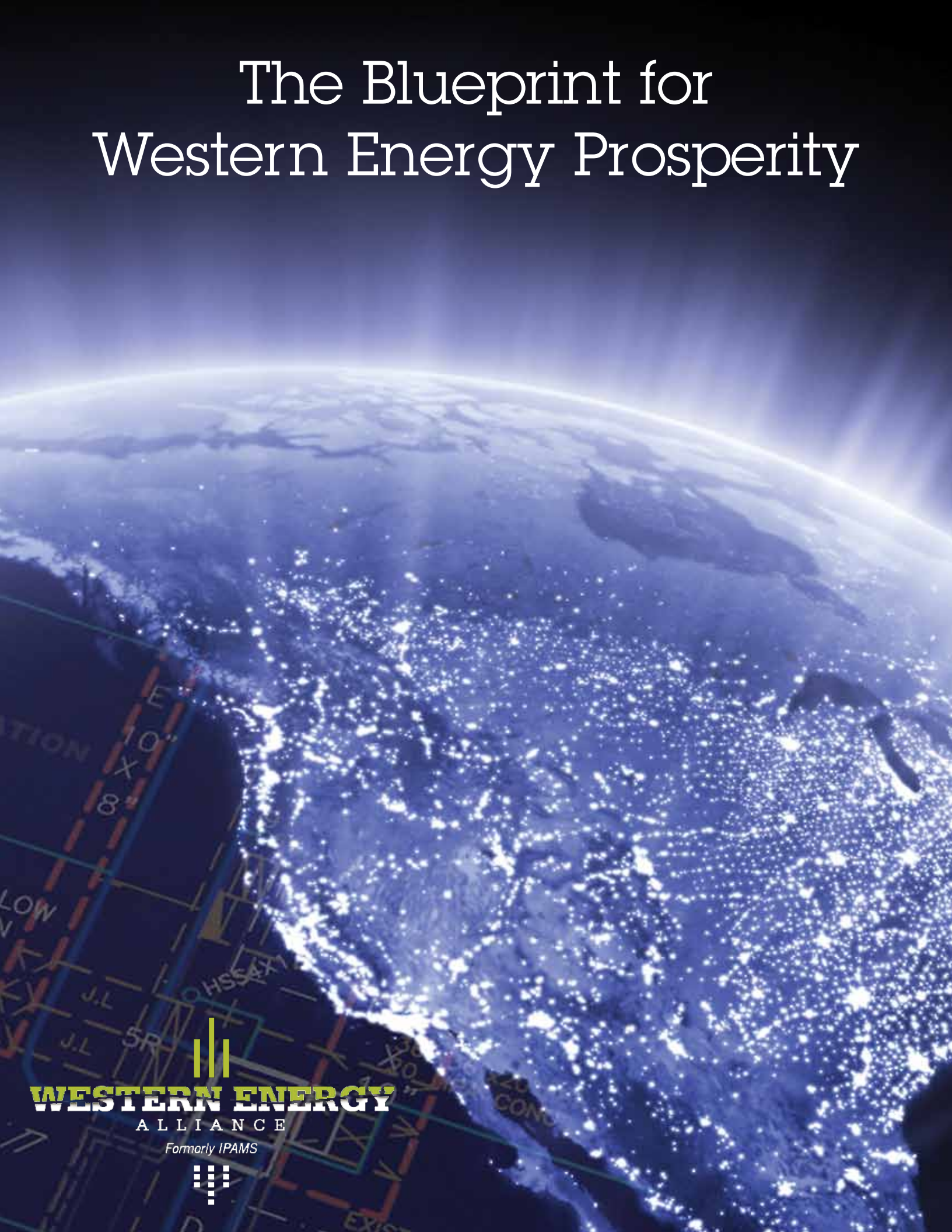


The Blueprint for Western Energy Prosperity



WESTERN ENERGY

ALLIANCE

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westernenergyalliance.org

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Projections of oil and gas resources, drilling, expenditures and production developed by ICF International from its quarterly subscription service forecasts. ICF International is not responsible for nor endorses the policy recommendations and conclusions contained herein.



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Executive Summary

Western independent oil and natural gas producers are able to help solve some of our nation's most pressing economic and energy security challenges, but bureaucratic red tape, redundant and burdensome government regulations, and the unending specter of litigation are standing in the way. There is a pressing need to reform the management and regulation of energy development in the West if the United States is serious about increasing its own domestic energy supplies and rebuilding the economy. As quickly as technological advancement has opened the door to a century's worth of new oil and natural gas in the West, misguided government action is preventing achievement of the region's full energy potential.

Key Findings:

- The West is projected to generate 1.3 million barrels of domestic oil and condensate production a day by the year 2020, an amount that exceeds the current daily oil imports from Russia, Iraq and Kuwait combined.
- The West has the potential to produce 6.2 trillion cubic feet (Tcf) of natural gas annually by 2020, an additional one Tcf from 2010 levels.
- Combined, western oil and natural gas is projected to produce more energy on a daily basis than the total U.S. imports from Saudi Arabia, Iraq, Kuwait, Venezuela, Colombia, Algeria, Nigeria, and Russia.
- Investment in western energy development could increase to \$58 billion annually by 2020. This prospective growth is more than double the investment made in 2010.
- The number of direct, indirect and induced jobs in the oil and natural gas sector is projected to increase by 16% to 504,120 by 2020.
- Annual state severance tax collections in the West are projected to increase from \$2.1 billion in 2010 to \$5.6 billion by 2020, generating a significant revenue windfall for schools, infrastructure and other basic services.

Points of Concern:

Western producers are gravely concerned that current and future government policies are significantly undermining these projections of growth, investment and expansion. Because much of western oil and natural gas is located on federal land, redundant and burdensome government regulations and bureaucratic red tape are making western energy production more difficult and expensive compared to other regions.

- The unending specter of litigation aimed at stopping domestic energy development is significantly driving up the cost of development and often preventing access to important energy resources altogether.
- Since almost all western oil and natural gas development requires hydraulic fracturing, proposals to transfer regulatory control from the states to the federal government could delay or prevent expanded production in the West.
- The abundance of American natural gas is good news for consumers and for our nation, but significant reserve additions from across the country have created significant gas-on-gas competition.



Policy Recommendations:

If America is serious about realizing the full promise of western energy production, regulatory policies and processes must be realigned to support, not hinder, responsible and timely access to oil and natural gas resources on federal lands. The West has the capability to meet new demand for natural gas such as increased electricity generation and transportation. Policymakers should promote policies that take advantage of western natural gas as an abundant, affordable, and clean energy source.

- A thorough review and comprehensive reform of the entire federal onshore process, including leasing, project environmental analysis, and permitting is needed.
- A moratorium on new and expanded layers of regulation is needed. The industry is committed to continued environmental improvements and best management practices, but through a more efficient, predictable means than the current and ever expanding maze of haphazard federal regulation. In particular, legislative and administrative efforts to take jurisdiction for regulating hydraulic fracturing away from the states and impose federal restrictions should be rejected.
- Measures must be taken to limit litigation that unreasonably obstructs domestic energy production and economic growth.
- Renewable portfolio standards should be amended to allow natural gas to compete for electricity generation capacity on the basis of fuel-neutral performance criteria such as cost and emissions profile.
- State and federal governments should adopt market-based alternative transportation policies that are fuel and technology neutral to remove barriers that prevent natural gas from fully competing as a transportation fuel.

Bending The Domestic Oil Supply Curve



The Bakken, with 12 billion barrels of technically recoverable oil, combined with the Niobrara, with 10.25 billion barrels of oil, contain thirty times more recoverable oil than the combined current annual crude oil imports from Venezuela and Saudi Arabia.³

The images of long gas lines and unprecedented spikes in the price of gasoline during the OPEC oil embargo of the 1970's made clear the danger of depending on foreign and unfriendly sources of energy. The years of the OPEC embargo represent the high water mark of domestic oil production in the United States. Indeed, with only a few isolated exceptions, domestic oil production in the U.S. has declined almost every year in the forty years since, as shown in Figure 1.

In 1970, the U.S. produced 3.5 billion barrels of oil. Today, even with an overriding economic and national security imperative to reduce foreign oil imports, the U.S. produces only 2 billion barrels a year.¹

In spite of the lofty speeches and political grandstanding from our nation's leaders over the past 40 years, America's domestic oil production has declined by 43%, making the U.S. increasingly dependent on foreign energy sources.

