Securing Idaho's Energy Future:
The Role of Energy Efficiency and Renewables

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ABOUT THIS REPORT

This study was authored by the Athena Institute (www.athenacompany.com), an independent firm providing research, consulting, and events for those seeking strategic advantage from clean and sustainable innovations. Athena helps businesses, buildings, utilities and regions find solutions that are more economically valuable, environmentally sound, and secure.

The study was commissioned by Climate Solutions through a grant from the Energy Foundation. Climate Solutions is a non-profit organization dedicated to accelerating practical, profitable solutions to global warming and to building a powerhouse clean energy industry in the Northwest (Oregon, Washington, Idaho and Montana) that employs tens of thousands of people. Climate Solutions is working with leaders from Idaho's agricultural community, business sector and non-profit organizations on the Energy Independence for Idaho campaign, which is designed to advance homegrown renewable energy in Idaho.

Work on this study began in October 2007. Over the course of the next 8 months the study team gathered available consumption and resource potential data, generated preliminary outputs and facilitated extensive review. Earlier drafts of the study were sent to a number of people working on energy issues in Idaho. This included all members of the 25x'25 Renewable Energy Council while it was under the direction of Agriculture Director Celia Gould, renewable energy and energy efficiency experts, renewable energy developers, academicians working in the field of energy, business and agriculture leaders, members of the Idaho state legislature and public utilities commission and relevant agency staff. We provided them with an opportunity to review and comment on the contents of this study and consequently integrated much of the input we received. After the first round of review, we worked with a team of experts in the renewable energy and energy efficiency field to provide an extensive and in depth review of study content, facts and figures. Over the time frame of the study, upgraded information became available from the Energy Information Agency and other sources, and so the study was adjusted to include new estimates, where available.

This preliminary study was not scoped to include in-depth analysis and complex modeling around energy uses and sources that a true energy plan should entail. Instead, the study began to draw the relevant data about Idaho's energy options into one place and illustrate the benefits of a more aggressive look at natural resources and energy efficiency and stimulate discussion around the merits of specific resources. The study was also focused on the long-term energy security value of particular resources rather than their environmental attributes. Therefore, information around climate performance of a resource is not included except where those attributes have a significant impact on its economics or acceptance.

Responsibility for content, conclusions and any factual errors in the report remain with the authors. That noted, the authors gratefully acknowledge valuable review comments provided by a number of individuals, including: Milt Adam, Steve E. Aumeier, PhD, Stan Boyd, Dave Chase, Treena Colby, Mike Costanti, Beth Doglio, Amy Frykman, John Gardner, Doug Glaspey, Todd Haynes, Nancy Hirsh, Jim Kempton, Glenn Ikemoto, Winston Inouye, Brian Jackson, Suzanne Malakoff, Paul Mann, Patrick Mazza, Ken Miller, Dar Olberding, Tim Raphael, Rich Rayhill, Rhys Roth, John Steiner, Garth Taylor, Kiki Tidwell, Joe Weatherby, John Weber, and Bob Zemetra.

EXECUTIVE SUMMARY

STUDY OVERVIEW

The future of energy in Idaho is critical to the overall health and economic well-being of the state. Idaho has traditionally benefited from a strong, lower-cost energy portfolio. But the state now faces a serious threat to its economy in the form of rising energy costs and energy security issues associated with its heavy reliance on out-of-state imports of natural gas, coal and petroleum. At the same time, Idaho is rich in untapped natural resource and energy efficiency opportunities that could serve important roles in meeting the state's energy needs. Developing these in-state resources will not only reduce Idaho's dependence on fossil fuel imports, but bring substantial new jobs and revenue to the state.

Idaho recognizes its need for a clear vision and commitment to a secure energy future that is economically viable, environmentally sound, stable and secure; state leaders took a number of important steps in 2007 in this direction. An energy plan issued by the legislature outlined energy goals for the state, prioritizing renewable energy and energy efficiency resources. In addition, Governor Butch Otter recently established the Office of Energy Resources to oversee the state's energy planning, policy, conservation and coordination, thereby elevating energy policy to the highest levels of state government. The Governor also established Idaho's 25X'25 Council to create a strategy to supply 25 percent of Idaho's energy from renewable sources on Idaho's working lands by the year 2025. Finally, the Idaho Public Utilities Commission, along with other Idaho agencies, joined a nationwide effort to enhance energy security and protect the environment by encouraging public and private organizations to implement energy efficiency measures.

In light of this clear commitment by the state to address Idaho's energy portfolio, the purpose of this study is to provide Idaho citizens and decision makers with information on the natural resources and energy efficiency opportunities available in Idaho. To that end, this study examined the growth of Idaho's energy demand, the vulnerabilities in its current portfolio and the natural resources and energy efficiency opportunities that are technically and economically feasible for the state. To illustrate the rich store of in-state resources, it maps out the feasibility of moving from today's portfolio—which is 80 percent dependent on out-of-state imports—to a portfolio in which energy conservation is fully leveraged and a much greater share of Idaho's power comes from in-state natural resources by 2025. Recommendations provided in this report aim to facilitate robust development of these resources and opportunities and maximize the resulting economic benefits for Idaho communities.

Tapping only existing publicly available data, this report provides a high-level overview of some important concepts that should be explored in more depth as Idaho works towards its energy goals. To strengthen the state's knowledge of its in-state opportunities, further research will be needed, perhaps leading to different conclusions on certain types of resources. But the basic tenet remains: natural resources and energy efficiency should play a key role in Idaho's energy future.

HIGHLIGHTS OF KEY RESULTS

A number of key conclusions have emerged as a result of this study's research synthesis and analysis:

Idaho Consumes Significant Energy, Largely from Imports. Idahoans consume more energy per person than any other Northwest state or province. These energy needs are expected to grow; this study estimates statewide demand for all energy types will grow from 503 British Thermal Units (Btu) per year in 2004 to over 650 Btu/Yr in 2025. In 2007, Idahoans were spending $$3.7 billion annually for all forms of energy.[1] But because approximately 80 percent of Idaho's overall energy supply for electricity and fuels is imported from out of state, the state is sending billions of dollars to support the jobs and revenues of communities outside of Idaho.

Idaho's Current Energy Portfolio is Not Secure. Historically, energy has been thought of as plentiful and cheap in Idaho because of abundant hydroelectric resources and affordable, reliable gasoline, diesel and natural gas supplies. Idaho's primary in-state energy source continues to be hydropower, but the state has also built up a heavy reliance on coal, natural gas and petroleum imports as core elements in the energy portfolio. Increasing market pressures, however, are impacting the economics and capacity of all the resources Idaho relies upon, including issues such as a growing demand for energy, fossil fuel price volatility, restrictions on existing power generation, the growing likelihood of greenhouse gas regulation and further environmental constraints and increasing competition for natural gas resources. These dynamics – largely beyond the control of Idaho leaders - will take their toll on the state's energy portfolio, exposing residents, agriculture and industry to potentially substantial increases and volatility in fuel and power costs. This will negatively impact many sectors of Idaho's economy and populace that for decades have relied on stable, low-cost power.

Natural Resources and Energy Efficiency Could Play a Central Role. While Idaho may not be able to exert much influence on the markets outside forces that are impacting short- and long-term costs of energy, the state can nevertheless take charge of its energy security. Idaho can become more energy independent by developing local renewable resources and maximizing energy efficiency. Idaho is a large state with extensive natural resources and a relatively small—but growing—population base. Wind, geothermal, solar and biomass resources in the state are in abundance, thereby providing the opportunity for Idaho to develop the capacity to serve much of its electrical load with in-state sources over time. On the demand side, advances in energy efficient heating, cooling, power and transportation technologies are providing new options for optimizing the state's energy system. This strategy is also a natural extension of the state's identity; Idaho has a very strong sense of pride, independence and self-reliance. It has a long history of developing its natural resources in agriculture and mining industries. On a personal level, Idahoans place a high value on their unique quality of life and are very close to the land for both work and recreation.

There are Multiple Ways to Leverage Natural Resources and Efficiency. There are any number of technology and policy combinations that could enable Idaho to tap its natural resource and energy efficiency potential. To illustrate the significant potential for efficiency and renewable energy, this study generates three example scenarios that increase the share of in-state resources in the state's energy portfolio from about 20 percent today to 50 percent in 2025

The three scenarios:

- Envision Idaho replacing a portion of its petroleum usage with alternative fuels and vehicle electrification (including all-electric and hybrid electric vehicles, public transit electrification, etc.).
- Project different adoption levels for system efficiencies at the plant and distribution, and energy efficient end-use technology replacements, upgrades and conversions that yield 10, 20 or 30 percent reductions in total projected energy needs.
- Involve a significant commitment to wind and solar energy, continued development of geothermal and biofuels/biomass energy, and investment in efficiency upgrades at existing hydro facilities, as well as some microhydro projects.

The three scenarios differ in the degree of build-out of particular resources, with varying levels of wind, solar and bioenergy resource development in each scenario.

Table 1: Scenarios for Developing Natural Resources and Energy Efficiency in the State

Portion of Estimated 653 Trillion Btu/Yr 2025 Demand		Example Scenarios of Energy Production Resources in Trillion Btu/Yr	
Efficiency Assumption	**50% In-State Natural Resources (TBtu/Yr)**		
High Efficiency (30% or 195.9 TBtu/Yr)	228.6	99.6	Wind
		42.0	Solar Electric/Solar Thermal
		27.0	Geothermal Electric/Geothermal Direct
		21.0	Biofuels/Biomass
		39.0	Hydro (currently 38.8)
Medium Efficiency (20% or 130.6 TBtu/Yr)	261.2	116.6	Wind
		47.0	Solar Electric/Solar Thermal
		27.0	Geothermal Electric/Geothermal Direct
		28.4	Biofuels/Biomass
		42.2	Hydro
Low Efficiency (10% or 65.3 TBtu/Yr)	293.9	141.0	Wind
		47.0	Solar Electric/Solar Thermal
		27.0	Geothermal Electric/Geothermal Direct
		33.5	Biofuels/Biomass
		45.4	Hydro

The scenarios are based on analysis of existing data on Idaho's resources and opportunities. However, that data is scarce in several areas; more robust and valid data would enable more refined projections of the realistic development potentials of the various resources.

The full economics of these portfolios are difficult to assess without more complete economic and operational modeling which was beyond the scope of the study. More in-depth analysis of these resources needs to be conducted which factors in specific resource economics, operational profiles, grid capacity and environmental impacts. In absence of full economic, operational, and risk analysis, we are not offering these scenarios forward as recommended courses of action. They do serve illustrative purposes, however, and demonstrate the value to be had by undertaken more robust modeling that would look to harness the power resident locally in natural resources and energy efficiency.

It is true, though, that the costs of renewable energy and energy efficient technologies are generally declining relative to traditional energy sources over time, for a number of reasons:

- Costs for traditional sources continue to increase.
- Governments are implementing policies that encourage adoption, allowing renewables to achieve economies of scale.
- An influx of venture capital and institutional investment will continue to bring new innovation and positive movements down the costs curve.

Natural Resource Development and Energy Efficiency Would Also Bring Jobs and Revenue. Not only would natural energy resources play a critical role in serving the needs for energy security, these projects and companies would bring jobs and revenue to the state's rural and urban communities. Development, management and delivery of larger scale renewable projects offer numerous family-wage jobs, many of these in rural areas. Distributed small-scale resources and energy efficiency projects create opportunities for information system integrators, engineering firms, installers and maintainers. Beyond the projects themselves, an active energy sector will also attract design and manufacturing firms specializing in these various technologies. In fact, the state is already beginning to attract significant solar (Hoku), biomass (Pacific Ethanol), geothermal (US Geothermal), and wind (Nordic Windpower) manufacturers and developers. Scaling up in-state renewable and energy efficiency resources could help control the cost of natural gas, the rising cost of which is impacting Idaho's agriculture producers because it is a primary factor that drives the costs of farm fertilizer. Finally, the success of these scenarios will increase tax revenues to counties and the state that could be used to strengthen infrastructure and local economies across Idaho.

Overall, this study has confirmed that the outlook for Idaho is positive. It demonstrates that taking into account energy efficiency and some transformation of the energy system, it may be possible to meet 50 percent of Idaho's energy demand with natural resources by 2025.

SUMMARY OF RECOMMENDATIONS

Idaho stands at a crucial energy and economic crossroads. There are several areas and opportunities for Idaho to increase its energy efficiency and in-state energy production. The following are specific recommendations that would put Idaho on the path to becoming energy independent, creating jobs and bolstering the local economy. The following section identifies a series of recommendations for the state to address its underlying needs for energy security.

1. Create a Statewide Energy Security Plan with clear strategies, targets and accountability for results.
2. Align state legislative policies, regulatory policies, and state agency activity under the Energy Security Plan.
3. Build Idaho's clean energy industry, develop its clean energy workforce and invest in innovation.

Leverage the Existing Momentum with a Clear Plan. Redirecting Idaho's energy future to reduce imports aggressively is not trivial; developing natural resources and energy efficiency will require commitment. While transitioning the energy system in Idaho poses challenges, the growing interest in energy and energy security stands ready to be harnessed. Idaho is not starting from scratch; several key agencies and organizations have already spearheaded and developed plans and initiatives around energy, water and economic development. Coordination – or at least some sort of information sharing – amongst all parties interested and/or responsible for these initiatives is essential. Even more paramount to this effort is a statewide energy plan with clear expectations, targets and inputs from counties and communities, combined with an ongoing approach to update the energy plan. Developing this next generation of the Energy plan will take some education of policymakers and residents, many of whom may still be under the false impression that a notably large portion of statewide electric power is from hydro sources and that the state's energy future is relatively secure. The plan should make a real commitment to a more specific path towards increasing domestic resources to cost-effectively achieve the 2025 goal. Policy should encourage utilities to strengthen integrated resource planning to be consistent with the statewide energy security plan. The plan should outline the key advances necessary to position the state to effectively compete for investment capital against others in the region, most of which have already moved ahead on renewable energy and fuels. Policy discussions and approaches should also focus on preparing for a future in which organizations will be charged for their fossil fuel emissions.

Align Key Government Activities to Bring Industry and Consumers Along. To further encourage investment from the private and public sectors, the state should look at sending strong signals to the market indicating Idaho's commitment to developing natural resources and energy efficiency. Beyond producing the plan itself, the state should provide resources to administrate the plan and establish a link and expectations around the various state-agencies who can contribute to growing this opportunity. The state should also establish statewide initiatives concerning transmission capacity, smart grid technologies and T&D efficiency—all of which will aid in the transmission of renewable electricity. The state needs to facilitate development of appropriately sited renewable energy projects by establishing effective state and local transmission site and zone policies and leveraging its own lands and role in the overall transmission planning process. There should be strong incentives for the development and deployment of renewable generation technologies for both small-scale customer-owned and large-scale utility-owned facilities. By implementing the above and by building an open access electrical grid that allows for easy interconnections of smaller-scale renewable generators, Idaho would be in line to be an energy leader in renewables. And to lead the way, the state government should start by building markets for new renewable electricity generation by committing to run state government facilities on new renewables.

The state has a number of legislative tools to facilitate the development of new energy resources and energy efficiency. Specific renewable energy initiatives could encourage locally produced renewable electricity, fuels, fuel infrastructure, and energy efficiency implementations. This can be achieved through a Governor's challenge, governmental department mandates, market incentives, renewable energy targets and/or standards for fuels and the power portfolio, appliance energy standards and more. Legislative action around economic incentives such as tax credits, tax exemptions and other investment incentives are needed to grow the adoption of renewable vehicle fuels and provide the fuel commodities and local infrastructure to deliver fuel to the consumer. Providing strong production incentive payments for ethanol and biodiesel production and/or consumption will level the economic playing field with gasoline and diesel. Providing incentives for building up the Idaho biofuels delivery network will help guarantee a free market for biofuels and renewable fuels. Building markets for flex-fuel vehicles capable of operating on E85, other alternative fuel vehicles and fuel efficient vehicles such as hybrids through public fleet purchases and tax exemptions will also move the state towards making renewable vehicle fuels a market reality.

Commit to the Economic Potential of Clean Technology Jobs with Commercialization and Growth Support. Additionally, promoting and funding Idaho's universities, overall R&D and the collaboration of universities and industry around key technology areas and more general topics would ramp up the development and deployment of technologies within the state, leading to jobs and revenues from technology production and manufacturing. This leadership role could extend nationwide with the abundance of developing technologies both privately and in conjunction with Idaho National Laboratory. Key areas such as dairy waste to energy, biomass initiatives and other R&D capabilities regarding the farming and dairy industries (and their byproducts) would increase the long-term economic opportunity and vitality for one of Idaho's largest industries. Further developing and broadening Idaho's economy to include renewable energy and clean technology firms would also bring potential collaboration between traditional industries and newer clean tech companies in these areas.

A shift to emphasize local renewable resources and energy efficiency is an absolute must to keep Idaho economically prosperous and secure, and to secure more of the job growth and tax revenue gains that result from the development of local energy resources. With state and local leadership, with a commitment to planning and incentives, and with specific initiatives around renewable electricity and renewable fuels advances, the state can maximize and leverage the potential benefits from these important resources in Idaho's energy future.

Idaho's Energy Consumption and Portfolio

Historically, Idaho has enjoyed relatively low-cost energy from local hydropower, a captive natural gas market, and imports of coal-based electric power and petroleum. The state now faces a number of interesting challenges to this low-cost energy portfolio that together could represent a significant threat to Idaho's economy. In this section, we identify the current energy use and load requirements, along with the impact higher energy costs might have on the state.

Idaho's Energy Consumption and Sources

According to the Cascadia Scorecard in 2007, Idahoans consume the energy equivalent of 17.4 gallons of gasoline per person in transportation fuels and electricity for homes, buildings and businesses every week. Overall, state residents use more gas, diesel and electricity per person than any state or province in the Northwest—one-third more than British Columbians and twice as much as Germans[2]. Other statistics that include natural gas consumption put Idaho's overall per capita energy consumption at almost twice that amount. A state by state ranking in 2004 of the overall Btu consumption on a per capita basis places Idaho 23rd in the nation, consuming 358.4 million Btus per person and spending more than $3.7 billion each year on energy.[3]

Idaho has several energy sources that it uses to meet its needs for heating, cooling, power and transportation. Table 2 illustrates how the consumption of energy currently breaks down across different uses and different sources, built from the most current data available from the Energy Information Administration, broken out by on a tBtu basis for better comparison. As the chart reveals, a significant portion of Idaho's overall energy consumption is in the form of petroleum for transportation uses. Hydro-electric power also plays a key role, as does the use of natural gas for residential heating.

Table 2: Idaho Energy Consumption– 2005

Example Components of the Energy System in Idaho	Estimated Make-Up of Current Demand , 2005 Data
	Trillion Btu/Yr [a]
Total overall Energy Consumption for State	503.0
Total Retail Electric Sales to Residential, Commercial, Industrial Customers	74.6
Breakdowns of Selected Components	
Hydro-Electric Power (conventional, does not included pumped storage)	85.4
Natural Gas Consumed by Electric Utilities	11.7
Electrical System Losses	139.4
Biomass and Geothermal Energy Consumption	25.9
Natural Gas—Residential Heating and Commercial Uses	78.2
Natural Gas—Industrial Heating and Process uses	24.1
Natural Gas—Transportation	5.7
Petroleum—Motor and Other Uses	160.8
Coal –Mostly Industrial Uses	11.3
Other	2.1

Source: Energy Information Administration, 2007.

Idaho's energy consumption further divides among industrial (37.9 percent), transportation (24.5 percent), residential (22 percent) and commercial (15.6 percent) uses. On the residential side, data from a 2003 federal Customer Expenditure Survey shows that the average household in Idaho spent approximately $3,000 annually on energy for electricity, natural gas and petroleum[4]. This represents about eight percent of median income, above the average for the nation. This ranking is driven both by the long distances that Idahoans have to drive and the state's lower median 2003 income ($39,492) compared with the national average median ($43,564). The United Nations defines energy poverty as needing to spend more than 10 percent of one's income to cover energy consumption. While not at that level overall in 2003, the cost of energy was still a significant burden for many lower income Idaho households and has climbed substantially for all Idahoans along with gas prices.

Heating is a significant energy expenditure for Idaho residents. Idaho homes are heated by natural gas (45 percent), electricity (34 percent), liquefied petroleum gas (6 percent) and fuel oil (5 percent) and various other fuels (10 percent). These energy costs are generally rising. In January of 2006, the Energy Information Administration predicted that the average home heating bill that year would increase by $257 (35 percent) for natural gas heat, $275 (23 percent) for oil heat, and $184 (17 percent) for propane heat. Electric costs also increased during 2006, though at a lower rate than other sources. In part due to these increases, more than 33,900 Idaho households received home heating assistance from Congress and the state in 2006, an increase of five percent from 2005.

Beyond individual household energy consumption, Idaho has also attracted a number of energy-intensive industries—forest products, mining, agriculture and transportation equipment—as a consequence of its natural resource wealth and traditionally low electric power rates relative to other states. Table 3 summarizes a sample of key industries, their importance to the state, and the impact energy costs have on them.

