of around \$3 billion and 17,000 direct and indirect jobs. Approximately 80% of this coal is then used to fuel the seven coal-fired electric power plants in North Dakota that supply 4000 megawatts of affordable electric power to two

million customers in North Dakota, South Dakota, Minnesota, Montana, and Iowa.

One of the major benefits of the large-scale coal-fired power plants in North Dakota is the result that North Dakota residents pay among the lowest electrical rates in the country. According to recent statistics from the Energy Information Administration, as of December 2012 North Dakota has the second lowest average retail price of electricity to ultimate customers, at 8.36 cents per kilowatt hour, with Idaho only one cent lower at 8.35 cents per kilowatt hour. These low rates demonstrate how electricity produced from coal can provide savings for our citizens.

The Challenges of Developing the Resource

One of the main issues nationwide with regard to development of coal energy resources is the federal regulatory environment with regard to environmental controls. An example of a proposed federal regulation that has caused great uncertainty regarding the status of coal-fired electric plants is the EPA proposed rule, first issued in early 2012, that would establish strict carbon dioxide limits for new coal-fired electric plants. The proposed limit would allow new coal-fired electric plants to release no more than 1000 pounds of carbon dioxide per megawatt hour. This standard is significantly lower than what any current coal-fired plant is able to perform at, and would place significant cost constraints on any entity attempting to build a new coal power plant. If similar standards are also proposed for existing coal-fired plants, the carbon capture and storage equipment needed to meet these stringent standards would likely make retrofitting these plants not feasible due to cost.

Another area of concern to coal energy producers in North Dakota is the fact that the Environmental Protection Agency has proposed that the by-products of coal-fired electricity production, including coal-ash be labeled as hazardous waste. This designation would prevent coal ash from being used for beneficial purposes such as using it to

make concrete. Section IV and V of this document will cover steps the state of North Dakota has taken to address these issues.

State Strategies to Overcome Challenges

• Continued State Regulation of Air Quality Issues

The State of North Dakota, via the North Dakota Department of Health Air Quality Division (Air Quality Division), will continue to actively enforce Clean Air Act provisions using knowledge of the local conditions present in the case of each permittee. The Air Quality Division will continue to work with coal-fired electricity plants and federal regulators to ensure that the air quality standards at each facility meet or exceed current federal regulations.

• Research and Development to Promote Clean Coal Usage

One way the State of North Dakota promotes continued use of coal throughout our state is through the Lignite Research, Development, and Marketing Program, which receives approximately \$8 million each biennium. This program concentrates on near term practical research and development projects that help to preserve and enhance development of North Dakota lignite resources. Since the program's beginning in 1987, funds have been used to help improve methods for more efficient and cost-effective reclamation; to find cleaner ways to burn lignite into existing boilers, to identify new market opportunities; to support coal gasification research efforts; and to meet challenges posed by new environmental regulations. For every state dollar invested, a total of six dollars is invested by other sources.

As regulations are implemented to reduce emissions from existing power plants and as additional regulations are being considered for new coal-fired power plants, research and development activities that lead to cleaner and more efficient technologies become increasingly important. To this end, the Lignite Research, Development, and

Marketing Program has placed a major emphasis on projects to reduce nitrogen oxides, mercury and carbon dioxide from plant emissions.

Regional or National Approaches

The State of North Dakota supports the development of federal legislation such as the "Coal Ash Recycling and Oversight Act of 2012", which would provide for state oversight for storage and management of coal energy production residuals. The bill was also designed to promote the use of coal ash for construction materials such as concrete. North Dakota is also currently considering legislation at the state level to promote state regulation of coal ash, as well as providing state-level support for the use of coal ash for use in making concrete and other construction applications.

We continue to support the idea that federal entities should allow states significant latitude in enforcing their own regulations on coal energy production. To this end, we believe that it is important to allow states to work with energy producers to retrofit existing electrical generation units to meet federal standards. State regulators have significant knowledge of the specific conditions that exist at each of the coal-fired plants in their state, which allows them to closely tailor retrofitting plans to each plant. This results in lower retrofitting costs for each plant, while offering environmental benefits commensurate with what would be seen under federal plans.

Conclusion

North Dakota will continue to support coal as a valuable energy production resource for the long-term, due to the abundance of lignite coal present in North Dakota and the fact that coal provides a low-cost energy source for our residents and businesses. North Dakota will continue to work with the federal government to develop and enforce regulations that identify and address the energy issues specific to our coal-fired electrical plants, and will work with energy producers to implement these standards.



MARY FALLIN
Governor, State of Oklahoma

A Pragmatic Energy Policy

Introduction



We are in the midst of an energy revolution, and Western states are leading the way. Western states are developing new supplies of natural gas, revitalizing oil production, and developing new ways to economically realize the potential of wind resources. Technology is making this possible and is dynamically reshaping and refining our energy system.

The nation has a new opportunity. Despite four decades of federal efforts to reduce America's dependence on foreign oil, imports have continued to rise – until now. Ideological efforts to replace traditional energy sources at any cost are being met with transformative, scalable technologies that improve the way we produce and consume traditional energy without massive federal subsidies or mandates. The twin national objectives of reducing oil imports and improving the environment are actually happening, but in ways many never expected.

In states like Oklahoma, pragmatic efforts are making this possible. Oklahomans are accessing new energy supplies with the help of new technologies and tools that enable optimization of the energy system and facilitate the production of clean, affordable, abundant, reliable, and

sustainable energy. We are working to improve our energy system to create jobs and grow our local economy. This begins with leveraging our unique human and natural resources at home and looking for ways to capitalize on our regional strengths.

Background

Oklahoma is fortunate to have a rich history as an energy state. In the early years of statehood, Oklahoma was the largest oil-producing region in the world, and still to this day, Oklahoma remains one of the nation's leaders in oil and natural gas production. In 2012 marketed production of natural gas totaled 2.02 TCF, and the state produced 88.77 million barrels of oil, ranking Oklahoma 4th and 5th respectively among producing states. Meanwhile, in 2011 Oklahomans consumed an estimated 0.656 TCF of natural gas and 98.41 million barrels of oil. In other words, Oklahoma exports more than two-thirds of its natural gas and produces roughly 90% of the oil it consume.

Oklahoma is also a leader in realizing the potential of renewable resources. At the end of 2012, Oklahoma had 3,134 MWs of wind generating capacity – a nearly 450% increase in the last five years. In fact, Oklahoma was one of only four states to add more than 1,000MWs of wind generating capacity in 2012. Oklahoma's world-class wind resource helps make this growth

possible, but pragmatic policy does as well. In 2012 Oklahoma surpassed its 15% renewable capacity target – 3 years ahead of schedule – without a renewables mandate.

The economic impact of the energy industry has on Oklahoma cannot be understated. In 2011 production and drilling activities supported approximately one-third of Oklahoma's gross state product, and in fiscal year 2012, gross production tax collections accounted for nearly \$1 billion. The oil and gas industry alone directly supports more than 83,000 jobs and indirectly supports more than 344,000 jobs, or nearly one-sixth of the state's workforce. Impressively, this generates more than \$9.4 billion in labor income, or more than \$113,000 per worker.

This background is important for understanding the regional emphasis of traditional and renewable energy resources in western states, such as Oklahoma. Different states are endowed with different resources, and as such, policies for optimizing the energy system may vary from state to state. But in Oklahoma, the state's native wind and natural gas resources offer a compelling opportunity for realizing local energy demands with clean, affordable, domestic resources. Understanding how to leverage these resources together is important for informing the development of sound energy policy.

The Importance of a Plan

Realizing the opportunities before us requires not only an understanding of our regional strengths but thoughtful identification of challenges and strategic measures for overcoming obstacles. In other words, planning is critical. It is with this understanding that I unveiled the Oklahoma First Energy Plan, the state's first comprehensive energy plan, in 2011. As the title of the Plan suggests, Oklahoma can and should play to its regional strengths.

The approach to planning is important. Just like assembling a puzzle, approaching the task only piece by piece will lead to endless attempts to determine how one piece might fit with another. But if reference is made to the entire picture, the image informs the way the pieces should come

together, and it becomes easier to see opportunities for how everything ought to fit.

The Oklahoma First Energy Plan was developed with this in mind. Instead of ideologically developing policy, treating fuels in individual silos, we attempted to take a more systematic approach. We set out a series of criteria that would help us identify opportunities. In soliciting stakeholder input in developing the plan, we attempted to find opportunities that would grow Oklahoma's economy, create Oklahoma jobs, protect and improve Oklahoma's environment, protect and improve the health of Oklahomans, provide affordable and reliable energy, focus on Oklahoma's unique human and natural resources, and leverage Oklahoma's resource base. Several opportunities resulted from this process, a select few of which I will spend the balance of this essay discussing.

Building Markets for Natural Gas

Natural gas forms the centerpiece, but not the only piece of Oklahoma's energy system. It accounts for more than 80% of Oklahoma's energy production on a btu-equivalent basis, and it also offers the opportunity to make everything around it better. It is the most diverse of Oklahoma's energy resources in its ability to satisfy power generation, residential and commercial, and industrial needs. Yet, natural gas serves the transportation sector only minimally, despite the fact that transportation fuels diversity is one of the nation's greatest energy challenges.

Compressed natural gas (CNG) vehicles offer a promising future to improve our environment, reduce our imports of foreign energy, and spur greater development of a resource of great regional importance to Oklahoma. But there are challenges, namely: there are limited options for CNG vehicles and those that are available often carry high associated incremental costs; and fuel infrastructure is limited and expensive to put in place. In other words, CNG vehicles present the classic chicken-or-egg conundrum – which comes first the vehicles or the filling infrastructure?

To address both these challenges, I worked with a bipartisan coalition of 15 other governors and

seven other states to develop a proposal that would help create demand for more CNG vehicles. By pledging to look for ways to transition state fleets to CNG vehicles when gasoline vehicles came due for replacement, the states could leverage their combined purchasing power to establish the threshold demand needed for auto manufacturers to build more affordable and functional CNG vehicles. At the same time fuel retailers would have the confidence that more CNG vehicles would be on the road to justify the construction of additional filling infrastructure.

Responding to this multistate effort, the automotive industry and the dealers who supply their products were able to offer CNG vehicles with incremental system costs reduced by more than 50% in certain instances. This means quicker payback periods and ultimately, greater taxpayer savings. In Oklahoma, where CNG is widely available for less than \$1.00 per gasoline gallon equivalent, this leads to life-cycle fuel savings well in excess of \$20,000 per vehicle for certain models. Considering some of the initial purchases already made by Oklahoma state agencies, savings are expected to exceed \$5 million dollars – or enough to build one or two more bridges just with the savings that will be generated from this year’s purchase.

This initiative is an example where government leadership can help move the needle with pragmatic policy. By purchasing vehicles the state would already need, more affordable and functional CNG vehicles will become available, and by purchasing CNG to operate the state’s fleet, retailers are able to invest in filling infrastructure with greater confidence. Ultimately, the broader public should be able to purchase these vehicles, and greater competition amongst fuel retailers will continue to drive CNG prices down.

In Oklahoma, we are reaching the tipping point when it comes to making CNG a greater option as a transportation fuel. A great many efforts are making this possible: legislative incentives to initiate private investment; innovative gas utility tariffs approved by state regulators that are helping Oklahomans offset incremental CNG system costs; commitments by energy companies to transition their fleets and support infrastructure



development; and many more. More CNG vehicles on the roads will lead to a cleaner environment, it means energy security can become a reality, and local job growth and economic expansion are sure to follow.

Leveraging the Complementary Partnership Potential of Wind and Natural Gas

A wave of new natural gas supplies brought about by new technologies has ushered in new, transformative opportunities to use the resource. Natural gas supply scarcity concerns of the 1970s and late 1990s have largely been addressed by new drilling practices that essentially make production a manufacturing process dependent on economics rather than discrete traps. Just at a time when the nation feared an energy crisis, we instead are confronted with an energy boom.

Natural gas is a clean-burning resource – mercury-free, virtually absent of particulate matter and sulfur dioxide, and with a substantially smaller

carbon footprint; nonetheless, the oil and natural gas industry faces public-perception challenges threatening development of the resource. Concerns with drilling and completion practices, waste handling, and industry transparency are placing the ability to access this enormous resource base at risk. Regardless of the veracity of claims asserted against the natural gas industry, the license to operate ultimately comes from the public. Realizing the full potential of this resource base will only be possible with proactive industry efforts to address these concerns – actions such as hydraulic fracturing chemical disclosure.

Meanwhile, the nation is also witnessing the rapid development of the wind industry. Wind produces 14 times the energy it did a decade ago, and in Oklahoma, it has emerged as an increasingly important piece of the power generation system. But wind energy is a variable energy resource capable of providing power only when the wind is blowing, which in many cases does not directly correspond with peak electricity demand. Thus, if renewables are to continue building their position in the power generation system, addressing integration challenges becomes increasingly important.

This is a perfect example of where Oklahoma's systems-based approach to energy becomes so critical. Rather than developing natural gas, or wind, or power generation policy in silos, looking at the overall system highlights synergistic opportunities to address the challenges of one resource with the strengths of the other. It is in this regard, that natural gas and wind form the perfect partnership.

Natural gas is unmatched in its ability to ramp up and down quickly to match wind generation peaks and lulls. This ability to quickly match variable supply is critical but happens to be operationally and environmentally challenging with other baseload generation sources. New highly efficient combined-cycle natural gas turbines make possible the ability to continue growing wind resources without integration barriers or unintended environmental consequences.

In a similar regard, the public perception challenges

of the natural gas industry and concerns of resource price volatility might be mitigated with a beneficial association with the wind industry. Americans that want to see renewables continue along their current growth trajectory will ultimately become more receptive to the reality natural gas is the key to making this possible. In this regard, natural gas can come to be viewed as the great enabler of renewables instead of the disruptive resource that reset the curve on energy supplies. Moreover, because wind energy can be secured on fixed long-term purchase power agreements, pairing wind and natural gas generation can mitigate any price volatility concerns, regardless of whether they are justified.

Ultimately, for Oklahomans, this could mean more Oklahoma wind and more Oklahoma natural gas is used to meet growing electric demands. It means an opportunity for economic growth generated from local resources and the prospect of a cleaner environment. And because wind and natural gas are the two lowest cost forms of new generation, this is possible all while ensuring Oklahoma retains its competitive advantage with low-cost electricity.

Targeting Improvements in Energy Efficiency, Beginning with State Facilities

Energy efficiency offers the most potential when considered in a total systems approach because optimizing any component of the energy system makes the entire system smarter and more efficient. It leverages all forms of supply by stretching the value of a given unit of energy. If we are to realize the greatest potential of these newfound energy supplies, we have to be smarter about how we use this set of molecules than we have in the past.

In 2011 the American Council for an Energy Efficient Economy (ACEEE) released its annual state energy efficiency scorecard, ranking Oklahoma the fourth worst state in the nation. This report corresponded with the release of the Oklahoma First Energy Plan, and highlighted to me that something needed to be done. Not only were we were squandering the resources that we have,

but by being inefficient in the way we use energy in state facilities for example, we were costing taxpayers millions of dollars in the process.

In effort to change the status quo, we looked to the Oklahoma First Energy Plan and with the help from the legislature we put in place a program that seeks to reduce energy consumption in state facilities by 20% by 2020 – an aggressive but attainable target. It calls for benchmarking and setting target efficiency gains in state buildings and through the use of behavior-based energy efficiency and conservation programs has the potential to save the state as much as \$300 million by modifying the way we use energy in state government.

We are learning that simple changes can make a big impact without compromising comforts and conveniences. For example by ensuring lights are off when rooms are unoccupied, adjusting thermostats for unoccupied office space, and augmenting temperatures with a fan instead of cooling office space in the summer to the point that workers are cold enough plug in strip-resistance space heaters, a

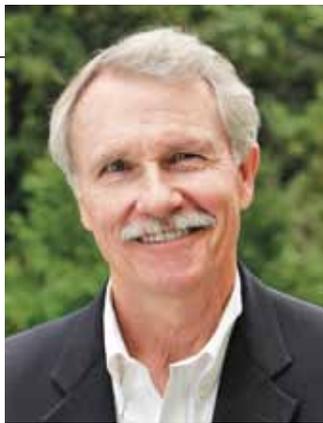
little change can go a long way. We can reduce the state's spend on utilities and devote those dollars to education, roads and bridges, or other uses.

With this effort and efforts from our electric and natural gas utilities, which are also investing in energy efficiency, Oklahoma is improving its reputation and is doing so quickly. In 2012 Oklahoma was recognized by the ACEEE as the most improved state in the nation! It's a success story, but one that is only beginning. Hopefully, it Oklahoma's program can become a model for other states as well.

Conclusion

Oklahoma's energy policy goals – affordable, reliable, secure, domestic, and clean – mirror those of the nation as a whole. How these goals are reached may vary based on a state's particular energy mix, but by stepping back and taking a look at the entire picture, Oklahoma is working to be an example of how it is possible to develop pragmatic energy policy.





JOHN KITZHABER
Governor, State of Oregon

The Cheapest Watt: Promoting Responsible Energy Use through Conservation and Efficiency

Background

Energy is the issue of our time – both globally and here in Oregon – and no single issue will have a greater impact on our state’s economy, environment and quality of life in the coming decade. The central question is whether we will shape our energy future through intentional investment and development, or whether it will shape us.

Over the last 37 years, Oregon’s policies and programs to reduce energy use and promote renewable alternatives have made the state a national leader.

In December 2012, Oregon released a 10-Year Energy Action Plan to guide the state toward a diverse, reliable, affordable and clean energy future. The plan is both a roadmap to a secure energy future and an economic action plan. It emphasizes getting urban and rural Oregonians back to work on energy-related projects. For

Oregon and the nation as a whole, clean energy development can be an environmental and economic strategy, positioning us to be better stewards of our resources and more competitive in the 21st century global economy.

A key component of Oregon’s past success in achieving affordable and clean energy has been adopting aggressive policies toward conservation and energy efficiency. The 10-Year Energy Action Plan aims to meet 100 percent of electricity load growth in the state through energy efficiency and conservation. While this goal is ambitious, there are still many opportunities available for this clean and low-cost way to meet energy needs.

The Role of Conservation and Energy Efficiency in Oregon, the West and the Nation

Once seen as primarily an environmental strategy, conservation and energy efficiency measures are now widely recognized as economic investments with high return. According to the American

Council for an Energy-Efficient Economy, efficiency improvements over the past 40 years have cut U.S. energy use approximately in half compared to what consumption would have been without such investments.¹ Still, there are large, cost-effective opportunities to increase energy efficiency further, helping us to reduce emissions and spur economic growth. Energy efficiency is a true resource capable of lowering utility costs to customers of every kind.

Building renewable and other clean generation will prepare Oregon for an uncertain future, providing a hedge against fossil fuel price volatility. Energy efficiency continues to be substantially less cost than building new fossil fuel generation. Saving energy costs 3 to 4 cents per kWh saved, compared to a U.S. average electricity price of 9.9 per kWh in 2011.² Even before environmental benefits are considered, energy efficiency measures deliver positive net benefits for all consumers, from a direct reduction in their utility bills to offsetting the need for more expensive utility investment in fuel, infrastructure and generation.