Significant technical developments in the West are already playing an exciting role in reversing the decline. For the last few years, thanks in part to skyrocketing production from the Bakken formation in Montana and North Dakota, America is actually bending the domestic oil supply curve upward, producing more oil each year since 2008. Innovations in horizontal drilling and hydraulic fracturing have unlocked huge quantities of oil in the region, and these resources are coming on-line quickly and in a substantial way.

A second emerging oil play in the region – the Niobrara formation in Colorado and Wyoming – promises to accelerate the trend of increasing domestic energy production in the West.

Western Oil Discoveries Can Transform America's Energy Security

Buried thousands of feet below the rolling hills of North Dakota and Montana prairielands rests a colossal ocean of oil – a reservoir of newly accessible domestic energy so vast that many analysts believe it has the capacity to substantially decrease our dependency on foreign sources of oil for many decades. The Montana and North Dakota oil play, made possible by pioneers in the energy field who modernized hydraulic fracturing drilling technologies to unlock oil trapped in low-permeability formations, has rapidly evolved from a geologic curiosity, to an energy producing possibility, to what is

now by most accounts the largest domestic oil discovery in more than a generation.

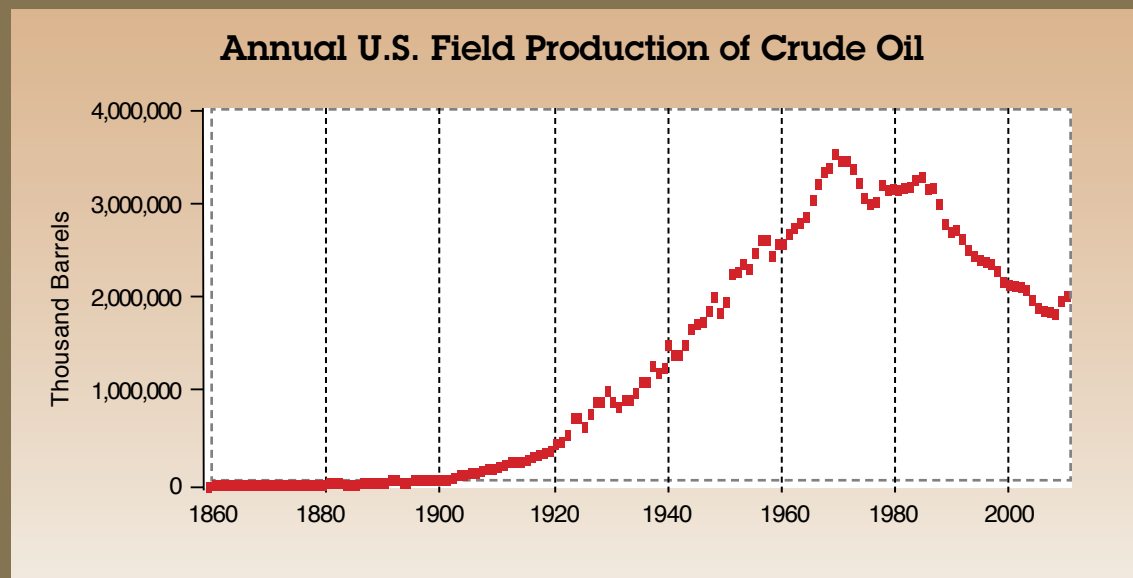
Already, oil production in North Dakota's Bakken formation has skyrocketed from just 2,000 barrels a day in 2005 to an average 289,000 barrels a day last year. Montana and North Dakota's Bakken and Three Forks Sanish formations could generate more than 650,000 barrels of oil a day by the year 2020, an energy payload so large that it is equivalent to 65% of all current oil imports from Venezuela.²

While the largest, the Bakken is not the only significant western oil discovery. The Niobrara discovery in Colorado and Wyoming holds a similarly vast energy promise. From the Niobrara, 286,000 barrels of oil and condensate could be produced by 2020, versus negligible production in 2010. By 2020, total oil and gas production in Colorado and Wyoming has the potential to represent nearly the same amount currently imported from Iraq.

The Bakken, with 12 billion barrels of technically recoverable oil, combined with the Niobrara, with 10.25 billion barrels of oil, contain thirty times more recoverable oil than the combined current annual crude oil imports from Venezuela and Saudi Arabia.³

By 2020, the West has the potential to produce more than 1.3 million barrels of oil every day, more than the current daily imports from Russia, Iraq and Kuwait combined. This is an increase of more than 529,000 barrels a day over the 2010 level.

Figure One



Source: U. S. Energy Information Administration, Annual U.S. Field Production of Crude

The West vs. Key Importers

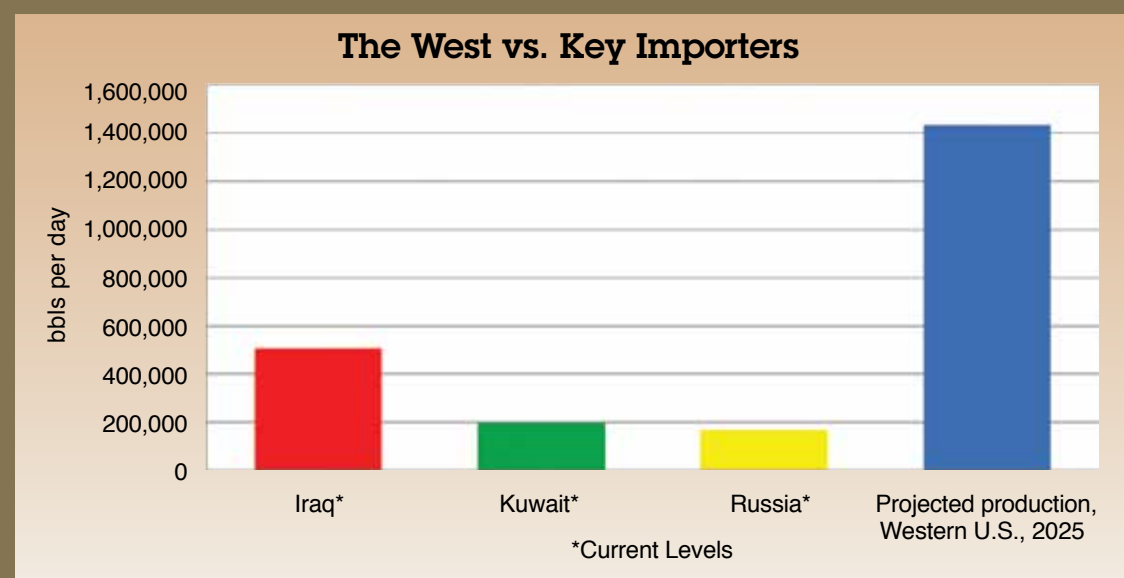


Figure Two

Source: Energy Information Administration, Crude Oil and Total Petroleum Imports Top 15 Countries

While some energy sources provide long-term supply, others are inexpensive, and still others generate low air emissions, natural gas stands alone in accomplishing all three elements of this trifecta of energy production. This triad forms the foundation of a growing body of evidence predicting the onset of a natural gas revolution in this country.

Once described as a bridge fuel, the competitive advantages of natural gas render the bridge label obsolete. As the only energy source that is simultaneously abundant, affordable and clean, natural gas is an energy resource destination in the 21st Century, not a bridge.

Technological breakthroughs have made rich reserves of natural gas widely available, introducing price stability to once volatile natural gas markets and uncovering a more than 100 year supply of an energy commodity once plagued by concerns that it would simply dry up in about fifty years.

Energy fads come and go, but the laws of supply and demand and the imperatives of environmental protection do not. In an era where the public and policymakers demand the seemingly contradictory goal of clean energy at an affordable price, natural gas is the one reliable fuel source that can do both.

By 2020, total gas consumption in the U.S. and Canada could increase 19% to an average of 92 Bcf per day.⁴

The Natural Gas Century

Natural Gas Is Abundant, Affordable, And Clean



As the only energy source that is simultaneously abundant, affordable and clean, natural gas is an energy resource destination in the 21st Century, not a bridge.