Table 3: Impact of Energy Costs on Selected Sectors in Idaho		
Sectors in Idaho	**Economic Impact to State**	**Impacts of Energy Costs**
Manufacturing, general	65,000 jobs in 2006, average $42,800 annual income per year per employee	High impacts from natural gas prices, transportation costs
Chemical manufacturing	2,000 jobs in 2005 and $155 million in export revenue	Depends highly on natural gas
Forest products	12,000 workers with annual payroll >$593 million Over 21 million acres of forested land	Energy is 18% of overall expenses, third largest cost category
Farming and Ranching, overall	25,000 farms and ranches, over 11.7 million acres, $4.4 billion in farm receipts in 2005	Higher costs in transportation, electricity and related costs impact this sector directly and indirectly; potentially devastating costs to family farms and farming communities
Cattle and Feed, general	Cattle and calves represented $1 billion in receipts in 2005	Corn requires large amounts of fertilizer and irrigation water, the supply of which depends on petroleum and electricity
Dairy products	2nd largest milk producing state in the west, 4th in U.S., $1.4 billion in receipts in 2005 19,400 jobs in production, processing, transportation and distribution	Energy costs impact feed stock, motors, lighting and transportation
Agricultural products	Potatoes account for $522 million in receipts, wheat and barley account for $491 million in cash receipts	Irrigation costs for energy and water, feed and ingredient processing, fertilizer and agricultural chemicals
Tourism	According to an economic impact study commissioned in 2004, Idaho's $2.97 billion tourism industry supports 68,839 jobs for Idahoans and generated $438 million in local, state and federal tax revenues.	Moderate impacts from transportation costs, although less sensitive than other sectors listed here

For Idaho's agriculture sector, for example, increasing energy costs have a variety of impacts. During the 2003 and 2004 growing seasons, U.S. farmers paid more than $6 billion in added energy-related expenses, a 41 percent increase over 2004, according to US Department of Agriculture's Economic Research Service. More recently, the same organization estimated that seed, fertilizer and pesticide expenses would be $36.1 billion in 2007, up five percent from 2006, the fourth straight increase of $1.8 billion or more per year. The cost of natural gas, which is up sharply, makes up about 90 percent of the cost of agricultural fertilizer. Clearly in today's environment of rising costs for petroleum products and natural gas, the agriculture sector is vulnerable and exposed to volatile price fluctuations for these imported resources. While larger agribusinesses may be better equipped to deal with these increases, smaller family farms and farming communities could be crippled by their weight.

Increased energy costs also impact the cost of business for state government and other major institutions. For example, the University of Idaho reports that it spends more than $3.3 million annually for power and fuel expenses, costs that will rise as electricity, petroleum and natural gas costs climb, diverting dollars could be used for other higher value initiatives.

Energy Demand Expected to Grow

So what kind of demand for energy overall can we expect in 2025? In a simple calculation, in 2005 Idaho consumed 503 tBTUs of energy, with a per capita energy consumption estimated at 353 million BTUs, based on an estimated population of 1.424 million. The population in 2025 is projected to grow to 1.852 million[5]. If the per capita consumption ratio holds, then Idaho's total energy consumption by 2025 would be 653 tBTUs.

Table 4: Projected Growth in Nationwide Electric Energy Consumption (billion kilowatt hours)			
Scenario	2005 Electric Sales	2030 Electric Sales	% Annual Avg. Growth Rate
Reference Case	3,660B kWh	5,168B kWh	1.6%
High Growth Case	3,660B kWh	5,654B kWh	2.1%
Low Growth Case	3,660B kWh	4,682B kWh	1.1%

Source: EIA Annual Energy Outlook 2007

Going forward, though, different pressures will influence how much energy consumption increases, decreases, or stays flat. Petroleum expenditures on transportation, for instance, have actually reduced on a per capita basis for the last several years, in part due to both the reduction of commutes in response to higher prices and likely also to the change in the level of commercial activity in some of the industry represented in the state. On the other hand, electricity usage continues to grow at a rate faster than the growth in population.

Nationwide, electric energy consumption has been on an upward spiral, growing nationally more than 30 percent over the last 25 years and continuing to climb. The Energy Information Administration (EIA) Annual Energy Outlook in 2007 lays out scenarios under different growth expectations that demonstrate some of the increases we will likely see over the next 20+ years in our demand for kilowatt hours (kwh) of electricity.

Growth in electricity demand is being driven by several factors. The commercial sector's demand is projected to increase the most due to the expected growth in the service industries. More generally, the growth in population and disposable income is increasing the demand for additional products, services and floor space. And as people continue to migrate to warmer regions, the need for cooling is expected to increase. All of these elements will, in turn, increase demand for electricity and ultimately require more investment by utilities across the country—but especially in those regions of higher growth.

As for Idaho, the state's electric utilities have been experiencing growth in their overall customer base, as well as growth in the per capita or individual demand that those customers represent. Boise-based Idaho Power, for instance, now serves more than 457,000 customers in southern Idaho and eastern Oregon. In 2006, the utility's customer base grew by 3.2 percent.

Reflecting these different pressures on growth, the projection for Idaho's growth in energy demand by 2025 can be broken out into three main areas:

Electric Power Demand— The 2007 Idaho Energy Plan shows a projected growth for Idaho's electric load from 2693 aMW (23.59B kWh) in 2005 to 3242 aMW (28.40B kWh) in 2015, an additional 630 average megawatt (aMW) and an average growth rate of 1.87 percent per year, hovering between the U.S. "Reference Case" and "High Growth Case" in Table 4 above. According to research generated through the preparation of the 2007 Idaho Energy Plan, electricity demand in Idaho is projected to grow another 1,182 aMW by 2025[6]. The projected Idaho population growth through 2030 is 1.41 percent per year according to the U.S. Census Bureau, so in this case electricity use is expected to grow somewhat faster than population, reflecting the increase in energy intensity if we pursue business as usual.

Direct Consumption of Fuels for Heating and Industrial Uses— Direct use is broken out into those areas that are likely to grow on a per capita basis (like residential and commercial heating), versus those that may grow on a pace driven by assumptions about industrial growth (like industrial uses for natural gas). In the case of the first, direct heating of residential and commercial buildings is estimated to continue to grow on a per capita basis, so we would expect growth of 32 percent to 103.2 t BTUs/year. In the case of direct use by the industrial base, an internally consistent projection would be one that is built from the industrial sector assumptions in the region, and the resulting demand for heat, steam, and other forms of energy. In absence of that data, our estimates increase the industrial need for heating and power at a 32 percent increase, or 31.8 tBTUs/year by 2025.

Transportation Fuels & Gases— Most transportation is fueled currently through petroleum products, with a limited amount at this point powered by gases or electricity. The actual consumption of petroleum has declined on a per capita basis over the last several years, and there are arguments that consumption may continue to fall in response to ever increasing prices. If consumption patterns remained constant on a per capita basis through 2025, the projection for transportation uses would be 219.78 tBTUs/year.

Taken together, these estimates yield a 2025 projection closer to 663 tBtu a year. From this top down analysis, it appears that energy demand will grow from 503 trillion BTUs (tBtu) a year today to somewhere between 653 and 663 tBtu per year by 2025, under 'business as usual' assumptions (absent the implementation of new efficiency and conservation measures). The 653 tBTU estimate is used in this study for constructing the three scenarios for scaling up use of Idaho's renewable energy and efficiency resources (see Table 18 below).

THE CURRENT ENERGY PORTFOLIO RELIES HEAVILY ON IMPORTS

To date, Idaho has benefited from a low-cost power portfolio made up primarily of domestic hydropower and imported natural gas, petroleum and electricity from coal. But this same portfolio now puts the state in a vulnerable position. It also represents missed opportunities for local jobs and revenues as the state spends more than $2 billion to buy energy from outside the state. In this section, we outline the portfolio mix and explore risks inherent in Idaho's current energy system and its reliance on fuels and electricity delivered from outside the state.

While in-state hydropower supplies nearly half the *electricity* used in the state, Idaho's overall energy portfolio is made up largely of out-of-state resources. The largest slice of Idaho's total energy portfolio is petroleum fuels (45 percent), followed by natural gas (22 percent), coal (13 percent), hydropower (11 percent) and biomass (7 percent).[1]

[1] This discussion of the breakdown of Idaho's current energy portfolio is based on information from various sources with minor variations in the actual percentages among the sources. These slight variations in values between sources do not materially impact the discussion and conclusions.

Table 5: Idaho Energy Resource Consumption Percentage Breakdown – Imported and In-State Resources			
	Percentage -- Energy Unit Basis	**Out-of-State Electric Power Generation**	**In-State Electric Power Generation**
Out-of-State (Import) Resources – Total 81%			
Coal -- electric power (out-of-state generation – electricity import)	11.4%	X	
Nuclear –electric power (out-of-state generation – electricity import)	0.2%	X	
Natural gas being piped to support locally generated electric power	2.3%		X
Petroleum –transportation fuels and other use	45.4%		
Natural gas -- other use	20.0%		
Coal -- other use	1.9%		
In-State Resources – Total 19%			
Hydro -- electric power	11.4%		X
Biomass -- electric power	0.3%		X
Biomass -- other use	6.9%		
Geothermal -- direct use	0.5%		

Source: Energy Information Agency, Idaho Energy Plan, Various INL studies and other sources

Table 5 brings together multiple data points to illustrate how the overall energy consumption breaks down between in-state and out-of-state sources. Figure 1 below graphically depicts the energy import streams as well as the relationship with in-state and out-of-state electric power generation for Idaho consumption. The percentages shown are based on total energy consumption that includes both electricity and fuels.

Retail electric sales make up just one-fifth to one-fourth of the state's total energy consumption. To generate this electricity, Idaho uses hydropower to fuel 45 percent of Idaho's electric generation primarily from Idaho Power and Bonneville, with another 45 percent coming from out-of-state coal fired plants, followed by in-state natural gas plants (leveraging fuel from out-of state) (9 percent) and in-state wood and waste (<1 percent) and some out of state nuclear (<1 percent), according to the Idaho Energy Plan.

On the transportation side, Idaho is fueled overwhelmingly by refined petroleum products, and the state receives petroleum products from refineries in Montana and Utah via two petroleum pipelines.

Idaho does not have any oil or natural gas fuel resources produced domestically. In other words, in serving needs that rely on these sources of energy, Idahoans must rely extensively on out-of-state resources.

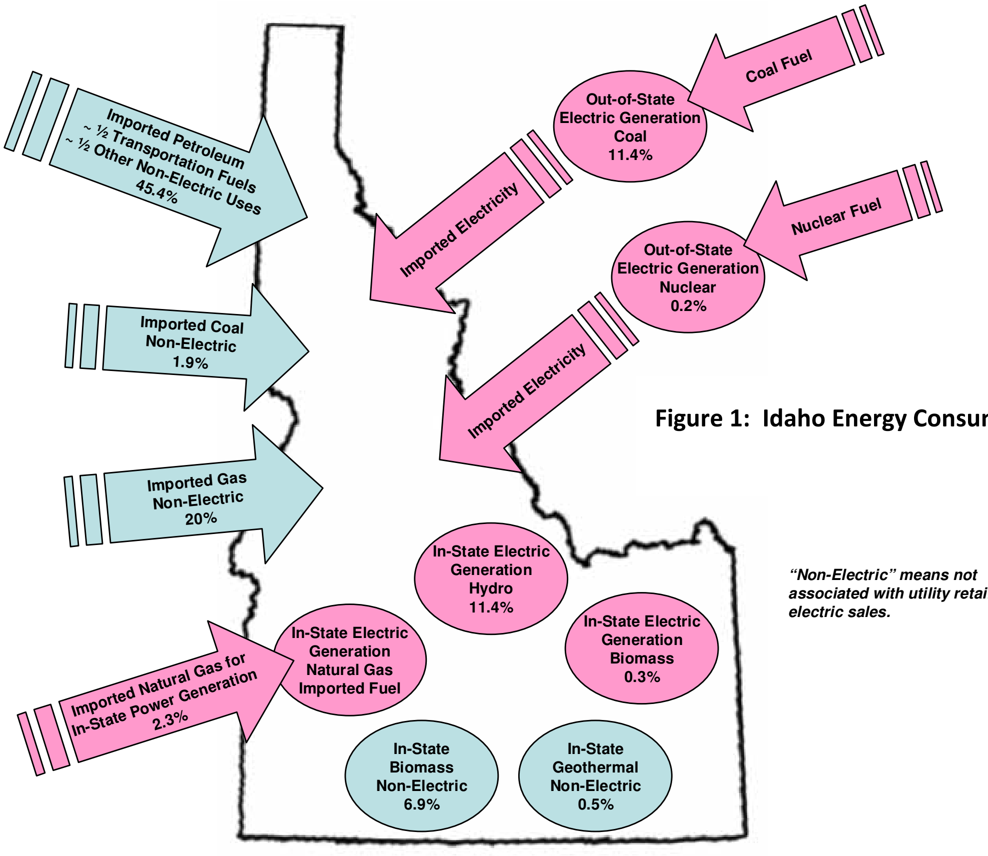


Figure 1: Idaho Energy Consumption

In total, about 80 percent of Idaho's overall energy needs are not served by Idaho sources, or come from in-state plants that rely heavily on fuel sources located outside of Idaho.

The Current Energy Portfolio is Vulnerable

Idaho's current portfolio mix is vulnerable to price pressures coming from a number of angles, which are described in the next section: volatility in the wholesale electric power market, limitations in the hydropower system, price variability in natural gas, emissions costs related to coal-fired electric plants, instability in petroleum supply sources and pipeline vulnerabilities.

Volatility In Wholesale Electricity Markets

Idaho Power's 10 year resource plan acknowledges that they have not kept up with building the power plants needed in order to meet load growth. Idaho Power also acknowledged that it relies on regional markets to supply a significant portion of its energy and capacity. Unfortunately, the Pacific Northwest electricity market has a large number of participants with short-term prices that can be quite high, volatile and sometimes even unavailable for peak-hour load periods. With restraints for building new in-state power plants to keep up with demand, and with new competition from other states such as California for out-of-state resources, Idaho is increasingly vulnerable to meeting demand and price pressures.

HYDROPOWER LIMITATIONS

Hydropower provides nearly half of Idaho's electricity, although it faces some challenges going forward -- from reduced streamflows to relicensing processes to competition from other river interests. Seven of Idaho's 10 largest generating facilities run on hydroelectric power. According to the 2007 Idaho Energy Plan, there are 136 existing hydro plants in Idaho with 2500 MW capacity producing 1300 aMW (38.8 trillion Btu per year).

But the capacity of those resources is changing. Idaho Power's 2006 Integrated Resource Plan identified that based on recent history, Snake River stream flows are expected to continue to decline by approximately 53 cfs per year, which results in a 25-30 aMW (~2 percent) loss of hydroelectric generation.

Idaho Power has an obligation to serve customer loads regardless of hydrologic conditions. After the energy crisis of 2000 and 2001, Idaho Power had to re-evaluate its planning criteria and use more conservative water planning. It now uses 70^{th} percentile average load, 70^{th} percentile water conditions, 90^{th} percentile water conditions and 95^{th} percentile peak-hour loads for energy planning. However, hydrologic conditions were worse than the 90^{th} percentile in 2001 and worse than the 70^{th} percentile from 2001-2005. During months when Idaho Power faces low stream flow, it plans to purchase off-system energy and capacity on a short-term basis to meet system requirements (see *Volatility in Wholesale Electricity Markets* section above).

Additionally, existing hydropower facilities must be relicensed by the Federal Energy Regulatory Commission (FERC) periodically. The process often imposes new costs and constraints on hydropower plants to address effects on the environment and on other users of the river system such as agriculture, fisheries and municipalities. As a result, relicensing requirements will likely drive the costs of hydropower up and potentially reduce the amount of power available from those projects. For example, Idaho Power recently filed a rate increase request for an average of 10.35 percent (4.5 percent for residential customers and up to 20 percent for irrigation customers) to recoup costs, which included $34 million for relicensing and equipment investments related to its hydroelectric projects.

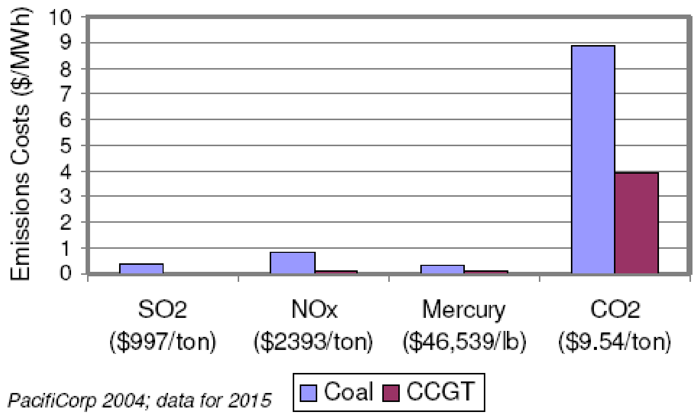
COAL-FIRED ELECTRICITY

About 45 percent of the electricity used in Idaho comes from out-of-state coal plants. Idaho Power has a number of interests in coal plants that it uses to serve the state's needs, including a one-third interest in the Jim Bridger coal complex in Wyoming, a one-half interest in the North Valmy plant in Nevada, and a 10 percent interest in the Boardman plant in Oregon.

The future of coal as an energy resource in the western power market is in question as California and other western states have enacted policies to reduce the greenhouse gas emissions profile of their electricity sectors. The potential for national carbon dioxide (CO_2) and mercury (Hg) regulations creates even greater uncertainty for coal as a resource. Federal regulations would increase the cost of coal-fired power upon which Idaho currently relies for nearly half its electricity. Figure 2 taken from PacifiCorp's 2004 Integrated Resource Plan illustrates estimated costs per ton on emissions for 2015 projected by PacifiCorp. Idaho Power's 2006 (IRP) projected CO_2 higher at $ 14/ton, Nitrous Oxide (NO_x) at $2,600/ton and Hg at $1,443 per ounce in 2012.

In addition to exposure to future emissions costs, coal has also become politically sensitive in many western states. Coal plants' air and water impacts have led to increasing resistance to new coal plants in local communities in Idaho and elsewhere.

Figure 2: Estimated Emissions Cost by Ton



There is evidence that these future costs and political challenges are impacting the feasibility of coal plants in the state's energy portfolio. Idaho Power told the Public Utilities Commission last fall that it was withdrawing 250MW in Wyoming coal planned for 2013, and replacing it with a combined cycle (natural gas) combustion turbine plant (CCCT). Avista no longer includes coal-fired generation in its power planning models; fixed price natural gas has taken its place.

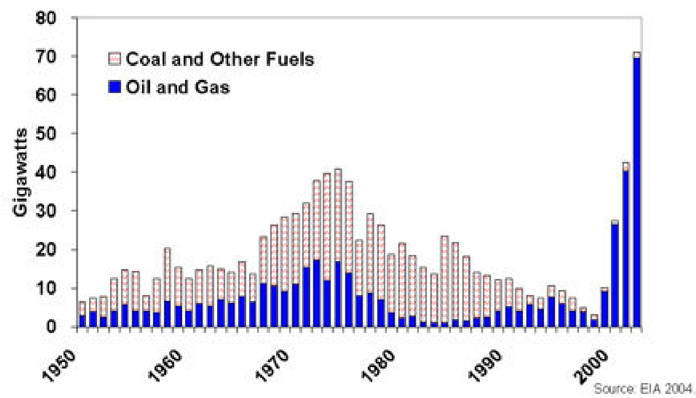
Idaho Power has stated that it will continue to explore the feasibility of a coal-fired resource in the next decade if cleaner technologies are developed. However, no such 'clean coal' technologies currently exist on a commercial scale, although research continues on whether climate-changing carbon dioxide and other greenhouse gases and toxic pollutants can be "captured" and sequestered from release into the environment. Efforts like FutureGen, a multi-entity project coordinated out of Battelle, attempts to coordinate the industry to move clean coal research and development forward, but it is difficult to project when these technologies will become commercially viable.

Natural Gas Price Volatility

Today, approximately 50 percent of Idaho households rely on natural gas as the primary resource for home heating. Natural gas is an important part of the state's fuel mix and is provided by several companies. But increased demand in the broader market, volatility in short-term and future prices and the physical security of the two primary supply lines could greatly impact the availability of affordable natural gas for Idaho consumers who rely on this resource.

Natural gas prices today have doubled from their 1990 levels, driven in large part by the increase in demand. Natural gas demand in the Mountain Census Region – Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah and Wyoming – is projected to remain high, increasing by 2.8 percent from 2.45 billion cubic feet (Bcf)[1] per day in 2007 to 2.52 Bcf per day in 2008. While retail gas for heating continues to grow, the real spikes since 2000 have come from the addition of thermal plants to generate electricity as more states work to diversify their own electricity resource mixes. Figure 3 outlines data from the EIA that frames the annual additions from oil, gas and coal to electric generation. In Idaho, utilities have simple cycle turbine power plants that are used to accommodate peak demands in the summer, and now Idaho Power has chosen to build a CCCT plant in Treasure Valley to serve baseload electricity needs. Even with price volatility, natural gas plants are still attractive economically. In addition, unlike coal plants, gas turbines can be ramped up or down. They can be used to follow load, or alternatively to help integrate new wind farms or other intermittent renewables into Idaho's power system.

Figure 3: Annual Additions to Electric Generation Capacity by Fuel, 1950 - 2002



In general, natural gas prices — and commodity prices — are steadily rising along with demand. Development of the Canadian tar sand and oil shale deposits would require large volumes of natural gas, diverting Alberta supplies away from the U.S., likely putting upward pressure on natural gas prices for Idahoans. California's emission performance standards will drive that state away from coal-based resources to even more natural gas, furthering regional demand for natural gas. In Idaho, utilities' shift away from coal towards natural gas power plants will tend to increase price pressures for natural gas that Idaho customers need to heat their homes and businesses. This challenge has been raised by at least one member of the Idaho Public Utilities Commission (IPUC), and it creates real concern for states trying to manage long-term energy affordability.