Over the next decade, energy efficiency and conservation will continue to serve as the cornerstone of Oregon's energy policy. When Congress passed the Northwest Power Planning and Conservation Act of 1980, it called on the Pacific Northwest to give energy conservation top priority when meeting its power needs. The region quickly learned that a megawatt saved is the equivalent of a megawatt produced. Since 1980, more than half of the increase in demand for electricity in the Pacific Northwest has been met with energy efficiency savings equivalent to eight to ten power plants.³

Annual savings in retail electric bills in 2012 from Oregon Department of Energy (ODOE) programs to date were about \$1.9 billion. Annual retail bill savings as of 2012 from 11 years of Energy Trust of Oregon (ETO) programs were \$1.3 billion.⁴ Since 2002, the ETO has reduced electric load for Oregon's two largest utilities by 4.5 percent compared to what it would have been without these programs. This has resulted in cumulative

savings of 368 average megawatts of electricity. ETO programs also saved 28.2 million annual therms of natural gas.

Funded through a public purpose charge, Energy Trust is an independent nonprofit organization dedicated to helping customers of Oregon's four largest investor-owned utilities save energy and generate renewable energy. Energy Trust programs have driven \$2.7 billion in economic activity in Oregon, including \$793 million in wages, \$155 million in small business income and employment equivalent to 2,240 full-time jobs lasting for 10 years.⁵ Utility bill savings and the resulting

economic benefits were achieved primarily through residential, commercial, and industrial energy-efficiency improvements including building insulation, high-efficiency lighting, high-efficiency HVAC and water-heating systems, changes to industrial manufacturing and process improvements, energy management enhancements and improved irrigation.

Energy efficiency improvements have had a far-reaching effect on

Oregon businesses and homeowners. More than 22,900 Oregon businesses have invested nearly \$2.4 billion in energy efficiency. Nearly 425,000 people have installed energy efficient appliances in their homes, such as refrigerators, dishwashers and washing machines⁶ through programs like the state's Residential Energy Tax Credit (RETC).

Oregon's publicly-owned utilities have also invested significantly in energy efficiency and conservation. From 2002 to 2011, public utility energy efficiency programs saved their customers 135.3 average megawatts, resulting in an average of 239 kilowatt hours of savings per year per customer.

Oregon's successes stem from longstanding public policies that recognize the myriad of benefits from efficiency investments, including lower energy bills for consumers, a cleaner environment, and local jobs. As a result of these efforts, Oregon ranks fourth in the nation in energy efficiency according to the American Council for an Energy-Efficient Economy.⁷

Over the next decade, energy efficiency and conservation will continue to serve as the cornerstone of Oregon's energy policy.

The Northwest Power and Conservation Council predicts that enough cost-effective conservation measures will be available to meet 85 percent of the region's load growth for the next 20 years.⁸ In Oregon, it is likely that we will exceed this, reaching zero or negative load growth in the coming decades. In fact, Oregon's total electric and gas usage declined between 2009 and 2011, a period of economic growth.⁹

Continuing to meet 100 percent of load growth through energy efficiency and conservation is an aggressive statewide goal, but one that is critical to driving more savings that will benefit Oregon businesses and ratepayers. While every utility serving Oregon customers is unique—some better situated to meet certain load targets than others—for the state as a whole this conservation goal is within reach. An analysis completed in support of the 10-Year Energy Action Plan demonstrates a scenario in which energy efficiency measures available to the state are able to meet new load growth through 2022 while providing net savings to consumers and significant greenhouse gas reductions.¹⁰

It is critically important that we, as a state and as a nation, push to meet such goals because energy efficiency is the cheapest way to meet new consumer demand and requirements for clean and affordable power. If executed correctly, maximizing energy efficiency and conservation will ensure that we maintain our competitively low cost of energy, making us an attractive place for businesses to locate and protecting Oregon consumers.

Challenges and Strategies to Developing Energy Efficiency

There are several market and policy barriers that consistently challenge the development of energy efficiency resources. Innovative solutions and partnerships are required from both state and federal policymakers to overcome these barriers and take full advantage of energy efficiency benefits. Major challenges include improving information for consumers, reducing government energy use, removing regulatory and legal barriers and enhancing energy efficiency finance options. Oregon is already addressing several of these

challenges and our 10-Year Energy Action Plan outlines strategies to further these efforts.

• Challenge: Improving Information

Ensuring consumers have accurate information when considering purchases or upgrades is essential to developing energy efficiency.¹¹ Often, however, accurate and easily comparable information is not available, effectively limiting the amount of investment in energy efficiency improvements. Lack of information that would allow homebuyers and renters to make energy cost comparisons between homes is a particular barrier. There is a similar lack of information in the commercial sector. While operating costs are never certain due to changing energy prices, easily accessible information can help consumers and businesses make more informed decisions, lowering utility bills and saving energy. Clear comparisons of products ranging from appliances to buildings are crucial to increasing knowledge and driving demand for energy efficiency improvements.

• Strategy: Performance Disclosure Mechanisms

Public building performance disclosure mechanisms are a critical tool in driving demand for energy efficiency and conservation. Currently, the ETO is providing homeowners with an energy performance score, a new tool that is similar to a miles-per-gallon energy efficiency and carbon emissions rating for the home. The score provides homeowners with information about how much it costs to operate their home and can provide a list of potential upgrades that will make their homes more comfortable and affordable. Oregon will build on both this pilot program and U.S. Department of Energy (U.S. DOE) home energy score efforts to make this tool available to all homeowners. This tool can help accelerate the market for energy efficiency and, when provided to potential buyers at the point of listing, would allow homeowners who wish to retrofit their new homes and amortize the costs of upgrades over the life of the mortgage to reliably determine the value of energy efficiency investments.

• **Challenge:**
Reducing Government Energy Use

While there are many opportunities for states to encourage private energy efficiency investment, government operations are often ripe for improvements that can save taxpayer dollars and demonstrate leadership. Government facilities and vehicle fleets use vast amounts of energy and represent direct opportunities to reduce energy use. Many government facilities are aging and out of date; efficiency improvements could considerably reduce operating expenses and taxpayer burden.¹² Barriers to reducing government energy use include making financing available to agencies and implementing incentives or penalties to ensure efficiency improvements are made in buildings and fleets.

• **Strategy:**
State Building Innovation Lab

Oregon will establish a State Building Innovation Lab in accordance with the U.S. DOE Better Building Initiative with a goal to reduce energy consumption in all state-owned buildings by 20 percent over the next ten years. ODOE estimates that a 20 percent reduction in the electric utility costs for state-owned buildings in Oregon would result in annual savings of at least \$100 million.

The State Building Innovation Lab will help the state determine how to pursue deep energy efficiency and conservation retrofits in the public sector. Over the next ten years, for every occupied state-owned building, the lab will establish benchmark energy use and conduct energy audits to identify cost-effective retrofits. The buildings will be retrofitted, improving the performance of up to four million square feet of identified office space and creating the data and experience to help drive a larger market. The State Building Innovation Lab will serve as a replicable model for both the commercial sector and one that could be adopted by local and regional governments to help them save money, reduce energy consumption, create local jobs and strengthen communities. Through this effort, ODOE will gather and analyze data, including the number of jobs created, the amount of money state entities save on utility bills and overall carbon reduction. The data will serve

as the foundation for understanding how to create innovative market opportunities and streamline the regulatory environment.

• **Challenge:**
Removing Regulatory Barriers

A common barrier for energy efficiency development involves the incentives in place for investor-owned utilities (IOUs). IOUs need a way to earn a return on investments in energy efficiency just like investments in generation capacity. Traditional regulatory structures can discourage utility investment in energy efficiency. New regulatory structures are needed to integrate energy efficiency into the delivery of energy services.

• **Strategy:**
Integrated Regulatory Structures

In Oregon and elsewhere, stakeholders have long discussed how to more effectively integrate energy efficiency and conservation into both investor and consumer-owned utility models that currently deliver energy services. Oregon has made significant strides in this area, including the creation of the ETO, collection and allocation of the public purpose charge and decoupling utility profits from sales growth. Moving forward, the state will analyze market barriers and work with stakeholders and the legislature to develop a new regulatory framework and financial mechanisms that allow IOUs to invest in deeper efficiency savings while still meeting customer and shareholder needs.

• **Challenge:**
Enhancing Finance Options

While energy efficiency improvements are cost-effective in the long run, challenges exist to secure the capital necessary for the initial investment costs. Financing for many projects can be limited and expensive. This is a particular concern for hard-to-reach markets such as small commercial and moderate-income multi-family housing where there is a small pool of private sector investment available.¹³ Low-interest financing is needed to encourage more businesses and homeowners to make initial investments that yield cost-savings

later. Energy efficiency loans, new mortgage structures and other financing tools can help scale private investment to create a secondary market that can meet the needs of energy efficiency development.

• Strategy: Public-Private Partnerships

Over the next decade, Oregon will coordinate existing energy efficiency capabilities while using new, innovative approaches for the direct use of utility and other private capital for investment in energy efficiency and conservation. Market transformation programs offered by entities such as the Northwest Energy Efficiency Alliance (NEEA), Bonneville Power Administration (BPA), Energy Trust of Oregon (ETO), Earth Advantage and the state's Residential Energy Tax Credit and business incentive programs can help scale energy-efficient technologies. Public-private partnerships such as Clean Energy Works Oregon (CEWO) will continue to unlock financing to encourage efficiency improvements. Since 2010, CEWO has remodeled more than 2,800 homes throughout Oregon, created or sustained more than 150 direct construction jobs and leveraged nearly \$20 million in private capital investment. Oregon will continue to support CEWO to deliver such services, make energy efficiency gains in the residential sector and save Oregonians money on their utility bills.

Finally, the Cool Schools program illustrates how the public-private relationships in energy efficiency can work to quickly deploy projects. The Cool Schools program tracked potential projects at 51 schools in 19 school districts, with project costs of around \$17 million. To date, Oregon's Small Energy Loan Program (SELP) has leveraged a \$175,000 investment from the state to generate over \$21 million in energy efficiency upgrades for 39 schools. Although this program is helping to decrease the cost of operations and maintenance for school districts statewide, it is also an important step in establishing the foundation for energy efficiency financing. We will need to capitalize the SELP program over the next several biennia to continue to deliver low-cost financing to conservation projects around the state.

The state will continue to develop new

financial tools in concert with new financing infrastructure to help utilities, consumers and commercial and industrial property owners leverage existing investor-owned and publicly-owned utility programs to unlock the benefits of energy efficiency. These investments could save homeowners and businesses money on their utility bills, create more jobs, strengthen our economy and protect our quality of life.

Regional or National Approaches

Oregon is working with partners across the region and nation to efficiently use our electricity generation resources. The Pacific Northwest Smart Grid Demonstration Project is a collaborative, five-year test of new technologies and capabilities that will make our regional power grid smarter. Projects piloted in Oregon are assisting consumers in shifting when they use electricity so that in addition to conserving resources, they are consuming electricity resources in the most efficient manner possible. This will allow utilities and the region to reduce peak electricity use and maintain low electric rates.

Conclusion

The U.S. has made great strides in advancing energy efficiency over the last several decades, but many untapped opportunities remain. In Oregon our goal is to meet 100 percent of electric load growth in the next ten years through conservation measures and improved efficiency. Key to this goal will be policies that improve information for consumers, reduce government energy use, remove regulatory barriers and encourage investments through public-private partnerships.

Today, energy efficiency is more important than ever. It is truly the only energy resource that is clean and emission-free while costing less than new energy generation resources. Efficiency serves our national goals of reducing our carbon footprint and enhancing our energy independence. In short, it is the world's most environmentally and economically responsible energy resource.



DENNIS DAUGAARD
Governor, State of South Dakota

Biofuels, Sustainability Leading the Way Today and Into the Future

Background

Biofuels are the leading alternative to traditional transportation fuels such as gasoline and diesel. Biofuels are important for three key reasons. First, they benefit the economy; second, they are expected to reduce the carbon footprint from the transportation sector; and third, they reduce dependence on foreign fuel and therefore provide energy security.

Biofuel is commonly defined as a renewable source of energy which is produced from biological material or biomass, such as sugar cane, corn, cellulose, or vegetable oils. The two most common types of biofuels in use today are ethanol and biodiesel. Ethanol, or grain alcohol, is used mostly as a blending agent with gasoline to increase octane and reduce carbon monoxide and other smog-causing emissions. Some vehicles, called Flexible Fuel Vehicles, are designed to use blends of up to 85 percent ethanol (E85). Biodiesel fuel is made from vegetable oil, animal fat, or recycled cooking grease which can be combined with alcohol or more commonly methanol, or wood alcohol. Biodiesel can be used as an additive

(typically 20%) to reduce vehicle emissions, or in its pure form, as a renewable alternative fuel for diesel engines.

Biofuels have earned a growing share of the global fuel supply and there is potential for much more development as the technology for advanced biofuels develops over the next decade. In the vast majority of the developed nations almost all gasoline is mixed with ethanol. In the United States ethanol holds approximately 10% of the gasoline market.

The United States is the global leader in biofuels production with approximately 13.3 billion gallons of ethanol and 1.1 billion gallons of biodiesel produced in 2012. In the United States, most of the ethanol production comes from corn and the biodiesel production comes from vegetable oil, animal fat, and recycled cooking grease.

As we look to the future, most of the growth potential for biofuels is with “advanced biofuels.” “Advanced biofuels” are derived from renewable biomass materials other than corn kernel starch. Advanced biofuels have minimal impact on the food or lumber supply because they utilize waste products of the farm and forestry industries. The supply of feedstock, or raw material, for

advanced biofuels exists in all regions of the United States. Consequently, biofuels development, and the benefits of generating biofuels, will not be as regional as it is today. By comparison, ethanol production today is primarily based in the Midwest where corn is grown.

The United States Department of Energy predicts the United States could sustainably produce an additional 85 billion gallons of advanced biofuels. This is enough to replace approximately thirty percent of our nation’s current petroleum consumption. Growth in advanced biofuels production across the nation will greatly benefit our economy, the environment, and our nation’s energy independence.

With rich topsoil, moderate temperatures, and an average rainfall of 14”-25” a year, South Dakota is uniquely positioned to produce biofuels. South Dakota has approximately 44 million acres of farmland, 46,000 producers, and 31,800 farms. Agriculture is South Dakota’s #1 industry, contributing over \$19 billion to the state’s economy every year. South Dakota has consistently ranked

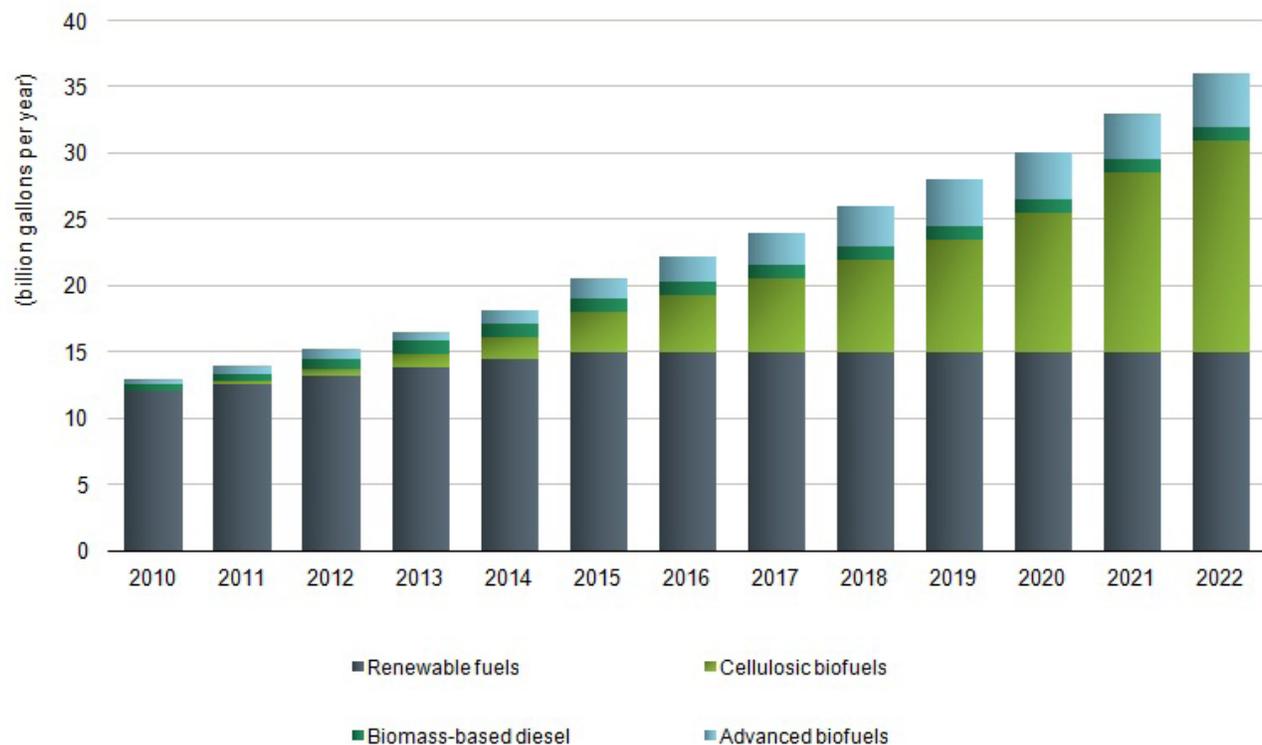
in the top 10 in production of 25 agricultural commodities, including corn, soybeans, wheat, alfalfa, sunflowers, and of course ethanol.

Corn is South Dakota’s largest crop, producing more than 500 million bushels each year. South Dakota has 15 ethanol plants with a total annual production capacity of over 1 billion gallons. These plants have helped South Dakota become the 6th ranked state in the nation in ethanol production.¹ With the world’s ever-increasing need for renewable resources, South Dakota will play a large role in biofuel production.

Role in National Fuel Policy/All of the Above Energy Strategy

Biofuels play a major role in our nation’s energy policy. They contribute to our current transportation fuel market and have potential for continued growth. Their role in our country’s energy fuel supply has been researched, analyzed, and debated for decades and undoubtedly that dialogue will continue into the future. Biofuels also

Figure 1: Renewable Fuel Standard II – Volumes by Year



Energkem. Accessed May 2013. <http://www.energkem.com/assets/images/RFS2%20Chart.jpg>

play a role in other policy discussions, including: agriculture, economic development, national security, natural resources, and the environment.

The biofuels industry has been a success story in the United States with annual production growing from approximately 1.5 billion gallons in 2000 to over 14.4 billion gallons today.² The industry's growth has created much business activity while at the same time increasing our fuel supply. The business activity generated by biofuels development has led to new rural development, hundreds of thousands of new jobs and wealth creation. Today the biofuels industry in the United States directly employs over 90,000^{3,4} people and indirectly employs almost 300,000.⁵ In 2012, the industry generated over \$45 billion dollars of the United States' gross domestic product.

Biofuels production has also benefitted our nation in ways that are not readily apparent. Our nation's dependence on foreign oil has been reduced. The uncertainty that comes with periodic oil spikes has also been reduced because our nation's energy portfolio has become more diversified with the biofuels that are a more stable commodity. The use of biofuels has also reduced the environmental and health impacts of transportation fuels by providing a cleaner alternative.