Annual Natural Gas Exports

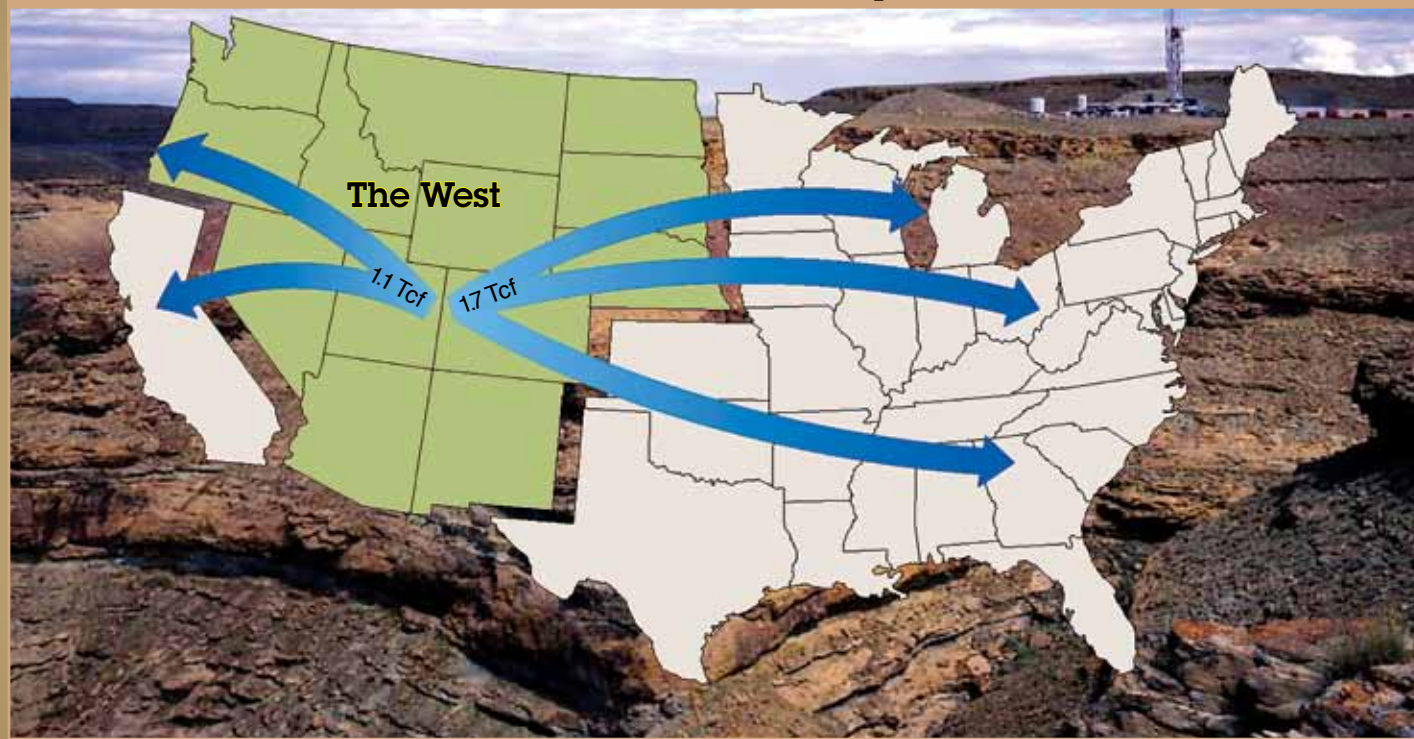


Figure Three

Source: BENTEK Energy, LLC Photo: Kurt D. Brown Photography

Total Marketed Natural Gas Production by State

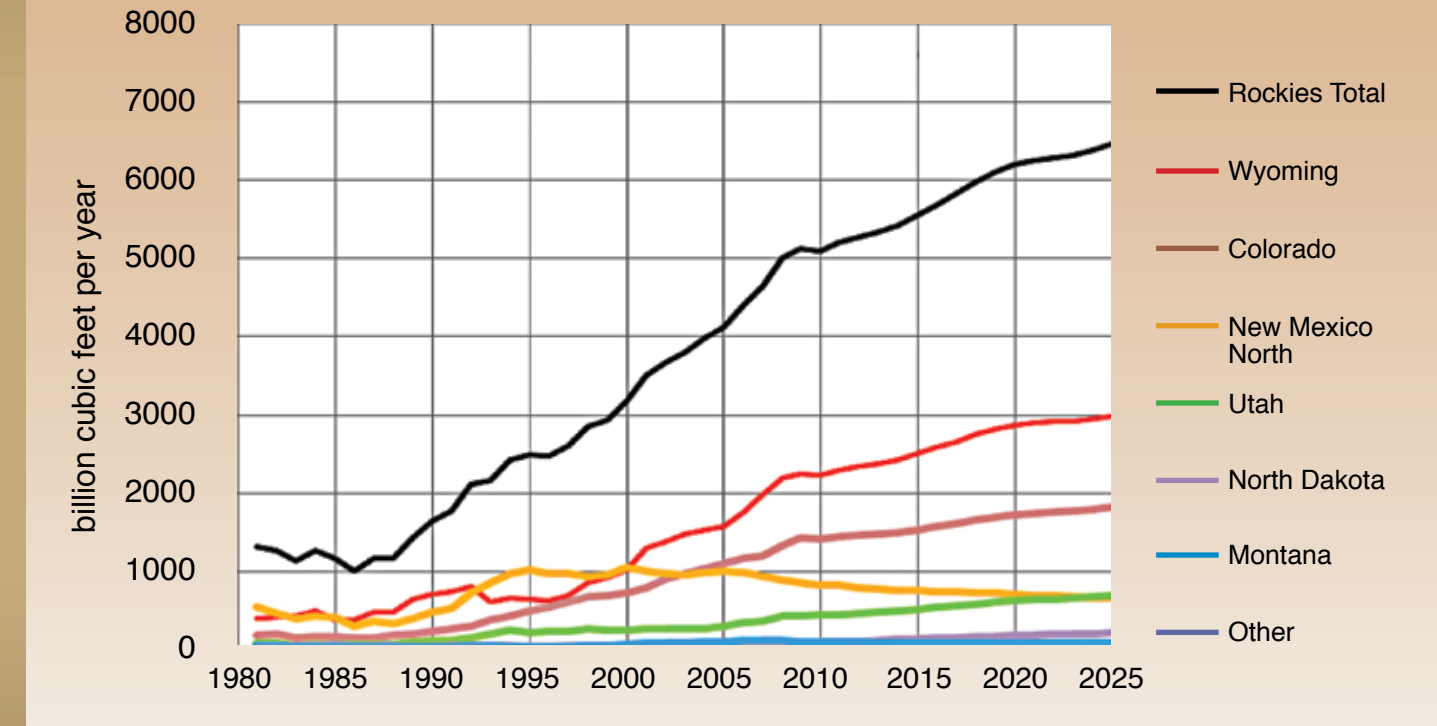


Figure Four

Source: ICF International 2011 Rocky Mountain Forecasts

The West at the Vanguard

With 31% (87 Tcf) of U.S. proved natural gas reserves, the West will be at the vanguard of the American natural gas revolution.⁵ With the help of the Ruby and Rockies Express Pipelines, western natural gas will play a critical strategic role in providing energy to large population centers on the West Coast, and in the Midwest and South in the years ahead. In all, more than one Tcf of Rockies gas is exported to the West Coast each year, and 1.7 Tcf flows to population centers in the Midwest and South.⁶

The West should see steady growth in natural gas production over the next ten years. The region could produce 6.2 Tcf of natural gas by 2020, up more than a trillion cubic feet from 2010. Leading the way in natural gas production are Wyoming, Colorado and Utah, where production is projected to increase by 29%, 21% and 42%, respectively.⁷

Investment in energy production is also projected to surge across the West -- \$58 billion in drilling investment is projected by 2020. This growth

would more than double investment over the 2010 mark, when drilling and completion expenditures equaled \$28 billion.⁸

While the ten year growth in natural gas investment and production represents a significant cumulative growth interval, annual growth is projected to occur at a rational and steady clip. A wider supply of natural gas reserves, coupled with the dramatic ramp-up in natural gas plays in the West, will create a pricing environment that evens out the booms and busts that have historically marked natural gas development.

Projections show an average year-over-year increase in natural gas production in Colorado, Wyoming and Utah of 2%, 3% and 4%, respectively.⁹ This growth pattern will result in significant cumulative production gains over the decade, solidifying the West's reputation as America's energy workhorse.



The West could produce 6.2 Tcf of natural gas by 2020, up more than a trillion cubic feet from 2010.

Energy Trifecta Part I: ABUNDANT

Just a little more than a decade ago, the nation's leading energy analysts believed that the United States' supply of natural gas would be depleted in 57 years.¹⁰ This lack of long-term supply, compounded by recurring short-term price irregularities, acted as a virtual deal breaker for those seeking to more broadly integrate natural gas into American energy markets.

But just as technology has caused a wholesale change in the survival rates from once incurable diseases, so too has technology dramatically elevated the long-term prospects of natural gas as an energy source to power an expanding share of the American economy.