The other side of the economic equation is projections around supply. Idaho has enjoyed a monopoly of sorts with natural gas resources because of limited pipelines. But the development of additional natural gas pipelines has allowed gas suppliers to offer their resources to additional states, exposing Idaho to more retail and wholesale market demand (and therefore higher costs) for that resource. Because out-of-state natural gas suppliers are privately held companies, they sell their product over time to any higher-priced and higher-demand markets that may surface. Idaho's out-of-state gas suppliers, Williams Company and TransCanada, have been developing new transportation means and additional pipelines for new markets in North America.

[1] Gas is metered by the cubic foot, but charged by units of energy, typically the therm or decatherm. A therm of natural gas is the energy equivalent of 100,000 British thermal units (Btu) and is nominally equal to 100 cubic feet of gas. A decatherm (Dth) equals a million Btu.

All these factors are combining to bring an end to the era of reliably low natural gas prices that Idaho has enjoyed. In all likelihood, gas prices will fluctuate. That means sometimes prices go down in the near term, as when the Intermountain Gas Company recently requested to lower natural gas rates in southern Idaho by eight percent based on short-term natural gas capacity. Other times, it means prices can spike up and have hit peaks of up to $15/million Btu's during periods of short-term demand. In the period between December 2000 and the end of 2004, for instance, average U.S. wholesale natural gas prices tripled, and then rose another 40 percent between 2004 and 2005. This led Avista to request an increase of 23.8 percent in revenue requirements to be passed through to consumers.

Commercial and industrial companies who use natural gas for business and/or manufacturing operations are especially impacted by cost increases and volatility. Agricultural sectors are also feeling the impact, as nearly 90 percent of the cost of fertilizer is natural gas.

INSTABILITY OF PETROLEUM SUPPLY SOURCES

Idahoans currently consume the most petroleum-derived automotive gasoline per capita in the Northwest, at an average of 8.5 gallons *per person per week*[7]. To support this need, Idahoans import nearly $2B in petroleum products annually from oil refineries in Montana and Utah.

These regional refineries are impacted by world markets, where natural and man-made disasters (Katrina, 9/11) and other geopolitical events can significantly drive up the price of oil. Idahoans—and Americans in general—are economically held hostage with the price of oil currently climbing well above $100 a barrel and gasoline prices near $4 per gallon. In parallel, the U.S. dollar is at or near an all-time low against foreign currencies. While a weak U.S. dollar allows U.S. exports to increase, it increases the economic burden of importing resources, such as petroleum.

In addition to the impact of instability in the Middle East on domestic oil prices, a recent Government Accountability Office (GAO) report determined that a sudden loss or redirection of Venezuelan oil on the world market could raise oil prices $11 per barrel, adding $23 billion to the cost of petroleum products in the U.S. Should the political regimes in Latin America of Hugo Chavez in Venezuela, Evo Morales in Bolivia and Rafael Correa in Ecuador form an ad-hoc oil cartel and punish the United States by diverting oil resources, even temporarily, the economic impact on the United States would be far greater. The GAO report emphasizes that the cushion between supply and demand for petroleum products has become so small that shutdowns in even the smallest oil-producing countries can have disproportionate impact. For Idaho, which relies heavily on imported petroleum products, this represents a significant economic vulnerability.

PETROLEUM AND NATURAL GAS PIPELINE VULNERABILITY

Idaho depends on relatively few pipelines to supply the state with petroleum and natural gas – only two oil pipelines and two natural gas pipelines currently. Therefore, Idaho's economy and consumers could be negatively impacted overnight by any terrorist or natural disaster incident that severs a pipeline, cutting the flow of these resources.

Despite the fact that Idaho's natural gas and petroleum pipelines are not as vast as the 800-mile Alaska Pipeline (which has been bombed, shot and sabotaged), Idaho's pipelines are extensive and lie in expansive un-patrolled rural areas. As such, without the manpower, capability or technology to patrol these pipelines, the Pentagon has declared such rural areas as "indefensible."

Should such an incident occur, petroleum products could be shipped to Idaho via other transportation means, but that would significantly raise the cost of oil products in Idaho. Natural gas can currently only be transported via a natural gas pipeline, and thus could not reach the nearly 400,000 Idaho consumers who rely on natural gas in the event of pipeline disruption.

Compounding the reliance on this physical infrastructure, Idaho's natural gas and petroleum pipelines share routes with several major power lines. In specific locations, any attack or disturbance could incidentally knock-out the existing pipelines as well as the major power line in the vicinity.

For decades, Idaho and its consumers have relied on out-of-state energy resources to fuel the economy. Rarely, if ever, has the flow of these imported resources into the state become a liability or concern for Idaho's policymakers. As such, state leaders in recent times have done little compared to surrounding states to aggressively plan for a future that is less dependent on imported resources. This past 'hands-off' approach to energy policy by Idaho policymakers leaves Idaho quite vulnerable to energy price increases resulting from the global and domestic drivers overviewed above. The increased urgency around energy issues exhibited by the Legislature and Governor recently suggests the political will may be growing to tackle the formidable energy challenges Idaho faces.

CHALLENGES WITH NUCLEAR POWER Currently, nuclear power supplies a very small fraction (~0.2 percent) of the energy used in Idaho, and nuclear power is not a focus of this particular study.

However, nuclear power has received significant attention in Idaho recently, due to proposals for two merchant nuclear power plants, including one by MidAmerican Energy Holdings that has since been withdrawn.

Supporters emphasize that nuclear power plants do not emit air pollutants such as carbon dioxide, a key greenhouse gas. Once built, their capacity factor has been reported at 90 percent and above. And because the resource is dispatchable, nuclear plants provide essential baseload power. Proponents also contend that the current fleet of nuclear plants has operated safely for decades and that technology improvements have further reduced the likelihood of a major accident.

Critics emphasize that the by-products of nuclear power production are uniquely dangerous and long-lived, and that the industry still lacks a permanent solution or repository for these wastes. They suggest that global expansion of nuclear power will increase the threat of nuclear proliferation and create inviting targets for terrorists. Economic critics suggest that the large-scale subsidies enjoyed by the industry are inappropriate for an industry that has been at commercial scale for over 30 years, and that the high cost of building these large centralized plants ties up capital investment for long periods that could achieve results more quickly and cost-effectively if invested in alternatives.

Intelligent Idahoans can and do make strong arguments, pro and con, on these points and others. Whether or not nuclear power can play a meaningful role in meeting the energy challenges Idaho faces could hinge to a large degree on economics, as well as the contentious issue of water.

In order to move beyond the sharply different and often contradictory positions taken by different sides, the Keystone Center in 2006 and 2007 brought together 27 individuals to develop a commonly agreed basis of facts. The Center is devoted to building dialogue, agreement and consensus on complex issues. The Keystone Center Nuclear Power Joint Fact-Finding (NJFF) involved representatives from the nuclear industry including major nuclear plant operators as well as the environmental community, ratepayer and consumer advocates, academic and public policy experts, state regulators, and two former NRC commissioners. The group released its report in June 2007.[8]

The group estimated new nuclear power plants might deliver power at a cost of 8.3 to 11.1 cents per kilowatt hour (kwh). To compare, Idaho's average retail rate in 2005 was just under 5 cents per kwh, 2nd lowest in the nation, but as noted above those costs are likely to trend upward. The Keystone Center group noted uncertainties that could put nuclear plant capital costs higher: "A rapidly growing nuclear industry can be expected to encounter more cost challenges in skilled labor and materials, uranium and enrichment services, and possibly public and regulatory support."[9] Indeed, more recent analyses by Moody's and Standard & Poors, as well as Florida Power and Light, have put all-inclusive capital costs to bring new nuclear generation online substantially higher than the Keystone Center projection.

MidAmerican Energy Holdings, a subsidiary of Warren Buffet's Berkshire Hathaway, decided recently against pursuing a nuclear plant in southern Idaho, due to economic considerations. Another company, Alternate Energy Holdings, has said it wants to build a nuclear plant on 1,400 acres in Elmore County.

Securing a reliable supply of water could be another very significant challenge for any prospective nuclear power plant in Idaho. Nuclear power plants can require tens of millions of gallons of water a day for cooling purposes. Securing control of an adequate water supply "is front and center of everything we will do in the future," Craig Nesbit, a spokesman for Exelon, the largest operator of U.S. nuclear power plants, told the *International Herald Tribune* in May 2007. In Idaho, apportioning water among current users -- farmers, municipalities, fishing interests and hydropower producers -- can already be difficult and contentious, especially when stream flows are low.

In general, it remains unclear if or to what extent nuclear power may play a role in Idaho's energy future. Significant economic and water supply, as well as regulatory, issues would need to be resolved for any nuclear power proposals to move forward.

ENERGY EFFICIENCY AND NATURAL RESOURCE OPPORTUNITIES IN IDAHO

What role could energy efficiency and natural resources play in Idaho's energy future? Could the development of these resources provide a practical, cost-effective pathway to reduce

Idaho's dependence on imported fossil fuels, while bringing new jobs and revenue to local Idaho communities and the state?

The 2007 Idaho Energy Plan emphasized the value of energy efficiency and natural resources in meeting Idaho's energy needs. It recommends that when acquiring resources, "Idaho and Idaho utilities should give priority to: (1) Conservation, energy efficiency and demand response; and (2) Renewable resources, recognizing that these alone may not fulfill Idaho's growing energy requirements." It also goes further to suggest that the Idaho PUC and Idaho's municipal and cooperative utilities should ensure that their policies provide ratepayer and shareholder incentives that are consistent with this priority order[10].

Table 6: Idaho Energy Consumption– 2005

Current Use	**Potential Renewables/Efficiency Replacement**
Hydro-Electric Power	Lower impact hydro, other renewable distributed generation, energy efficiency
Natural Gas—Electric power	Wind, geothermal, solar, hydro, energy efficiency
Biomass and Geothermal Energy Consumption	Biofuels, ethanol, other alternative fuels, energy efficiency
Natural Gas—residential heating and commercial uses	Solar thermal direct, geothermal direct, electric power heating, gas efficiencies
Natural Gas—industrial heating and process uses	Combined heat and power, solar, geothermal direct, gas efficiencies
Natural Gas—transportation	Alternative fuels, vehicle electrification, vehicle efficiencies
Petroleum—motor and other uses	Alternative fuels, vehicle electrification, vehicle efficiencies
Coal –mostly industrial uses	Combined heat and power, solar, geothermal direct, energy efficiencies
System losses	Reduce through plant, transmission and distribution system efficiencies

Many other states have seen the value in conservation and renewables and have gone beyond identifying the promise in these areas to setting some level of expectations for either renewables or energy efficiency:

- Procurement standards are in place for energy-efficient appliances and equipment in at least 23 states.
- Renewable energy standards requiring monopoly electric utilities to include a certain percentage of renewable power in their portfolios have been adopted in 25 states.
- State facilities in 16 states have green building and/or energy performance requirements.
- Vehicle fleets in 21 states are required to meet efficiency standards, use greater percentages of alternative fuels, and/or purchase more alternative fuel or hybrid electric vehicles.
- At least 10 state governments have green power requirements for their own electricity use.

Even states known for fossil fuel resources, like Texas, are moving aggressively into renewables. Then Governor George W. Bush signed a state law in 1999 which required 2,000 MW of new renewable energy resources by 2009. Subsequently, this requirement was increased to 5,000

MW by 2015 and 10,000 MW by 2025.   Wind development in Texas continues to outpace the minimum targets required in law -- by the end of 2007, Texas boasted a total installed capacity of 4,446 MW, adding 1,618 MW in 2007 alone. In both respects (total installed capacity and 2007 additions), Texas is now the U.S. leader. At the end of 2005, Texas' installed wind capacity was just 1,990 MW, illustrating the astounding growth stimulated by the strong state wind policy.[11]

According to the National Renewable Energy Laboratory, development of just 912 MW of Texas wind in 2001 brought 2,500 jobs with a payroll of $73 million to the state, along with $2.5 million in lease payments to rural landowners and $13.3 million in tax revenues for schools and counties.[12]

No less a Texas oilman than T. Boone Pickens is convinced of the viability of wind power. "I have the same feelings about wind as I had about the best oil field I ever found," said Mr. Pickens in an interview with the *New York Times*. Mr. Pickens is planning to build a $10 billion wind farm which would be the world's biggest. "I like wind because it's renewable and it's clean and you know you are not going to be dealing with a production decline curve."[13]

Idaho stands to gain like other states, as it is rich in energy efficiency opportunities and natural resources. Table 7 below outlines some of the resources available for development in Idaho, summarizing known information about their installed and potential capacity.

One of the significant challenges for this study—and for the state—however, is to find accurate data on these resources. Data sets are scattered, incomplete, and often based on different time periods or even in conflict.

The Energy Information Agency shows a total renewable energy installed base of 113.1 trillion Btu in 2005 (includes ethanol, geothermal, conventional hydroelectric power, solar thermal and photovoltaic energy, wind, wood and waste).   Finding accurate and consistent numbers around the installed and projected/potential for individual resources was more difficult. As a consequence, the data below around installed capacity falls well short of the Energy Information Administation figure.

As for renewables potential, no total state-wide estimates are available. As such, the data for this assessment are incomplete; resources where no estimates exist and where we could not make those estimates reasonably are identified in the table below. Some categories like wind or geothermal have previously been evaluated more in depth and so information is provided here, while for other areas like solar thermal and energy efficiency there is no statewide data available. Further, these values are aggregated capacity and do not breakout the operational profile of particular resources.

Following the table, more information on each resource is provided in the rest of the section.

Table 7: Available Resources for 2025 Natural Resources / Efficiency Scenario

Resource Type	Installed Capacity Trillion Btu / yr	Potential Capacity Trillion Btu / yr	Strength of Data
Building / Appliance/ Industrial Efficiency	n/a	**10 – 40%, based on national estimates**	Statewide data needed
Plant, Transmission and Distribution System Efficiency	n/a	**5 – 20%, based on national estimates**	Statewide data needed
Vehicle Efficiency	n/a	**10 – 20% for both passenger and commercial vehicles, based on national targets**	Statewide data needed
Vehicle – Grid Powered	Data needed	Data needed	Statewide data needed
Wind	0.6 (existing) 14.2 (proposed projects)	167.3 to 538.2 89.52 (based on 10,000 MW capacity @ 30% CF) 116.6 (13000 MW) 134.54 (15000 MW)	Significant variance among data sources depending on class of wind, Used conservative capacity factor estimate of 25%[1], but developed projects are often 35 -40% or more
Geothermal Direct use	3.0		Statewide data needed
Geothermal Electric Power	0.4 (near term – project final testing underway)	22.7	Estimates from Western Governors
Solar Electric Generation (PV and solar thermal concentration)	Data Needed	204.8 (RNP says capacity factor of 16-30%. If 23%, then 47.1)	Estimate based on 10% solar conversion efficiency, 0.5% of state land area (from Renewable Energy Atlas)
Solar Thermal Direct Use	Data Needed	4.1	Estimated based on general assumptions–in renewable energy atlas, actual data needed
Biomass Power Generation	1.9 (wood waste, non-utility entities)	30.72	Renewable Energy Atlas
Biomass Methane (other than landfill gas)	0.1 (near term – project underway)		Statewide data needed
Combined Heat and Power	2.89		Statewide data needed
Municipal Waste (landfill gas power generation)	<0.1		Statewide data needed
Biodiesel	Data needed	11.7	
Ethanol (agriculture crops)	6.4 (projects recently or nearly operational)	7.5	Based on capacity of 89 Mgpy
Ethanol (cellulosic)	0	4.3	
Hydro Electric Power	2500 MW capacity	2,000 MW developable potential	INL Study on hydropower potential Statewide data for low-impact hydro needed
Source: EIA, DOE, INL, Idaho Energy Plan, Various			

[1] According to the American Wind Energy Association, a reasonable capacity factor would be 0.25 to 0.30, and a very good capacity factor would be 0.40. We have used the more conservative figure here. http://www.awea.org/faq/basicen.html

Some of the assumptions driving the chart above are listed below.

Wind:
1 Megawatt hour of wind = 3,413,000 BTUs **26.23M x 3.413M = 89.52 trillion BTUs
13,000 MW x 365 x 24 x 30% CF = 34.16 million MWh
34.16M x 3.413M = 116.6 trillion BTUs
15,000 MW x 365 x 24 x 30% CF = 39.42 million MWh
39.42M x 3.413M = 134.54 trillion BTUs

Geothermal:
860 MW x 365 x 24 x 90% CF = 6.78 million MWh
6.78M x 3.413M = 23.14 trillion BTUs

Biomass from Residue (Renewable Atlas)
Electricity Generation Potential: 9 million MWh/yr.
9.0M x 3.413M = 30.72 trillion BTUs

Solar Electricity Potential: 60 million MWh/yr (Renewable Energy Atlas)
60M x 3.413M =
204.78 trillion BTUs

Ethanol:
1 gallon of ethanol = 84,400 Btus
89 million gallons/yr capacity = 7.5 trillion Btus

Hyrdopower:
560,000 MWh current capacity
2,000 MWa developable potential in small and low power hydro
1 MWa = 1 average megawatt = 8760 MWh
1 Megawatt hour of electricity = 3,413,000 BTUs

Table 7 indicates a total renewable potential for Idaho of at least 486.6 trillion Btu per year, depending on how missing elements are estimated. Most of this is renewable generated electricity. The higher wind potential estimate would add an additional 370 trillion Btu per year. For comparison, providing 50 percent of the estimated energy demand in 2025 will require about 327 trillion Btu per year in efficiency gains and in-state renewable energy production.

Below we outline each of the major resources that offer some solution to Idaho's energy challenge, identifying what is known about the potential in the state and technology advances that will help commercialize the resource.

ENERGY EFFICIENCY IN THE BUILT ENVIRONMENT AND ENERGY SYSTEMS

The cheapest unit of energy is often the one that doesn't have to be produced, so creating a built environment that requires less power—especially during peak times—can help Idaho "provide" that power more economically. This is an area recognized by the Idaho Energy Plan and various Integrated Resource Plans (IRPs) from the major utilities. Activities can vary between peak shifting or shaving, overall demand reduction and specific demand response in reaction to market or operating conditions.

Information from the U.S. Department of Energy concluded that in 2002, about 56 of the total 97 quads of energy units across the U.S. energy system were wasted, primarily through system losses. The lost energy is 1.6 times the "useful" energy actually delivered (about 35 quads). The total energy consumption for Idaho in 2004 (see Table 6) was 348.4 trillion Btu. Assuming the same lost-energy to delivered-energy ratio applies, the energy lost from in-state and out-of-state components of Idaho delivery systems in 2004 may have been on the order of 560 trillion Btu. There are ways to improve the efficiencies of our energy system starting with the power plants, and extending through transmission and distribution of energy, to residential/commercial, industrial and transportation end-uses.

Energy efficiency is also receiving a growing level of national attention. In November 2007, the National Action Plan for Energy Efficiency, co-chaired by Marsha Smith, a Commissioner of the Idaho Public Utilities Commission and the President of the National Association of Regulatory Utility Commissioners, laid out a set of recommendations to pursue cost-effective energy efficiency[14]. Their review of studies reveals that the efficiency resource available in the electricity sector can meet 50 percent or more of the expected load growth over the time frame from now through 2025.

We were unable to find an energy efficiency potential study in Idaho for the built environment, but utilities are leveraging energy efficiency opportunities with some success. Avista Utilities' "Every Little Bit" campaign to get northern Idaho customers to reduce energy consumption has achieved a 13 percent greater increase in electricity conservation than expected last year, and natural gas conservation was 40 percent higher than expected.

Examples of built environment and system efficiency potentials include:

Building Efficiencies. As building innovation advances, more possibilities for efficiencies exist in lighting, HVAC systems, overall building design, distributed generation, passive solar and many other areas. Efficiencies are impacted by both regulation and incentives. Building codes are typically a state and municipality focus. Idaho's building codes lag behind those of more aggressive states in requiring efficiency gains, which indicates that there is likely room for advancement over the next decade and beyond. Idaho Power announced that in 2007, the building efficiency program paid nearly $540,000 in incentives, resulting in an estimated combined savings of nearly 2.8 million kWh/year, or enough energy to power nearly 200 average homes. Incentive payments have ranged from $45 to $100,000, averaging $25,000 per project, and have included the elements outlined in Table 8. Lighting represents a large portion of the electric bill (generally between 20 – 40 percent for commercial buildings).

Table 8: Summary of application types for Idaho Power Electric Conservation Incentives

# of applications	Focus
¾	**Lighting**
2/3	**Air conditioning**
> ¼	**Building shell**
> ¼	**Controls**

Appliances. Twelve states have set energy efficiency standards for some types of appliances and equipment not covered by federal Department of Energy standards, although Idaho has not yet chosen to do so. Several states have applied for waivers where their state standards may go beyond a more recent federally set standard. Beyond the efficiency of the appliances themselves, various studies have shown that the standby consumption of electrical appliances can represent up to two-thirds of an appliance's electricity consumption.