To spur further growth in the biofuels industry in 2007, the Energy Independence and Security Act (RFS II) was signed into law as comprehensive energy legislation to amend the Renewable Fuel Standard Act (RFS) signed into law in 2005. The RFS requires that advanced and cellulosic biofuels will fill 21 billion gallons of the standard (see chart at left).⁶ The RFS II grows the RFS requirement to 36 billion gallons by 2022 and was adopted to reduce foreign oil dependence and greenhouse gas emissions and to provide meaningful economic opportunity across this country. The RFS set the framework for the biofuels industry to drive America forward as a leader in energy stability and sustainability.

Today the United States biofuels industry is producing over 13 billion gallons of ethanol and 1.1 billion gallons of biodiesel (considered an advanced biofuel). The next generation of biofuels production will produce advanced biofuels.

Scientists are developing technology that allows them to make advanced biofuels from cellulose and hemicellulose. These fibrous materials make up the bulk of most plant matter, and are normally not used as food. Studies to date have shown that advanced biofuels offer the advantage of greater energy outputs and lower environmental impact.

Commercial development of advanced biofuels has been slower than expected, causing the United States EPA to reduce the national requirements for cellulosic and other advanced biofuels. Fortunately, there are at least eight commercial-scale cellulosic or advanced biofuel production facilities under construction with many others in various stages of design and engineering. When these advanced biofuels projects begin operation, the industry will be poised for another growth stage.

Producing an additional 21 billion gallons of advanced biofuels in our nation by 2022,⁷ as called for in the Renewable Fuels Standard, shows the following impact⁸:

- **Create** 190,000 direct jobs/ 807,000 total jobs
- **Generate** \$37 billion direct economic output
- **Produce** \$148.7 billion total economic output effect for the U.S. economy
- **Prevent** \$70 billion in U.S. petroleum imports annually
- **Reduce** oil prices
- **Provide** a .8% GDP contribution to U.S. and .21% to global GDP
- **Displace** 13.6 billion gallons of imported petroleum
- **Shrink** greenhouse gas emissions by the equivalent of removing 27 million cars from the road.

South Dakota has benefited greatly from the biofuels industry, siting 15 large production facilities and being home to one of the world's largest ethanol producers, POET. The biofuels industry in South Dakota directly employs over 1,900 people and contributes over \$3.8 billion to

the state's gross domestic product.⁹ Most of the state's production facilities are locally owned in small communities. These facilities have provided rural development and wealth creation in areas of the state where young citizens had been leaving in search of greater career opportunities in more populous communities. Demand for corn by the industry has also increased competition in the market for agriculture producers and resulted in higher local prices.

Challenges

The biofuels industry faces numerous challenges. Infrastructure incompatibility, misguided public perceptions, market volatility, technology development, and deployment are issues for the industry to overcome. Still, the industry has grown from less than 1% of the gasoline market 20 years ago to 10% of the current gasoline market.¹⁰

A significant challenge facing the industry today is the current infrastructure of the transportation system. The transportation & storage of biodiesel requires special management. Biodiesel must be blended properly and the product does not perform as well in cold weather because it has a higher cloud-point than diesel. Gasoline blended with 10% ethanol, commonly called E10, is compatible with almost all infrastructure and gasoline engines but higher ethanol blends may not be compatible. The current transportation infrastructure has limited the use of higher blends of ethanol for most consumers.

The United States has hit a "blend wall," meaning that ethanol use is at or near the saturation point of 10% content level due to the limited ability to distribute or use additional ethanol. To address this limit in 2012, the U.S. Environmental Protection Agency (EPA) gave final approval for blends of 15% ethanol (E15) to be sold to consumers with vehicles 2001 and newer. That approval was based on test results provided and conducted by the U.S. Department of Energy (DOE) and other test data and information regarding the potential effect of E15 on vehicle emissions. EPA approval was an important step for the industry; however automakers have denied warranty coverage for the use of E15 in non-Flex Fuel Vehicles. Thus far, E15 has only been sold to

a very limited market.

Demand for other mid-level blends, such as E20 and E30, which are legal for use only in Flex Fuel Vehicles, has increased. To sell E15 and other mid-level blends, retail fueling stations may need to update infrastructure, such as fuel dispensers, piping, and tanks, which may not otherwise be compatible with higher ethanol blends. Fueling infrastructure upgrades can be very costly for retail fueling stations.

One public misperception about biofuels is that crop diversion to ethanol has caused higher food prices. This food versus fuel debate expresses concerns that agricultural producers have diverted farmland or crops for biofuels production in detriment of the food supply. The ethanol industry does use approximately 40% of the U.S. corn crop, but over half of that corn's feed value is retained and returned to the animal feed market as protein rich distiller's grain. The food versus fuel debate is irrelevant when considering advanced biofuels because they are produced from non-food biomass.

A second misperception is that the production of ethanol uses more energy than is available from the ethanol produced. This has been proven erroneous by numerous studies, but some members of the public still believe that ethanol is a waste of energy. A recent study shows that ethanol takes approximately 1 unit of energy to produce and yields up to 2.3 units of energy to the consumer.¹¹

Developing and deploying advanced biofuels has proven to be a very difficult task. The technological challenges of producing high quality biofuels in a way that is both sustainable and economically competitive with gasoline has taken years and billions of dollars. It is taking considerable innovation and technology breakthroughs to grow, harvest, gather, transport, and transform extensive volumes of biomass into an advanced biofuel that is economic and affordable at market scale.

Strategies to Overcome Challenges

Biofuels need demand from consumers, support from policy makers, and investment dollars to ensure success for the industry in the future. The

promise of E15 and ethanol blender pumps offer near-term solutions for growth in the industry, but only if they are embraced by consumers and the transportation industry. Policy makers must have the patience and the wherewithal to continue support for biofuels. As our country continues to grow our biofuels industry with new products, it is important to remember that we cannot replace a transportation system built over a century in a matter of a few years.

The ethanol blend of E15 offers a great opportunity for the biofuels industry to increase market share since the US EPA approved the use of E15 in vehicles built in 2001 or later. The approved group of vehicles includes more than 75% of the cars, trucks and SUVs on the road today. To support the broad use of E15, it is important for states to ensure they do not have laws or rules that prevent E15 from being sold in their state.

Providing regulatory and financial support for ethanol blender pumps is a great way to expand ethanol use. Ethanol blender pumps, or flexible fuel pumps, offer a variety of mid-range ethanol blends like E15, E20, E30, and E40 in addition to the more common E10 and E85. The pumps draw different percentages of ethanol and gasoline from underground tanks and mix them together to form these intermediate fuel blends for use in Flexible Fuel Vehicles. Blender pumps give consumers different choices at the pump and allow retail stations the flexibility to serve several different markets. The U.S. Department of Agriculture Rural Energy For America Program offers grants of up to 25% of project costs to assist with the cost of purchasing and installing flexible fuel pumps for mid-range ethanol blends.

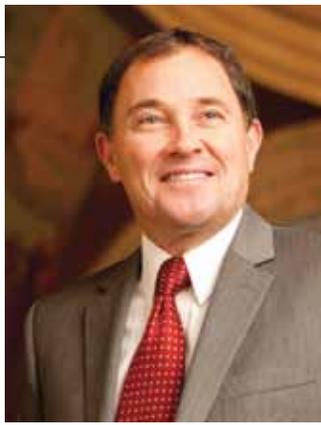
Several states offer their own incentives for the installation of ethanol blender pumps. The State of South Dakota has provided grants for retail stations that install new ethanol blender pumps. South Dakota's program to date has provided over \$1.4 million for the installation of 90 ethanol blender pumps at 49 different retail stations across the state. The program, and similar programs in the upper Midwest, has made the state and region a leader in the number of installed blender pumps.

Supporting biofuel technology through university and private research can help expedite the broader use of biofuels. In fact, the development of new biofuels which could utilize the current transportation fuel infrastructure without changes would remove many of the infrastructure challenges of the industry.

Conclusion

Biofuels are a vital part of the energy equation and will continue to play an increasingly significant role over the next several decades. The existing industry has had a positive effect on our nation. Biofuels burn cleaner and are better for the environment than petroleum alternatives. By using more of our country's homegrown renewable energy resource, the United States is less dependent on foreign oil imports, and volatile oil prices. Domestic production of biofuels ensures that domestic money stays at home instead being spent on expensive foreign oil. And, increased domestic biofuels production creates jobs and lowers the cost of fuel. The benefits of biofuels are conclusive and establish the basis for the United States to support biofuels as a growing part of our energy future.





GARY R. HERBERT
Governor, State of Utah

Developing Oil Shale and Oil Sand Resources

Introduction



Utah became known as the “Crossroads of the West” because of its central location and historical importance in connecting our region and nation.

Utah is similarly at the heart of many of our region and nation’s most valuable energy resources. Located in the middle of the Western Energy Corridor, Utah boasts world-class traditional, unconventional and renewable energy resources.

Utah’s citizens benefit from a vibrant economy and high quality of life. In 2012, for the third year in a row, Utah was ranked the #1 state for business by Forbes magazine. Energy is a key component of Utah’s successful formula. Energy development contributes nearly \$5 billion annually to Utah’s economy and energy jobs pay nearly twice the state average. Energy development in Utah also contributes to our high quality of life, which is made possible by low energy costs for businesses and residents alike. Although I’m encouraged by Utah’s achievements in energy, I’m confident that the best is yet to come.

To realize Utah’s energy potential, I have made

Energy one of the Four Cornerstones of my administration, along with Education, Economic Development and Self-Determination. At the outset of my administration, I brought together many of my state’s energy leaders to formulate a strategy to advance and secure Utah’s energy future, “Utah’s 10-Year Strategic Energy Plan.” This strategy recognizes that industry, entrepreneurship and technology are the key to more affordable, clean, reliable and secure energy.

Over the past decade, industry, entrepreneurship and technology have led to a transformative shift in the domestic production of natural gas and oil. Innovative technologies and techniques are opening up new domestic energy reserves, which in turn have spurred economic growth, reduced dependence on foreign oil and reduced carbon and other emissions as more natural gas has been utilized. These same forces are available to unlock other energy resources in our region. Oil shale and oil sands have the potential to greatly extend the United States’ energy leadership, and provide the crucial transportation fuels needed to fuel the economy.

As occurred at the dawn of this past decade’s energy transformation, many naysayers will argue that our oil shale and oil sand resources cannot

be developed responsibly. Fortunately, Utah loves a challenge. Industry, entrepreneurship and technology are coming together in the state to find cleaner and more affordable ways to unlock the potential of our immense oil shale and oil sand resources and contribute to a better, more secure energy future.

Background

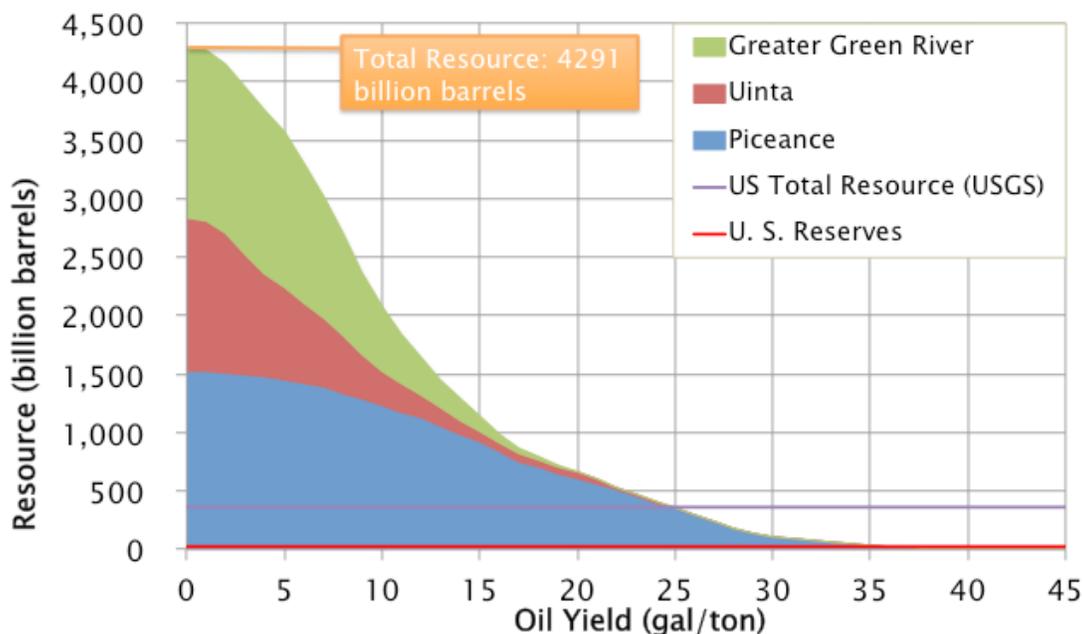
Deposits of oil shale are found in various locations around the world. The most concentrated deposits of oil shale in the world are found in the Green River Formation in southeastern Utah, western Colorado and southern Wyoming, which contains upward estimates of 4.3 trillion barrels of oil, a volume far exceeding the world's current proven conventional reserves. Taking into consideration current technology and constraints on oil shale development, the Utah Geological Survey has determined that roughly 77 billion barrels of oil located in north-central Utah's oil shale could be potentially extracted economically. In its October 2010 report, the Government Accountability Office highlighted the central role oil shale could play in

meeting our nation's growing energy demand.

After the Arab Oil Embargo in 1973, the U.S. Department of the Interior established an oil shale leasing program in Eastern Utah and Western Colorado. By the early 1980's most of the major oil companies had established pilot oil shale projects. The oil shale industry, however, collapsed in subsequent years with falling oil prices. Recently, due to the development of new technologies and rising oil prices, there has been renewed interest in developing the West's oil shale resources.

Oil sands play an increasingly important part in satisfying the world's demand for liquid fuels. Canada, the U.S.'s largest supplier of petroleum, produces the majority of its oil from oil sands. In the U.S., most oil sand resources are concentrated in Eastern Utah. Utah's oil sands, also referred to as tar sands, are estimated to contain 15 billion barrels of recoverable oil. While Canada's oil sands industry has demonstrated the economic viability of large-scale development, new projects in Utah aim to greatly reduce the environmental impact of commercial-scale oil sands development.

Green River Formation Oil Shale Resources



The Role the Energy Source Plays in State, Region and Nation

The U.S. relies on net imports of crude oil to meet about 45% of its oil consumption, which is directed almost entirely to transportation. Interestingly, the U.S. is a net exporter of refined transportation fuels. Oil Shale and oil sands could provide crucial new sources of crude oil to offset our dependence on foreign supplies, while also leveraging the U.S.'s advanced refining infrastructure to dramatically increase exports of finished transportation fuels and other petroleum products. Increasing the U.S.'s production of domestic oil would also erode the ability of hostile states to manipulate oil markets.

Commercial oil shale projects have been operating in Estonia, Brazil, China and other countries for decades producing tens of thousands of barrels of oil annually. Interest in developing oil shale resources is widespread. Pilot projects dot the global map and commercial projects are being developed in diverse places, such as Israel, Jordan, Russia and Australia. Oil shale conferences and

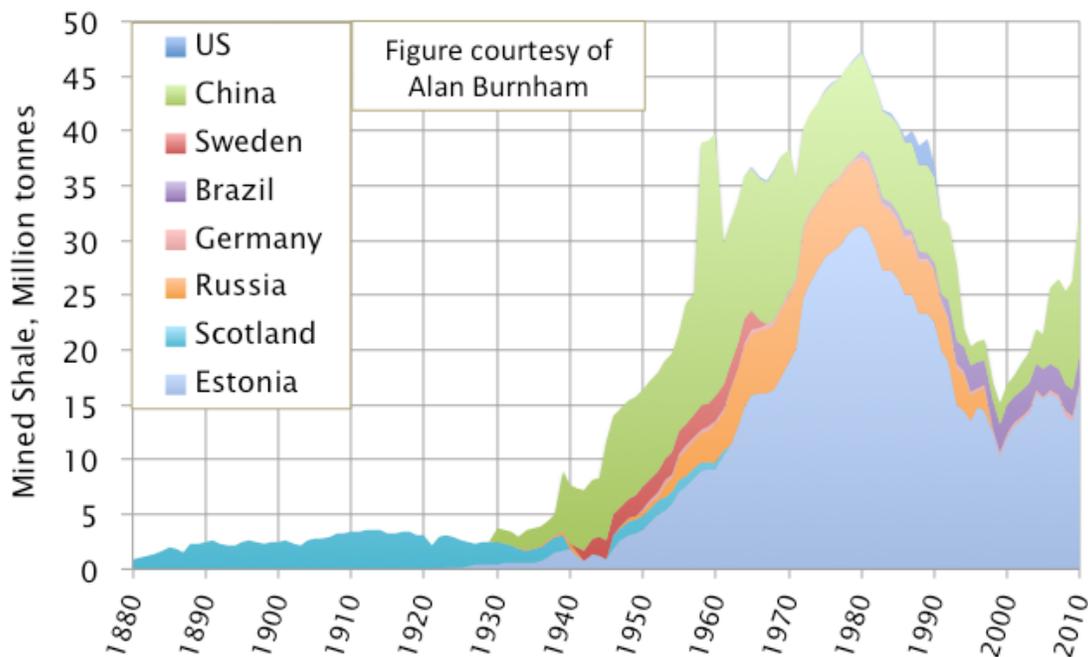
meetings, including breakout sessions at the Governor's Energy Development Summit in Utah and the Colorado School of Mines Oil Shale Symposium, attract representatives from around the world.

Although required under the 2005 Energy Policy Act, the U.S. currently does not offer commercial leases on federal land. Federal lands administered by the Bureau of Land Management (BLM) contain about 80% of the oil shale resource in the West. The absence of federal research and development funding and a federal commercial leasing program has created unnecessary challenges to the development of this valuable resource.

Fortunately, Utah has taken a leadership role in offering a commercial oil shale leasing program on state lands. The State Institutional Trust Lands Administration (SITLA) has leased nearly 100,000 acres of state lands for oil shale and oil sands development. Development royalties go to a permanent state education trust fund to support K-12 education.

There are numerous commercial oil shale and

Historic Oil Shale Production



oil sand projects underway in Utah. Significant technological breakthroughs reducing the financial and environmental cost of oil extraction have helped attract hundreds of millions of dollars of investment to these projects.

Enefit American Oil owns or leases more than 30,000 acres of oil shale property in Utah. Its parent company, Eesti Energia, produces 90% of Estonia's energy from oil shale and has successfully produced oil from oil shale for over 30 years. Regulated by the European Union, Eesti Energia has operated its commercial oil shale operations complying with the European Union's strict environmental regulations. Enefit American plans to commence the commercial production of 25,000 barrels of oil per day in Utah in 2020, ramping up to 50,000 barrels per day in 2024. Red Leaf Resources has successfully demonstrated its EcoShale In-Capsule Technology at pilot scale producing hundreds of

Over the next 20 years, Utah's oil shale and oil sands industry is projected to generate thousands of new jobs, hundreds of millions of dollars for Utah's school children and several billion dollars for Utah's economy.

barrels of oil at its site outside of Vernal, Utah. Red Leaf recently entered into a \$400 million joint venture with the global energy company Total to build a commercial scale EcoShale plant with plans to produce 10,000 barrels a day by 2015.

U.S. Oil Sands has developed a new solvent-based technology for extracting oil from oil sands. Capital costs are much less than current commercial oil sand operations in Canada. The extraction process uses a biodegradable solvent made from citrus and recycles 98% of the solvent and 95% of the water. U.S. Oil Sands has invested \$35 million in its Utah project to date and has received all necessary permits to begin commercial development. U.S. Oil Sands plans to begin producing 2000 barrels per day in 2013, scaling up to 20,000 barrels per day by 2018.