In a recent analysis, the Center for Strategic and International Studies described succinctly the breadth and full ramifications of America's newfound natural gas abundance:

Although the upper limits of the United States' vast natural gas supplies remain uncertain, there is broad consensus—from the U.S. Geological Survey and the U.S. Department of Energy to the Potential Gas Committee (PGC) and Cambridge Energy Research Associates (CERA)—that our nation has enough domestic supplies of natural gas to power the United States for generations.¹¹

The most important innovations have been the modernization of hydraulic fracturing and horizontal and directional drilling techniques.

According to an MIT analysis:

*Despite the relative maturity of the U.S. gas supply, estimates of remaining resources have continued to grow over time — with an accelerating trend in recent years. As the conventional resource base matures, much of the resource growth has occurred in unconventional gas, especially in the shales.*¹²

Unconventional gas discoveries have increased total undiscovered recoverable natural gas resources by a remarkable 100% since 1999.¹³ From 2010 to 2011, the estimated undiscovered resources of shale gas in the United States increased 135%, from the 368 Tcf to 862 Tcf.¹⁴ The full potential of America's shale gas will likely not be known for years.

Shale gas is not the only driver of the surge in natural gas supply. Production from tight gas formations, much of which is in the West, is projected to nearly double by the year 2035.¹⁵ Meanwhile, coal-bed natural gas, the other unconventional gas resource common in the West, also contributes to the nation's robust supply posture. According to EIA, Colorado and Wyoming have significant reserves of coal-bed methane that will continue to add to the supply.¹⁶

Unconventional gas discoveries have increased total undiscovered recoverable natural gas resources by a remarkable 100% since 1999.¹³

This revolutionary increase in natural gas supply means that by 2035, less than 1% of the nation's overall natural gas usage is projected to come from foreign imports.¹⁹

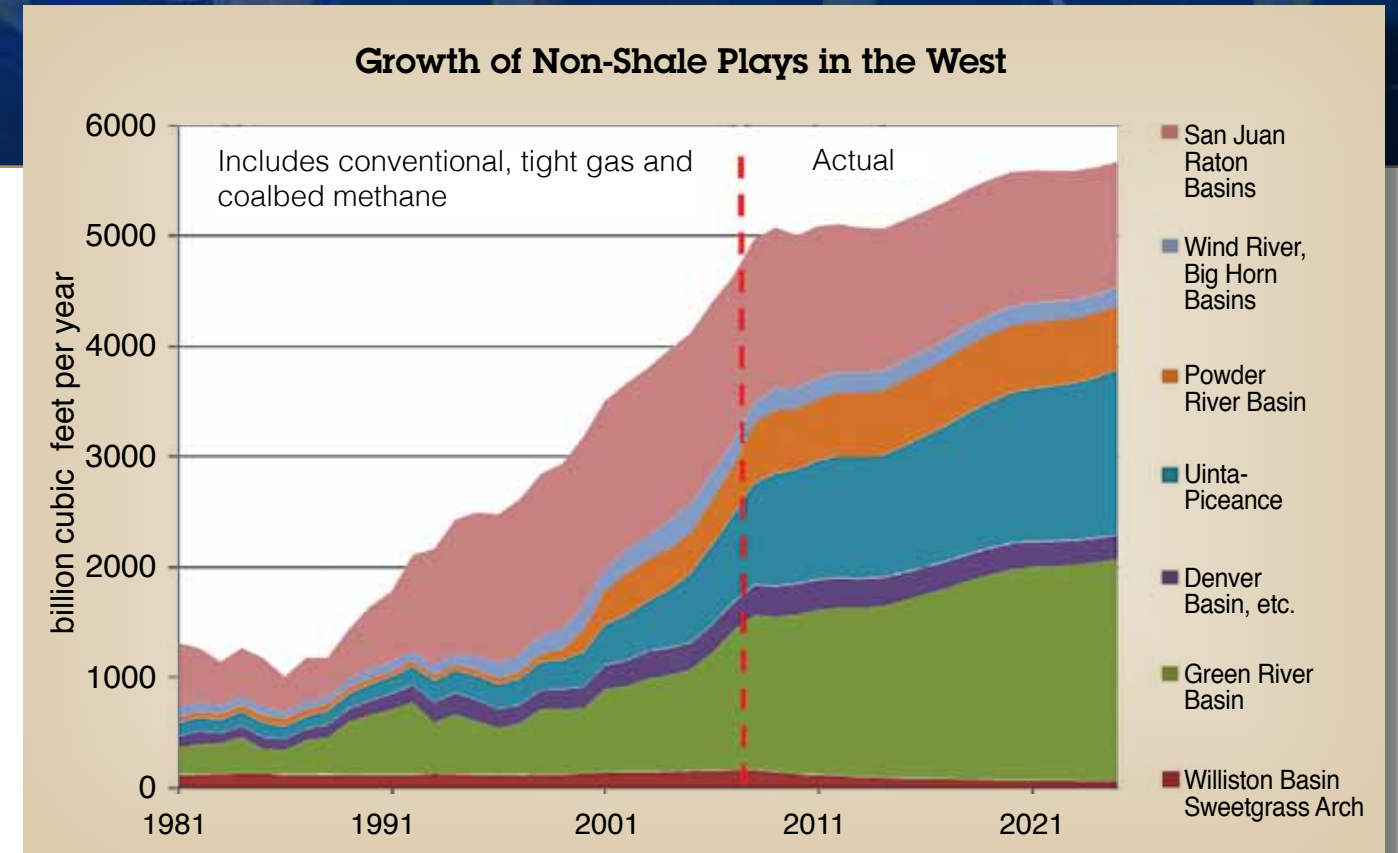


Figure Five

Source: ICF International 2011 Rocky Mountain Forecasts

The advent of large-scale unconventional natural gas development has put to rest any question about the reliability of long term domestic supplies of natural gas. Whereas twelve years ago the United States was thought to have at most a 57 year supply of natural gas, the nearly 2,600 Tcf of natural gas available in the U.S. today is enough to sustain the current levels of consumption for 120 years.¹⁷ Estimates of available natural gas resources, even in more conservative analyses, corroborate the steep growth in supplies projected by the EIA and others. The Potential Gas Committee at the Colorado School of Mines, for example, projected the future U.S. gas supply at 2,170.3 Tcf,¹⁸ a huge increase over the projected available resource from even a few years ago.

This revolutionary increase in natural gas supply means that by 2035, less than 1% of the nation's overall natural gas usage is projected to come from foreign imports.¹⁹

Energy's Trifecta Part II: AFFORDABLE

In the past, natural gas had been described as scarce, comparatively expensive, price volatile, and thus not an economically reliable fuel source for electricity providers or many other large-scale end users of energy. In the realm of base load electricity generation, for example, a lack of affordability and price volatility prevented natural gas from competing with coal, which boasted long-term supplies and the kind of affordability and price certainty that energy consumers expect and demand.

With the advent of unconventional natural gas discoveries, natural gas now competes with, and in many cases beats, other energy sources on cost. Not only have unconventional natural gas supplies made what was once believed scarce abundant, but what was once expensive and price volatile has become affordable and cost consistent.

For the first time, the EIA also determined that the levelized cost of natural gas fired electricity, which includes all cost elements, is actually less than the cost of power generated from coal.²¹ Natural gas' price advantages are even more evident when compared to wind, solar and other renewable energy sources.