Industrial and Manufacturing Process Efficiencies. Industrial processes in the state use a significant portion of the natural gas imported into the state. Enhancing the energy efficiency of industrial processes not only helps Idaho's energy picture but will also benefit the individual firms' bottom line. Food processing is a sector in Idaho which has put a strong focus on energy efficiency, from both individual firms as well as through the Northwest Food Processors Association. J.R. Simplot Company, a notable local firm, works to share best practices among its subsidiaries and bring industrial improvements across its organizations.

In 2006, the Department of Energy implemented its Save Energy Now initiative, where it trained teams from 200 plants to reduce energy use and emissions. The assessments of these plants revealed more than $500 million in potential energy savings. Individual plants in the program had the potential to cut energy bills by 10 percent or more each year, on average $2.5 million per plant, and to save 17.3 percent of natural gas and 20,200 metric tons of CO2 emissions annually[15].

Agriculture Efficiencies. Agriculture is a significant industry in the state, and increased energy efficiency can help profitability in this foundational sector while alleviating some of the local energy market pressures. Advances can be found in more efficient farm vehicles and equipment, as well as irrigation management, low-energy farming practices such as low-till/no-till, improved lighting and ventilation, and shifting to local markets. These enhancements can reduce the use of diesel fuel in farm equipment and energy in freight transport, lower the need for herbicides and tillage, reduce the energy and water used in irrigation and optimize the energy consumed by facilities.

Idaho Power offers irrigation customers financial incentives for improving the energy efficiency of an irrigation system or installing a new one. Utility agricultural representatives administer incentive funds for qualified, energy-saving projects.[16]

In total, the irrigation sector represents approximately 30 percent of Idaho Power's summer peak load and 12 percent of total system energy sales per year. In the summer of 2007, Idaho Power reported its Irrigation Peak Rewards program reduced the average peak load by 28.9 megawatts, by the end of the year, that number was 32 megawatts.[17] Its Irrigation Efficiency Program reduced energy use by over 12,000 MWh through 819 projects in 2007.

Plant Efficiencies. Another significant opportunity is to reduce the energy lost throughout the power plant system so that the energy that is produced is usable. Electricity production and distribution from basic energy sources—coal, gas and nuclear—is only around 30 percent efficient overall, and operating approaches and technologies that improve plant efficiencies could help increase the amount of usable power. Unfortunately, some of those technologies do not yet exist, but several of the national laboratories like the National Renewable Energy Laboratory have made these power efficiencies areas a significant research and development focus.

Transmission and Distribution Efficiencies. The grid and pipelines that carry power and fuels also experience line and pipeline losses. Within the pipelines that transmit natural gas and petroleum, there are fewer efficiency gains to be had. With electricity, though, the transmission and distribution systems have become a major focus for policy and technology advances to improve efficiencies. Improvements are emerging in 1) overall grid planning and layout, 2) the efficiency of individual grid components like circuits, transformers and other areas, 3) conservation voltage reduction approaches that manage the amount of energy substations needed to maintain the system and 4) "smart grid" technologies and system diagnostics that help pinpoint and identify approaches to better system management to increase delivery efficiencies.

Smart Grid as a Major Enabler for System and Customer Efficiencies

Smart grid approaches involve customer and system meters, intelligent devices and software applications to manage and model data, and take automatic actions on the system. The solutions give system planners and operators the ability to leverage more data about the grid into better analysis, diagnosis and operating approaches that target inefficiencies and increase grid performance. Beyond system efficiencies that can come from better knowledge of how the grid operates, a smarter grid can also enable the system to support more renewables by giving system operators more flexibility to deal with the operating characteristics of intermittent resources and distributed generation. The smart meters and customer devices can also be an integral part of load management and promoting customer efficiencies.

Transportation Transformation

Like other states, a large amount of Idaho's energy consumption is petroleum for transportation. Idaho has no inherent competitive access to petroleum, and faces significant economic pressures as a result of reliance on out-of-state resources to fuel transportation. A large amount of energy transformation through renewables and energy efficiency needs to happen at a transportation level for the state to have a secure energy future.

Three large opportunities for vehicle transformation to reduce petroleum consumption exist for the state:

- Advances in vehicle efficiencies
- Conversion of petroleum to alternative fuels
- Conversion to all-electric, partial electric or fuel-cell based transportation

Advances in vehicle efficiencies are being pursued at a federal level, and California has also made strong efforts to increase the standards for vehicles sold in the state. Market momentum is moving toward more efficient vehicles, and Idahoans will gain from these efforts.

Alternative fuels and biogases are also being harnessed to move away from petroleum. Many alternative fuels can be leveraged by existing vehicles without modifications and in many cases without impacting warrantees. Continued advances along that vein are expected. The local opportunities around biofuels and other alternatives are addressed in a subsequent section.

Another potential area for gains in the state is through vehicle electrification, or conversion of petroleum-using vehicles to electricity-dependent vehicles.

Vehicle electrification can be achieved through a number of vehicle strategies:

- Hybrid gas-electric vehicles that extend fossil fuel efficiencies
- Plug-in hybrids that further extend the efficiencies and can potentially serve as a grid resource if enough market adoption exists
- All-electric vehicles for broad or neighborhood use

Because Idaho does not have large urban settings, extended battery range is more of an issue here than in other locales. Yet there is considerable routine driving in rural and lesser developed settings that could still lend themselves to these types of vehicle choices.

The INL's Advanced Vehicle Testing Activity (AVTA) initiated a Plug-in Hybrid Electric Vehicle (PHEV) testing program in the latter part of 2006. Fleet application tests are being conducted at various urban locations throughout the U.S. In October 2007, INL announced a one year PHEV urban demonstration project in Seattle. INL, located in Idaho Falls, has the national level lead for the U.S. Department of Energy field testing and life testing of advanced technology vehicles. This represents a regional as well as Idahoan knowledge and resource base that can be applied to investigating and developing PHEV applications in Idaho. INL currently has a collaborative effort underway with a number of other Northwest utilities and organizations to convert, deploy and test PHEVs.

There are currently no available estimates of electric and hybrid vehicle potential in the state.

Table 9: The Transportation Transformation Market Opportunities

		Gas-Based Transportation (hydrogen/fuel cell, natural gas)	Alternative Fuels (biofuels, ethanol, flex fuels, etc.)	Vehicle Electrification
Vehicle Systems, Components & Enabling Services	Vehicles	• Public transport vehicles • Smart personal transport vehicles	• Commercial, cargo transport & specialized vehicles	
	Components	• Smart motors, engines, drive trains & devices	• Batteries and on-board energy storage	
	Services	• Maintenance and sourcing of vehicles and fuels	• Car sharing and motor pooling services	
Fueling/Charging Infrastructure & Enabling Services		• Distribution, storage and dispensing systems • Fuels transport & logistics services		• Charging infrastructure • Access point stationary power solutions
Fuels/Energy Value Chain		• Gas extraction, refinement, processing	• Gas processing, creation • Agricultural products	• Distributed renewables

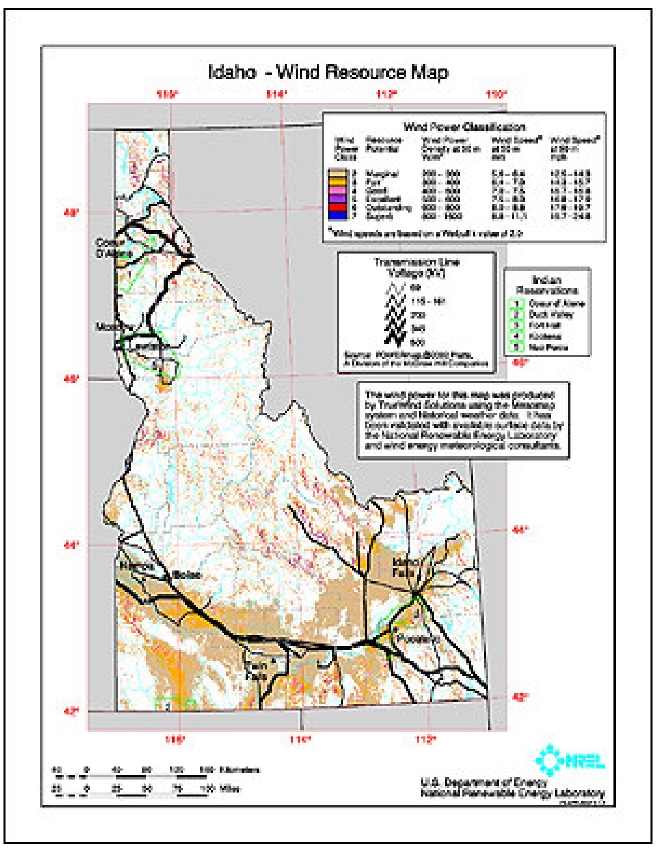
Source: The Athena Institute

Beyond the vehicles themselves, there are also opportunities to electrify truck stops and rest areas to enable trucks to serve their on-board power needs with electricity rather than through engine idling. The California Energy Commission estimates that truck stop electrification alone could reduce statewide diesel consumption by 6 percent -- saving 250 million gallons of diesel fuel a year.[18] New York and several other states have accelerated efforts to install electrical outlets in parking spaces at truck stop facilities. Basic equipment to use these devices costs less than $200. To get more savings, some vehicles move to larger investments like electrical AC units that would move more of the on-board load to the electrical system.

WIND

Wind energy has become an accepted part of the bulk electricity supply system and was a major winner globally in 2007. Led by the U.S., China and Spain, over 20,000 MW was installed, bringing worldwide installed capacity to 94,112 MW, an increase of 31 percent over 2006 installation volumes.[19] Wind is part of the energy mix in over 70 countries around the globe. U.S. wind power generating capacity grew 45 percent in 2007, with double the amount of wind installation (5,244 new MW) than in 2006, just under a third of the new power producing capacity in 2007. Total installed wind capacity is now 16.8 GW in the U.S., and it is expected that by 2009 the U.S. will overtake Germany as the leader in installed capacity. Texas is now the national leader, building from just 180 MW installed in 1999 to 4,296 in 2007 – over 70 percent greater than California, which was the uncontested national wind leader in 1999. Developing these in-state wind resources creates both jobs and new revenues for those counties where projects are sited.

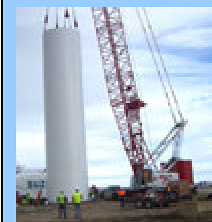
Figure 4: Map of Idaho's Wind Potential



As for Idaho, the state has been cited as having the 13th largest wind potential in the U.S. by the American Wind Energy Association. More importantly, it has the largest wind resource west of the Rocky Mountains. Yet the state's wind development lags far behind the west coast states, which have lower total potential.

This is primarily due to their larger population bases, but is also due to more favorable legislative and regulatory environments and better infrastructure. However, Idaho's vast wind resources are an important strategic advantage, as can be seen by the higher rates of wind energy development in less populated states east of the Rockies. To exploit this advantage, Idaho needs to increase its own consumption of wind energy and export its surplus.

Idaho Wind Farm



Like everywhere else in the country, the housing market has fallen in Idaho, so when Idaho Wind Farm's projects got under way, local contractors working on the projects had a rich pool of skilled labor to draw from.

Early on, Idaho Wind Farms made a commitment to using local contractors and local workers whenever possible, the biggest contractor being Mullen Crane and Transport, of Soda Springs, with a local workforce of 35. In addition, there were contracts for equipment rental, concrete, road building, hauling, excavation and electrical construction resulting in many more high paying local jobs.

The other benefit of Idaho WindFarm's two projects is the revenue streams they will create for farmers and ranchers – not only do landowners benefit from leasing their land, they can continue to use their land for on the ground farming – wind augments their agricultural revenue without using much land and no water.

Still under construction, the two projects with a total of 20 turbines will generate 42 MW of energy, enough to power 8,800 Idaho homes when completed. And the county will collect over $7 million in property taxes over the lives of the projects – revenue that will be fed back into the communities where the wind farms are located.

Unlike fossil fuels, electricity derived from renewable energy must be generated at the source. Thus, the high value activity of energy conversion will occur within the state, resulting in substantial local economic development.

Though blessed with abundant wind potential, Idaho has been relatively slow to develop its wind power potential compared to the 17 states that have moved ahead of Idaho in installed capacity. At the beginning of 2007, 75 MW of wind power installed capacity was operational in Idaho with nearly 1,900 MW of additional wind generation proposed from 13 projects throughout the state. In December 2007, Idaho Power reported that an additional 69.4 MW was under construction. This overall installed or potential capacity has to be de-rated by its projected capacity factor. Assuming a conservative capacity factor of 25 percent would mean that the 75 MW and 1900 MW capacities represent an estimated 18.75 aMW (0.6 trillion Btu per year) and 475 aMW (14.2 trillion Btu per year) respectively.

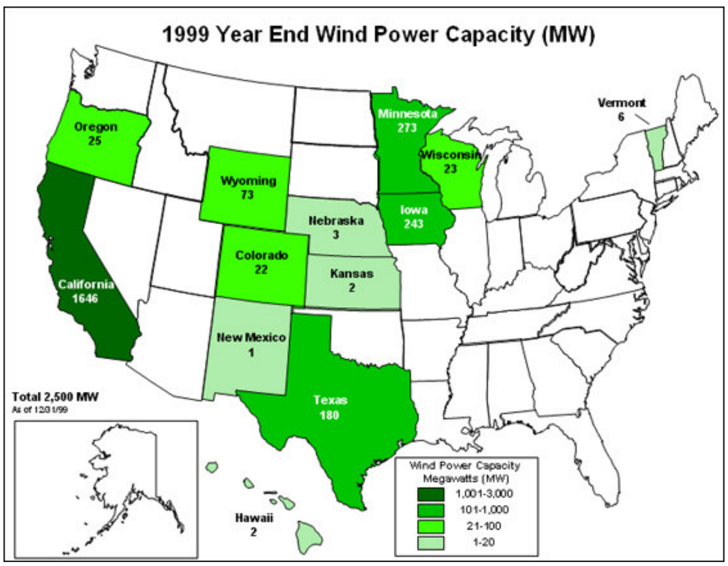
Getting an accurate sense of potential can be challenging. Estimates for wind vary widely from various regional wind resource studies that estimate an annual wind electricity generation potential in Idaho ranging from 5,594 aMW (167.3 trillion BTU per year) to over 18,000 aMW estimated on a county by county basis as illustrated in Table TK (538.2 trillion Btu per year). There is some discrepancy between overall wind potential of a state, and the actual ability to develop a particular resource. Regardless of the estimate used, however, Idaho has billions of dollars of developable wind resource and both Idaho domestic and large export markets west of the Rockies. While the transportation of bulk electricity to these markets is challenging, the trade in renewable energy is beginning to take the form of contractual agreements instead of physical delivery, much like the trade in other commodities. This means that not only does Idaho have opportunities to meet its own needs, but could also generate opportunities from developing resources for export capacity. In addition, the likely evolution of regional, national or even international markets for environmental attributes (e.g. renewable energy credits) will greatly benefit natural resource developers, such as Idaho, who can use these opportunities to enhance the economics of local projects and open up more opportunities for development. Wind electricity into bulk electricity market is maturing, ancillary firm it up on a regional. One strategy for Idaho would be to help cultivate these resources for both domestic and export use, recognizing that this capacity could available to the state over the longer run.

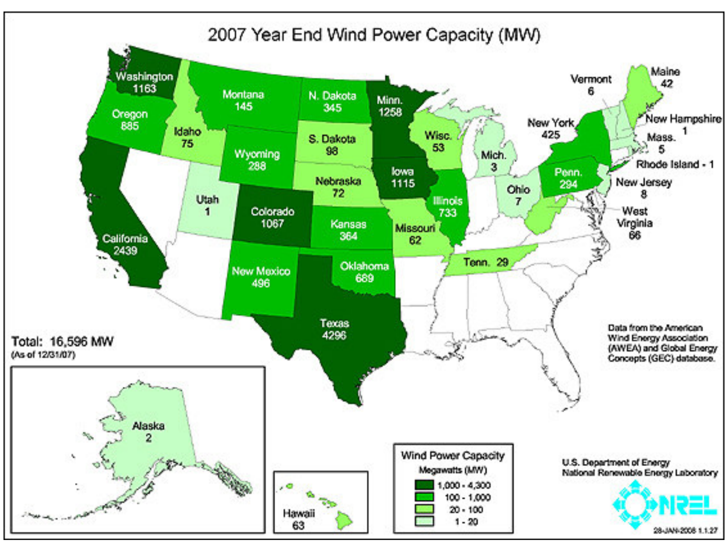
The charts below compare installed wind capacity in U.S. states between 1999 and 2007. While Idaho had developed only 75 MW of wind generating capacity at the end of 2007, its neighboring states had installed 2482 MW. In response to various pressures to expand renewables in their portfolios, regional utilities are currently incorporating wind into their IRPs, leading to a jump in wind projects in adjacent states. Idaho is “wind wealthy”, with the approximate wind potential of Washington and Oregon combined; yet Idaho currently has just 3.7 percent of their installed wind capacity.

Compared to other adjacent high volume, high class wind (higher wind velocities) states like Montana or Wyoming, more of Idaho’s wind is at lower classes, but in interviews with wind developers for this study their data shows that Idaho’s wind blows more consistently.

Transmission often presents a key challenge for any new generation resource, including wind. This is particularly true for the first wind resource in a particular location that may be forced to bear a higher proportion of the cost of extending transmission infrastructure to their project compared to later projects that come to the area subsequently. Many states are working on ways to better address this issue through a number of mechanisms: stronger transmission planning, discussions around trust funds to cover the initial transmission investments, and collaborative arrangements with transmission builders to route lines and interties to best benefit the broader system.

Figure 5: Comparison of Wind Capacity 1999-2007





Wind power is an “intermittent” resource, meaning that the power generated by a wind farm will vary throughout the day and over time with the strength of winds blowing over the site. Intermittent resources are often considered more challenging for power grid managers to integrate into the system compared to base load power, which delivers a constant quantity of power with relative reliability.

Recent research, however, suggests that as more wind power comes on line, a growing percentage of the power generated can be treated as base load. A recent study by a Stanford University Department of Engineering team modeled wind power development at 19 sites over a large area of the Midwest. The researchers found that with high density and geographic distribution of wind power projects, an average of one-third and a maximum of nearly one-half of the average annual wind power generated could be used as reliable base load power. Greater benefits were realized as more sites were added over larger areas.

A Minnesota Legislature-commissioned study completed in 2006 to examine the feasibility of providing up to 25 percent of the state's electricity needs with wind found that interconnecting wind projects with greater geographic diversity increases the probability that wind energy will be generated in different locations at a given point in time. The study concluded that 25 percent wind "can be reliably accommodated" with integration costs of less than 0.5 cents per kilowatt hour.

One difficulty faced by wind operators is managing sharp increases in power production known as 'ramps' that happen when wind suddenly picks up. The Minnesota Legislature's study found that, "…a progressive increase in the distribution of wind production had a dramatic effect on reducing the frequency of very large ramp rates… to values near zero for greatest degrees of geographic dispersion." It also found that "…forecasts for the ensemble of sites were substantially more accurate than for a single site."[20]

A group of integration experts recently wrote in the power engineering magazine IEEE Power & Energy, "…several investigations of truly high penetrations of wind (up to 25 percent energy and 35 percent capacity) have concluded that the power system can handle these high penetrations without compromising system operation. These studies have also shown that system-operating-cost impacts need not be significantly higher than results obtained with lower penetrations… the value of sharing balancing functions over large regions with a diversity of loads, generators and wind resources have been clearly demonstrated."

A study by U.S. Department of Energy scientists bears this out. "Increasing the size of balancing areas, or collectively sharing the balancing obligation among a group of balancing areas (much as is now done for contingency events with reserve sharing groups), holds the promise of significantly reducing wind integration costs." [21]

These findings suggest intelligently planned, aggressive and large-scale wind development can be cost-effectively integrated into the grid, and that Idaho's diverse topography and climatology could prove to be a natural advantage in providing a well-balanced portfolio of wind regimes.

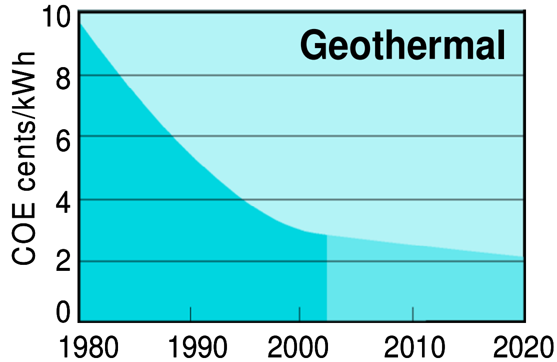
While the biggest gains for the state in energy security and economics will be had from larger scale wind projects, smaller wind turbines for on- or off- grid use will continue to open up even more rural applications. Net metering arrangements with Idaho's investor-owned utilities support small independent wind projects less than 100 kW. An example is a 20 kW wind turbine on a farm near Burley, Idaho. It provides enough power to heat and power the owner's house as well as run the well and welding equipment on the farm. It is also, at times, providing more power than consumed on the farm, with the surplus power being purchased by Idaho Power at avoided cost.

GEOTHERMAL

Geothermal can take the form of direct use in greenhouses and fish farms, as well as district heating, where hot water from geothermal wells is used to heat city water piped through heat exchangers to warm air for heating nearby buildings. Where temperatures are higher, geothermal can also be harnessed to produce electricity.