Over the next 20 years, Utah's oil shale and oil

Commercial Oil Shale Technology



sands industry is projected to generate thousands of new jobs, hundreds of millions of dollars for Utah's school children and several billion dollars for Utah's economy. The U.S. Oil Sands project alone estimates that over the next 10 years it will create 500 to 1,000 full time, high-paying jobs, contribute roughly \$200 million to SITLA, and generate \$800 million in new state tax revenues. As infrastructure is improved and processes optimized, it is expected that efficiencies and productivity will increase rapidly. Production costs in Canada's oil sands declined by 80% from 1980 to 2003, and cost reductions should be expected if our region's oil shale and oil sands resources are developed commercially.

The Challenges of Developing the Resource

One challenge is the ability of oil shale and oil sands to compete profitably in a global market dominated by conventional oil. While estimates of cost for oil shale production vary, sustained oil prices above \$70 a barrel would allow sufficient profit margins for the current oil shale and oil sand projects in Utah. It is expected that economies of scale and new infrastructure would greatly reduce production costs. Oil shale and oil sands operations generally require significant front end capital investment. Canadian oil sand operations, whose production costs have dropped dramatically since inception, addressed many of these financing challenges through significant government investment. Production costs for a barrel of oil from Canadian oil sands is now below \$30 a barrel.

Other concerns about oil shale and oil sand developments relate to its impact on the region's air, land, water and wildlife. These concerns must be addressed to provide a path forward for large-scale development. Commercial oil shale and oil sands activities will have to comply with state and federal standards, including the Clean Air Act, the Clean Water Act, the Safe Water Drinking Act, and the Endangered Species Act, as well as any new regulations that may be enacted, including potential controls on carbon emissions.

While industry can likely address the economic

and environmental challenges of development, unfortunately, one of its greatest challenges is largely outside its control – federal policy. The federal government, which controls over 80% of the oil shale resource in the U.S., has failed to provide a reasonable regulatory path forward for the commercial development of oil shale on federal land. The federal government still has not provided commercial leases in compliance with the Energy Policy Act of 2005. Further exacerbating this situation, the BLM has recently placed an additional 1.2 million acres of its lands off limits to oil shale and oil sands research and development in a final programmatic environmental impact statement (PEIS). This is a dramatic departure from a previous PEIS the BLM conducted in 2008. The BLM's unclear leasing program and uncertain path to commercialization creates significant and unnecessary hurdles to development of our nation's oil shale and oil sand resources.

Strategies to Overcome Challenges

I'm confident that industry, entrepreneurship, technology, and a little good governance can address the economic, environmental and political challenges still standing in the way of significant oil shale and oil sands development. Lower costs and increased certainty would help draw into the market many companies who are currently testing Utah's oil shale and oil sands resource and have expressed interest in establishing operations in Utah.

Market forces should be allowed to determine how we achieve our shared goal of affordable, reliable and clean energy. However, Utah recognizes that starting a new energy industry isn't easy, and that priming the pump is sometimes needed. To help address the combination of high initial production costs, and high initial capital investment, which generate significant headwinds for otherwise promising oil shale and oil sands projects, the state of Utah has put two incentives in place. First, passed in 2012, the Alternative Energy Development Incentive provides a fixed post-performance credit of 75% of all newly generated state revenues for qualifying oil shale and oil sands projects. Secondly, the Utah Energy Infrastructure Authority, also passed in 2012, offers tax free revenue bonds that

advance energy delivery projects that facilitate responsible energy development.

As the oil shale and oil sands industry gains momentum, the need for these incentives will be revisited. The State of Utah is also assisting industry through developing extensive mineral resource information, and providing efficient and fair leasing terms and permitting compliance. Utah has opened up over 100,000 acres of state land for oil shale and oil sands leasing, and the Utah Division of Oil, Gas and Mining (DOG M) has expended significant resources providing and defending permits for the industrial development of oil shale and oil sands.

Utah is already working upstream to address the air, land, water and wildlife impacts of oil shale and oil sands development. The state is conducting several environmental impact studies and is creating and implementing plans to mitigate the impacts of energy development. For example, the State of Utah is wrapping up a year-long effort to develop a comprehensive plan for ensuring a healthy and robust Sage Grouse population in Utah, whose habitat could be affected by oil shale and oil sands development.

Utah is investing in research and new technology. Oil shale and oil sands companies are actively working with the University of Utah's Institute for Clean and Secure Energy (ISCE) and Energy and Geoscience Institute (EGI) to advance promising oil shale and oil sand technologies. Resources such as the ISCE's advanced computer simulation modeling technology can help speed up oil shale development in Utah by reducing the costs associated with scaling up promising technologies that have been successfully demonstrated at a smaller scale. Utah's research universities are also actively exploring ways to reduce the environmental impact, water use and carbon emissions associated with oil shale and oil sands development, including geologic sequestration of oil shale carbon emissions.

Most importantly, Utah is supporting the efforts of industry and entrepreneurs that are deploying new technologies that greatly reduce the environmental impacts of oil shale and oil sands development. For example, Enefit American is designing its Utah

project using the strict European Union Industrial Emissions Directive, under which the commercial oil shale extraction plant of its parent company, Eesti Energia, is regulated. Eesti Energia's commercial plant also complies with the European Union's greenhouse gas emissions regulations. Red Leaf Resources EcoShale capsule technology allows for the economical control of its emissions, and can be modified to capture and sequester its carbon emissions. U.S. Oil Sands technology produces emissions, including carbon emissions, which are similar to conventional oil extraction. All of these technologies are also designed for quick reclamation of the land.

Conservative estimates hold that three barrels of water will be needed for every barrel of oil produced using standard above ground oil shale processing technology. To put this into perspective, it takes eight barrels of water to produce a two liter bottle of cola. While this rate of water usage is similar to other alternatives for producing liquid fuels, new technologies being deployed in Utah would dramatically reduce water usage. For example, Red Leaf Resources EcoShale technology does not use any water in its process and U.S. Oil Sands process recycles 95% of the water it uses.

Conclusion

The challenges of developing Utah and the West's oil shale and oil sand resources should not be minimized; however, neither should the opportunities. This vast resource could provide enormous economic benefits to our region and greatly extend our nation's ability to provide affordable and reliable domestically produced liquid fuels. Not long ago, many so called "experts" predicted that U.S. natural gas and oil reserves had been largely exhausted. Fortunately, industry, technology and an entrepreneurial spirit moved forward to find new ways of extracting natural gas and oil from domestic resources. As our nation reaps the benefits of this energy transformation, I would ask the western states to work more closely with each other and with the federal government to pursue more reasonable policies that would enable another energy transformation developing our domestic oil shale and oil sand resources.



JAY INSLEE
Governor, State of Washington

A Legacy of Clean Energy, an Opportunity for Climate Action

Clean Energy Legacy



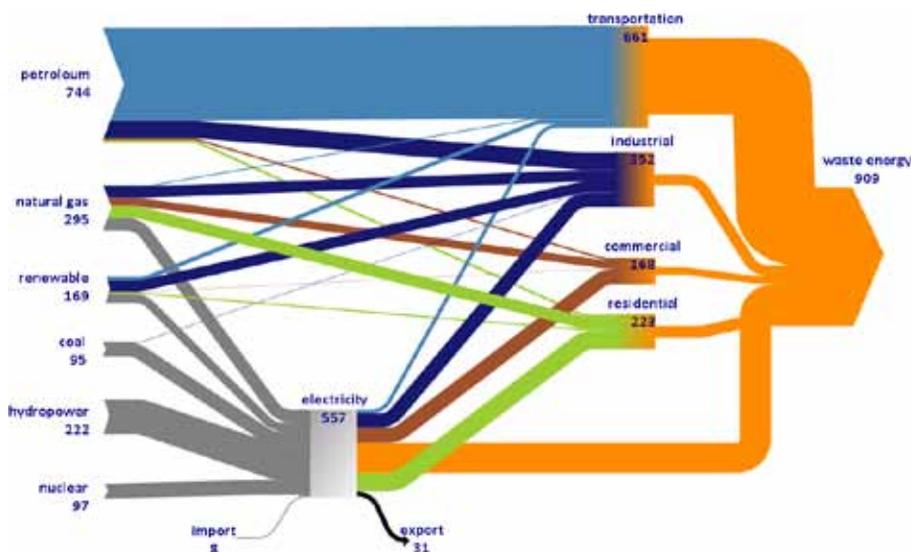
On Dec. 7, 1935, Washington's Gov. Clarence Martin poured the first concrete for the Grand Coulee Dam — “The biggest thing that man has ever done.” That action not only laid the foundation of a massive, new electricity-generating project, it also ushered in nearly eight decades signaling Washington's prominence as a national leader in clean, abundant and inexpensive electricity. Cheap electricity spawned new and expanded industries from aluminum production to airplane construction and forest products to data processing. It created a publicly owned electricity system of municipal utilities, public utility districts and electricity cooperatives that now serve more than half of Washington's electric load.

Today, Washington is home to 30 major hydroelectric generating projects that, during abundant water years, meet more than 70 percent of the annual electricity needs of Washington citizens, businesses and industries. Coupled with the emergence of Washington as one of the top 10 states for wind development, nearly one-fifth of all the renewable electricity produced in the United States comes from Washington.

However, the need for and opportunities in clean energy remain enormous. A swelling global population and demand for energy, along with the serious consequences of unabated climate change — already visible in Washington through more frequent wildfires, increasingly acidic sea waters and other impacts — will create markets for cleaner, more sustainable energy technologies and systems in the United States and around the world. Today, there is no challenge greater for Washington — with more opportunity for job growth suited to the state's unique mix of innovation, entrepreneurship and environmental stewardship — than becoming a national and international leader in this 21st century clean energy economy.

Shrinking our dependence on imported energy and boosting home-grown, clean energy will strengthen and expand Washington's economy. In fact, job creation rates in Washington's clean energy economy are well above those in other sectors, and clean energy jobs pay better. We must help our clean energy industries compete effectively in this growing global economy by attracting investments and leading the world in technology development. Volatile gasoline prices, dependence on fossil fuels and the reality of climate change will drive world demand for clean energy. We can turn those forces into economic opportunities by moving quickly to power our transportation system with clean

Figure 1: Source and consumers of energy in Washington (2010)



and affordable electricity. This will ensure state investments in transportation contribute to clean energy and climate solutions as we generate jobs and save taxpayer dollars.

Already Washington is home to companies on the cutting edge of clean energy technology. From solar and advanced composites manufacturing, to development of advanced biofuels and low-impact hydropower, to energy-efficiency services: the Evergreen State has a burgeoning sector upon which we can launch our state into the global leadership role in clean technology.

This chapter outlines several characteristics of Washington’s energy system — particularly the role of clean energy — while highlighting some of the major accomplishments and future policy directions that offer the greatest potential for reaping economic and environmental rewards.

Washington’s Energy System

Washington’s energy flows are illustrated in the Sankey energy diagram above. When compared to other states, Washington’s energy system is relatively clean and served by low-cost electricity from hydroelectric generators, thermal energy with a larger-than-typical contribution from biomass and fairly typical transportation energy. The state’s greenhouse gas footprint is dominated by transportation energy, thanks to the relatively low

greenhouse gas emissions related to the electric grid.

In the figure, the thickness of each line is proportional to the quantity of energy being delivered or consumed; these quantities appear as numeric values on or adjacent to each line, in trillions of British thermal units (TBTU). Of the more than 1,600 TBTU of primary energy consumed annually by the state, one-third was used by electric generators, with the remainder going directly to three consuming sectors (transportation, industrial and residential/commercial). The transportation sector is the least efficient user of primary energy, delivering just 26 percent of the primary energy as useful energy services and losing the remainder as waste heat.

To meet these statewide energy needs, Washington’s residents, institutions and businesses spend more than \$20 billion each year on energy. Of that \$20 billion, more than \$15 billion goes to petroleum and natural gas, neither of which is produced in the state.

Clean Energy Jobs in Washington — Now and in the Future

The “2011 Green-Economy Jobs Report,” produced by the Washington Employment Security

Department, identified some 120,000 green jobs in the state, about 4.3 percent of total state employment. Of those 120,000 jobs, one-third (32.4 percent) were associated primarily with increasing energy efficiency and 14 percent were in the production of renewable energy. Overall, more than 90 percent of energy-related jobs were in the private sector.

Looking toward the future, the Pacific Coast Collaborative (PCC), composed of the states of Washington, California and Oregon and the province of British Columbia, commissioned a study of future clean economy job opportunities: “The West Coast Clean Economy — Opportunities for Investment and Accelerated Job Creation.” The study concluded that with a strong focus on clean energy policy and program development, jobs in these industries would grow by 200 percent in the period from 2010 to 2020, with the largest growth potential in energy efficiency and green buildings (more than 400 percent), followed by clean transportation (more than 270 percent).

The PCC analysis also underscored some of the particular strengths of Washington that contributes to this potential, including:

- A high concentration of clean tech and high-tech establishments
- World-class public research universities (University of Washington and Washington State University) and the Pacific Northwest National Laboratory
- The first green-jobs training program in the nation coupled with a highly educated and skilled workforce
- A network of clean technology companies represented by the Washington Clean Technology Alliance
- Strong global trading relationships with China, Japan, India, South Korea and Canada
- An energy policy base that includes strong and well-implemented building codes, a combined renewable energy and energy efficiency portfolio standard, and high levels of investments in renewable electricity and energy efficiency

To lead clean energy industries, our state has recognized the need to invest in a trained clean energy workforce. As one example, our state has created the Pacific Northwest Center for Excellence in Clean Energy at Centralia Community College, in southwestern Washington. Led by a steering committee representing utilities, government, energy efficiency companies and energy industry specialists, this program focuses on electric utility industry skills needs and includes an in-depth, smart grid curriculum. By the end of March 2012, more than 2,800 individuals had received some type of smart grid-related training at the center.

Clean Energy Accomplishments

• Wind Energy

In 2001, Washington State had no commercial-scale wind energy generation. By the end of 2012, independent power producers, along with public and private utilities, had developed more than 2,800 megawatts of new wind representing more than \$5.7 billion in investment. Washington is now one of the top 10 wind energy-producing states. These investments have brought new clean electricity to customers, created construction and operating jobs and strengthened the tax base for many rural counties.

• Biomass Energy

Washington, as a major agricultural and forestry state, has long looked to forest and farm as important sources of energy supply. For decades, many of Washington’s forest products facilities have used “waste” biomass to provide thermal energy for their production processes while cogenerating hundreds of megawatts of electricity. Today, we have become a national leader in integration of nutrient management and energy production through research and development of anaerobic digesters. Our coastal biodiesel refinery, Imperium Renewables, with a refining capacity of 100 million gallons per year, is one of the largest refineries of its kind in the country.

Looking to the future, it seems appropriate that our state, a world center for commercial and military aircraft design and fabrication, should

advance production of state-of-the-art aviation biofuels. Washington farms, forests and fields offer the natural advantage of producing nearly every type of potential biofuel feedstock. The University of Washington and Washington State University have been funded to undertake world-class research in biofuels. In addition to aircraft makers such as Boeing, companies such as Alaska Airlines are willing to test these new bio-aviation fuels. In November 2011, Alaska Air flew 75 of its regularly scheduled flights with a blend of regular jet and bio-based fuels.

• Highly Efficient Buildings

One of the great clean energy success stories in Washington and the Pacific Northwest region concerns our achievements in building energy efficiency. The Northwest Power Act of 1980 identified investments in electrical energy efficiency as the most flexible and cost-effective way to meet our state's and region's growing needs. Since that time, our utilities have accrued energy efficiency savings equivalent to several times the annual electric load of Seattle, at an average cost of little more than 3 cents per kilowatt hour. These investments have not only provided very low-cost resources for utilities, they have also spawned a large and growing number of energy efficiency companies.

Since 1987, the Washington State Weatherization Program, administered by the Department of Commerce, has provided energy-efficiency upgrades to Washington homes. Twenty-five local agencies provide weatherization services to low-income families in every county, supporting hundreds of jobs. So far, upgrades to some 125,000 Washington homes have saved families an average of 25 percent on their energy bills.

Also, in 2005, our state enacted a high-performance green buildings law that requires new public buildings exceeding 5,000 square feet, such as schools and government facilities, to meet green building standards. As of 2012, 52 new public buildings have been built to this standard, with average estimated energy cost savings ranging from 12 to 46 percent.

• Transportation Energy

Transportation is both our biggest challenge and our largest opportunity. Of our state's energy-using sectors, transportation of people and products is the largest in energy consumption and in expenditures and greenhouse gas emissions. Yet it is the least efficient in converting energy inputs into useful services.

Although transportation remains the largest untapped energy opportunity, Washington has some notable achievements. Last year, we completed the installation of charging stations for electric vehicles along Interstate 5 from British Columbia to Oregon — the first border-to-border, rapid-charging network in the country and a key link in the West Coast Green Highway system from Whistler B.C., to Baja California. Washington's public vehicle fleet has among the highest percentages of hybrid vehicles in the country. We have also set the nation's highest mandate for biodiesel content in public fleets, not a small requirement for a state with one of the largest diesel-powered ferry systems in the world.

Governor Inslee's Clean Energy Priorities

Invest to develop clean energy solutions. Help Washington businesses develop and demonstrate technologies to produce and consume clean energy. These technologies will integrate clean, renewable energy into the grid through electrical energy storage and smart-grid solutions. Establish a clean energy fund to leverage federal, utility and private investment in research, development, demonstration and early deployment of high-value, clean energy technologies, especially those technologies that can increase our competitiveness and provide export opportunities.

Invest in clean energy and climate solutions for transportation. Extend the electric vehicle fast-charging network across Interstate 90 to Spokane and out to the Washington coast, thus increasing consumers' access to electric vehicle transportation

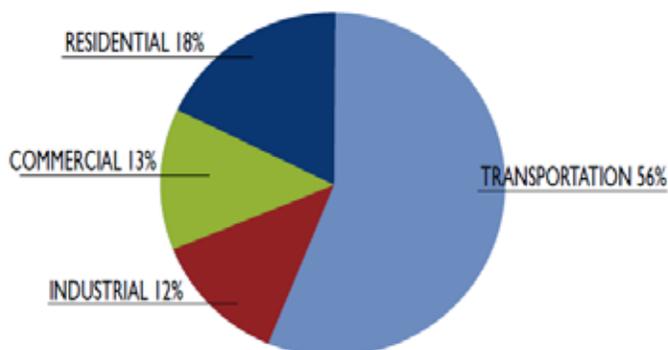
throughout the state. Leverage our clean and low-cost hydropower and wind resources to lead the nation in vehicle electrification and make local electric utilities a part of the solution to support sustainable transportation alternatives.

Support increased production at the state's biodiesel refineries and oilseed farms. Continue our work to grow, process, refine and use advanced biofuels at commercial scale. Invest in biofuels for our state's ferry system and state vehicle fueling centers.

Use Washington's world-class research institutions to lead in development of clean energy technologies. Establish a new Center of Excellence for Alternative Jet Fuels and Environment at Washington State University to nurture partnerships among research institutions and the agricultural, aviation and maritime industries, and position Washington to be the leader in aviation biofuels and development of key markets for co-products. Establish a new Clean Energy Institute at the University of Washington, with special focus on research of energy storage and solar energy technologies to make the UW a magnet for federal and private research funding and leader in clean tech innovation.