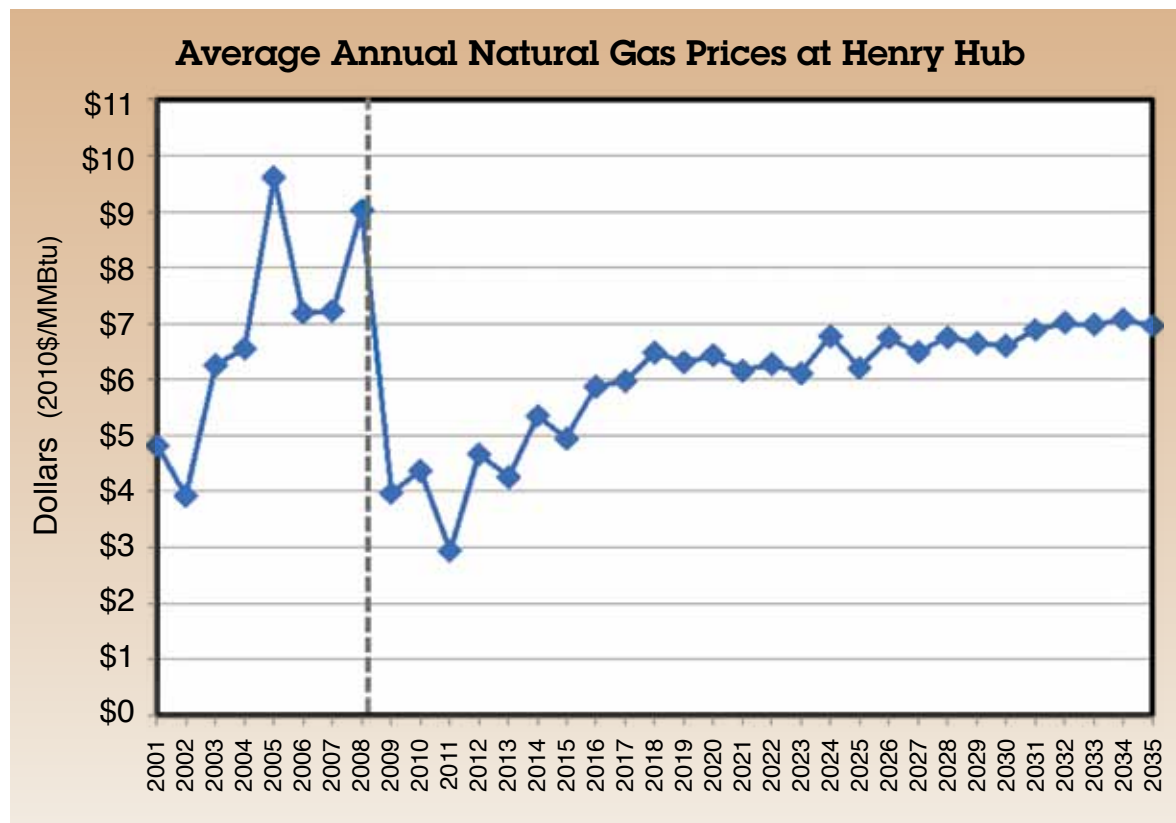


Figure Six

Source: ICF International 2011 U.S. and Canada Gas Market Overview Board on the GMM Base Case

Between January and December of 2000, natural gas prices skyrocketed from \$2 per MMBtu to nearly \$9, and ensuing years saw similar price fluctuations. As new unconventional supplies have hit the marketplace in recent years, however, price has significantly stabilized at \$4 per MMBtu, or 50% below the average of \$8 per MMBtu during the prior 5 years.

In addition to lowering the base commodity price, this era of increasing natural gas supplies could also serve to even out formerly volatile gas markets over the next 25 years. Even in the face of strong growth in demand for natural gas, only incremental price increases are predicted into the future, from \$5 per MMBtu in 2012, to \$6 per MMBtu in 2025, and \$7 per MMBtu in the year 2035.²⁰

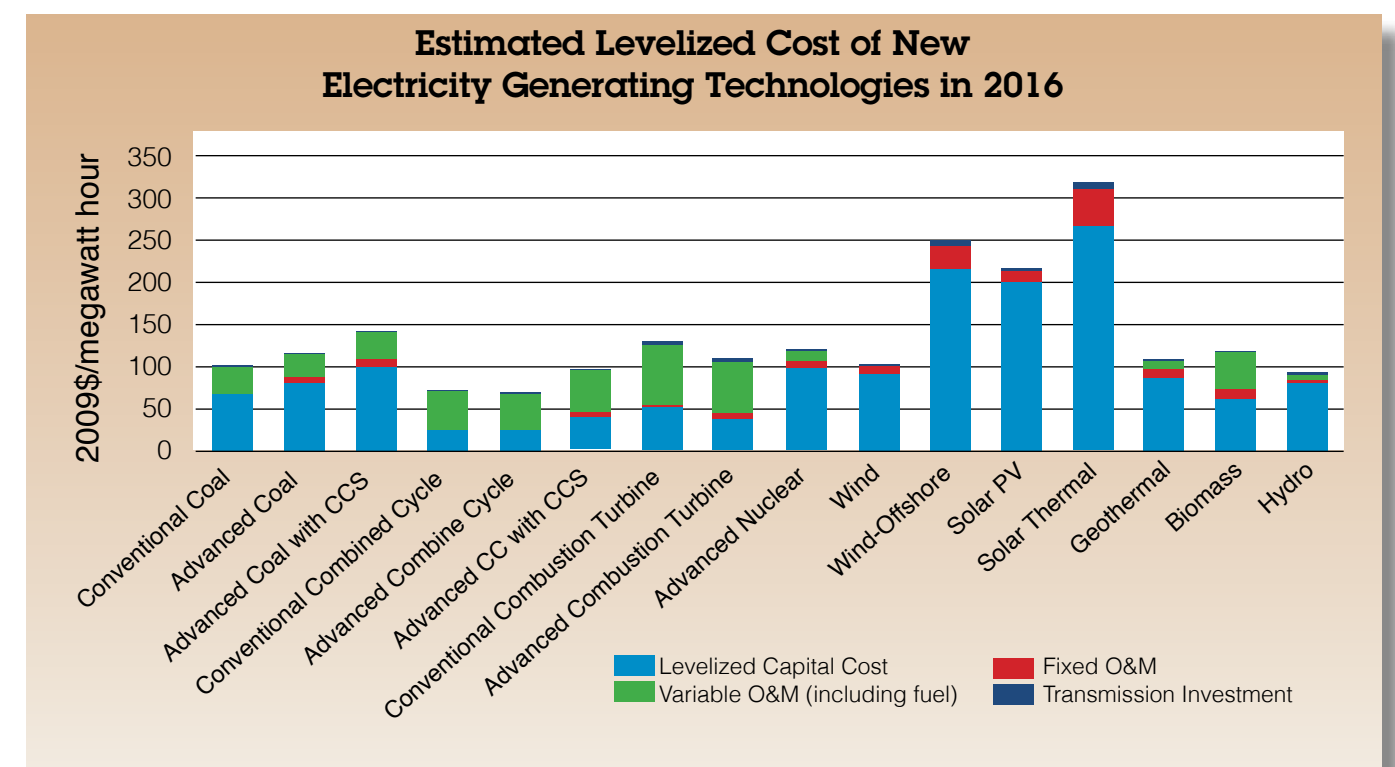


Figure Seven

Source: U.S. Energy Information Administration, Annual Energy Outlook 2011

In its annual look at the comparative price of electricity generation from various fuel sources last year, EIA found that when all costs are accounted for, natural gas generation is significantly cheaper than electricity produced from wind, solar and nuclear fuel sources. For the first time, the EIA also determined that the levelized cost of natural gas fired electricity, which includes all cost elements, is actually less than the cost of power generated from coal.²¹

When combining clean-burning natural gas' air quality advantages with its price advantages, what emerges is a marketplace where natural gas not only competes with other energy sources in a least-cost environment – natural gas actually wins.