Idaho is blessed with a large number of springs and wells that offer geothermal potential. Back in 1892, Idaho created the first modern heating system that used geothermal water for district heating. Now multiple systems in Boise are joined by a number of additional systems throughout the state to make up 102 MW (3.0 trillion Btu per year) of geothermal energy. The direct use applications in Boise include the operation of at least 15 greenhouses, nine fish farms, and 366 buildings, together representing more than 4.4 million square feet of space. An injection well for the city's geothermal heating system helps reduce discharge into the Boise River[22].

Figure 6: Renewable Energy Cost Trends Levelized cents/kWh in constant $2000— this is confusingly worded



Source: NREL Energy Analysis Office

US Geothermal

U.S. Geothermal commenced commercial power production in January 2008 at the newly constructed Raft River Unit One geothermal power plant 200 miles southeast of Boise.

The US Department of Energy began construction of the world's first commercial-scale binary geothermal power plant at the same site in early 1980, but it was closed down after 1982. When US Geothermal looked at the Raft River project they saw more than abandoned wells and unused equipment foundations. They recognized an opportunity to capitalize on the growing interest from local utilities to add more renewable power to their generation resource mix.

This is the first commercial geothermal power plant in Idaho. Idaho Power has signed a Power Purchase Agreement with U.S. Geothermal for the first 10 megawatts of electricity from that plant and negotiations have begun for a 25-year power purchase agreement an annual average of 45.5 megawatts

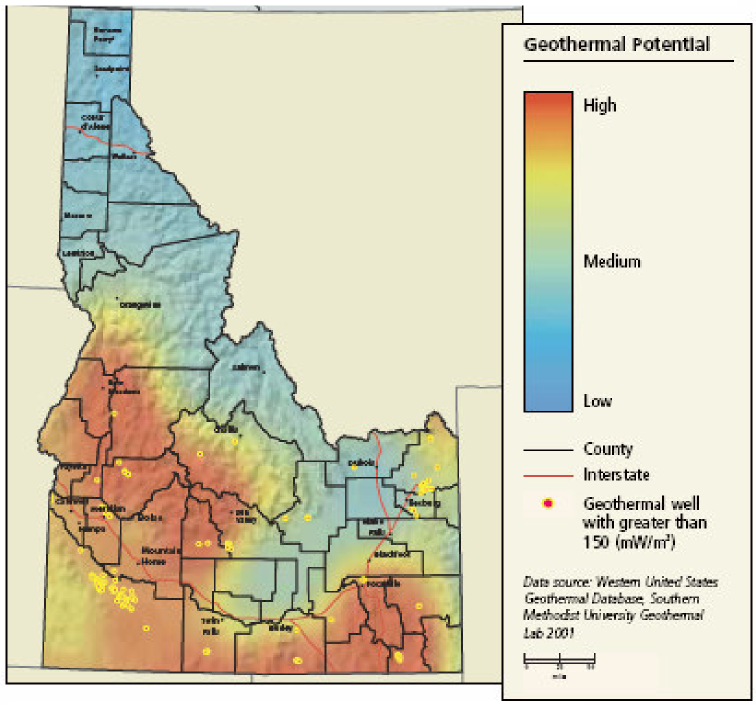
This is the first commercial geothermal power plant in Idaho. Idaho Power has signed a Power Purchase Agreement with U.S. Geothermal for the first 10 megawatts of electricity from that plant and negotiations have begun for a 25-year power purchase agreement an annual average of 45.5 megawatts.

Idaho's geothermal development potential is comparable to Nevada and California which together produce over 2,700 megawatts of electricity from geothermal plants.

Due to an absence of data, the potential for expanding geothermal direct use and ground source heat pump throughout the state could not be quantified for this study. However, because of the extent of low temperature geothermal resources throughout the southern half of the state, it is believed that (with appropriate efforts to identify potential uses and opportunities near specific resource sites) heat pump and direct use applications could be meaningfully increased.

As for geothermal electricity production, the Western Governors' Geothermal Task Force Report from 2006 listed six potential geothermal sites in Idaho with adequate conditions (including resource temperature) totaling 860 MW total generation capacity[23]. These sites could provide 774 aMW (23.1 trillion Btu per year) with assumed capacity factor of 90 percent.

Figure 7: Map of Idaho's Geothermal Potential



Source: Map from Energy Atlas.org

Currently, the Raft River site is the only geothermal electric generation site in Idaho. In January 2008 commercial production began for the initial 13 aMW (0.4 trillion Btu per year) unit. Project owner US Geothermal plans additional capacity of up to 110 MW at a later time.

The economics of geothermal are increasingly attractive. For many utilities, geothermal generation is now considered economically viable. Recently, the Federal Renewable Energy Production Tax Credit (1.9 cents per kWh) was expanded to geothermal. Figure 6 above outlines projections by the National Renewable Energy Analysis Office projecting continued cost declines for geothermal. Future technology breakthroughs for geothermal could open up the possibility of electricity production at lower temperature geothermal areas in the state.

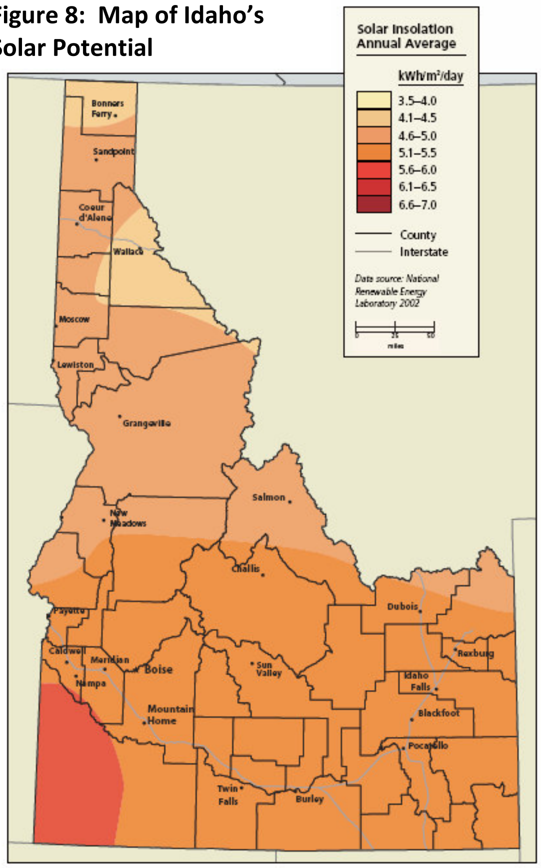
SOLAR

Solar power comes in multiple forms—electric power generation using solar photovoltaic (PV) and solar thermal concentrator technologies, and thermal direct use (water heating, etc.) using flat plate panels. Idaho has good available resources for both flat-plate and concentrating collectors, especially in the southern part of the state. Idaho enjoys long days, clear summer skies and a summer daytime peaking load, which makes the state ideal for solar.

The *Renewable Energy Atlas of the West* estimates the annual solar electricity generation potential in Idaho to be 60 billion kWh per year (204.8 trillion Btu per year).[24] This analysis eliminates a number of areas in the region they deemed unsuitable for solar. Their estimates also assume systems with a 10 percent efficiency, using 30 percent of the available area, and on rooftops and open spaces representing 0.5 percent of the total area of the state.

There are no estimates available of the current use of solar in the state, but we assume a relatively low rate of penetration of solar currently. A key impediment to solar PV in Idaho has been the high relative cost to implement, which many analysts believe is likely to decline sharply in the next decade. Another impediment is the fact that the first-in cost is borne by the end-user. Recognizing this, some states have implemented aggressive programs to address these barriers through rebates and other incentives.

Figure 8: Map of Idaho's Solar Potential



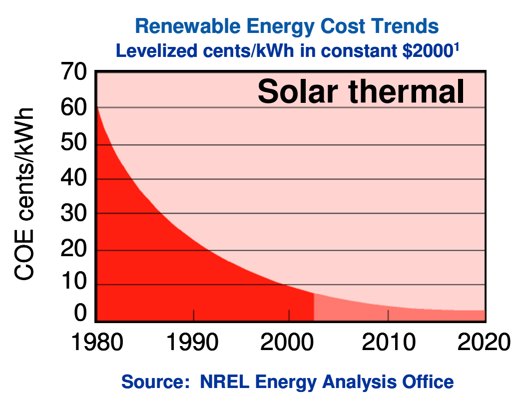
Source: Map from Energy Atlas.org

Overall, grid-connected solar is still only one percent of the world's electricity, but it increased nearly 50 percent to 5,000MW in 2006. Idaho has a net metering option to encourage grid-connected solar, but currently there is only one customer with a photovoltaic system using the Schedule 86 set up for this purpose.

Rapid growth in production and advancements in production efficiencies are projected to bring down the costs of solar significantly in the next three years.[25] Global production of solar cells has grown rapidly since 2000, and grew over 40 percent in 2006.

Rapid growth has created a near-term bottleneck in available polysilicon supply, a key ingredient in solar PV. But silicon production is scaling up to meet the vigorous demand. Hoku Scientific is building a polysilicon production plant in Pocatello to supply 3500 metric tons to the solar PV market annually, with expansion plans for up to 8000 metric tons.

In the meantime, the short supply has motivated innovation and acceleration of new technologies like thin films, which use amorphous silicon and other low-cost materials. This technology uses perhaps just one percent of the resources of silicon or cadmium sulphide, gallium arsenide, etc. semiconductor materials currently required to make solar cells. More than a dozen companies are scaling production of these low cost solar modules. Further, China's emergence as a low-cost producer of PV and the introduction of more than a dozen companies in Europe, China, Japan and the United States bring on unprecedented levels of production capacity in the next two years. The learning generated by these volumes will lead to higher efficiencies, more reliability, better throughput rates and lower failure rates during manufacturing.



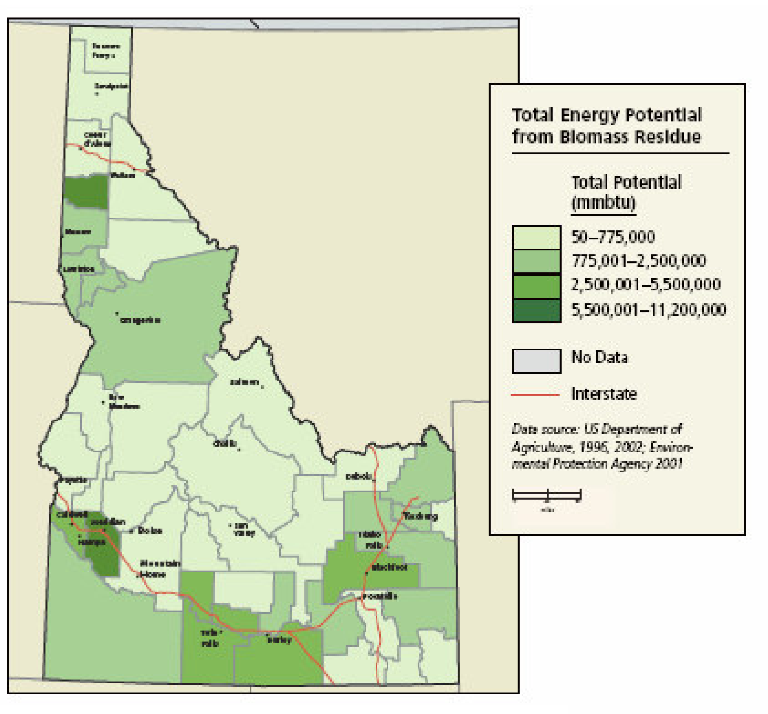
One of the more common solar thermal direct use applications is the use of flat panel solar collector systems to heat water for residential and other uses. About 15 to 20 percent of a residential building's energy load is for heating water. According to the U.S. Department of Energy, water heating energy requirements can be reduced by 50 to 80 percent with a solar water heating system. While these systems are being used, information on the current extent of the application of this energy resource in Idaho was not available for this study. Compared to conventional gas or electric water heating, the adoption of this technology is still limited.

Solar thermal technology advances are focused on improved reflectors and lower cost heliostat designs, improved solar thermal receivers, heat exchangers, fluid handling technologies, turbines, generators and volume manufacturing. The balance-of-system cost is also declining.

BIO-ENERGY

Bio-energy refers to the generation of commercially useful energy from biomass. This can be in the form of electricity, heat or steam, or systems that combine generation approaches to increase efficiencies, such as combined heat and power (CHP), co-generation, district heating systems or biofuel and biogas refineries. Biofuels include ethanol and biodiesel from corn or other grains, soy, lignocellulose, or various feedstocks ranging from potato skins to algae to switchgrass.

Figure 9: Map of Idaho's Biomass Residue Potential



Source: Map from Energy Atlas.org

Idaho has a number of potential biomass and biofuels opportunities from organic matter that are available on a renewable or recurring basis:

- **Wood and Wood Waste/Residues**—wood fuel, wood byproducts and wood waste
- **Agriculture Waste**—animal manure, crop residues, food processing residues
- **Urban Waste**—methane and other products from municipal solid waste, landfill and manufacturing process waste, biosolids, food wastes, green wastes, waste oils and fats, sewage and other wastewater
- **Agriculture**—dedicated energy crops, trees, plants (including aquatic plants), microbes and grasses, grains and other starch crops, sugar crops

Because these assets and plants are often located in rural areas, and they involve many companies as part of their value chain, this energy category could aid both rural and urban economies in Idaho.

Wood is a key opportunity.

Idaho's largest existing use of biomass energy is in the industrial sector, where wood fuels constitute approximately 14 percent of energy consumption. But the source is primarily from wastes from mills, other timber processing and industrial processes. Some industrial sites are finding ways to harvest more energy from this waste through combined heat and power plants located on-site.

A second source of wood is removal of material from forests where past forest management practices have created an unhealthy overstocking of small diameter trees and brush. Assuming sound and sustainable approaches to remove this material are practiced, harvesting this wood can help thin the forest, reduce insect infestation, reduce wildfire danger, and utilize millions of tons of a valuable natural resource. The potential harvest in readily accessible areas that had been previously logged and easier to get to has been estimated at 762,000 bone dry tons per year, sustainable over a 22 year period.[26] A 10 MW power plant burns 86,000 to 130,000 tons per year, approximately 13,000 tons per megawatt. This results in a potential of 59 aMW (1.8 trillion Btu per year).

The Energy Information Agency indicates current installed capacity of 126 MW in non-utility waste biomass power generation from the wood products sector in Idaho. An assumed capacity factor of 50 percent (as suggested by U.S DOE NREL for this type of generation facility) yields 63 aMW (1.9 trillion Btu per year).

A gallon of diesel fuel produces 138,000 BTUs and in 2007 cost over $3.00, or $35 per ton. A feasibility study looking at biomass utilization[27] found that producing an equal amount of BTU's as a gallon of diesel would require approximately 30 pounds of wood chips, costing 52 cents. Cost comparison using 1,000 gallons of diesel for fuel versus wood equivalent are shown in Table 10, illustrating the potential economic advantages from biomass.

Table 10: **Costs Comparison of Diesel vs. Biomass for fuel** (costs for 1,000 gallons)

Scenario	Costs for BTU equivalent
Diesel	$3,000
Wet Wood	$525
Dry Wood	$283

Schools and public buildings especially could benefit by using wood chips for energy. For instance, there has been a tremendous savings of 75 to 80 percent on fuel used at a school in Council, Idaho through biomass energy for heating and air conditioning.

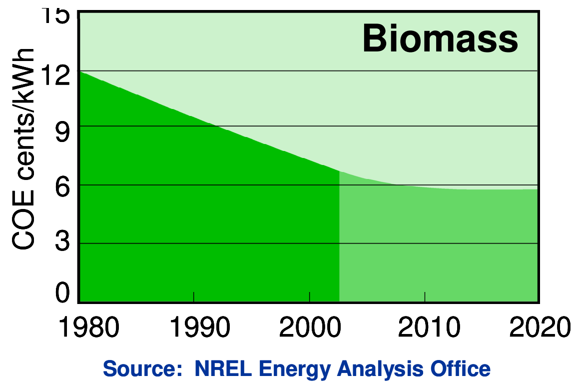
The Fuels for Schools program is a relatively new joint initiative involving local communities in cooperation with the Forest Products Lab, the U.S. Forest Service's State & Private Forestry Division and state foresters. These efforts focus on using wood biomass as a renewable resource for heating schools and other public buildings—the first project from this program is targeted for Darby, Montana. The Forest Service now has the authority to provide grants to those owning or operating facilities that use biomass as a raw material in producing energy, sensible heat, transportation fuels, and bio-based products. Grants are limited to costs related to the purchase of biomass.

Such grants were used to start the Cascade Forest Resource Center in the Boise National Forest. In cooperation with city officials, this business incubator is focused on developing a cluster of small businesses centered on the use of biomass and small-diameter trees. All of these efforts are designed to cultivate an efficient woody biomass transportation system.

One of the dilemmas with using some biomass sources and technologies is the potential impact on air quality from contaminants. Wood combustion can lead to releases of significant amounts of particulate matter (especially PM10 and PM2.5). The most significant health risks to air quality posed by wood combustion are associated with the fine particulates, in particular "inhalable" particulates < 10 µm in diameter and "respirable" particulates < 2.5 µm in diameter.

Biogas power generation in Idaho holds promise. Biogas is an energy-rich methane produced from agricultural and food industry waste that can offset the use of traditional fossil fuels. Biogas is produced through the anaerobic digestion of animal wastes and other agricultural or organic wastes. It is composed of approximately 60 percent methane – the principal ingredient of natural gas.

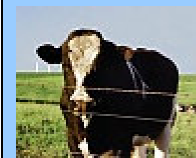
Figure 10: Biomass Renewable Energy Cost Trends Levelized center/kWh in constant $2000



Biogas is a reliable "24/7" source of renewable energy and is, therefore, inherently suitable for generating base load power. It can be used for thermal energy, can power a generator for renewable electricity, or can be refined to nearly pure methane and used in the existing natural gas infrastructure. Other advantages of biogas are that it reduces greenhouse gas emissions of both methane (which is captured in the biogas) and carbon dioxide when fossil fuels are displaced, and it can improve local air quality through odor control and water quality through better manure management. The production of biogas, like other renewable energy generation, can also stimulate local economies by creating new green job opportunities within communities that are heavily dependent on agriculture.

These advantages of biogas recovery and increased financial support from state and federal programs have led to a substantial increase in the number of operational animal waste digestion systems in the United States. In the last two years alone, the number of operational systems has increased by 30 percent. The majority of this growth has focused on farm-scale systems with a small, but emerging, number of centralized applications for dairy operations. However, despite this recent success, significant opportunities remain for the further growth of biogas recovery systems.

Intrepid Technologies and Resources



Intrepid Technology and Resources (ITR) reached a milestone by producing clean natural gas from animal waste at Idaho's first full scale on-farm anaerobic digester. ITR produces pipeline quality natural gas from animal waste - for example manure - from the Whitesides Dairy in Minidoka County. ITR's innovative technology not only provides Idaho businesses with a clean, homegrown source of energy, but it utilizes a waste product that would otherwise is difficult to manage.

Industrial plants that rely on propane due to a lack of access to natural gas have proven ideal customers for natural gas from the Whitesides methane plant. While propane prices have tripled, ITR offers a locally-produced renewable energy source that can be trucked on site at an affordable price.

Because ITR has passed the Department of Transportation's stringent gas transport standards and met the Gas Technical Institute's certification, it is the only biomethane producer in the country that can deliver its product directly to customers over the open road. ITR is looking forward to working with Idaho policymakers and businesses to further develop this virtually untapped energy resource in Idaho.

Idaho Falls-based Intrepid Technologies and Resources (ITR) operates Idaho's first two dairy digester plants, using innovative dairy biogas digester technology to clean up the gas for sale in the heating fuel market. ITR's first plant is at a dairy in Rupert, and their second operational plant is on a large 6,000 cow commercial dairy in Wendell. The facility will initially produce 150 million cubic ft of methane per year (0.1 trillion Btu per year) for sale into the heating fuel market in Southern Idaho.

A recent study focused on the feasibility of converting dairy waste to methane gas and then to electricity[28], commonly referred to as anaerobic digestion. The study found that producing 2MW of electricity using anaerobic digestion of dairy waste was technically feasible, and several sites in Magic Valley are good candidates for anaerobic digestion. The study also identifies two pilot projects, estimated at $ 7.8 million or $600/cow (13,000 cows total), that realize economies of scale benefits. Study proponents believe that there is potential for a win-win-win among the dairy industry, environmental agencies and electric utilities/small power producers.

Information on the overall potential for bio-methane in Idaho was not available for this study.

Waste to energy for municipal waste is of interest. There is only one operational landfill gas electrical generation facility in Idaho. This facility, owned by G2 Energy and located in Ada County near Boise, has a 3.2 MW capacity with a reciprocating engine as the prime mover. Information on the capacity factor was not available for this study. An assumed 80 percent capacity factor would provide 2.6 aMW (<0.1 trillion Btu per year). The EPA lists 30 additional landfill sites in Idaho that may be candidates for landfill gas electrical generation, however, information was not available on the energy potential if these sites were developed.

Waste to energy in industrial processes is a focus in the Energy Plan. Combined heat and power, or co-generation, produce both electricity and heat from a single resource with substantial gains in efficiency. This category of opportunity was called out specifically in the 2007 Idaho Energy Plan. According to the U.S. Clean Heat and Power Association, systems currently operating in the U.S., often biomass-based, are saving $5 billion in energy costs and reducing energy demand by over 1.2 trillion BTUs.