Identify actions to achieve our greenhouse gas emissions limits. This year, the Legislature passed a bill to create a bipartisan Legislative and Executive Work Group to determine the best ways to meet the state's legally binding emissions reduction goals. That study and recommendations will be completed by the end of 2013.

Figure 2: Sector contributions to energy waste in Washington State (2010 data). Energy waste is heat released to the environment without performing a useful function first.



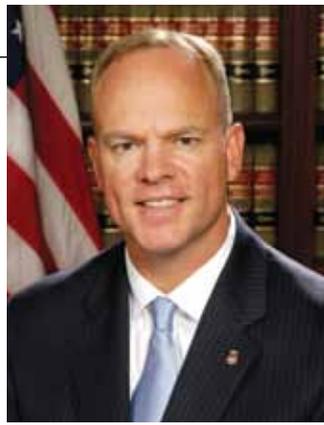
2012 Washington State Energy Strategy — core solutions for economy, jobs and climate

The Washington State Department of Commerce issued the 2012 Washington State Energy Strategy in December 2011. This strategy, chartered by the state Legislature and governor, focused on balancing critical aspects of our energy system:

1. Maintaining competitive energy prices that are fair and reasonable for consumers and businesses, and support Washington's continued economic success;
2. Increasing competitiveness by fostering a clean energy economy and jobs through business and workforce development; and
3. Meeting the state's obligations to reduce greenhouse gas emissions. A 2008 state law established statewide greenhouse gas emissions goals of returning to 1990 emissions levels by 2020, and decreasing emissions to 25 percent below 1990 levels by 2035 and to 50 percent below by 2050.

Using the knowledge and expertise of a wide range of policy and technical experts, the strategy concentrated on approaches that could help build a more efficient and coordinated transportation system, make our buildings more energy efficient and diversify our energy supply portfolio through distributed energy systems ranging from solar photovoltaics to district energy.

Figure 2 illustrates the energy wasted by each major sector. A common theme throughout the strategy is the large opportunity that reducing waste and improving energy efficiency can provide toward the goals of preserving low-cost energy, creating clean energy jobs and reducing greenhouse gas emissions.



MATT MEAD
Governor, State of Wyoming

Coal is Part of Our Future



The Western United States is chock-full of energy resources and natural wonders. The beauty and economic potential of the region astound us. That is why so many people put down roots in the West and call it home. That is why so many businesses and workers want to be here. That is why so many visitors from other states and around the world come back to the West again and again.

Wyoming's history shows that we can develop our energy resources and retain our state's physical beauty. We would not choose one over the other. Our past and present history shows that we can have both, and the future will be no different.

Coal will be part of America's future. It is an incredible resource. It has energized America throughout modern history, lighting our homes and factories, contributing to our stature as an economic powerhouse, and enhancing quality of life through the affordable, abundant heat, light, and power it provides. I am privileged to write about coal for the Western Governors' energy initiative.

The Ten Billionth Ton of Coal

In May 2013, Wyoming mined its ten billionth ton of coal. This is a significant milestone. Wyoming has 18 actively producing coal mines. Those mines

provide more than 7,000 direct jobs. The Powder River Basin (PRB), located in Northeast Wyoming and Southeast Montana, contains the largest coal reserve in the United States. The reserve in Wyoming alone is estimated to be 61 billion tons.

Wyoming's North Antelope Rochelle and Black Thunder Coal Mines accounted for 20% of the U.S. coal mined in 2012. Wyoming mines—the most efficient in the nation—produced more than 400 million tons of coal in 2012, with total sales of \$4 billion. Most of the lands where coal mines operate are public lands administered by the Bureau of Land Management. Coal in Wyoming is primarily mined at the surface - the coal is shallow and safer to mine. Mines are reclaimed to a natural state with improved, productive soils.

The quality of coal is a combination of physical characteristics: sulfur, heat-value, moisture, and ash content. One of the great benefits of PRB coal is its low sulfur content. This attribute is one of the reasons PRB coal is used in 34 states. Low sulfur PRB coal is often blended with other coals to meet environmental objectives. Another reason PRB coal is used in so many states is its low cost to everyone in the chain of production, including end users.

A BTU, short for British thermal unit, is a standard energy measurement. It is the amount of energy needed to heat one pound of water one degree Fahrenheit. Average coal heat values of Wyoming

coal range from 8,580 BTUs per pound to 10,000 BTUs per pound. Wyoming coal has provided nearly 176 quadrillion BTUs in energy to this country. This is enough energy to power the entire nation's electricity grids for more than eight years.

Coal mining has provided thousands of direct jobs in Wyoming over the last 150 years—and countless more indirect jobs in our state and across the country. With the advent of the steam-powered locomotive, coal became a major transportation fuel. Then the Industrial Revolution came along, creating more demand for energy. Coal dominated that Era's economic and technological advancements.

Coal's uses and contributions continue to evolve and play a vital role in Wyoming, the United States and around the world. And achievements by the industry continue to astonish us.

In 2011, Basin Electric's Dry Fork Station, a coal-fired power plant near Gillette, Wyoming began operation. Basin Electric invested more than \$336 million for advanced environmental controls at the new plant. Dry Fork uses advanced technologies to exceed all state and federal permitting requirements. The 422 megawatt plant uses one-fifth the water needed for traditional coal-fired power plants. The plant captures nearly all the mercury created from burning coal.

The clean, modern Dry Fork Station joins the likes of the recently opened John W. Turk Power Plant in Arkansas. The new Arkansas plant uses high temperature and high pressure combustion technologies requiring less coal and producing fewer emissions.

Ten billion tons of mined coal has made a significant impact in many ways and yet most people do not know much about coal. In fact, few people really think about where power comes from—other than a wall socket. We need to fill the information gap.

Wyoming has been working on a state energy strategy for the past two years. This has been a high priority for me, and it is set to be published as I write these words. Energy education is part of the strategy. We hope to see energy education incorporated in the k-12 system and included in

public awareness campaigns. It is important for citizens to know how our economy remains vital and how our standard of living remains high – coal is at the heart of both.

There are 318 gigawatts of coal fired power generation in the United States. In 2012, coal provided 37.4% of U.S. electric generation and, in 2010, coal was the primary source of electrical generation in 25 states. The average price of generation in those states was 8 cents a kilowatt-hour. The average cost for states with a primary source of generation other than coal was almost 12 cents - a third again more.

Ten billion tons of coal mined in Wyoming is a marvel, and we have many billion tons more to be mined in the future.

Demand and Supply

Demand for energy will continue to grow. The energy needs of the United States will grow along with our economy. By 2035, global demand for energy is expected to increase by a third.

Energy is fundamental to the basic necessities of life - safety, food, housing, transportation and communication. We want our communities to prosper with jobs, infrastructure, and strong economies. For America, energy is tantamount to growth, prosperity, security, and quality of life. On a global basis, people everywhere deserve the best life possible, and we want that for them as well as for ourselves. What once was the American dream is now the dream of the entire world. Energy now is key - as is energy in the future.

Wyoming has every kind of energy resource in abundance. These resources include oil, gas, coal, uranium, wind, and solar. If Wyoming were a country and compared to other energy-producing countries, our state would rank 10th in energy production. Wyoming is the largest net energy exporter for the U.S. and benefits its economy equivalently. Ten percent of the BTUs consumed in the U.S. come from Wyoming. This equates to one of every two American homes heated and lighted by Wyoming BTUs. These examples give a sense of the magnitude of Wyoming's energy resources and Wyoming's contribution to the nation.

Wyoming is one of the top three natural gas producing states (2.1 trillion cubic feet annually). It is the eighth largest producer of oil (50 million barrels in 2012). Wyoming is the number one producer of yellowcake (uranium) in the country. We have 40% of the class 5-7 onshore wind in the country and have 1,412 megawatts of installed wind capacity. And, of course, the Cowboy State is the nation's leading producer of coal. Wyoming is grateful for the blessings nature has bestowed on our state and proud of our contribution to the energy needs of the country. We look forward to contributing to global energy needs. Our state's supplies, including coal, can help meet the country's and world's growing demands.

Regulatory and Other Challenges

Over the past 40 years, the Environmental Protection Agency (EPA) has developed measured rules and regulations to improve air quality from coal generation. These regulations have by-and-large worked. The utility industry has made huge investments to reduce emissions. Emissions have dropped by 63% since the 1980s. A new coal-fueled power plant today emits 70 to 90 percent fewer emissions than the typical plant it replaces.

However, recent regulatory pressure from the EPA is not measured; rather, it is unrelenting and often unachievable in terms of timing, cost and technology. We must work with the EPA and arrive at solutions that account for the time and resources it takes to comply with new regulations. Economic reality must be part of that discussion. In the end analysis, EPA through federal regulations should not pick energy winners and losers. Coal got our country where it is now, and it will take us into the future. We have it in abundance, and it must not go to waste.

Not long ago there were significant funds for coal research, coal conversion and CO2 capture technology. These are advanced coal technologies – ones to further develop and build upon. The combination of smaller federal budgets and a federal priority for renewable energy has all but dried up meaningful coal research funds. This is likely to continue in the years ahead. Coal research

benefits the economy and the environment. Environmental strides have been made and if they are to continue, we must fund the research, development and commercialization of new, clean technologies.

Current federal regulatory pressure on coal is fostered with the apparent purpose of discontinuing the use not only coal—but of all fossil fuels. Coal is a primary target of environmental groups focused on greenhouse gas emissions and climate change. Coal is not the only emitter, but it has become the scapegoat for all things environmental. It is important to keep in mind that the objective of the environmental groups is not simply coal, it is all fossil fuels and then what – wind turbines, other energy resources? Coal just happens to be the first in the crosshairs.

In addition to regulatory pressure, the coal industry will need to adjust to competition from inexpensive natural gas. This is evidenced by the utility sector's fast and broad-based shift to natural gas. Domestic markets for coal are contracting. The Energy Information Agency (EIA) estimates 49,000 megawatts of coal generation will retire by 2022 and will be replaced by other fuel types—primarily natural gas.

Natural gas prices are more volatile than the long-term predictable price of coal. The current price of natural gas in Wyoming is 225% higher than it was in April 2012. Major capital investments in power plants look at price stability as a key component of the investment decision. Financial institutions are reluctant to consider commitments of needed capital for new power plants, whether coal or gas powered, if there is market volatility or regulatory uncertainty. It is unclear how long this resistance to large-scale investments will continue, but it is clear the situation presents a serious threat to our economic and energy security.

Advances in power plant technology take investment, time and a willingness to use the latest technologies. We are up to the challenges. We will continue to use Wyoming's abundant coal reserves to meet the energy needs of the nation. We look forward to helping those abroad meet their energy needs too. In this regard, the environmental analysis of port facilities in the

Pacific Northwest must be accomplished with a sincere resolve to identify solutions – not barriers – to environmental concerns. Expanded port capacity and infrastructure will benefit trade of all types - from Washington apples to Idahoan lumber to South Dakotan winter wheat to Wyoming coal.

We are going to need a diversity of energy sources, and energy sources should not be adversarial. Rather, they are complimentary partners working to balance each other's weaknesses so we can meet growing energy needs in a smart, responsible way with a clear and achievable regulatory path. The prospects ahead, given our country's great mix of resources and great ability to innovate, are boundless – and that includes the prospects ahead for coal.

Wyoming's Energy Strategy

We can balance economic progress and technological innovation globally while protecting the environment. To achieve this balance we need a long-term, achievable policy framework that accounts for all fuel types.

In May 2013, I released the first action plan for Wyoming's energy, environment and economy. At the apex of the strategy is the overall vision

statement: "Wyoming will achieve excellence in energy development, production, and stewardship of its natural resources for the highest benefit of its citizens." This is a comprehensive strategy that will lead our state forward in developing its energy resources while at the same time protecting our environment.

We can responsibly develop, ship, regulate and provide the growing economies of the world the energy they need to provide higher levels of basic living to billions of people. We can also protect the environment. We intend to do both.

In the absence of a national strategy, states will lead the way. Wyoming accepts the responsibility as we know other states do too.

Conclusion

Coal is part of the energy future. We must have a complete range of energy resources. How well we use all that we have depends, not on luck, but on planning, coordination, determination, research and sheer hard work. In Wyoming, we have rolled up our sleeves and "got going." We are laying the groundwork for tomorrow and for 100 years from now – coal will be on the job.





ALISON REDFORD
Premier, Province of Alberta

Alberta's Oil Sands

Introduction

Located on the eastern slopes of the Rocky Mountains, Alberta is one of Canada's robust energy economies. Alberta is emerging as a global energy leader due to its role in the facilitation and responsible development of energy and natural resources. Seventy-six per cent of total Canadian oil production occurs in the province and its vast oil sands endowment places Alberta third in the world in proven oil reserves, behind only Saudi Arabia and Venezuela.

The importance of the oil sands resource to Albertans is reflected in the achievements of industry, researchers and government, who have made the province a world leader in oil sands development. And this effort continues - in 2011, average daily production more than doubled, with some \$21.6 billion invested in that year alone. In the same year, Alberta exported roughly 1.7 million barrels of oil per day to the United States, accounting for about three-quarters of all Canadian exports to the U.S.

Relationships and production volumes of this magnitude impose a number of responsibilities on industry and government. In generic terms, the principal task is to ensure the well-being of citizens

in Alberta, and beyond, through conscientious economic development of its incredible natural endowment. Alberta has always offered a stable investment climate, and a reliable, secure source of supply to Canadians and the United States. However, the challenge is different today, and Alberta is working to maintain strong social and environmental performance through innovative regulatory and environmental regimes that establish the province as a globally recognized centre of responsible energy development. In this regard, Alberta has work to do - the energy-intensive nature of oil sands development, for example, is far more widely known than its recent achievements at the forefront of international energy policy, and the province must do more to share its gains in carbon capture and storage technology, its legislative and regulatory approach to greenhouse gas emissions, and its incorporation of renewable energy in the generation of electricity.

To maximize the economic opportunities and establish Canada as a responsible supplier of energy related products and services, Alberta and Canada alike are looking to rapidly expanding economies as potential new markets. However, in order for resources to reach those markets, adequate oil and gas infrastructure must be in place to secure important new export options.

In the long term, realizing the full potential of

the province's energy endowment will require a continued and strengthened focus on clean and responsible development. Alberta has been at the forefront of international energy policy in the last decade with significant leadership in carbon capture and storage technology, and the legislation and regulation of greenhouse gas emissions.

Background

Oil sands have become increasingly important in meeting global demand for liquid fuels. Similar types of deposit are found elsewhere – Russia, Kazakhstan, Venezuela and Utah– but the scope of the Alberta endowment makes it unique, with the resource spanning some 55,000 square miles in the northern part of the province. From initial established reserves of 177 billion barrels, some 168 billion barrels remain, offering a static reserve life index of some 238 years at current levels of production.

In addition, only 21 per cent of the world's proven oil reserves are not state-controlled and accessible to private sector investment. Canada is more distinguished amongst oil producing countries because Alberta's oil reserves are not controlled by a national oil company, but are open to private investment representing over half of the world's open and accessible reserves.

Alberta leads the world in oil sands development, enabling Canada to increase oil production and exports. Approximately \$128 billion was invested in the oil sands during the 2002-2011 period. According to Statistics Canada, total oil sands investment in 2011 was \$22.6 billion. Preliminary actuals from Statistics Canada indicate that in 2012, investment in the oil sands was even higher, reaching an estimated \$25.2 billion.

For decades, this resource has been a benefit both to Alberta and the rest of Canada. According to the Conference Board of Canada, between 2012 and 2035, \$364 billion in price-adjusted oil sands investment is expected to take place to support oil sands development. This will directly support 880,000 person years of employment over the examined period, and resulting domestic supply chain effects will generate an additional 1.45 million person years of employment. The majority

of supply chain effects over the 2012-2035 period will be in Alberta, but nearly one-third will occur in other provinces, with Ontario receiving the largest benefit, followed by British Columbia, Quebec, the Prairies, and Atlantic Canada.

Developing the Resource

As with all natural resources in Canada, the oil sands are also under the jurisdiction of the provincial government. Albertans own 81 per cent of the mineral, oil, and natural gas resources. The federal government owns a total of 10.6 per cent, which is held in trust on behalf of First Nations, and within National Parks. The remaining 8.4 per cent are privately owned.

Private companies must apply for development with the provincial energy regulator to purchase mineral rights for a specific area. The application requires a very comprehensive environmental impact assessment, water use requests and a socio-economic impact study. Public meetings may also be held to ensure affected stakeholders are heard. If approved, development proceeds only based on terms set out in the project approval, with annual reporting and frequent compliance inspections to ensure compliance. At the end of the project, the land disturbed by the project must be reclaimed to a condition equivalent to its native state making the impacts only temporary.

The product from the oil sands is a very heavy oil, therefore more difficult to extract as the bitumen needs to be separated from the sand with the application of heat, and diluted so it can flow through pipelines and be sent to heavy oil refineries for upgrading. At this stage, sulfur and coke are removed from the bitumen to obtain lighter oil.

Current mining technology enables producers to extract more than 90 per cent of the oil in place, this efficiency is important when considering the land disturbance for mining compared to conventional production which typically leaves much of the resource behind.

In-situ production has a significantly smaller footprint than mining production, and is comparable to a conventional operation, but with much greater efficiency. In addition, in-situ

production does not require tailings ponds and does not use any fresh river water to generate steam but rather utilizes brackish water from saline aquifers.

Where conventional oil production only recovers some five to ten per cent of the oil in place, Steam Assisted Gravity Drainage (SAGD) recovers 50 to 60 per cent. With the addition of directional drilling from a central pad, a SAGD operation can produce up to the same volume and leave up to 150 times less of a footprint compared to conventional oil – a complete step change in both production efficiency and impact reduction over conventional oil.

Alberta's Efforts Towards Market Diversification

In recent years, sole reliance on U.S. markets for Alberta's crude oil has resulted in reduced returns, due partly to depressed U.S. demand, and partly to the significant price differential that exists between Western Canadian Select (the benchmark price for Canadian heavy oil) and West Texas Intermediate (the benchmark for sweet crude oil in North America).

These dynamics have unfolded alongside increasing interest in the oil sands from international investors. Though this is not new – foreign investment has been deemed critical to the commercial success of the oil sands from the beginning – the rapid growth of demand in East and South Asia for all types of energy products has become one of the most important drivers in the global energy sector. However, longstanding relationships and simple geography – which, in the energy business, usually translates directly into economics – dictate that the U.S. will remain the best energy partner for Alberta. Yet, declining U.S. demand, supply bottlenecks and pricing constraints combine with expanding Asian demand and favorable price differentials to provide strong incentive for Alberta to diversify its export markets. For these reasons, the province is working to expand its international profile and establish access to additional markets, in ways that were unimagined a decade ago.

The Government of Alberta supports all viable

options to diversify and expand market access for Alberta's energy products, whether they involve expanding current pipeline capacity, developing new pipelines, or moving product by rail.

The proposed Keystone XL pipeline, a project that would provide access to the large Gulf Coast refinery market is one example increasing market access. This project will provide important gains for Alberta producers and generating jobs, tolls and tax revenue in both Canada and the United States.