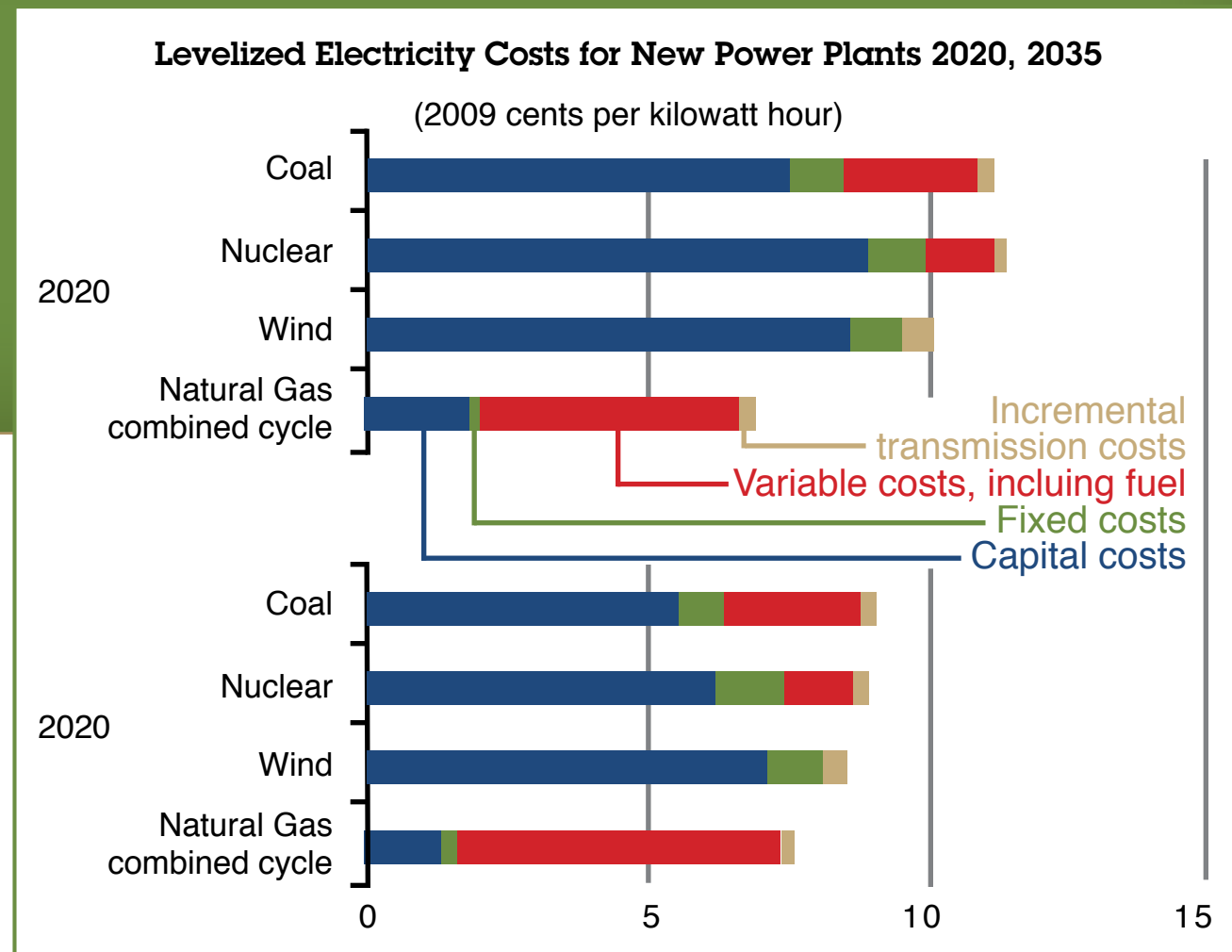


Figure Eight

Source: U.S. Energy Information Administration, Annual Energy Outlook 2011

Natural gas' price advantages are even more evident when compared to wind, solar and other renewable energy sources. A CSIS/Brookings/Breakthrough Institute Report called Post Partisan Power described it this way:

*According to the U.S. Energy Information Administration, the levelized costs of new renewable electricity technologies remain substantially higher than conventional coal and natural gas-fired fossil power plants: onshore wind power is ... 80% more expensive than conventional gas-fired combined cycle plants; offshore wind is even more costly; solar thermal power is ... 84% more expensive than conventional gas combustion turbines; and solar photovoltaic power plants are nearly three-times more expensive than conventional gas combustion turbines and five-times more expensive than conventional gas-fired combined cycle power plants.*²²

Natural gas electricity generation produces virtually no mercury emissions, no sulfur-dioxide emissions, and no lead emissions.



This study provides a stark description of the limits of renewables and other emerging technologies when compared to more reliable and affordable fuel sources like natural gas:

*High cost continues to be the largest barrier to the scalability of emerging clean energy technologies. Relative to fossil fuels, clean energy technologies are still too expensive and their performance too unreliable to be widely adopted on either a national or global scale.*²³

When considering its clean-burning characteristics (explored more fully in the next section), natural gas' overwhelming price advantages cast doubt on the wisdom of electricity set-asides for higher-priced renewable energy sources, commonly known as renewable portfolio standards. In all, 42 states have adopted a renewable energy set-aside of some kind in recent years. But as natural gas' overwhelming cost advantages race to the fore, public policymakers may feel the tug from cost-conscious energy consumers to allow natural gas to compete for market share in a non-subsidized clean electricity market place.

Energy Trifecta Part III: CLEAN

Natural gas has consistently enjoyed an advantage over other fuels as a remarkably clean energy source. As demand for energy grows, the clean-burning characteristics of natural gas will become a high-value commodity in and of themselves.

Natural gas electricity generation produces virtually no mercury emissions, no sulfur-dioxide emissions, and no lead emissions. Meanwhile, natural gas electricity emits 81% less nitrous oxide than coal,²⁴ and generates between 48% and 72% less carbon.²⁵

While policymakers are locked in a debate over how CO₂ should be regulated as a pollutant, there is no dispute that emissions of sulfur, mercury, and lead can have profound and negative public health and environmental impacts. When it comes to these sources of known harmful air pollutants, natural gas emits effectively none.

The clean properties of natural gas have figured prominently in the global climate change debate. A recent MIT study, citing a range of economic and environmental considerations, found that:

...unconventional gas, and particularly shale gas, will make an important contribution to future U.S. energy supply and carbon dioxide (CO₂) emission reduction efforts.

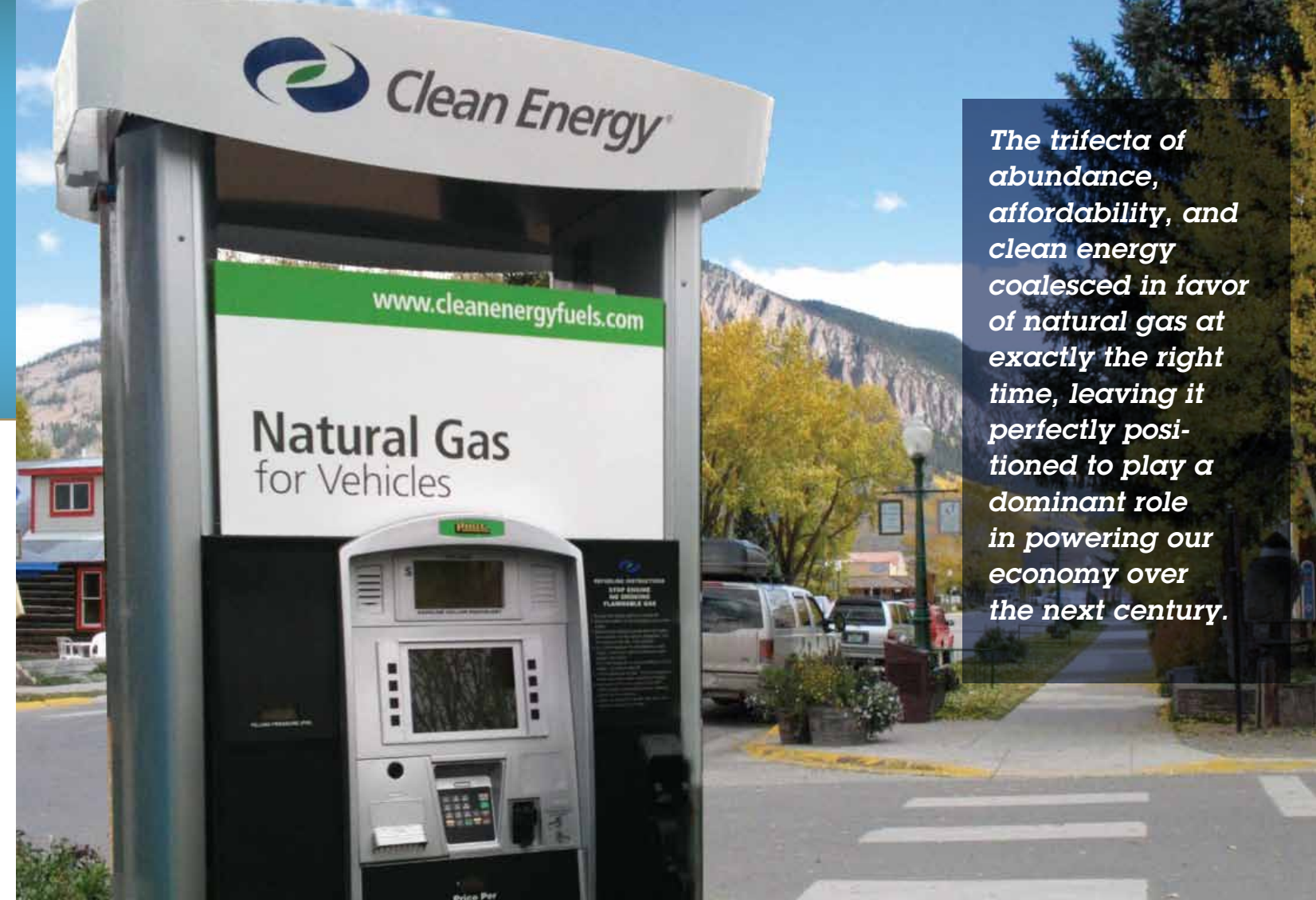
...In effect, gas-fired power sets a competitive benchmark against which other technologies must compete in a lower carbon environment.²⁶

A recent study by a Cornell academic attempted to cast doubt on the clean-burning qualities of natural gas, but that study has come under widespread dispute.²⁷ The study claimed that natural gas is a much larger emitter of greenhouse gases, methane in particular, than previously thought. But both government researchers and environmental groups have challenged the data used by the Cornell study.