Ethanol production capacity for alternative fuels is growing. In 2007, the U.S. produced 6.5 billion gallons of ethanol, nearly double the production level in 2004, according to the Renewable Fuels Association. At the outset of 2007, there were 110 ethanol plants operating in

21 states, and over a third of the plants were farmer-owned. Nationally, the USDA estimates that 3.0 billion bushels of field corn are being used for ethanol, 20 percent of the entire U.S. crop.[29]

In 2003, Idaho had an ethanol production capacity of one million gallons per year (gpy) (<0.1 trillion Btu per year), and a 2002 report estimated that 25 percent of the state's production of wheat, barley and corn could be refined for a potential 98 million gallons of ethanol per year (7.4 trillion Btu per year). Since then, ethanol development and production has increased greatly.

In April 2008, Pacific Ethanol began production at its Burley plant with a 60 million gpy capacity. Idaho Department of Commerce estimates the plant will generate $7.2 million a year in new household income for residents of Cassia County. Central to Pacific Ethanol's growth strategy is its destination business model, whereby each of its ethanol plants achieves lower process and transportation costs by servicing local markets for both fuel and feed, greatly benefiting local feed markets.

Idaho Ethanol Processing LLC (IEP) is currently producing about 4,000 gallons a day from potato scraps in Caldwell, Idaho, and the company plans to add Midwest and local corn in November to its feedstocks. The company has an air permit for 5 million gpy and an Alcohol Fuel Producer permit for 15 million gpy with plans to apply for a new air permit and try to increase the capacity from 5 million gpy to 15 million gpy.

Renova Energy is building a 21 million gpy ethanol plant and 3.2 megawatt waste-to-electricity power plant in Heyburn using corn feedstock. In December 2007, with construction 60 percent complete, Renova temporarily halted construction to evaluate cost overruns before completing construction.[30] The Pacific Ethanol, IEP, and Renova projects and plans that are underway would provide over 85 million gpy (6.4 trillion Btu per year) ethanol production capacity in the near term. The target potential for the production of agricultural crop-based ethanol in Idaho (98 million gpy) may, in a short time, be substantially developed.

Cellulosic ethanol is an emerging opportunity in the state. Beyond ethanol, Idaho also has cellulosic biorefinery opportunities. While ethanol relies primarily on corn and has encountered 'food vs. fuel' criticism, cellulosic ethanol uses non-food plant materials such as wheatstraw, switchgrass, wood chips and sawdust to produce alternative fuel. Cellulosic ethanol has a more complex refining process but ultimately yields a greater net energy benefit and results in much lower greenhouse gas emissions.

Canadian company Iogen, the largest cellulosic producer in Canada, indicated in 2005 that it would be locating a facility in Shelley, Idaho. The plant was originally planned to process 500,000 tons a year of wheat straw, barley straw, corn stover, switchgrass and rice straw into 50-60 million gpy of ethanol. Some 300 farmers were under contract to provide straw to the facility, contingent on it being built. However, in May 2008 Iogen announced that it was suspending its operations in Idaho to focus its first commercial-scale plant efforts in Canada.

Nevertheless, Idaho National Laboratory, growers and industry partners have developed expertise in the processes necessary to make cellulosic ethanol work. They have evaluated technologies and tradeoffs and established requirements for a feedstock supply system designed to supply 800,000 tons of wheat and barley straw annually to a biorefinery. This equals approximately 56.4 million gpy (4.3 trillion Btu per year) based on the feedstock consumption rate for the Iogen project. The study mapped the activities and operations required to remove the biomass from the field and deliver it to the biomass conversion facility. Jobs and revenues are created along the feedstock management chain – from harvest to collection, transport, storage and preprocessing for cellulosic ethanol production.

Biodiesel has Strong and Growing Potential
As of January 2007, there were 105 commercial biodiesel production plants across the U.S. with a capacity of 864 million gpy, up significantly from seven million gallons produced in 2005. Seventy seven plants were under construction in 2007, which when complete would bring the overall capacity up to 1.7 billion gpy. Like other notable universities (e.g. UC Davis, UC Berkeley, etc.) the University of Idaho is conducting research on biodiesel and could prove to be a strong contributor to this developing industry.

Concerns about biofuels diverting food from people and livestock have received much media attention recently. The use of land for energy crops, especially where those involve food crops and not crop residues, will need to be managed successfully to ensure that local markets are not unduly impacted.

HYDROPOWER RESOURCES
As outlined in the earlier section, hydropower is a major in-state natural resource supplying electricity to Idaho's power grid today. Of Idaho's total energy portfolio, about 11 percent is from hydropower. Hydropower provides reliable and flexible power that can be scaled up or dialed back -- as electricity demand or wind power production fluctuates.

Going forward, utilities are anticipating somewhat reduced hydropower output due to climate-related stream flow changes and accommodation of other river user interests. Proposals for new large-scale hydropower dams would face some difficult permitting and financing challenges. Therefore, this particular study focuses on hydropower resources that face minimal obstacles of this sort – efficiency upgrades at existing plants, 'microhydro' applications and tapping the hydro-energy of irrigation canals.

The Electric Power Research Institute estimates that 3,100 MW of efficiency gains are achievable at today's U.S. hydropower facilities.[1] Based on Idaho's share (~2.55 percent) of U.S. hydropower capacity (98,000 MW), the efficiency opportunity in Idaho could total 80 MW (2.3 trillion BTU).[31] Technology advancements in the coming decade could increase the size of this efficiency resource.

Microhydro is generally defined as small-scale hydropower technologies of less than 100 kW. These systems are 'run-of-river', meaning not based on impounding water behind a dam. Instead, according to Appalachian State University, "a fraction of the stream's water is diverted downhill through a pipe to a small turbine that sits alongside the stream. Properly designed, a microhydro system causes minimal environmental disruption to the stream."[32]

[1] http://www.hydro.org/hydrofacts/EPRIEESITheFutureofWaterpower060807.pdf

A 2004 survey by the U.S. Department of Energy estimated 85,000 MW of microhydro capacity is undeveloped in the country.[33] Idaho-specific data for microhydro is not currently available. A back-of-the-envelope calculation: If 5 percent of U.S. Department of Ecology's identified microhydro capacity proves both economically viable and environmentally sound, and the Idaho resource is 2 percent of the nations, the microhydro resource in Idaho could be another 85 MW. The actual resource in Idaho may be significantly larger or negligible; further study will be required to produce a valid assessment.

The water flowing through irrigation canals can also be tapped for energy.[34] Flows are strongest during rainy periods and seasonal snow melt. There are 100,000 miles of irrigation canals in the U.S. and thousands of miles in Idaho.

The scenarios in this study assume that development of efficiency opportunities at existing facilities as well as new microhydro and irrigation canal energy projects can roughly compensate for any reductions in future streamflows and make a small contribution to in-state energy supplies.

Potential Sequencing of Renewable Energy and Efficiency

An appropriate sequencing/prioritization strategy in selecting and implementing a renewable energy and efficiency strategy should include considerations along the following lines:

- Choices that are easily achievable based on perceived lower risk to investors, technology and associated industry maturity, policy precedence, utility industry acceptance, application experience and market and industry momentum/inertia
- Choices that, in addition to providing lower cost clean energy and greater energy security for Idaho, also maximize tax revenues, employment and economic development within the state of Idaho

Table 11 below organizes potential projects into three groups all with the potential for meaningful returns but differing on timing, risk and complexity. The first group represents those with strong near-term opportunities, the second that have meaningful returns but may be more complex to implement, and the third that have even higher risks and complexities.

Table 11: Review of Potential Opportunities in Idaho and Commercialization/Deployment Issues		
Nature of Opportunity	**Explanation**	**Example Solutions**
Near-Term Returns/Lower Risk	Initiatives and projects where meaningful results can be achieved with shorter lead times, lower investment risk and fewer barriers or challenges, as well as initiatives and projects critical for the overall success	▪ **Large Scale Wind Projects** ▪ **Efficiency and Conservation Programs (residential, commercial, industrial)** ▪ **Fuel-Efficient Vehicle Incentives (private, fleet)**
Meaningful Returns/More Complex to Secure	Initiatives and projects where meaningful results can be achieved and are important for the overall energy security objectives, but are more complex in the approach necessary for realization and implementation	▪ **Small Scale Solar/Small Scale Wind** ▪ **Biomethane (Gas, Electric Generation)** ▪ **Wood Waste** ▪ **Biofuels** ▪ **Geothermal Direct Use (district heating and individual building/facility heating)** ▪ **Electric Grid Upgrade/Build-out for System Efficiencies and Renewables Transmission** ▪ **Plug-in Electric Vehicle Support Infrastructure**
Meaningful Returns/ Higher Risks and Complexities	Initiatives and projects where meaningful results may be achieved, but with higher levels of risks and uncertainties--more significant challenges such as technology development and commercialization issues; complexity in regulatory, siting and stakeholder processes, and uncertainties in resource capability and project economics.	▪ **Low Impact Hydro Build Out** ▪ **Geothermal Electric** ▪ **Large Scale Solar**

Taking into account this analysis, it is possible to focus more immediate energy strategies on the near-term/low risk group to ensure that the state makes tangible progress and generates momentum in the near-term. Then, other strategies can focus on more intermediate or longer-term solutions in a way that more fully addresses the particular complexities that they represent. In this way the state can capture some of the commercial energy around key solutions while allowing other solutions to continue to mature and benefit from further R&D or manufacturing scaling that may be beneficial for performance and economics.

SUMMARY OF ENERGY EFFICIENCY AND RENEWABLE ENERGY OPPORTUNITIES IN IDAHO

As demonstrated, information on the currently installed base and future potential is not universally available across resource types. The data that are available demonstrate that the state has a number of areas for development and exploration – wind, geothermal, biomass, solar and efficiency, for example -- to secure more of its resource mix with in-state resources.

ECONOMIC BENEFITS OF DEVELOPING ENERGY EFFICIENCY AND NATURAL RESOURCES

Building out Idaho's energy efficiency and renewable energy sector can generate positive economic benefits in counties where projects are located, as well as for the state as a whole.

Other states have already made the connection between in-state production of clean energy and jobs and revenue benefits. For instance, Nevada has 15 geothermal power plants totaling 276 MW of electricity capacity, plus another 64 MW of direct use geothermal applications.[35] Roughly 9 percent of the electricity in northern Nevada comes from geothermal plants. In addition, state governments receive tax revenue. In 1993, Nevada's geothermal power plants paid $800,000 in county taxes and $1.7 million in property taxes. The U.S. Bureau of Land Management collects – and returns to state government – half of nearly $20 million each year in rent and royalties from geothermal power plants in Nevada producing power on federal lands. Nevada is now working towards producing more than 1000 MW of geothermal power over the next three to five years, an amount that will meet approximately 25 percent of Nevada's total power needs.

Wind power development in the Northwest is already delivering economic benefits. In just one year (Oct 2005-06), according to the Renewable Northwest Project, the 954 MW of wind development that came online, brought rural counties:[36]

- $1.38 billion in new capital investment
- 1,300 construction jobs
- $2-3 million in annual royalties to landowners
- $5.8-6.8 million per year in local property taxes

In contrast, a similarly sized natural gas project sends $11-24 million out of the region every year for fuel costs alone[37].

DIVERSE SET OF COMPANIES REPRESENTED

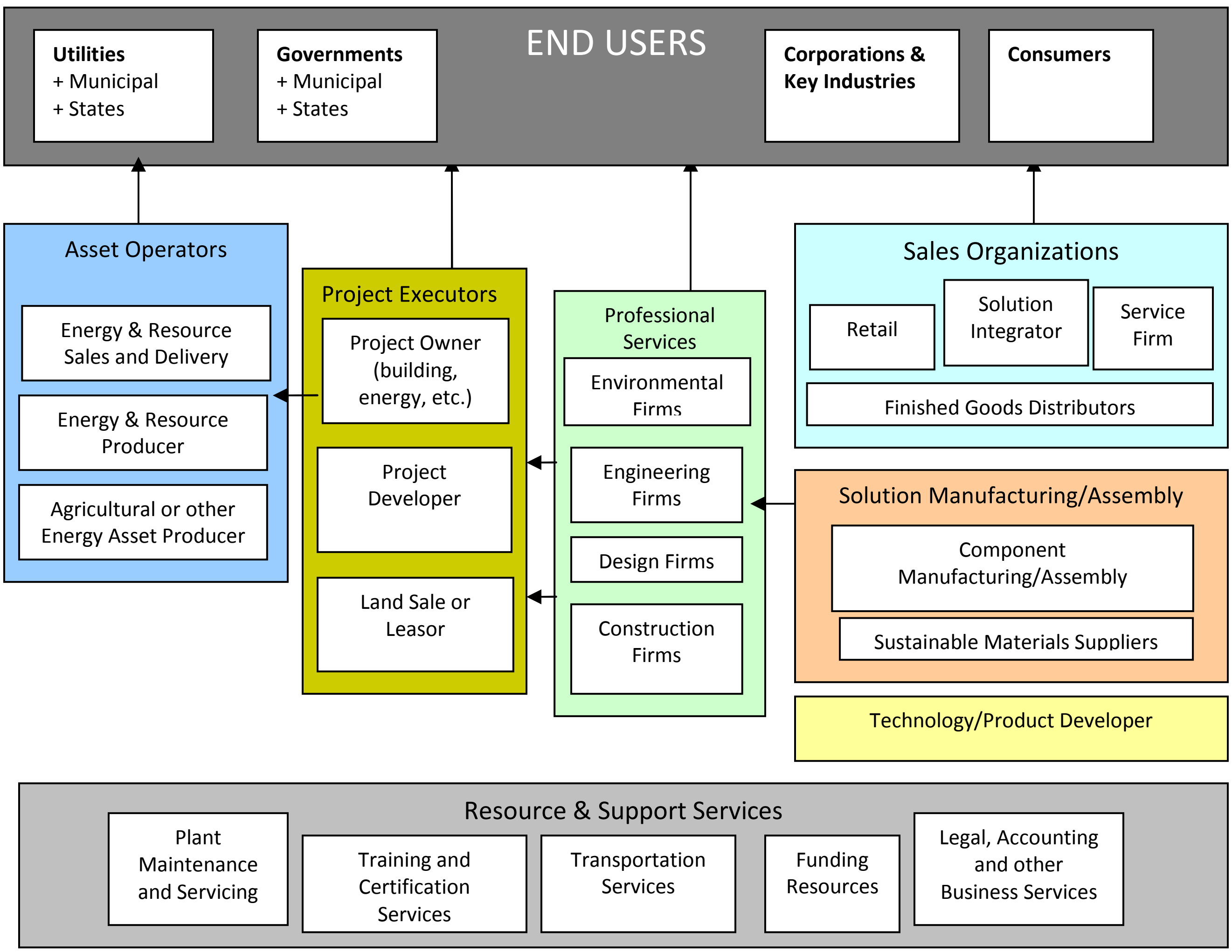
There are a wide variety of companies and jobs that come into the installation and operation of renewable energy and energy efficiency projects. Work by the Athena Institute to map the value chain in the clean technology sector reveals a wealth of jobs in companies that benefit (and in turn benefit their communities) from increased activity:

- **Energy and Resource Sales and Delivery**—manages the delivery and servicing of energy or resources to the end-user
- **Energy and Fuel Producer**—generates, extracts, processes, or produces fuels, energy, usable electricity, heat, steam, energy by-products or capacity of some form
- **Agricultural Producer**- produces organic or sustainably-harvested foods or crops for energy consumption
- **Project Owner and/or Developer**—finances, owns and develops projects for sell through initial/follow-on risk positions in projects—e.g. energy plants, buildings, etc.
- **Professional services firm**— firms that aid with design, engineering, environmental analysis, construction, installation, system integration and servicing
- **Sales Organizations**—those who sell and/or distributes technologies or solutions to the marketplace, which includes manufacturer representatives, wholesalers, distributors, retailers, on-line exchanges, etc..
- **Solution Integrators—**specialize professional service firms focused on bringing multiple components together to work on a customer premise
- **Solution Manufacturer/Assembly**—manufactures and/or assembles components or solutions

- **Technology developer**—designs technology for development into a product or solution that supports renewables or efficiencies
- **Asset owner/manager**—the owner of the asset (e.g. farmland, waste products) that receives revenue for the use of the asset in the production of energy or other solutions, as with land for wind farms[1]
- **Resource/Support Providers**:--private, government, and NGOs providing support and resources for the clean tech and sustainability industry.
- **Support Services providers**—provides informational, transportation, marketing, or other service. Included companies such as media/publishing; public relations; Consultants; venture capital; lawyers.

This variety of companies benefiting along the clean technology value chain is illustrated in Figure 11 below.

Figure 11: Map of Value Chains in Clean Technology Industries



Source: Athena Institute

[1] included only where that asset is an integral part of the production

In turn, jobs in these organizations range from highly technical to semi-skilled. A sample of this rich variety of job opportunities is illustrated in Table 12 below.

Table 12: Examples of Diversity in Jobs in Clean Energy Firms

Type of Firm	Offering of Firm	Sample of Types of Jobs
Solution and Component Providers	Turbines, solar panels and components, building systems and solutions, building materials, geothermal well shafts, drilling equipment, pumps, power plant equipment and controls	Engineers, welders, mechanics, machinists, electricians, carpenters, assembly, manufacturing specialists, marketing specialists, sales
Siting Consultants and Contractors	Search for wind, geothermal, etc. resources, modeling resource availability, economic analysis for financing assessments	geologists, hydrologists, engineers
Environmental Service Firms	Environmental impact analysis, site assessment and permitting, geothermal well and water testing	Scientists of a variety of backgrounds, environmental engineers
Project Developers and Construction	General contracting and others to develop a site, including plant design, architecture, construction.	Construction and drilling equipment operators and excavators, surveyors; architects and designers
Power Plant Operators	Operate, manage and maintain a power plant	Certified power plant operators, engineers, maintenance staff
Raw Energy Material Providers	Feedstock/waste harvest, collection, assembly, transport, storage	Skilled & semi-skilled machine operators, labor
Distribution System Operators	Manage the systems that distribute alternative power or fuels	Planners, engineers, operators
System Integrators, Installers and Building Maintenance Firms	Specify systems, install and maintain smaller scale resources and energy efficiency solutions	Engineers, sales, HVAC technicians, electrical, mechanical, and structural engineers, pipe fitters, plumbers
Source: Athena Institute		

This same diversity around jobs also exists in conventional resources like coal and natural gas, but there are some important differences in the number of jobs generated through these types of plants versus renewable plants. As Table 13 illustrates, the employment rates for renewable technologies are more significant per MW. Renewable energy creates more jobs per MW of power installed, unit of energy produced and dollar invested than fossil energy.

Table 13: Employment Rates by Energy Technology				
Power Source	Construction Employment (jobs/MW)	O&M Employment (jobs/MW)	Total Employment for 500 MW	Factor Increase over Natural Gas
Wind	2.6	0.3	5635	2.3
Geothermal	4.0	1.7	27050	1.1
Solar Electric	7.1	0.1	5370	2.2
Solar Thermal	5.7	0.2	6155	2.5
Landfill Methane/Digester Gas	3.7	2.3	36055	14.7
Natural Gas	1.0	0.1	2460	1
Source: Electric Power Research Institute, prepared for the California Energy Commission (CEC), California Renewable Technology Market and Benefits Assessment, November 2001. Source: Renewable Energy and Jobs - Employment Impacts of Developing Markets for Renewables in California, and based on California Renewable Technology Market and Benefits Assessment, Electric Power Research Institute, November 2001				

There are a number of statistics that speak to the job opportunities already being captured by many communities. Energy efficiency now employs eight million people and renewable energy 450,000 in the U.S. Denmark's wind industry employs 20,000 and Spain's 35,000. U.S. wind power was responsible for 16,000 direct jobs and 36,800 total jobs in 2006. Germany employs 214,000 in renewable energy, including 64,000 in wind. The Massachusetts clean energy sector employs 14,000 and will soon be the state's 10th largest economic sector. Already across America over 66,000 rural jobs have been created in the production of 75 GW of biopower and over 40,000 jobs have been created in biofuels.

There are also a number of projections for where employment will rise in response to growth in adoption. California's Million Solar Roof Initiative will generate 15,000 jobs there. A national light vehicle efficiency standard of 35 mpg by 2018 will create 241,000 jobs including 23,900 in the automotive sector while saving consumers $37 billion in 2020 alone. Washington State's 15 percent renewable energy standard is projected to result in a net increase of 1,230 jobs in state. Generating 20 percent of U.S. electricity from new renewable energy by 2020 will add 185,000 new jobs, while cumulatively reducing utility bills $10.5 billion and increasing rural landowner income by $26.5 billion.