In its recent Supplemental Environmental Impact Statement, the U.S. State Department noted that even if Keystone XL were not built, strong demand for heavy oil in the Gulf Coast would see it move there by other more energy intensive means. Alberta strongly believes that Keystone XL represents the safest and least energy-intensive opportunity to move more than 700,000 new barrels a day through a pipeline built to exceed the safety standards that exist under American law.

Environment Protection and Responsible Resource Development

Concerns regarding the environmental impact of oil sands development have influenced the ability of Alberta to expand its abundant oil supply. Much of the scrutiny and criticism that Alberta has faced in recent years over the oil sands is a direct result of being an open, transparent and democratic society.

Alberta proudly believes it is a price worth paying to ensure development occurs in a politically, economically, environmentally and socially responsible manner. Oil sands production in Alberta is regulated and subject to environment laws, regulations and regional plans that place legal limits on the industry's total impacts on water, air, land, and biodiversity. These impacts are monitored through a comprehensive system of facility and regional based information sources.

Single Regulator

In 2012, new legislation was passed to enable the creation of the Alberta Energy Regulator, a

single regulatory body with unified responsibility for regulatory delivery of upstream oil, gas, oil sands and coal development activities, which was previously divided amongst several government departments. The mandate of the regulator is to provide for efficient, safe, orderly and environmentally responsible development of energy resources in Alberta. It is also a single point of contact that will strengthen accountability in the regulatory delivery of upstream resource development activities.

The Alberta Energy Regulator is targeted for operation in June of 2013. Nevertheless, the Government of Alberta is committed to continue setting policy direction for energy resource development and public land, water and environmental management and protection after the commencement of operations by the Alberta Energy Regulator.

Climate Change Strategy

Alberta's 2008 Climate Change Strategy took a practical and comprehensive approach to reducing greenhouse gas emissions and protecting the environment. Key actions under the strategy include conserving and using energy efficiently, greening energy production and implementing carbon capture and storage (CCS), a technology that collects carbon dioxide (CO₂) from large industrial processes and stores it permanently and safely deep underground.

In 2007, Alberta became the first jurisdiction in North America to legislate GHG emissions reductions for large industrial facilities by passing the Specified Gas Emitters Regulation (SGER). SGER requires all facilities in Alberta emitting over 100,000 tonnes of CO₂ per year to reduce their emissions intensity by 12 per cent below their 2003-2005 baseline emissions intensity levels.

The three compliance options under SGER are to physically reduce emissions, purchase accredited Alberta offset, or pay \$15/tonne of CO₂ over reduction targets into the Climate Change and Emissions Management Fund (CCEMF) which supports projects and technologies aimed at reducing greenhouse gas emissions in the province.

In 2011, greenhouse gas emissions intensity per barrel was 26 per cent lower compared to 1990.

The Climate Change and Emissions Management Corporation (CCEMC) was created in 2009 to be a key part of Alberta's climate change strategy and movement toward a stronger and more diverse carbon economy.

The CCEMC is an independent organization that supports and builds on the strategic direction established in the Climate Change Strategy. It also recognizes the direction set by Alberta's Carbon Capture and Storage Development Council and seeks to complement decisions made on large carbon capture and storage projects.

To date, the Climate Change and Emissions Management Corporation has initiated and finalized requests for proposals, finalized and allocated approximately \$181 million to 49 technology projects, \$7 million to three adaptation projects and \$594,000 to three biological projects. The estimated emission reduction from the 49 projects is eight million tonnes of carbon dioxide equivalent over 10 years.

The Alberta Carbon Trunk Line and Quest Projects, both oil sands-related projects, will begin to come on line in 2015 and will store 2.76 million tonnes of carbon dioxide per year by 2016. These projects will lead to greater greenhouse gas emission reductions when adopted into the market.

Through the sharing of lessons learned from the funded projects, the Government of Alberta will help the global CCS community bring down the costs of CCS. Knowledge sharing reports from the projects will be posted on the Government of Alberta website from 2013 onward.

It is estimated that by 2016, CCS will help Alberta reduce greenhouse gas emissions by 2.76 million tonnes per year. This is the equivalent of taking 550,000 cars off the road. Alberta's target is to reduce emissions by 200 million tonnes, or 50 per cent below business as usual, by 2050. In doing so, growth in green jobs and an economic transition to green energy production will occur, enhancing Alberta's competitiveness.

Water Use and Air Quality

In Alberta, water use by the oil and natural gas industry is well regulated through a system of licensing and monitoring that ensures all industry sectors achieve provincial water conservation and productivity objectives. Oil sands mines produce tailings that are a mixture of water, clay, sand and residual bitumen produced during the extraction process. In February 2009, the ERCB announced new rules to regulate the reclamation of tailings. Directive 074 *Tailings Performance Criteria and Requirements for Oil Sands Mining Schemes* requires operators to reduce tailings by capturing or extracting the fine particles from the waste water and then storing the captured solids in the disposal areas. Approximately 15 per cent of the current tailings pond footprint has been undergoing reclamation to date, with new technologies leading to reduced size and faster reclamation of mining related tailings ponds expected over the next few years.

Air quality in the Fort McMurray oil sands area is monitored 24 hours a day, 365 days a year by approximately 50 monitoring sites. Air quality in the oil sands region is rated Low Health Risk – the best air quality level – 97 per cent of the time.

Cumulative Effects-based Regional Planning

Albertans have a special relationship with the land. Alberta's prairies and parklands, forests and foothills, Northern Boreal and the majestic Rockies shape communities and lives in unique and powerful ways. The province is big, beautiful and bountiful, and Albertans are grateful for the opportunities it is providing.

Today's rapid growth in population and economic activity is placing unprecedented pressure on Alberta's landscapes. Oil and gas, forestry and mining, agriculture and recreation, housing and infrastructure are all in competition to use the land—often the same parcel of land. There are more and more people doing more and more activities on the same piece of land. This increases

the number of conflicts between competing user groups and often stresses the land itself. Alberta's land, air and water are not unlimited. They can be exhausted or degraded by overuse.

Alberta needed to ensure this land—and all the activities it sustains—is managed responsibly for future generations. This means developing and implementing a new land-use system that will effectively balance competing economic, environmental and social demands.

Therefore, it was the spirit of conservation and environmental protection that drove the Government of Alberta's unprecedented commitment to develop a comprehensive Land-use Framework. As part of implementing this framework, place-based regional plans will be developed in consultation with Albertans to map out the strategic direction for each of Alberta's seven unique regions. The Lower Athabasca Region, where most of Alberta's oil sands are located, was the first to have such a plan developed. This legally-binding plan was a priority for meeting the high expectations of Albertans and Canadians around enhanced environmental management and orderly growth in one of the most dynamic economic regions in the world.

All decisions related to existing and new oil sands, metallic and industrial minerals, coal, and petroleum and natural gas agreements, issued under the *Mines and Minerals Act*, within or partially within new Conservation Areas and new Provincial Recreation Areas are made by the Minister of Energy in consideration of the Government of Alberta's policy direction provided by the Lower Athabasca Regional Plan (LARP). Total conserved land within the oil sands region in Alberta is larger than the states of Connecticut and Rhode Island and the District of Columbia, combined.

Work to develop the remaining regional plans is underway, with the South Saskatchewan Regional Plan being the next to be finalized and implemented. The Land-use Framework and other initiatives are part of the Government of Alberta's plan to implement an Integrated Resource Management System in order to better coordinate natural resource management in the province and

understand the cumulative effects of development for the environmental, economic and social benefit of all Albertans.

Information Sharing, Monitoring and Control

In stark contrast to many other global sources of crude oil, information collected through the regulation of this resource and the monitoring system is easily accessible to the public – Alberta’s Oil Sands Information Portal is a one-stop, online source for environmental data related to oil sands development: www.osip.alberta.ca. An interactive map allows users to quickly select and view information on details and locations of oil sands projects, the location of regional monitoring stations and surface mining disturbance and reclamation. The data displayed on the map includes among others air quality, water quality, water use, greenhouse gas emissions and land disturbance.

For example, mining disturbance in Alberta’s oil sands region has significant land impacts. Industry is legally obligated to reclaim all disturbed land to standards that are equivalent to pre-development state requirement of project approvals. Although mines are often in operation for decades, companies are expected to apply progressive reclamation practices, which entail ongoing reclamation work during the lifecycle of a mine. Reclamation activities and progress indicators are included on the oil sands information portal.

The first oil sands land reclamation certificate was issued to Syncrude in March 2008, for a 1.04 km² ha parcel of land north of Fort McMurray. Approximately 715 square kilometres of land have been disturbed to date by oil sands mining activity. Approximately 71 square kilometres are currently under active reclamation.

The Government of Alberta is moving forward with a number of enhanced reclamation initiatives to improve clarity, security, and environmental performance within the oil sands and coal mining sectors. New reclamation initiatives include a strengthened mine financial security program, enhanced reclamation reporting, and an aggressive strategy to manage existing tailings ponds and

encourage quicker reclamation.

As well, in February 2012, Alberta launched a world-leading oil sands environmental monitoring program in cooperation with the Canadian federal government. The *Joint Canada-Alberta Implementation Plan for Oil Sands Monitoring* committed to a new, integrated, and transparent environmental monitoring program, starting in the oil sands region, that would be one of the most progressive and comprehensive of any industrially-developed region in the world. The program would improve the overall understanding of the current state of the environment and enhance the governments’ ability to detect environmental change and manage cumulative effects.

Recent enhancements through the joint plan include the development of an information and data portal that will house all data collected through the joint monitoring program. By the time the three-year plan is fully-implemented in 2015, the number of sampling sites will be higher and over a larger area; the number and types of parameters (such as metals and other contaminants) being sampled will increase; the frequency (how many times) that sampling occurs each year will be significantly increased; the methodologies for monitoring for both air and water will be improved; and an integrated, open data management program will be created.

Conclusion

Alberta will continue to play the central role in the stewardship of Canada’s energy industry, facilitating the development and use of resources in a sustainable manner for the future benefit of Albertans, other Canadians, our neighbours, and our valued international partners.

The ‘can do’ spirit, as defining a feature of Alberta’s long and prolific history as it is for that of our neighbour to the south, continues to drive the individuals and companies involved in the energy industry, often under incredibly challenging conditions. The current need to meld this technological challenge with environmental responsibility on one hand and economic health, on the other, is no different. Viewed in this light, the province’s current efforts in environmental

management and market diversification are far less a departure from this spirit and tradition than manifestations of it, and there is tremendous optimism in Alberta that our approach to these challenges will enable the province to continue to celebrate its existing trade relationships, and to open new doors.

We know the world is changing. We know the

world is watching. We also know that the work is far from complete. Fortunately, we have good neighbours, good partners, and some of the best in-house talent in the world. Through continued best practice, honest reflection and continuous improvement, we will draw on these considerable resources to find the balance we need, and make an appropriate contribution to the demands of global citizenship.





GREG SELINGER
Premier, Province of Manitoba

Canadian Hydropower in the Integrated North American Energy System

Introduction



The Western Governors' Energy Report comes at a vital time in the North American energy sector, when many factors are changing at a rapid pace. Governor Herbert's willingness to invite contributions from Western Canadian provinces is a reminder that the growing and changing demand for energy is a common challenge, one that each of our jurisdictions must meet for its citizens. Manitoba understands the importance of an "all of the above" approach because our province uses a variety of energy sources. While hydroelectricity provides 98 percent of our electricity needs, Manitobans also rely on natural gas, geothermal, and other sources of energy to power, heat, and cool our homes, schools and businesses.

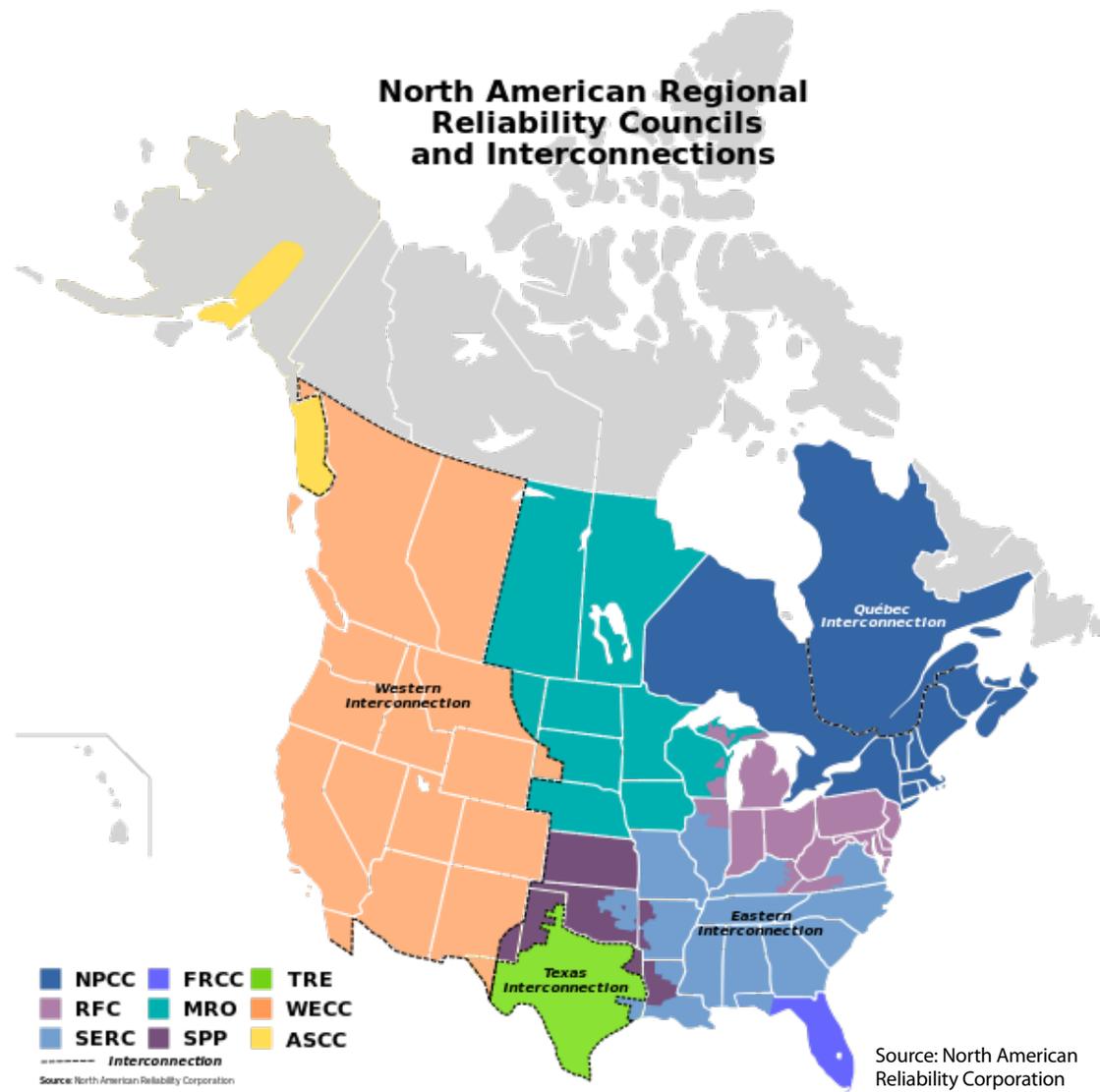
Given the challenges now facing the North American energy sector, it is important for states and provinces to have the flexibility to respond using their own unique energy profile. We must all have the ability to use the energy tools at our disposal to their fullest extent. At the same time, we can and should work toward common

solutions, sharing what works across jurisdictions as a way to inform energy innovation in the Western states and provinces and throughout North America.

The United States and Canada have long enjoyed the largest trade relationship in the world, a relationship vital to both nations' success. The energy sector is one of the most important parts of this relationship. While the Canadian oil and gas industry has become a well-known part of North America's domestic energy supply, the role played by Canadian electricity is less well-known. In fact, Canada provides 98 percent of the electricity imported by the United States, and hydroelectricity accounts for the vast majority of these imports.

This is not a one-way relationship. The United States and Canada effectively share a single North American electrical grid totaling 200,000 miles of high-voltage transmission lines. In most Canadian provinces, the grid is more closely connected north-south with neighboring American states than east-west to other provinces (Figure 1). In 2012, the total amount of electricity that flowed across the Canada-US border— from Canada to

Figure 1: North America's integrated electrical grid, showing North-South interconnection



the US and vice-versa – exceeded 70,000,000 Megawatt hours (MWh). As a result, millions of Canadians and Americans depend on the reliable operation of our integrated grid every second of every day.

This trade exists for a simple reason: it makes good business sense for utilities on both sides of the border. Both the transmission capacity and the generating resources have been built from the bottom-up, allowing utilities and their customers to take advantage of the energy resources that are the most available and affordable in their own regions. Our challenge is to make sure that both the grid and the generating resources that supply it can continue to meet the growing need

for reliable, sustainable and secure electricity in the future. The best way to meet this challenge is to approach it in the same way that the integrated North American grid was built in the first place – by working across national borders so that states, provinces, and utilities have the flexibility to find solutions that make the most sense in their regions.

Background – Hydropower in Canada and Manitoba

While the harnessing of energy from the movement of water is one of the oldest forms of

power – Canada has been producing hydropower for over 130 years – today’s generation stations are part of the new era of modern and highly efficient clean energy technologies. The backbone of Canada’s power sector is hydroelectric generation. It accounts for 60 percent of Canada’s electricity production and 97 percent of its renewable generation. In fact, Canada’s combined national installed hydropower capacity of over 160,000 Megawatts (MW) makes us the third largest in the world after China and Brazil. This capacity is primarily located in the provinces of Quebec, British Columbia, Ontario, Newfoundland and Labrador, and Manitoba. Potential capacity exists in all thirteen provinces and territories and it is estimated that Canada can double its current generation capacity provided the demand for power and suitable market dynamics are present.

In Manitoba, hydropower plays an important part of our provincial economy – 98 percent of our provincial power output is from hydropower, with the remainder supplied from natural gas and wind technologies. Manitoba’s hydroelectric generation stations, primarily in northern Manitoba, have a combined capacity of just over 5,000 MW. And over the next ten years as our population and economy grow, we are planning for the development of new hydroelectric capacity and associated transmission infrastructure that will require investments of approximately CAD \$20 billion.

The development of new hydropower capacity is a key part of Manitoba’s recently released Clean Energy Strategy. Our other energy priorities focus on expanding transmission that improves electricity reliability and security; adding more wind power as economics allow; promoting geothermal, biomass and solar for heating needs; developing our biobased fuels; and leading in cutting edge transportation solutions. Manitoba is also pursuing innovative ways to improve energy efficiency. Manitoba is the first jurisdiction in Canada to introduce pay-as-you-save financing for energy and water retrofits, that allows customers to pay back the financing of energy efficiency

The development of new hydropower capacity is a key part of Manitoba’s recently released Clean Energy Strategy.

investments in their homes with the savings on their energy bills. Beyond Manitoba’s borders, we are working with other provinces on a Canadian Energy Strategy to assess the new challenges facing the energy sector and ensure that Canada has a strategic, forward-thinking approach for sustainable energy development that recognizes regional strengths and priorities.

Pending environmental and economic reviews, Manitoba’s planned expansion of over 2,300 MWs of hydropower capacity would be large enough to replace the demand growth of recent decades and to meet the expected domestic demand beyond 2020. Each new generating station project has been designed to dramatically reduce environmental impact from

past projects, as well as create unprecedented cooperation with aboriginal communities affected by these projects. Further, these projects will create thousands of jobs in Canada and the US, provide us with affordable power well into the future and support our neighbors’ needs for clean and reliable energy.