The Environmental Defense Fund estimates relevant methane emissions are almost 75 percent lower from natural gas drilling than the figure used in the Cornell study.²⁸ A National Energy Technology Lab (NETL) study compared the lifecycle greenhouse gas footprints of coal and natural gas power generation.²⁹ Natural gas retains a large advantage, with 54% and 48% lower global warming potential over one hundred year and twenty year time horizons, respectively.

Even while offering dubious conclusions about natural gas' life-cycle emissions of greenhouse gases, the Cornell study did not challenge the fact that natural gas is cleaner burning when it comes to known pollutants like mercury, sulfur oxides, dioxides and particulates.

These environmental attributes, combined with the cost advantages, will be key drivers of growth in natural gas electricity generation over the coming decades.



The trifecta of abundance, affordability, and clean energy coalesced in favor of natural gas at exactly the right time, leaving it perfectly positioned to play a dominant role in powering our economy over the next century.

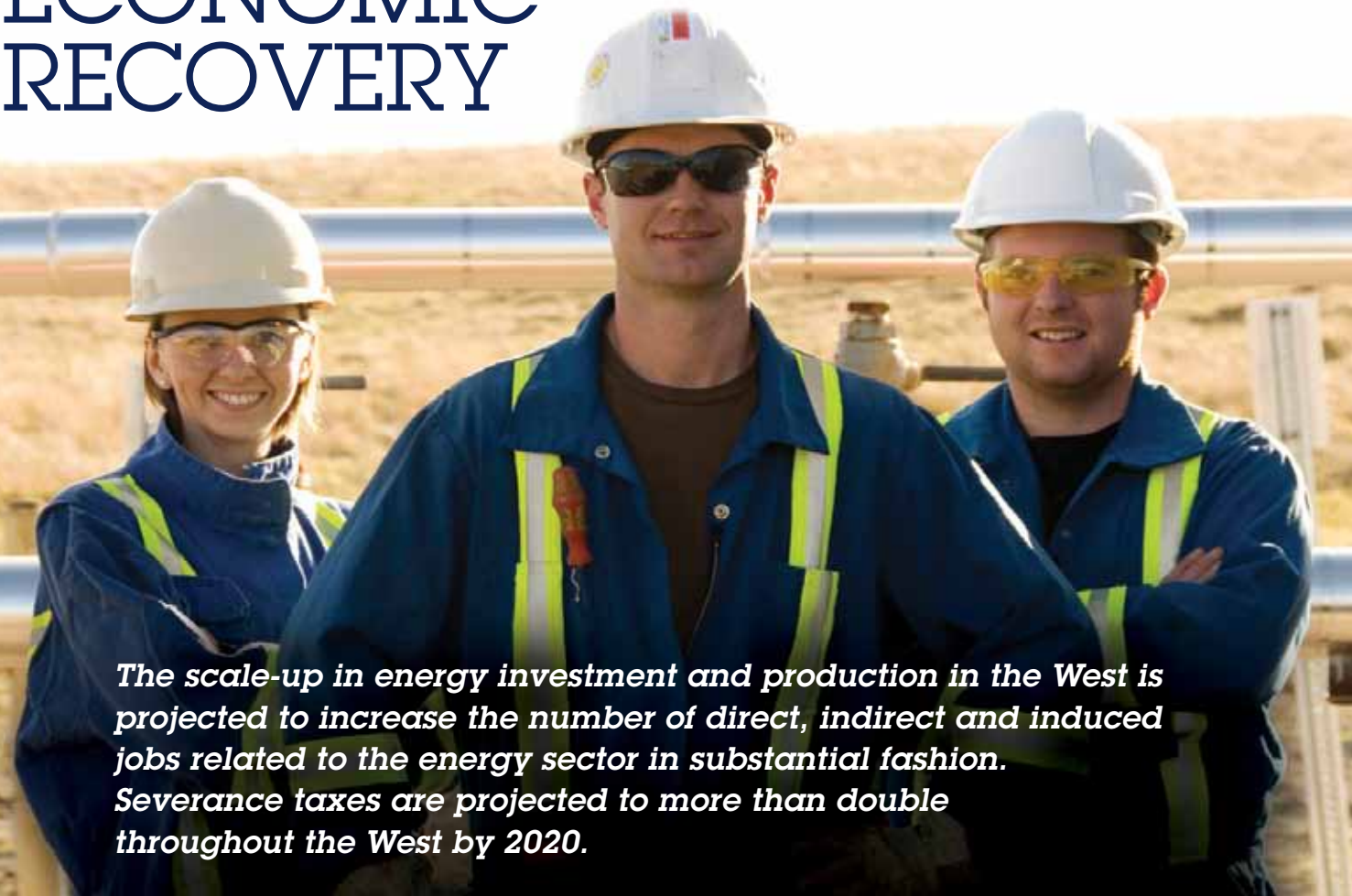
An April 2011 analysis by CREDIT SUISSE projected that a combination of cheap gas, growth in electricity demand and the impending retirement of an aging fleet of old, Clean Air Act non-compliant coal plants could increase natural gas use nationally between 13%-18%. The report found:

Layering a reasonable coal plant closure scenario with sustained power demand growth served by gas generation could (result in) growth of 11.8 Bcf/d.³⁰

This report and others tell the story of a century in which natural gas is poised to dramatically grow in importance. In total, the trifecta of abundance, affordability, and clean energy coalesced in favor of natural gas at exactly the right time, leaving it perfectly positioned to play a dominant role in powering our economy over the next century.

Indeed, the convergence of these variables will result in a doubling of natural gas usage in the power sector in the next twenty years.³¹ As the role of natural gas expands across the American economy, the energy producing states in the West will provide a growing share of gas for American consumers, each and every step of the way.

OIL, GAS AND ECONOMIC RECOVERY



The scale-up in energy investment and production in the West is projected to increase the number of direct, indirect and induced jobs related to the energy sector in substantial fashion. Severance taxes are projected to more than double throughout the West by 2020.

Steady growth in natural gas and oil production across the West will do more than generate a sharp increase in homegrown energy for America. This expansion will also play a central role in the economic recovery of a region hit hard by national recession. Western energy production over the next ten years will result in tens of billions of dollars in new capital investment, billions in new tax revenues for cash-starved states and school districts, and tens of thousands of new jobs.

The economic benefits will be broad-based, with a projected \$58 billion in investment across the West in 2020 – more than double 2010 levels of \$28 billion.

The scale-up in energy investment and production in the West is projected to increase the number of direct, indirect and induced jobs related to the energy sector in substantial fashion, from 434,373 in 2010 to more than 504,120 in 2020 – a resuscitating 16% boost in oil and natural gas related jobs in an otherwise foundering regional jobs market.³²

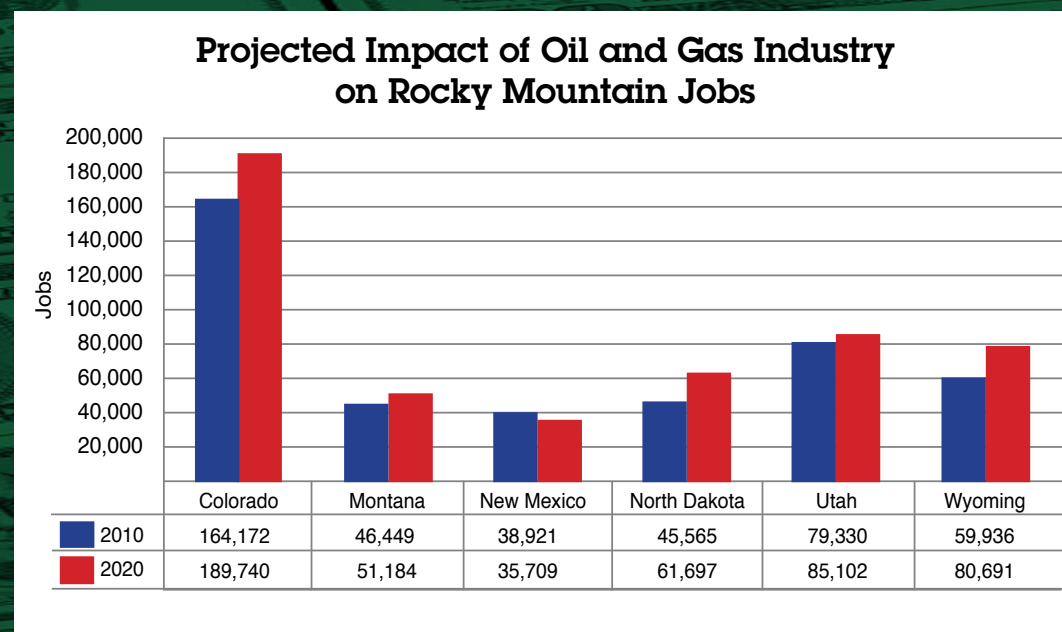
For states at the center of this surge in new energy production, the growth in jobs is projected to be even more pronounced. North Dakota's oil boom results in, according to projections, an increase of more than 16,000 jobs by the year 2020, a 35% increase over 2010 levels. Wyoming is projected to see a net growth in en-

ergy jobs amounting to 19,626, or 33%. Robust job growth is expected in Colorado and Utah as well, where the energy sectors are projected to grow by 26,000 (16%) and 5,700 jobs (7%) respectively.