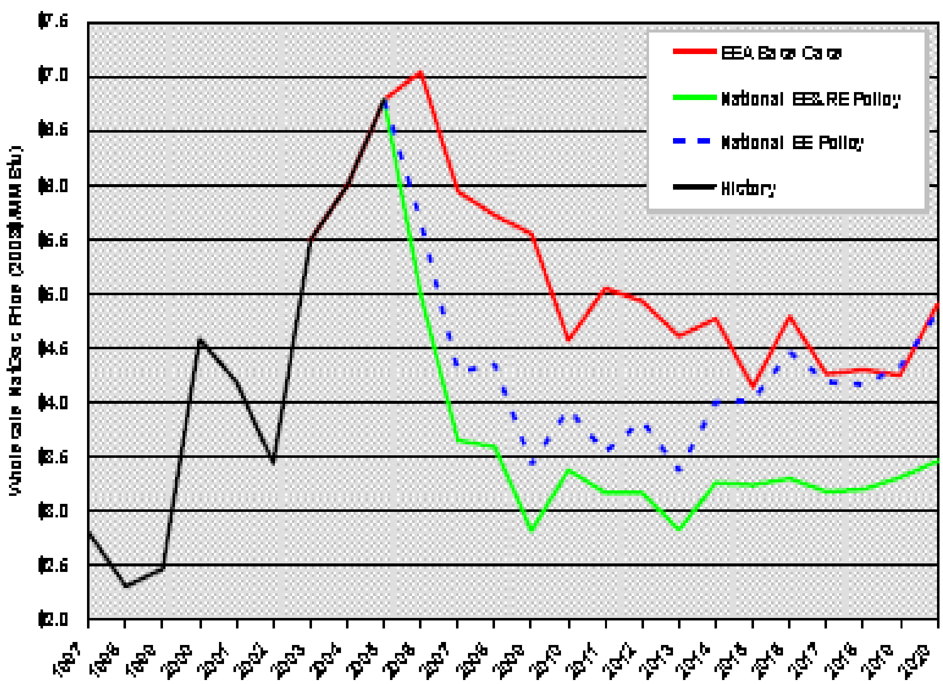
Renewable Energy Can Positively Impact Other Energy Costs

Energy efficiency and renewables can also benefit the economy by reducing fuel risk exposure in the state's energy portfolio; in other words, the risk of rising costs for petroleum, natural gas and coal, for example. Further, in-state renewables and efficiency can save consumers money and help reduce price pressure on natural gas. In fact, a study by the American Council for an Energy-Efficient Economy shows that efficiency measures that result in modest near-term reductions in gas and electricity consumption, coupled with increased renewable energy use, could significantly impact natural gas prices and availability. The study projects that this could save U.S. consumers more than $75 billion on their natural gas bills over the next five years. Various analyses of this type have been done by the Energy Information Administration and others. While the numbers vary from conservative to more aggressive, a more conservative estimate from EIA shows that achieving a 10 percent share for renewable energy in the U.S. electricity supply could reduce power prices by 1.9 percent, while a 20 percent share could reduce natural gas prices by $0.25/million Btu, resulting in cumulative gas bill savings of $15 billion through 2025.

Beyond the price point changes, there is also the avoided consumption of natural gas. EIA estimates indicate that under the 10 percent scenario, renewable electricity could save as much as 0.5 trillion cubic feet (Tcf) per year compared to business as usual in 2020, and 5.1 Tcf cumulatively from 2005-2025 (Fig. 4). Achieving 20 percent renewable electricity by 2020 could increase the natural gas savings to 1.8 Tcf per year (20.6 Tcf cumulatively), equal to six percent of total projected 2020 gas use.

Figure 12 below illustrates the projected impact from an energy efficiency and renewables policy on natural gas prices.[39]

Figure 12: Impact on Wholesale National Gas Prices of National Energy Efficiency and Renewable Energy Policy



BENEFITS TO THE STATE OF IDAHO SPECIFICALLY

Implementing energy efficiency and developing these in-state resources will enable Idaho to gain positive financial impacts in a number of ways:

Direct Financial Benefits to Companies and Communities in the State

- Reducing the dollars spent externally for energy imports keeps revenues and investment capital in the state
- Development and production from energy projects can generate community and property tax revenue from energy producers for local and state benefit
- Energy projects can use valuable renewable resources (and in some cases like wood and waste, perishable resources) that would otherwise go unused
- Passive revenues for asset holders like farms and ranches, as well as for those corporations who have land holdings

- Jobs and commercial activity from companies pursuing renewable energy projects and operations, delivery systems and products and services to aid with energy efficiency and renewables

Strengthening the Economics and Risk Profile Around the Underlying Infrastructure

- The shift to renewable fuels also means that the portfolio could grow increasingly more economical than a fossil-fuel based system as increased fuel and environment costs play out over time.
- Shifting to local resources that rely on renewable fuels reduces the state's vulnerability to petroleum and natural gas fluctuations and interruptions.

Other Risk Management Benefits

- A stronger in-state renewable portfolio also increases the ability of the state to meet evolving air quality regulations. Such a portfolio better positions the state in the face of eventual carbon and emission standards.
- There are also numerous positive impacts on specific risk areas. For instance, some of the wood waste strategies can help manage the increased fire risks stemming from rapid growth in wildland/urban interface areas.

Where data was available, we have taken the next step to quantify some of the benefits in Idaho around taxes and employment:

Opportunity for Tax Benefits. For the state of Idaho, a number of studies have looked at the potential for increased tax revenues from renewable energy projects. Table 14 below summarizes the impacts that the state and counties stand to gain from annual tax receipts just from wind.

Table 14: Tax Implications of Wind Projects in Idaho

Statewide Total Projected Annual Tax Receipts (ATR)	County Specifics			% of Counties with ATR Potential Greater than $500,000
	Median ATR	Average ATR	Highest ATR	
$69,213,591	$1,562,127	$1,922,599	Elmore Clark Owyhee Power Custer	80%

Source: Computed from data from Idaho Office of Energy Resources

Owyhee County has developed a county energy plan that includes resources in wind classes 3 through 7. Based on a very robust estimate of wind output potential of 13,490 MW, they calculate that Owyhee County stands to gain some $68 million in annual tax revenues— while reducing the money that is currently being sent out of state in the form of import payments. One project currently under analysis in the county is Slacks Mountain-Windy Point. With a rated output of 290 MW and a capacity factor of 35 percent, the annual tax revenue to the county from this one project alone (three percent of gross electric sales) is projected at $ 1,600,452 each year. The Department of Energy in Idaho tracks current and potential wind projects in the pipeline, and has identified a number of potential opportunities for the state, as evidenced in Table 15 below.

Table 15: Tax Implications of Identified Potential Wind Projects in Idaho					
County/Area	**Rated Project(s) Output**	**Projected Annual Tax Receipts if 100% were Built Out**	**County/Area**	**Rated Project(s) Output**	**Projected Annual Tax Receipts if 100% were Built Out**
Ada	175.0 MW	$827,831	Elmore	1,305.7 MW	$6,176,490
Adams	399.5 MW	$1,889,795	Franklin	130.0 MW	$614,952
Bannock	707.0 MW	$3,344,393	Gooding	330.0 MW	$1,562,127
Bear Lake	305.0 MW	$1,442,772	Idaho	372.0 MW	$1,759,709
Benewah	330.0 MW	$1,561,032	Jerome	.002 MW	$95
Bingham	392.5 MW	$1,856,652	Kootenai	365.0 MW	$1,726,700
Blaine	190.0 MW	$898,776	Latah	152.0 MW	$721,481
Boise	252.0 MW	$1,194,426	Lemki	560.0 MW	$2,649,024
Bonneville	240.0 MW	$1,135,305	Lincoln	18.0 MW	$85,147
Butte	575.0 MW	$2,719,980	Madison	150.0 MW	$709,560
Camas	457.5 MW	$2,164,158	Oneida	302.1 MW	$1,428,888
Canyon	60.0 MW	$283,828	Owyhee	1,150.0 MW	$5,440,055
Carribou	342.5 MW	$1,620,162	Payeth	20.0 MW	$94,608
Cassia	643.3 MW	$3,043,161	Power	997.5 MW	$4,718,574
Clark	1,177.8 MW	$5,571,229	Shoshone	552.5 MW	$2,613,546
Clearwater	20.0 MW	$94,608	Twin Falls	563.5 MW	$2,665,589
Custer	895.0 MW	$4,233,708	Valley	500.0 MW	$2,365,200
Total MW: 14,630 Total $69,213,591.00 Does not include data from remaining counties in Idaho, which was unavailable in the source documents					
Source: Computed from data from Idaho Office of Energy Resources[40]					

Employment Opportunities in Idaho. A recent report released by former Senators Bob Dole and Tom Daschle laid out the promise of clean, domestic energy and the connection to renewing our current agriculture sector. Many of these energy projects are located in rural areas where unemployment rates are often higher than those of their urban counterparts, so the benefits to the state can be significant. These new jobs in exciting, growing fields increase the state's ability to keep youth in rural communities and in the state overall.

Turning again to wind opportunities in the state, there are a number of analyses that demonstrate the positive economic benefit from jobs in the sector. Analysis by the University of Idaho in 2004 identified employment and tax impacts from a subset of projects in the following six counties, laid out in Table 16 below:

Table 16: Examples of Wind Project Impacts on Employment and Taxes							
		Bannock	Bonneville & Bingham	Cassia	Elmore	Power County	Twin Falls
Size of Plant		(100 MW)	(250 MW)	(220 MW)	(300 MW)	(200 MW)	(300 MW)
Construction	Change in Local Output	$6,201,552	$12,028,530	$11,211,261	$15,037,003	$9,445,687	$ 17,357,599
	Change in Local Employment	61	109	114	134	92	180
	Change in Local Employee Earnings	$1,580,254	$3,243,119	$2,842,665	$3,752,726	$2,337,245	$4,617,973
Operations	Change in Local Output	$22,864,049	$46,124,955	$54,399,851	$55,173,654	$41,558,628	$68,592,146
	Change in Local Employment	97	186	215	207	150	306
	Change in Local Employee Earnings	$2,832,126	$6,031,858	$6,012,565	$6,577,834	$4,522,213	$8,878,558
	Change in Property Tax Revenues[1]	$1,409,338	$2,757,409	$2,526,072	$3,248,727	$ 0	$3,496,061
Source: University of Idaho, 2004							

And it is not just wind where the region stands to gain. For rural economies, biomass technologies can have a major impact on creating new jobs and improving local conditions. In Adams County, for instance, utilizing woody biomass can help resource-dependent rural communities recover from the loss of sawmills and establish jobs tied to their agricultural base. It is these benefits around new sources of income for farmers, landowners and others that are a driver for the increased role for biomass technologies in federal energy policies.

Many of the jobs outlined in the studies focusing on job growth often fail to mention the job flattening or eventual decline in traditional energy sectors over time. But in the case of Idaho, little cannibalism exists. Since the state primarily reaches out of state for its energy sources, and it doesn’t have a local stock of coal or other resources with invested market structures, the state stands only to gain, not lose, from a transition to local sources of energy.

Within Idaho there are also opportunities to:

- Build manufacturing businesses for solar systems and R&D centers for biomass
- Create synergies around the presence of INL as a resource for energy technologies and plug-in vehicle infrastructure development
- Develop renewable business opportunities that are synergistically integrated with existing, well established Idaho businesses and industries, such as agriculture and forest product industries.

Table 17 below summarizes some of these opportunities by the resource type outlined earlier.

[1] These statistics are based on available information about property tax rates in 2004, and as such they do not reflect any changes that have been made in these rates.

Table 17: Potential Value from Each of the Resources

Resource Type	Value to the Community
Wind	Jobs and revenue from wind farm siting, construction and operations
Geothermal Direct Use	Jobs and revenue from project development, construction, installation and operations
Geothermal Electric Power	Jobs and revenue from project construction and operations
Solar Electric Generation (PV and solar thermal concentration)	Jobs and revenue from solar manufacturing, distributors, installers, construction of sites and operation of sites
Solar Thermal Direct Use	Jobs and revenue from solar manufacturing, distributors and installers
Biomass Wood Waste Power Generation	Jobs and revenue from project construction and operations
Biomass Methane (other than landfill gas)	Jobs and revenue from facility construction and operation, improved operation economics of existing "primary" business
Municipal Waste (landfill gas power generation)	Jobs and revenue from facility construction and operation
Biofuels	Jobs and revenue from feedstock or supply growing, harvesting, transporting, processing, and distributing fuels; also jobs and revenue from component production for fuels or fuel distribution systems
Ethanol (agriculture crops)	Jobs and revenue for construction, operations, and feed stock supply
Ethanol (cellulosic)	Jobs and revenue for construction, operations, and feed stock supply
Building / Industrial Efficiency	Jobs and revenue from energy audits, retrofit installation, and equipment and system suppliers
Vehicle Efficiency	Savings in transportation fuel expenditures
Vehicle – Grid Powered	Savings in transportation fuel expenditures. Jobs and revenues associated with new business structures related to technology support and new infrastructure components, potential for "symbiotic" improvement of local grid reliability.

SCENARIOS FOR NATURAL RESOURCES AND ENERGY EFFICIENCY

One of the most crucial questions facing policy makers today around long-term energy security is "what is the potential value from--and the best way to go about--harnessing the value of the natural resources and energy efficiency in Idaho?"

This section presents three scenarios that illustrate the feasibility of reducing Idaho's energy imports and substantially increasing the share of Idaho's energy coming from in-state natural resources. The scenarios offer portfolios in which energy efficiency is fully leveraged and a much greater share of Idaho's power comes from in-state renewable energy sources by 2025. The scenarios describe alternative routes to supply 50 percent of Idaho's energy portfolio through in-state natural resources, to illustrate the robust opportunities.

Can half of the energy consumed in Idaho be served by in-state sources that eliminate out-of-state fuel risk and provide jobs and revenue opportunities to the state? Answering this question fully would involve systematic energy planning:

- **More complex modeling of the nature of the use of energy**—what are the daily, monthly and seasonal cycles that need to be addressed through our energy portfolio? What are the specific consumption areas (e.g. power, heating, cooling, refrigeration, transportation etc.) and how are those growing or changing over time?
- **Assessment of efficiency potential across energy uses**—where could efficiencies impact statewide vehicle fuel consumption, building heat, industrial process heat loads, etc.?
- **Modeling the economic and operating nature of the potential resources**—what is the capacity of specific resources to provide power, heat, steam, etc.; what are their development lead times; which projects have true developable potential; what are the first-in and ongoing economics based on cost curve shift; where could potential commercialization issues be addressed to make the resources more viable?
- **Looking at energy shifting opportunities**—where could we encourage the shift from energy from one use to another, for example, building heat from oil and gas to electric or district heating from geothermal, or vehicles from motor fuel to plug-in hybrids to encourage more optimal consumption, and how would that shift the consumption projections?
- **Analyzing the delivery adequacy around resource opportunities—**what is the current capacity of our transmission and delivery systems, where could those be economically built out, where could resources be used locally to avoid the additional costs of transport, what impact does that have on the amount of renewables feasible for development in a particular time frame?
- **Establishing the optimal portfolio—**identify the range of possibilities that meet our long-term needs for energy security taking into account the analysis above
- **Evaluating the risk profile of the resulting portfolio**—where is the portfolio exposed to technical, market or policy risks?

This process is similar to the integrated planning efforts that major utilities undertake. But it goes further to look across the entire energy picture, looking at optimizing both use and source in a way that manages technical, operating, market and policy risks state-wide.

Scenario Analysis

In absence of the data and the study scope to undertake the more complex modeling outlined above, this study offers up some preliminary scenarios for illustration of the potential in energy efficiency and natural resources.

The scenarios are based on analysis of existing data on Idaho's resources and opportunities. However, as already noted that data is scarce in several areas; more robust and valid data would enable more refined projections of the realistic development potentials of the various resources. As a starting illustration, the three scenarios below illustrate the impacts that energy efficiency can have, and various approaches to build out renewables.

First, we begin with projected total energy consumption in 2025, identified as 653 trillion Btu per year. In order to meet 50 percent of this through renewables and efficiency/conservation measures would have to provide at least 326 trillion Btu per year. The renewable electricity generation and petroleum alternatives identified in Table 7 on page 23 indicate a potential in

Idaho of at least 467 trillion Btu per year to work with to meet needs. So on the surface the resources are there, but further modeling would reveal whether they be developed economically and in a way that would fit with the nature of the energy demand profile.

Beyond the energy efficiency considerations, the renewables selected for the scenarios are based on high-level analysis that illustrates where early emphasis may be placed for maximum near-term benefits. It then progresses to technologies that require either longer project development and implementation time or are at earlier development (less mature) stages where further R&D may be beneficial for performance and economics. The scenarios also work to emphasize technologies that support state economic and business development. All of these scenarios assume modest advances in new energy technologies (and the national policies enabling them) that continue to improve the ability of these supply and demand-side resources to serve as cost-effective options.

Each of the scenarios rely on a more significant build out of wind, solar pv and geothermal electric, and involve some build-out of Idaho's bioenergy and conversion of end-use technologies to maximize use of grid based power; solar and geothermal direct use for building and water heating; and widespread implementation of efficiency/ conservation programs and associated end-use technology replacements, upgrades and conversions. These scenarios also include a significant contribution from increased efficiencies at existing hydro facilities, and microhydro and irrigation canal energy projects.

Available data to quantify the potential for energy efficiency in Idaho is sorely lacking. Therefore, the three scenarios are built upon different baselines of achievement of statewide energy efficiency gains for the energy system as a whole. The first scenario is the most aggressive, assuming Idaho can use energy 30 percent more efficiently in 2025 than today.

Is there reason to believe that an efficiency target as high as 30 percent could be cost-effective and achievable? For the electricity sector, data from other states and regions suggests that 30 percent efficiency gains by 2025 is an aggressive but achievable target. Recent state level studies of the potential for low-cost energy efficiency found that Texas can meet 18 percent of its projected 2023 electricity demand via cost-effective efficiencies, while Maryland can reduce per capita energy use 29 percent by 2025 at a net cost savings on energy bills of $21 billion from 2008 to 2025.41 The Western Governors Association has set a 20 percent energy efficiency goal for 2020, while Utah aims to reach 20 percent by 2015, "thereby saving Utah's citizens and businesses energy and money."42 A review of 11 state and regional efficiency potential studies by the American Council for an Energy Efficient Economy (ACEEE) shows a median potential reduction of electricity usage of 24 percent through cost-effective efficiency technologies. This estimate is "inherently conservative" because it is based on today's technologies which are advancing rapidly.43

What efficiencies can we expect around transportation fuels? Today, the average new Ford car gets fewer miles per gallon (mpg) than Henry Ford's Model T. The potential for innovation and efficiency advancement with regards to automobiles is enormous. Plug-in hybrid vehicle technology is seen by many as the technology most likely to dominate the market in coming decades. Proponents anticipate PHEVs will get about twice the fuel economy of today's vehicles. Some of that efficiency gain is moderated somewhat by the fact that electricity is used instead. Already, Idaho drivers have been reducing their use of gasoline – on average, from 9.2

gallons per person each week in 1999 to 8.3 gallons in 2007, a reduction of nearly 10 percent on a per capita basis.[44]

Table 18: Scenarios for Developing Natural Resources and Energy Efficiency in the State			
Portion of Estimated 653 Trillion Btu/Yr 2025 Demand		Example Scenarios of Energy Production Resources in Trillion Btu/Yr	
Efficiency Assumption	50% In-State Natural Resources (TBtu/Yr)		
High Efficiency (30% or 195.9 TBtu/Yr)	228.6	99.6	Wind
		42.0	Solar Electric/Solar Thermal
		27.0	Geothermal Electric/Geothermal Direct
		21.0	Biofuels/Biomass
		39.0	Hydro
Medium Efficiency (20% or 130.6 TBtu/Yr)	261.2	116.6	Wind
		47.0	Solar Electric/Solar Thermal
		27.0	Geothermal Electric/Geothermal Direct
		28.4	Biofuels/Biomass
		42.2	Hydro
Low Efficiency (10% or 65.3 TBtu/Yr)	293.9	141.0	Wind
		47.0	Solar Electric/Solar Thermal
		27.0	Geothermal Electric/Geothermal Direct
		33.5	Biofuels/Biomass
		45.4	Hydro

Scenario 1: High Energy Efficiency, Wind and Distributed Generation Scenario
This first scenario, as noted above, is the most aggressive regarding energy efficiency. It assumes that 30 percent of projected load can be eliminated through energy efficiency, load management, conservation and demand response activities. This includes efforts around buildings, industrial processes, municipal infrastructure, delivery systems and vehicles. What remains after efficiency is 228.6 TBtus of energy requirements to be met by through a number of renewables. The solar electric and solar thermal in this scenario might be met more effectively, since the education and incentive efforts needed to build out high levels of efficiency could also be leveraged to encourage solar adoption. This scenario also assumes that solar prices drop considerably, consistent with industry projections. This scenario involves a modest buildout of biofuels and biomass electricity and a significant buildout of wind, although less than other scenarios.

Scenario 2: Wind, Bioenergy and Solar, Medium Efficiency
The second scenario involves 20 percent energy demand reduction, leaving a target of 261.2 TBtus to serve. This need is met through a more significant emphasis on wind, along with continued reliance on geothermal, solar, and bioenergy. Like the energy efficiency scenario, this scenario also assumes that solar prices are decreasing, and that similar activities can be used to encourage efficiency and distributed generation gains.

Scenario 3: Large Scale Wind and Solar, Some Efficiency
This third scenario involves 10 percent overall energy demand reduction, leaving 293.9 TBtus of in-state production needed to meet the 50 percent threshold. This increased need is met primarily through a significant build out of wind, solar, geothermal and bioenergy.

These three scenarios illustrate how with commitment and stretch, the combined contributions from both the overall identified in-state renewable energy potential and reasonable goals for statewide efficiency and conservation measures can enable Idaho to meet over half its energy needs from in-state natural resources by 2025.