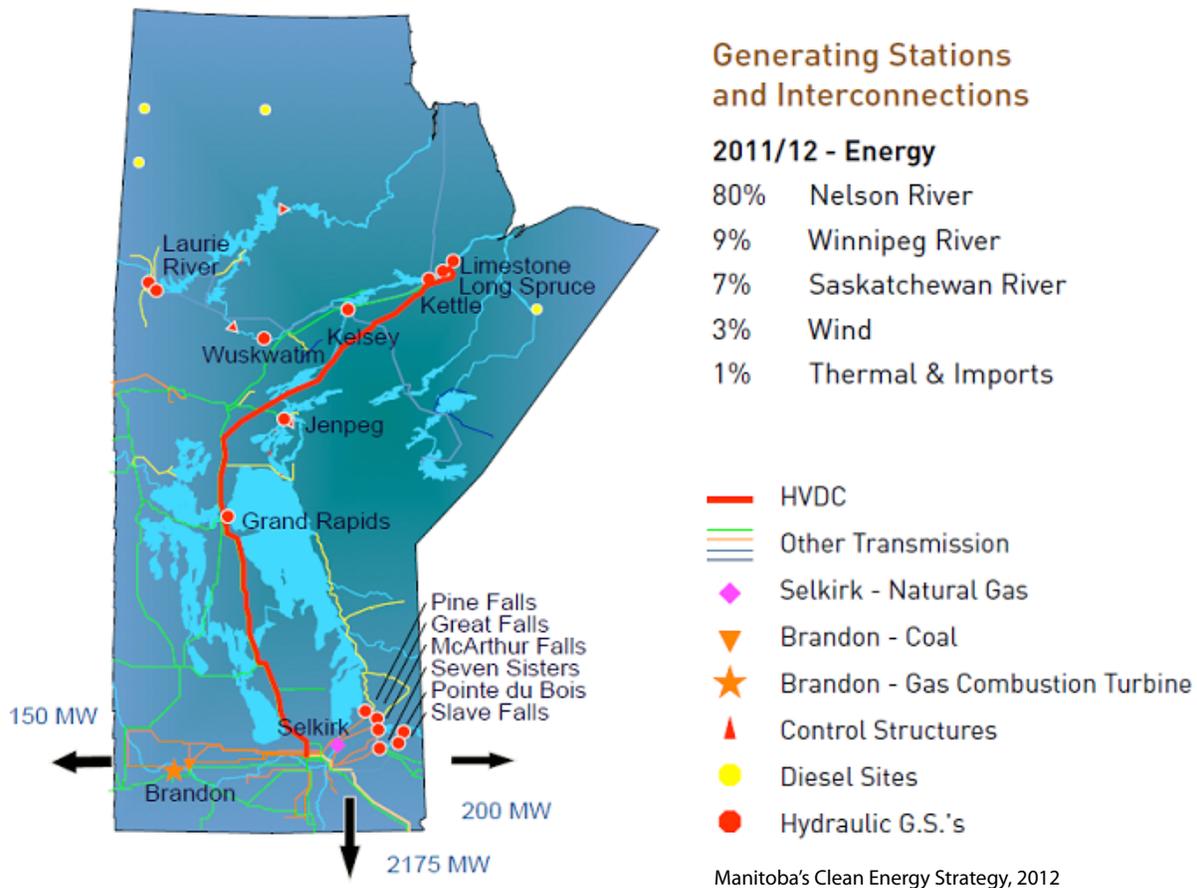
For example, Manitoba Hydro regularly procures US-sourced equipment and materials for the development and maintenance of its fleet of fifteen generating stations and its transmission system, including from suppliers in Alabama, Georgia, New York, Massachusetts, Minnesota, Missouri, South Carolina, Tennessee, Virginia, Washington and Wisconsin.

Hydropower’s Role in an “All of the Above” Energy Strategy for North America

When it comes to energy security and the long-term challenge of climate change, Canadian hydropower can support North America’s “all of the above” energy strategy in three ways.

First, Canadian hydropower contributes significantly to renewable electricity capacity in

Figure 2: Manitoba's Hydropower; 2011/2012 Energy Production



regions such as New England, the Midwest and the Pacific Northwest. While electricity imports from Canada account for less than one percent of US electricity demand, approximately 10 percent of all renewable electricity consumed in the US is generated by Canadian hydropower. On average, Canada exports 40 terawatt hours of hydropower per year to the US, enough to power approximately 3.5 million US homes.

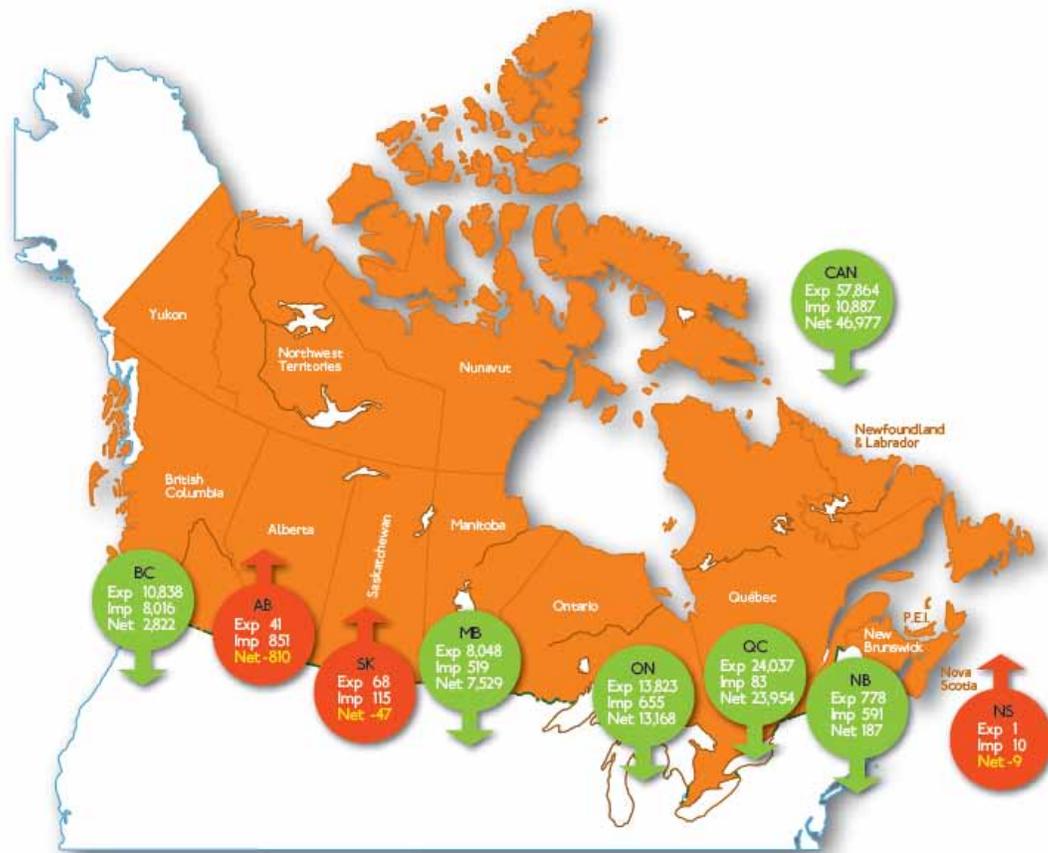
Canada's supply of clean and secure energy is particularly important to many states near the US-Canada border. For example, one-third of all electricity consumed in Vermont is supplied by Canadian sources, and in the state of New York 7 percent of electricity is supplied from Canada. In Minnesota, hydropower delivered to the state from Manitoba is equivalent to 11 percent of the total electricity demand in that state. Even in California, which is hundreds of miles distant from the Canadian border, electricity provided

from British Columbia, Canada, is sufficient to power more than 320,000 homes in the state.

Second, Canadian hydropower helps keep electricity affordable for businesses and families, which supports economic growth. Communities serviced by hydropower have an advantage in attracting industries precisely because of its affordability, reliability and unique operational and environmental attributes. For example, BMW Automobiles recently chose to build its advanced carbon fiber manufacturing facility in Washington State specifically because the region is serviced by reliable, renewable and competitively priced hydropower.

Third, hydropower is the only form of proven, renewable electricity generation that can provide reliable baseload power, which is the minimum power utilities must make available to their customers to meet reasonable expectations of customers. This characteristic of hydropower is

Figure 3: Canada-US Electricity Trade



Data displayed are in gigawatt-hours.
Source: National Energy Board, Electricity Exports and Imports, 2012.
Retrieved February 21, 2013.

particularly attractive given the ongoing retirement of older coal-fired generation and the need to support transmission grid stability. Hydropower is also highly responsive to customer demand, with very fast ramp-up and ramp-down times. Cross-border exchanges of electricity help utilities on both sides of the border to balance generation and demand, and thus ensures that needs are met as efficiently as possible. The sharing of electricity resources enables both countries to minimize the need to employ less efficient backup generation during peak load periods.

These characteristics have real advantages in terms of system stability. For example, during the Northeast blackout of 2003, affecting affecting a large swath of the Northeast from Ontario, Canada to New Jersey, hydropower facilities were the first generation sources back online, helping to restore power to millions of people. Canadian hydropower

generation alone allowed New York State to restore nearly 45 percent of the state’s total electricity load within 6 hours of the onset of the blackout. The availability of Canadian hydropower can also help to support the development of intermittent renewable energy sources in the US, such as wind and solar, by acting as a backstop when these resources are not generating power.

Challenges and Strategies for Hydropower

The North American power sector is expected to undergo a significant reorientation over the next decade. According to the North American Electric Reliability Corporation, the change in the mix of resources producing electricity is a particularly important consideration facing power utilities, consumers, and industry across North America.

Future uncertainties include electricity market changes, fuel prices, potential and planned environmental regulations, and transmission capacity, all in the context of an effort in North America and around the world to move our societies toward cleaner and more renewable sources of electricity. The pace of Canadian hydro development and its ability to contribute to US clean energy objectives will depend on many factors, and four issues and potential strategies are discussed here: changes in the electricity market due to the abundance of natural gas, the need for new baseload power generation, the ongoing challenge of transmission capacity, and changing energy generation.

The Changing Electricity Market

One challenge that faces all renewable energy sources is the current low price of natural gas, which is exerting downward pressures on the market prices for electricity throughout North America and becoming an important consideration for power planners as they evaluate long-term resource and investment options. Although hydroelectric generating stations have low and stable operating costs and very long lifespans, they also require significant front-end capital investment and lengthy construction periods. As mentioned above, while significant new hydroelectric capacity is currently under development to meet needs in Canada and the US, there are many other potential projects that will likely be deferred, in part due to the expectation that natural gas will continue to be abundant and affordable.

However, the current natural gas boom includes a number of unknowns and challenges for long-term energy planning, as can be seen in the forecasts of major energy planning and statistical bodies like the National Energy Board in Canada and the US Energy Information Administration. There are uncertainties in particular around shale gas, such as the accuracy of shale gas reserve estimates, production and depletion rates, the long-term sustainability of today's exploration and development business model, in the face of extremely low natural gas prices and the potential

cost of GHG emissions from shale gas exploration and production. It should also be noted that while GHG emissions from natural gas are half that of coal they are still considerably more than renewable sources.

In short, while natural gas prices are currently low and will likely play an increasingly important part in the North American energy mix, there is no guarantee that today's prices will continue for the next 10 years, much less for the next 20 or 30 years and beyond. With Manitoba's next major hydro projects potentially coming online from 2019 to 2025, and then earning their major revenues in the decades to follow, natural gas prices in 2013 are less important than the prices in 2033 or 2043. In the long term, Manitoba expects that hydroelectric power's wide range of benefits – more stable prices and greater energy security, lower emissions, and more jobs and business in Manitoba and its region – will still make hydroelectricity the right choice for Manitoba, with benefits for our neighbours in both Canada and the US.

Finding New Baseload Power Resources

Perhaps the most significant development in the US power sector has been the replacement of older coal-fired generation by new gas powered generation technologies. Although coal plants still generate 40 percent of the electricity in the US, power generated by natural gas has doubled to 21 percent. It is now the dominant source of new electricity in the US and is rising quickly as old coal burning plants are shut down. The reason for this switch is about more than natural gas prices, however. It has a great deal to do with the aging stock of conventional baseload power generation.

It is estimated that about 71,000 MW of fossil-fired generation will be retired by 2022, with over 90 percent of this being retired by 2017. In particular, the retirement of mostly older coal-fired generation is expected to affect power system characteristics and the geographic distribution of generation assets. While North American natural gas is currently shouldering some of this burden, prices for natural gas will not necessarily remain

low and stable. This may create opportunities for hydropower, which is the only proven renewable baseload power technology.

Complicating this is the need for the electrical grid to become even more resilient to resource shifts and other challenges. Intermittent renewable resources like wind and solar are growing in importance in many areas of North America as more and more jurisdictions encourage their development. Across North America, renewable generation made up 15.6 percent of all on-peak capacity resources in 2012 and is expected to reach almost 17 percent in 2022. Even in Manitoba, where we can meet 98 percent of our electricity needs from hydropower, we currently have over 258 MW of installed wind power capacity.

Intermittent renewable resources such as these will need to be paired with flexible baseload power generation or energy storage capacity to support their continued growth as part of the overall electricity supply. Hydropower offers both baseload power and storage capacity. In this way, hydro can support and ease the transformation of the power sector while maintaining grid stability. In fact, in some US border states, the availability of Canadian hydroelectricity as a clean, flexible and affordable baseload power resource can support the development of the states' own renewable energy sources. For example, the recently completed sale between Minnesota Power and Manitoba Hydro includes a 'US wind storage' provision, allowing power to be "stored" in hydro reservoirs in Manitoba while the wind is blowing in North Dakota, and released through increased hydro output when it is not.

Transmission

The reliability of our transmission infrastructure is critical to both the US and Canada, and hydropower presents some unique challenges in this respect. Hydropower is tied to geography, and much of Canada's existing and potential

hydroelectric generating capacity is located a significant distance from major load centers. This is the principal reason that Manitoba has been a world leader in using high voltage direct current (HVDC) transmission to connect northern electricity supply with demand centres in major cities in southern Manitoba and across the Midwest. This is an important consideration that highlights the need for integrated transmission planning across state, provincial, and national borders.

Manitoba is prepared to move forward with larger transmission projects to meet energy needs in the future that will be able to complement other energy sources supplying the North American grid.

Some of the regulatory infrastructure needed to ensure that this planning can happen is already in place. Our shared grid is overseen by the North American Electric Reliability Corporation (NERC), a non-profit entity that has been given broad oversight authority by the US federal government and by provincial governments in Canada who work together to meet NERC objectives. And there has been real progress

in meeting transmission challenges. For example, according to NERC, the pace of transmission construction has more than doubled in the last five years to a rate of 2,300 circuit miles per year, which is expected to increase to 3,600 miles per year over the next five years. Across the continent, almost a quarter of new transmission is specifically linked to the integration of mostly intermittent renewable generation such as wind and solar. However, more progress is needed to ensure that the projected increases in cross-border electricity flow can proceed.

Manitoba is prepared to move forward with larger transmission projects to meet energy needs in the future that will be able to complement other energy sources supplying the North American grid. It will not be able to succeed in these efforts alone. Priority should be given to ensuring that we move ahead with larger transmission decisions that go across state lines, provincial lines, and international boundaries. It is vital that regional transmission planning and funding policies span the Canada-US border. These projects allow power to flow both ways, and will require construction

of new transmission infrastructure, which drives jobs in design, engineering, construction and production of materials on both sides of the Canada-US border. Manitoba's priority is the construction of Bipole III, a proposed new high voltage direct current (HDVC) transmission project intended to improve overall system reliability and dependability. As transmission infrastructure continues to develop and Canada increases its hydropower infrastructure, the potential for longer-range power trade relationships increases.

Clean Energy Policies

Finally, it is important that energy policies do not create artificial barriers that would distort the relatively open market that already exists for electricity. Given the fully integrated North American electricity market, Manitoba has strongly advocated for the recognition of hydropower in proposed renewable and clean electricity standards at the federal level in the US, regardless of which side of the Canada-US border it is situated on. Hydropower is a significant part of the existing renewable energy stock in both countries, and we believe that hydroelectricity can be treated fairly while still promoting the development of new and innovative renewable energy sources.

Equally important is the need to ensure that states and provinces retain the flexibility to “green the grid” in the ways that make the most sense in their regions. “All of the above” does not mean that “one size fits all,” and states and provinces, in cooperation with their utility partners, are best situated to find the right mix of sustainable, available, and economically viable energy sources to meet the needs of their businesses and communities. Many states have passed regulations for Renewable Portfolio Standards (RPS) and goals to encourage production of renewable electricity. Different states have included different resources, including wind, solar, biomass, and geothermal. While large hydropower from Canada is currently only included in Vermont's RPS, other states do recognize some hydro installations as renewable. Moreover, several states (including Minnesota, Connecticut, and Rhode Island) are currently

reviewing the treatment of hydropower in their RPS regulations.

Manitoba believes that states should have the opportunity to recognize hydropower where this makes sense. Hydropower, including Canadian hydropower, can enable states to meet their renewable energy goals more easily and adopt more ambitious goals, while providing a backstop for wind and solar energy as these technologies develop.

Conclusion

Manitoba, like all Western states and provinces, is committed to a cleaner, more secure energy future for North America. Our challenge is clear: we know that electricity demand is set to increase, despite ongoing economic uncertainty around the world, and we know that consumers are demanding reliable, efficient, social and environmentally responsible, and affordable energy. Meeting these expectations means pursuing an ‘all of the above’ approach to a cleaner energy future in both America and Canada, while letting states and provinces proceed according to the needs and priorities of their citizens and their economies.

New, abundant sources of baseload power will be necessary if the US is to develop its own secure and clean energy sources. Hydropower has provided a clean, reliable and secure source of electricity for Americans and Canadians for decades, and we believe it will continue to play an important role for generations to come. In Manitoba, our economy and our population continue to grow and we are looking at a variety of options to meet our clean energy needs. We are entering a new phase of hydropower development just as the North American power sector is reinventing itself through the emergence of cleaner and renewable sources of energy, advances in transmission infrastructure and the ‘smart grid’, and the promotion of conservation and energy efficiency. While we face challenges along the way, this transformation is an immense opportunity for consumers and power providers across the continent, and also one in which hydropower on both sides of the Canada-US border is playing an important role.



BRAD WALL
Premier, Province of Saskatchewan

Curbing our Carbon Dioxide Emissions: A Saskatchewan Perspective on the Challenge and the Opportunity

Introduction



Fossil fuels have powered our society for more than a century. They fuel our cars, heat our homes and generate the electricity that keeps our lights on at night. Most states, provinces and countries blessed with fossil fuel resources have strong economies. While petroleum, natural gas and coal are non-renewable resources, they are abundant, and with new discoveries regularly being made, will continue to be our primary energy source for decades to come.

However, the production of fossil fuels comes with an environmental cost – a fact readily apparent to citizens and legislators alike. The greenhouse gas emissions produced by these fuels contribute to climate change. Those of us from jurisdictions that produce fossil fuels are working hard to reduce our environmental footprint and are developing more renewable energy sources. But the transition from fossil fuels to renewable energy will take time, and the challenge of greenhouse gas emissions is one that we must tackle.