SUMMARY AND FEASIBILITY OF ACHIEVING THE SCENARIOS
The specific economics and full feasibility of these portfolios are difficult to assess, and complete economic and operational modeling is beyond the scope of the study. It would be easy to criticize the scenarios as overly simplistic, and based on significant bias in absence of economic considerations. More in-depth analysis of these resources needs to be conducted which factors in specific resource economics, operational profiles, grid capacity and environmental impacts. But as a preliminary illustration to stimulate discussion around the potential of energy efficiency and renewables in the state's energy portfolio, the scenarios have value.

Under any scenario, building out energy efficiency programs and renewables over the next two decades will involve hundreds of millions of dollars in commitment, both for the energy efficiency programs and resources themselves and the infrastructure necessary to develop and operate them. But given Idaho's projected demand increases, monetary commitment in some form will absolutely be required to increase energy available to meet those needs. The question now is whether that investment will be made inside the state into resources that have a strong win-win, or whether that investment will continue to flow to external energy producers.

Even in absence of the data and scope to perform a more thorough economic analysis, it is clear that these three scenarios have some potential economic advantages over a "business as usual" scenario that relies heavily on market purchases, natural gas and coal from out of state. For example:

- The increased efficiencies enable residents and businesses to reduce the direct costs they pay for energy
- The development of local jobs, generation of new tax revenues and retention within the state's economy of hundreds of millions of dollars currently spent on imported energy
- The reduction of natural gas price pressures that would occur with significant natural gas power plant build out in our region
- The higher likelihood of being able to get these projects developed (over coal, nuclear or natural gas) in today's finance and policy climate
- Reduced exposure to rising costs and price volatility of fossil fuels which can create hardship for residents and make business planning more challenging

It is also true that the costs of renewable energy and energy efficient technologies are generally declining relative to traditional energy sources over time, which will positively impact the scenarios' economics. Costs for traditional sources continue to increase. Governments are implementing policies that encourage adoption of alternatives, which allow renewables to

achieve economies of scale. And an influx of venture capital and institutional investment will continue to bring new innovation and positive movements down the costs curve.
Based on this preliminary analysis, meeting 50 percent of Idaho energy consumption in 2025 with in-state renewables and efficiency is a viable target. In absence of full economic, operational, and risk analysis, we are not offering these scenarios forward as specific recommended courses of action. The scenarios do illustrate, however, the value in working through more aggressive options to harness the power resident locally in natural resources and energy efficiency.

RECOMMENDATIONS TO BUILD A NEW IDAHO ENERGY ECONOMY

While transitioning the energy system in Idaho represents challenges, growing interest in renewable energy and energy security stands to be harnessed. The following section offers a series of recommendations for the state to reduce its reliance on imported energy and develop its natural resource and efficiency opportunities in ways that benefit the economy. More detailed proposals are clustered under three high level recommendations:

- Create a statewide Energy Security Plan with clear targets and accountability for results
- Align state legislative and regulatory policies, and state agency activity under the Energy Security Plan
- Build Idaho's clean energy industry and workforce, and invest in innovation

1. CREATE A STATEWIDE ENERGY SECURITY PLAN WITH CLEAR STRATEGIES, TARGETS AND ACCOUNTABILITY

It is critical for the policymakers in the executive and legislative branch of Idaho to continue to provide direction and oversight for long-term energy security for the state, and to do so in a way that demonstrates bold leadership in the face of tough, complex and sometimes contentious problems. The Idaho Energy Plan is a solid start toward a coordinated energy policy. The next generation of the plan should lay out further action- and results-oriented goals and objectives, addressing a number of key issues:

- Performance goals and criteria around the desired resource mix to reduce exposure to rising fuel costs and increase capture of in-state opportunities
- Incentives and policies to accelerate investments in residential, commercial, industrial, agricultural and municipal efforts on efficiency, renewable power and transportation
- A strong link between energy and transmission capacity planning, identifying opportunities to cluster resource development or link new generation to transmission projects underway
- Targets around grid advances to support integration, reduce system losses and further support demand-side management
- Policies and guidance to ensure state government facilities, fleets and energy investments lead the way
- Promotion and education strategies to raise public awareness of the need for energy efficiency and the value of developing our resources

In addressing these issues, a good plan should also have a number of other key characteristics:

Establishes Clear Responsibility and Accountability. This strategy needs to be developed as a collaborative effort between legislators, regulators, community leaders and the utilities. But ultimately, successful implementation will require clear leadership that is accountable for delivering results. It is critical that the executive and legislative branches provide a united front and agree on who will 'own' the responsibility for developing an energy security strategy for Idaho, overseeing and updating that strategy, coordinating that strategy with key regulators (e.g. PUC), and reporting the results. In 2007 the Governor created the Office of Energy Resources and the 2008 Idaho Legislature approved a reliable funding mechanism to enable the Office to coordinate the state's energy efforts. Responsibility for delivering on the goals and objectives of the Statewide Energy Security Plan would likely go to the Director of the Office of Energy Resources. The Governor has appointed a 25 X '25 committee to represent the major state organizations and other entities in a cohesive effort around building a portfolio of 25 percent renewables by 2025. This group could play a vital role in building out a transition plan. The Governor also appointed a seven member board of the Idaho Energy Resources Authority (IERA) to provide more opportunity for transmission investment, although there is not yet state funding to serve the mission of the organization. These groups can play a role in advancing the statewide energy strategy, but if individualized efforts continue in absence of a larger coordinated strategy that also values in-state developed renewables, Idaho will continue to invest in other states' efforts to modernize and transform their energy systems, instead of bringing those jobs and revenues to the state.

Ongoing Updates. Energy planning is a process that takes a number of iterations before the state will have a level of competency in working through the real differences of opinion and political issues that will emerge. And market conditions change in ways that should be leveraged into new initiatives and targets. It is critical for the long-term energy security of the state that this is done frequently. The Idaho Energy Plan itself states, "We strongly recommend that the Legislature and other state policy-makers maintain vigilant oversight of the implementation of this Idaho Energy Plan and stay abreast of energy issues by frequently revisiting these recommendations to ensure that they continue to advance Idaho's interests." A reasonable frequency would be to require a report to be delivered every other year from the leader responsible for implementing the statewide Energy Security Plan to the Legislature and Governor. The report could measure results, highlight important changes in energy markets and recommend adjustments to the statewide plan.

Links to and Improves Other Planning Efforts. The energy plan should be leveraged to align other key planning activities, primarily those at the utility and municipality level:

- **Strengthen Utility-Level Integrated Resource Planning.** While the investor-owned utilities do biannual integrated resource plans (IRP), Idaho should consider requiring *all* load serving entities to generate integrated resource plans on this biannual schedule. These IRPs, in turn should look at generation sources, delivery adequacy, and conservation in a manner that is consistent with the statewide energy security plan.

- **Ask Counties and Communities to Collaborate and Produce Energy Plans.** The state should encourage counties to develop their own energy plans that outline how they are going to implement goals for energy efficiencies and local generation. Individual communities and counties hold many of the key policy pieces to develop a robust market for energy and energy efficiency in the form of local code, land-use policies and more. They also stand to gain from the taxes and jobs these projects represent. At critical mass, they can also provide additional political support for the legislative and regulatory initiatives that may be required.

Anticipates Future Federal Legislation. The Idaho Energy Plan should responsibly prepare for a future in which fossil fuel emissions carry a price. Corporations have due diligence responsibilities to anticipate future risks and many are anticipating a future in which carbon emissions carry a cost per ton. Regardless of the state position on global warming, a national policy to limit carbon emissions appears increasingly certain, with many analysts predicting it as soon as 2009. Additionally, a national "Renewable Portfolio Standard" requiring utilities to meet targets for inclusion of renewable energy in their electricity portfolios is a distinct possibility in the next few years, as is further legislation to reduce U.S. dependence on foreign oil. The Idaho Energy Plan should position Idaho to maximize benefits and minimize risks as such federal policies add further cost advantages to clean energy over fossil energy.

2. ALIGN STATE LEGISLATIVE AND REGULATORY POLICIES, AND STATE AGENCY ACTIVITY, WITH THE PLAN

The value of a plan is in its ability to guide actions, and the statewide Energy Security Plan should serve as the prime vehicle for the executive and legislative branches, regulators, and agency directors to align initiatives and policies. Strong alignment will powerfully communicate to the market Idaho's intention to develop in-state renewable resources and energy efficiency opportunities. In addition to clear and accountable leadership, and strong commitment to the plan from top policymakers, this involves a number of activities:

- Providing resources for the plan
- Establishing initiatives around transmission, state lands and facilities
- Making state government a leader
- Exploring aggressive incentives and policies to encourage adoption

Provide Resources and Clear Expectations to the Energy Efforts. The statewide energy security plan needs to be recognized as the chief coordinating vehicle for energy policy in the state and it needs to be resourced adequately to serve essential functions-- for example, research and interagency coordination. It will be important that a collaborative link between state-level agencies (Energy, Agriculture, Water Resources, Commerce and Labor, and Environmental Quality) are married with community level planning and industry parties. It will also be important to ensure this coordination extends to the 25X'25 Renewable Energy Council, as well as other initiatives that touch on energy. Establishing the various efforts is not nearly as powerful as setting expectations and identifying what resources might be available under the right circumstances.

Establish a Statewide Initiative Around Transmission Capacity, Smart Grid and T&D Efficiency. Idaho needs to build the capacity of the grid to transmit energy from wind farms, geothermal plants and other renewable power generation. The Office of Energy Resources should evaluate the merits of a renewable energy transmission corridor to bring the wind in the southern part of the state on-line. Developing out transmission capacity in a one-off approach is not necessarily more economically sound, and it adds significant time to the production schedules for bringing plants on line. The state and counties play a large role in transmission siting, and should use that oversight to facilitate development of appropriately-sited renewable energy projects by establishing effective state and local siting and zoning policies. The state can explore ways to provide low-cost financing for new transmission projects that benefit Idaho and support regional efforts to improve the western transmission grid. Utility regulators could require utilities to develop a plan for building transmission capacity in a staged manner consistent with reaching the state's energy security goals. Building new transmission lines is not the only answer, however. New smart grid technologies can help open space on the existing transmission system to integrate intermittent wind and solar power at lower costs than new construction.

Make the state government an energy leader. Idaho should build markets for new renewable electricity generation by committing to run state government facilities on new renewables, setting a target date by which state facilities will be powered 100 percent by renewables. State government offices should also work with their utilities and the industry to immediately move to realize all cost-effective energy efficiency opportunities. The commitment to leadership should extend to transportation – for example, purchasing 'flex fuel' and plug-in hybrid vehicles.

Leverage State Lands as Key Resources for Renewable Energy Siting. Some of the power and transmission opportunities are located on federal or state lands. The state should be aggressive in evaluating its own lands for environmentally-sound opportunities to contribute to the state's energy security and economic development goals.

Continue to Pursue Legislative Action. Idaho needs to enact aggressive incentives and policies to ensure it can compete with other states for private investment in clean energy projects. The legislature needs to continually enhance its initiatives to economically incentivize key development opportunities. Incentives could include sales tax exemptions, income tax credits, and other investment incentives. Examples of specific economic incentives and policies that might be considered are outlined in Table 19 below.

Table 19: Example of Potential Policies

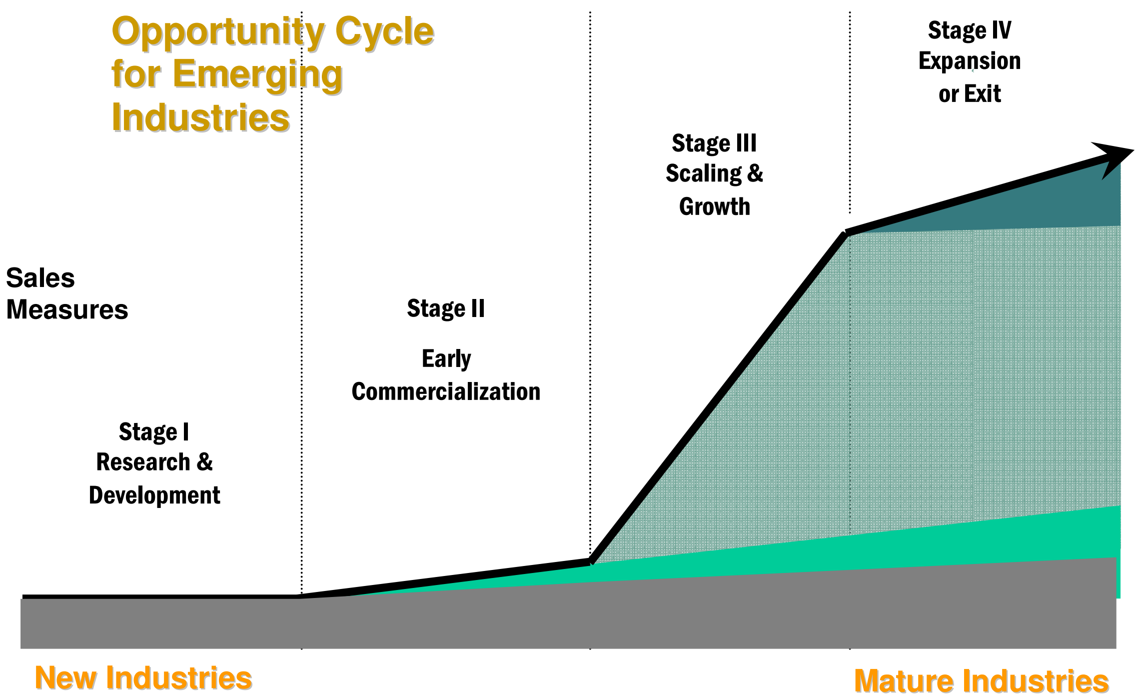
		Potential Policies/Incentives
Renewable Generation	Small-Scale Distributed Generators	▪ Production payments ▪ Low cost financing ▪ Tax incentives ▪ Increase limits on allowed residential generating capacity from 25 kW to 125 kW ▪ Create premium value paid to grid-tied systems that feed power to the grid during peak demand times. ▪ Uniform standards and practices on interconnect to reduce costs
	Larger-scale Distributed Generation	▪ Add an agriculture and industry tariff that allows larger generators and sets payments for surplus at a substantial percentage of market prices ▪ Upgrade loan amounts and loan guarantees to support larger project-specific bond sales

Table 19: Example of Potential Policies		
		Potential Policies/Incentives
		▪ Create business energy tax credits up to 35% of project costs on projects up to $10 million ▪ Exempt purchases of clean energy generators and equipment from sales tax ▪ Adopt production and investment tax incentives for qualifying renewable energy projects
	Utility-scale Installations	▪ Consider incentives in PUC proceedings that provide improved returns to shareholders of investor-owned utilities that invest in renewables ▪ Implement Renewable Energy Standards to require monopoly utilities to meet minimum standards of renewable content in their power portfolio. Successfully adopted in 25 states.
Energy Efficiency	Residential	▪ A residential tax credit for energy efficiency retrofits, equipment and appliances to capture cost effective efficiency potentials.
	Business	▪ A business tax credit of 35 – 50% of project costs for select efficiency measures to kick-start adoption
Renewable Transportation	Advanced Technology Vehicles	▪ Offer tax incentives for private purchases advanced flex-fuel and hybrid vehicles ▪ Make significant public fleet purchases
	Renewable Fuels	▪ Production incentives to launch use of in-state feedstocks by the biofuels industry
	Vehicle Infrastructure	▪ Offer sales and use tax exemptions, income tax credit and grants to fuel retailers and wholesalers who deploy pumps and other infrastructure to supply high-percentage blend biofuels such as E85 and B20.

Critics will likely argue that the efforts laid out here are only a fraction of what is possible or desirable. There are certainly other more aggressive, innovative things that Idaho could do to move forward renewables and energy efficiency. But even with the activities reflected here, Idaho could send a strong signal inside and outside the state, and could accelerate adoption along the path toward more energy independence.

3. BUILD IDAHO'S CLEAN ENERGY INDUSTRY AND WORKFORCE AND INVEST IN INNOVATION

To fully gain the benefits from these energy initiatives, Idaho should also develop strategies to grow a vibrant 'clean tech' sector, supporting companies to innovate and grow and preparing workers with the skills needed by industry.



The figure above shows the stages of development for companies moving technology into the marketplace. Resources and support can help technology companies be successful at each stage:

- **Research and Development**--Investments in research and centers of excellence can aid at this first stage
- **Early Commercialization**--Industry outreach and state initiatives can support efforts by firms to establish their initial customer base and find the other enabling technologies and infrastructure necessary to commercialize their products
- **Market Growth**—Providing access to larger markets, both in-state and nationally, and ensuring that companies can recruit locally the talent necessary to grow, can help firms move through market growth and stay in Idaho as they find success
- **Expansion or Exit**—Retaining or attracting companies at this stage means having more to offer down the road, like unique access to research and development through some of the same investments that were made to start the pipeline.

The following recommendations could have industry development and job creation value across multiple stages of growth, including R&D centers of excellence, clean energy jobs training, firm recruitment, and pilot projects.

Fund and Promote Energy Centers of Excellence and Encourage University and Industry Collaboration with Idaho National Lab.

Identify Center of Excellence opportunities for Idaho around key research and development efforts. Idaho is in a strong position to build R&D capability in a few of key areas, such as waste to energy for the agriculture sector, advanced biofuels (including cellulosic ethanol and renewable diesel), and smart grid technologies and applications. For example, a biogas technology center has been suggested to evaluate technologies and outputs from regional pilots, and then disseminate this information to Idaho dairies to implement on-farm dairy anaerobic digesters. The state should strategically invest in efforts that leverage existing industry strengths and that engages Idaho National Lab and Idaho state university assets, as well as R&D initiatives in adjacent states.

Target Funding for Pilot Efforts in Key Technology Areas

Demonstration projects enable industry, entrepreneurs, utilities and others to partner to try out innovative new approaches with minimal risk. While successful projects can be replicated on a larger scale, even projects that prove less successful generate valuable data and lessons. The state should establish **"Renewable Energy Enterprise Zones"** to encourage innovative demonstration projects, providing seed funding that can be leveraged to attract federal grants and private investment. Targeted projects should engage partners capable of taking successful models to a larger scale, and should advance Idaho expertise in clean tech sectors identified as holding promise for the state to build competitive advantage. For example:

- **Dairy Waste to Energy Initiative.** The Idaho Dairy Waste Conversion to Electricity Pilot Program would demonstrate biogas technology and economically viable electricity generation and likely will require grant funding. These efforts should also incorporate new technologies wherever viable.
- **Biomass Initiatives.** A four-county partnership (Adams, Boise, Gem and Valley) is being organized, and other partnerships are forming in Salmon, Northern Idaho and Western Montana to develop and promote biomass. It is a $100,000 year program, 75 percent funded by grants and each county contributes $6,000 per year for the other 25 percent of the program.

Ridgeline

Ridgeline Energy started as a small, two man operation and has grown to 10 utility-scale wind projects in development in Idaho—leveraging the growing interest in renewable energy into clean energy, jobs and financial opportunities for rural Idaho.

Ninety-eight to ninety-nine percent of Ridgeline Energy's permitted projects in Idaho are sited on private lands. Ridgeline staff prides themselves on the relationships they have built with Idaho farmers and ranchers and have spent many hours around kitchen tables ensuring that they do right by their partners in wind development.

Through wind development, landowners can make use of marginal land and supplement their agricultural income. But the benefits of wind go beyond the financial for Idaho communities.

For instance, growing the wind industry will create a demand for more workers that could help keep young Idahoans in their communities. And these job skills will be in high demand. In neighboring states, technical and community college programs geared for the specialized training that these jobs require already have waiting lists.

Ridgeline Energy is workingwith policymakers to create an environment that will attract wind and other renewable energy developers to the state and allow Idahoans to enjoy all the benefits that clean energy can bring.

Clean Energy Jobs Training

As the electric industry faces significant retirements over the next 3 – 5 years and the prospects for clean energy technologies increase, the demand for talent in the energy and efficiency industry will be significant. The state should aggressively support industry and educational institutions to collaborate to establish training programs that will help cultivate the workforce necessary to make this sector successful. Engineers, specialty information technologists, wind and other renewable technicians and various trade positions are just a few of the opportunities for training that would support the growth of this industry.

Recruit Energy and Energy Technology Firms and Help Existing Firms to Expand

Energy and clean tech represent an opportunity for Idaho, just as they do for most major areas in this region. Global revenues for solar photovoltaic, wind power, biofuels and fuels cells grew 40 percent between 2006 and 2007, to $77.3 billion. New investments in such energy technologies grew 60 percent, from $92.6 billion in 2006 to $148.4 billion in 2007, according to Clean Edge, which tracks global markets for clean technologies.[1] As awareness grows that clean tech is a serious and substantial growth industry, the competition to attract the companies and jobs in this particular sector stands to get relatively fierce. Idaho economic development professionals at the Department of Commerce and in local communities should ramp up proactive outreach to the clean tech community to promote Idaho as a great state to site a business in their sector. Vigorous in-state development of renewable resources and advanced efficiency technologies, along with comprehensive incentives for the sector and a skilled workforce, will help make Idaho an attractive place for growing clean tech companies to do business.

[1] http://www.cleanedge.com/reports/reports-trends2008.php

CONCLUSION

A shift to emphasize local renewable resources and energy efficiency is an absolute must to keep Idaho economically prosperous and secure, and to secure more of the job growth and tax revenue gains that result from the development of local energy resources. With state and local leadership, with a commitment to strong policies and incentives, and with specific initiatives to accelerate deployment and grow the state's clean energy workforce, Idaho can maximize and leverage the economic benefits from these important resources in Idaho's energy future.

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