Among the options available to address climate change is carbon dioxide (CO₂) capture and storage (CCS) technology – in essence, removing carbon dioxide from emissions and injecting it deep underground. CCS can also include commercial utilization of the captured CO₂ by employing it as an agent in enhanced oil recovery, where the injected CO₂ increases output from oil fields before becoming permanently stored underground (some refer to this aspect of CCS as CCUS, or carbon capture utilization and storage).

While CCS is still in its commercial infancy, it offers industry and governments a “win-win.” It helps us reduce greenhouse gas emissions while assisting in the recovery of more oil from existing reservoirs. And it assists us in the responsible and “greener” development of our fossil fuel resources.

In this chapter I explore how CCS has emerged as a strategy and activity to help address our climate change problem. I look at some of the work that has been done on CCS to date, and some of the issues that still need to be addressed. I will frame my observations within the context of my home province of Saskatchewan – a province of just

under 1.1 million people that has made a major commitment to CCS and is a world leader in the development of the technology.

Background

Fossil fuels are expected to dominate the world's energy supply for the foreseeable future, despite the fact significant investments have been made throughout the world in renewable energy and energy efficiency. Fossil fuels such as oil, natural gas and coal currently account for about 80 per cent of the world's primary energy consumption. That's our current reality and our future reality as well -- the International Energy Agency (IEA) predicted recently that energy demand could increase by 33 per cent by 2035 and fossil fuels will still meet 75 per cent of that increased demand.

Fossil fuels will continue to be our primary energy source despite predictions the world would soon run out of oil. The reality is we are finding more oil, thanks to advancements in exploration techniques, improvements in recovery technologies and discoveries in areas not previously thought to have much potential.

These new discoveries, coupled with a dramatic increase in shale gas finds, are leading experts to suggest the United States could be energy self-sufficient in a matter of decades. That's quite a turnaround. In Saskatchewan, we don't have to look too far to see evidence of this transformation, as we watch the phenomenal oil production occurring in North Dakota from that state's portion of the Bakken Formation, described as one of the hottest oil plays in North America.

Saskatchewan shares that play with North Dakota, and thanks to a combination of technology and prices, our Bakken production has gone from a modest 760 barrels a day in 2004 to almost 70,000 barrels a day now. That production has helped cement our status as the second largest oil producer in Canada and the sixth largest oil producer among all American states and Canadian provinces. Our oil and gas industry is our province's number one industry, generating billions of dollars in sales each year, annually contributing well over a billion dollars to our provincial treasury through royalties and taxes,

and employing more than 30,000 people (directly and indirectly).

Our government is a strong supporter of the oil and gas industry and wants to see it continue to grow and prosper in order to maximize benefits for our province. Saskatchewan's resource endowment extends beyond oil and gas. The province is also blessed with abundant supplies of potash, uranium and coal, which is used primarily for electricity generation. Saskatchewan has an estimated 300 years worth of lignite at current rates of use. That lignite coal annually supplies more than 50 per cent of Saskatchewan's electricity.

In developing these resources, we are mindful of the attendant environmental challenges. Saskatchewan's per capita greenhouse gas emissions are among the highest in our country, because we rely on coal and natural gas to generate most of our electricity, and because our role as a major energy exporter (oil, natural gas and uranium) increases our emissions relative to other jurisdictions.

Reducing our carbon footprint is thus a priority for us, and we're addressing that challenge through various means: energy conservation measures; strict new standards to control greenhouse gas emissions from the venting and flaring of associated natural gas; and an expansion of renewable energy sources, such as biofuels, hydro and wind power. Other jurisdictions, faced with their own rising greenhouse gas emissions, are adopting similar measures, and we can point to significant investments by Canada, the United States and other countries in the areas of renewable energy and energy efficiency.

The challenge for all jurisdictions that produce fossil fuels can seem daunting. In a recent report, *Tracking Clean Energy Progress 2013*, the IEA notes that the global energy supply is not getting cleaner, despite efforts to advance renewable energy. According to the report, world coal generation grew by 45 per cent from 2000 to 2010 while non-fossil fuel generation grew by only 25 per cent. Coal's share of electricity generation increased from 39 per cent in 2000 to 42 per cent in 2010. The IEA acknowledges progress has been made on renewable technologies, but asserts that the bar on energy

sector carbon intensity has barely moved over the last 20 years.

That brings us to CCS technology. CCS should never be viewed as the “silver bullet” that will solve the climate change problem – it is just one approach to reducing greenhouse gas emissions. But more and more it is regarded as one of the only technologies available in the short- to medium-term to bring about significant emissions reductions.

The IEA recognizes the contribution CCS can make as a clean energy technology. It cites CCS technology as “essential in a world that continues to rely heavily on fossil fuels.” In another recent report, the agency projects that by 2050, CCS will contribute 17 per cent of all emission reductions necessary to avoid dangerous climate change. Closer to home, Canadian studies have concluded that implementation of CCS will be the source of the largest future reduction in emissions in Canada by 2020 (38 per cent of total reductions).

The environmental movement also recognizes that the deployment of CCS is imperative if emissions are to be drastically reduced.

In December 2012, the Environmental Non-Government Organization (ENGO), a network of 10 prominent environmental groups, including the Clean Air Task Force, the World Resources Institute and Canada’s Pembina Institute, released a report on CCS, which said: “given the world’s current and projected reliance on fossil fuels, CCS should be considered a critical mitigation technology that will provide faster and deeper emission reductions.”

The case is being made for CCS, here in North America and around the world.

The CCS Imperative

Researchers working on CCS technologies have collaborated to establish a website, www.ccs101.ca, which provides a lot of good, basic information about the process and technologies involved in carbon dioxide capture and storage. According

to that website, the CCS process itself involves extracting CO₂ from gas streams typically emitted during electricity production, fuel processing and other industrial endeavours. After the carbon dioxide is captured and compressed, it is transported by pipeline or tanker truck to a storage site, often to be injected into an underground storage site or geological formation where it can be safely stored for the long term.

CCS has proven useful as an enhanced oil recovery technique – the “win-win” I referred to earlier. CO₂ that is captured from industrial facilities and injected into oil reservoirs has increased production from those reservoirs before being permanently stored underground. A number of those reservoirs have received a second life of oil production as a result of CCS.

CCS has been a major part of American climate change policy, with U.S. policy makers recognizing that 42 per cent of the electricity in the United States

is generated by coal and that the electricity sector accounts for nearly 40 per cent of total U.S. emissions. A number of regional partnerships, demonstrations and commercial projects have been undertaken, such as the Illinois Basin-Decatur Project and Southern Power’s Kemper County Integrated Gasification Combined Cycle Facility.

The American oil and gas industry has been using CO₂ in enhanced oil recovery (EOR) for almost 40 years, and can point to 100 specialized EOR projects and approximately 3,100 miles of carbon dioxide pipelines. Texas has been a leader in developing CO₂ injection technology.

Saskatchewan, our neighbouring province of Alberta and our federal government are strong proponents of CCS technology in our country. Our province has taken a leadership role on the file in recent years, through government policies and industry initiatives. And that brings me back to the question of “why us, why Saskatchewan?”

Our massive coal reserves can provide Saskatchewan with a very large, secure and low-cost source of electric power for decades to come.

Saskatchewan, our neighbouring province of Alberta and our federal government are strong proponents of CCS technology in our country.

We want, and we need, to use that coal in as green a fashion as possible.

We have favourable geology that lends itself to CCS projects. We have synergies between the projects that capture CO₂ and the oil companies that will pay for that captured CO₂ to increase recovery in their fields. And we have in our publicly owned utility SaskPower a company that can take the long view in terms of electrical generation needs.

Saskatchewan also has a history of being a pioneer in CCS technology, and it's that history which moves us forward in our commitment to CCS.

The Saskatchewan Experience

Saskatchewan has been involved in some form of CCS research for almost 30 years, dating back to 1984 when the first carbon dioxide enhanced oil injection in our province began as a small pilot project in the Midale reservoir in southeast Saskatchewan. Over the years our research capacity has expanded in the field through the University of Regina and its petroleum engineering studies and through research facilities affiliated with the university, such as the renowned Petroleum Technology Research Centre (PTRC), established in 1998.

Now, as a result of years of that effort, Saskatchewan can lay claim to having stored three million tonnes (or 3.9 million tons) of CO₂ last year – roughly 15 per cent of the total for the entire world.

A tour of Saskatchewan CCS projects starts with a CO₂ enhanced oil recovery project in an oil field near Weyburn in southeast Saskatchewan. Cenovus Energy has invested more than \$1.1 billion in Saskatchewan's first commercial-scale CO₂ EOR project. The project will produce 200 million incremental barrels of oil, and oil production from that field has increased by 60 per cent as a result. The project offsets the greenhouse gas emissions from 510,000 vehicles each year.

The Cenovus project is an example of cross-border cooperation, in that the company buys CO₂ that otherwise would be emitted by a coal gasification plant in Beulah, North Dakota. The CO₂ is shipped

through a 320-kilometre (200-mile) pipeline that crosses the Canada-U.S. border. CO₂ injection began in 2000 at the Weyburn field.

Saskatchewan's second commercial-scale project has yielded similarly impressive results. Apache Canada has reinvested in the Midale reservoir mentioned above and will spend \$760 million over the lifetime of the project to produce 67 million barrels of incremental oil and store eight million tonnes (8.8 million tons) of CO₂.

Taken together, the Weyburn and Midale projects make an impressive contribution to greenhouse gas emissions reduction. As of the end of February 2013, they had stored more than 25 million tonnes (27.5 million tons) of CO₂.

At the same time as the Cenovus and Apache projects were proceeding, perhaps the most significant global research project ever undertaken on carbon dioxide and storage was occurring in the same reservoirs. The International Energy Agency (IEA) Greenhouse Gas Weyburn-Midale Carbon Dioxide Monitoring and Storage Project concluded its work in 2012 after 12 years of operation. The project was the world's largest monitored CO₂ geological storage project and was set up specifically to monitor the CO₂ being stored by Cenovus and Apache in their fields. Managed by our PTRC, this IEA project received \$80 million in funding and in-kind contributions over its existence, including \$5 million from the U.S. Department of Energy. It also attracted many international delegations of scientists, eager to view the monitoring efforts first-hand.

The IEA Weyburn project has proven fundamental to the world's understanding of the geological sequestration of carbon dioxide. Results from the research there provided scientific evidence to support the safety of long-term geological storage of CO₂ in the Weyburn field and for geological projects around the world. Indeed, the research indicates that the injected carbon dioxide will safely remain in the Weyburn reservoir for at least several thousand years.

The Weyburn research project and the two commercial initiatives of Cenovus and Apache have paved the way for significant new investments by

government and industry in CCS in Saskatchewan. The centrepiece of those investments is the Boundary Dam Integrated Carbon Capture and Storage Demonstration Project, operated by our electrical utility SaskPower and scheduled for commercial operation in the first quarter of 2014. We view this project as a potential game changer in work to address the challenges of greenhouse gas emissions.

Our government (through SaskPower) and the Government of Canada are investing \$1.24 billion in what will be the world's first and largest commercial project to capture CO₂ from a coal-fired post-combustion power station. The project involves a retrofit of the 43-year-old generating Unit #3 (BD 3) within SaskPower's Boundary Dam Power Station near the city of Estevan in southeast Saskatchewan. It will annually capture and safely store one million tonnes of CO₂, or 90 per cent of its CO₂ emissions – the equivalent of taking 250,000 cars off the road every year. That same CO₂ will be sold to Cenovus for injection in its Weyburn field.

SaskPower is involved in another major CCS initiative, also set to open in 2014. It is partnering with Hitachi Ltd. to build a \$60 million carbon capture test facility at SaskPower's coal-fired Shand Power Station near Estevan. The new facility will provide a venue for international researchers and companies to test their carbon capture technology. Hitachi's proprietary amine technology will be the first tested at the new facility.

SaskPower has established a CCS Global Consortium (<http://www.saskpowerccsconsortium.com/>) to share knowledge it has gained from the development of the Boundary Dam project.

The final Saskatchewan CCS project that I will reference is the Aquistore project, which is managed by PTRC. Aquistore will demonstrate the feasibility of injecting carbon dioxide into a deep saline formation and will use some of the CO₂ captured from BD 3. The injection well and

observation well drilled under this project are the two deepest wells ever drilled in Saskatchewan, with depths of 3.4 kilometres (2.1 miles).

The Way Ahead

CCS represents just one approach to help meet our shared goal of reducing greenhouse gas emissions and combating climate change. But we should not minimize the technical, economic and regulatory issues that CCS projects face.

More research needs to be done, for example, to develop more efficient and lower-cost capture technologies. This is important in part because developing countries with rapidly growing coal-fired generation may find the cost of reducing emissions with CCS systems to be onerous. We're confident the economics of carbon capture will continue to improve, but as the IEA notes, governments throughout the world must do more to motivate industry to accelerate the development and deployment of CCS technology.

Regulatory clarification and consistency is also necessary among jurisdictions as CCS projects move forward. The Canada-U.S.

Clean Energy Dialogue recognizes this, and has a working group developing mechanisms for closer collaboration between the two countries on CCS.

Saskatchewan will continue to take part in the conversation on CCS, through policy discussions with states and provinces and at the national level on both sides of our border. And we will continue to lead on the ground through the deployment of CCS technology and our research activities.

CCS will allow us to dramatically reduce greenhouse gas emissions without compromising our continent's economic competitiveness and energy security. As the IEA notes, "without (CCS) the world will have to abandon its reliance on fossil fuels much sooner – and that will come at a cost."

Simply put, the world needs CCS to ensure a green and prosperous energy future.

Saskatchewan will continue to take part in the conversation on CCS, through policy discussions with states and provinces and at the national level on both sides of our border.

Gov. Sean Parnell

- ¹ John B. Coghill, *Growing up in Alaska*, p. 207 (2009, Kayto Publishing Co.). Governor Walter J. Hickel noted, "Alaskans had lived through lackluster administrations by territorial governors without the authority to carry out their will. Since the governor had been a presidential appointee, territorial legislatures, elected by Alaskans, gradually diluted his power and gave more authority to officials chosen by them or elected directly by the people. At the time of the [constitutional] convention, Alaska elected its attorney general, treasurer, highway engineer, and commissioner of labor..." with a multitude of boards and commissions managing diverse areas of policy domains. Hickel, *Crisis in the Commons*: p. 80
- ² John B. Coghill, *Growing up in Alaska*, p. 207 (2009, Kayto Publishing Co., Juneau).
- ³ Heritage Foundation, 2008

Gov. John Hickenlooper

- ¹ http://www.coga.org/pdf_studies/cu_econbenefits.pdf
- ² <http://www.usatoday.com/story/news/nation/2012/11/26/personal-income-2011-oil-gas-boom/1728123/>
- ³ <http://www.pxd.com/docs/economic-impact/economicfastfactsheet---colorado.pdf?sfvrsn=2>
- ⁴ <http://www.mineralweb.com/news/natural-gas-royalties-paid-in-the-billions/>
- ⁵ Colorado Department of Local Affairs, "Local Government Energy and Mineral Impact Assistance Program Thirty-sixth Annual Report." FY 2012.
- ⁶ Colorado Revised Statute 39-29-109.3(2).
- ⁷ <http://coloradoenergynews.com/2012/12/report-shale-industry-generate-more-than-121000-jobs-colorado-by-2020/>
- ⁸ <http://money.cnn.com/2012/08/06/news/economy/wind-power-colorado/index.htm>
- ⁹ http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/natural_gas_1998_issues_trends/pdf/chapter2.pdf
- ¹⁰ http://www.eia.gov/todayinenergy/detail.cfm?id=7350#tabs_co2emissions-1
- ¹¹ http://rechargecolorado.org/images/uploads/pdfs/Colorado_Clean_Air_Clean_Jobs_Act_GEO_WhitePaper.pdf
- ¹² http://www.slate.com/articles/health_and_science/project_syndicate/2012/09/thanks_to_fracking_u_s_carbon_emissions_are_at_the_lowest_levels_in_20_years_.html
- ¹³ Colorado Oil and Gas Conservation Commission and Colorado Water Conservation Board. "Water Sources and Demand for the Hydraulic Fracturing of Oil and Gas Wells in Colorado from 2010 through 2015." http://cogcc.state.co.us/Library/Oil_and_Gas_Water_Sources_Fact_Sheet.pdf.
- ¹⁴ <http://www.eia.gov/state/analysis.cfm?sid=CO>
- ¹⁵ <http://www.eia.gov/state/rankings/?sid=CO#series/28>
- ¹⁶ http://www.afdc.energy.gov/fuels/fuel_comparison_chart.pdf
- ¹⁷ HB 13-1110.
- ¹⁸ http://www.denverpost.com/business/ci_22149912/mines-grad-capturing-oil-gas-emissions

Gov. John Kitzhaber

- ¹ Overcoming Market Barriers and Using Market Forces to Advance Energy Efficiency, American Council for an Energy-Efficient Economy, March 2013. <http://aceee.org/files/pdf/summary/e136-summary.pdf>
- ² U.S. Energy Information Administration, http://www.eia.gov/electricity/annual/html/epa_02_04.html.
- ³ Sixth Northwest Power and Conservation Power Plan, Northwest Power and Conservation Council, February 2012.

⁴ The ODOE and ETO savings estimates cannot be added together as some projects received both ODOE and ETO incentives. Savings from such projects are included in both the ODOE and ETO savings estimates. The ODOE value for savings excludes projects that are older than their expected lifetimes. ETO projects are generally too young to have exceeded their expected lifetimes. The ETO savings estimate is for total cumulative savings reported through 2012, as reported in ETO's annual report: http://energytrust.org/library/reports/2012_ETO_Annual_Report_OPUC1.PDF

⁵ Ibid.

⁶ Oregon Department of Energy.

⁷ American Council for an Energy Efficiency Economy (ACEEE) 2012 State Scorecard.

⁸ Sixth Northwest Power and Conservation Plan, Northwest Power and Conservation Council, February 2012. The region includes Idaho, Montana, Oregon and Washington.

⁹ According to the Oregon Public Utility Commission, electricity use in Oregon peaked in 2000. Electric sales dropped 0.9 percent from 2009 to 2011. Similarly, natural gas usage dropped by 2 percent over the same period. In contrast, in 2010 and 2011 Oregonians' adjusted gross income increased over the previous year's level by 5.5 and 3.1 percent, respectively, according to the Oregon Department of Revenue.

¹⁰ Year Energy Action Plan Modeling: Greenhouse Gas Marginal Abatement Cost Curve Development and Macroeconomic Foundational Modeling for Oregon, Center for Climate Strategies, July 30, 2012.

¹¹ Overcoming Market Barriers and Using Market Forces to Advance Energy Efficiency, American Council for an Energy-Efficient Economy, March 2013. <http://aceee.org/files/pdf/summary/e136-summary.pdf>

¹² Ibid.

¹³ Ibid.

Gov. Dennis Daugaard

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- ⁸ *Global Economic Effects of US Biofuel Policy and the Potential Contribution from Advanced Biofuels*. Oladosu, K. *Biofuels*, 2012.
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- ¹¹ "40 Facts about Ethanol." Renewable Fuels Association. Accessed May 2013. <http://www.enerkem.com/assets/images/RFS2%20Chart.jpg>

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