More investment means more jobs and more tax revenues for governments. In total, severance taxes are projected to more than double throughout the West by 2020. Indeed, the six main energy producing states in the West could see a doubling of severance taxes between 2010 and 2020, from \$2.1 billion to \$5.5 billion.³³

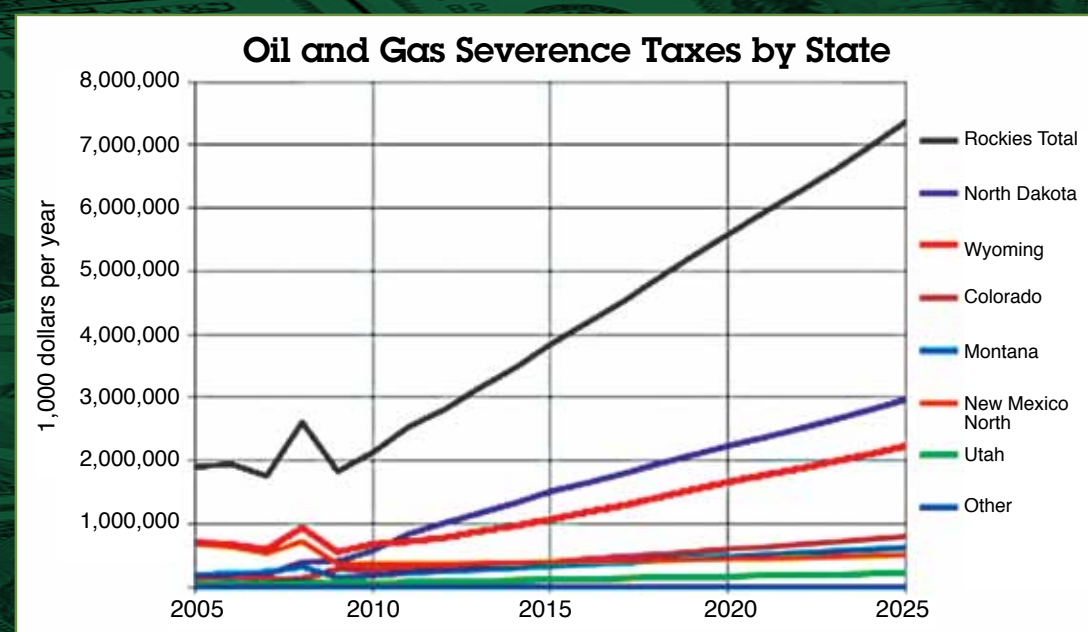
Here again, the growth numbers in specific states paint an even more compelling story. Take North Dakota, where a windfall in energy taxes and royalties has already made it one of the few states with an actual budget surplus in the midst of national recession. Over the next ten years, new production in the Bakken and elsewhere is projected to generate a near quadrupling in severance taxes paid to North Dakota, up from \$583 million in 2010 to over \$2.2 billion by the year 2020. In Wyoming, severance tax payments could grow 145%, from \$677 million to \$1.6 billion. In Colorado, severance tax receipts are projected to grow from \$264 million to \$592 million or 124% over the next decade, and in Utah by more than \$104 million dollars.³⁴

Figure Nine



Source:
ICF
International
2011
Rocky Mountain
Forecasts

Figure Ten



Source:
ICF
International
2011
Rocky Mountain
Forecasts

Obstacles And Opportunities: *An Actionable Plan For Western Oil And Natural Gas Development*



There is clear evidence that increasing western natural gas and oil development presents a profound opportunity for the region and the country to create jobs, reduce foreign oil imports, and improve energy security and the environment. Enormous economic and social benefits could be realized through expanded investment and exploration.

Evidence is less clear that government policies recognize and support the value proposition of western oil and natural gas. Increasingly, governments have imposed artificial barriers that limit the benefits of oil and natural gas development. Policies which unnecessarily increase risk, uncertainty, and regulatory burden are stifling investment and employment in the region. Likewise, government mandates, incentives and subsidies which favor certain energy technologies over others, penalize consumers and businesses who would otherwise benefit from competition between energy source providers.

Many leaders across party lines are gravely concerned about both excessive top down regulations, delays and unreasonable limits on access to federal lands, as well as far reaching autonomy at the local BLM offices where uncertainty, inconsistency, changing guidelines and extensive delays are the norm. In one small but revealing case, the BLM field office is requiring exhaustive wildlife surveys, engineering studies and soil analysis along the full length of a multi-mile private ranching road between the highway and well site, only because the road crosses 500 feet of BLM land as it departs from the highway. If America is serious about realizing the full promise of the West's natural gas and oil resources, regulatory policies and processes must be realigned to support, not hinder, responsible and timely access to oil and natural gas resources on federal lands. Recognition by policymakers of the value of natural gas as a key part of our economic recovery and balanced en-

ergy plan is in vain unless there is an affirmative alignment of policies and priorities that promote this proposition.

The U.S. is at a tipping point and a special effort to advance the development of natural gas is perfectly positioned to get beyond the usual political gridlock in Washington, and gather bipartisan support. More importantly, increased use of natural gas will earn the confidence of the American people that there is, indeed, a path forward that will not only produce more jobs, but also provide cleaner air and a more secure energy future.

If America is serious about realizing the full promise of the West's natural gas and oil resources, regulatory policies and processes must be realigned to support, not hinder, responsible and timely access to oil and natural gas resources on federal lands.

New regulations implemented in the last two years have added three additional layers on top of a process that already involved five layers of burdensome regulations.

Achieving The Promise Of Western Oil And Natural Gas Resources

Policymakers have a clear choice – establish a regulatory and fiscal environment in which producers can access and develop western oil and natural gas resources, or forego the significant economic growth, job creation and government revenue that development brings.

Below are high-level policy recommendations for reducing barriers to achieve the full promise of western oil and natural gas potential.

Policy Recommendation 1

At the forefront of concerns for western energy producers are federal public lands policies, which are causing the West to be less competitive with other regions.

The processes and administrative requirements that govern the production of energy resources on federal lands have evolved over several decades. What began as well intentioned protections and procedural requirements to guide thoughtful management has become a morass of competing, redundant, and highly subjective requirements so unwieldy that they represent the single greatest impediment to a balanced domestic energy policy for the West.

Reasonable and timely access to federal lands for development yields the environmental benefit of clean-burning natural gas and the domestic energy security benefits of oil. For years, western producers have been frustrated by the uncertainty the long timelines for operating on federal land create. From leasing through project approval and drilling permits, the bureaucratic quagmire and shifting requirements increase time and cost while thwarting the certainty producers need to create long term business plans. New regulations implemented in the last two years have added three additional layers on top of a process that already involved five layers of burdensome regulations.

In addition, policies and priorities vary wide-

ly from administration to administration, creating even more uncertainty and leaving companies unable to determine timelines and costs, raise capital, and plan development. States and field offices operate under widely varying interpretations of regulations, and producers are subject to the whims of low-level field office staff who can add ad hoc requirements to permits that have no basis in law. Improving and clarifying current regulations was needed even before the addition of recently enacted leasing policies added more redundancy to the process. In order to realize the full economic and jobs potential that western oil and natural gas offer, companies must have certainty in the process along with reasonable time and cost expectations to enable them to execute their business plans.

Access to federal lands: A fresh look

Instead of undertaking ad hoc, piece-by-piece changes to regulations, a thorough review of the planning and regulatory processes is necessary as part of a holistic reform. Western Energy Alliance advocates for a comprehensive re-engineering and reform of the entire federal onshore process, including leasing, project NEPA analysis, and permitting, to ensure the timely, efficient, predictable and responsible development of federal energy resources.

Western Energy Alliance advocates for a comprehensive re-engineering and reform of the entire federal onshore process.

Western Energy Alliance supports a moratorium on new regulation until the economy rebounds.

Comprehensive reform should take advantage of emerging technologies and best practices, eliminate redundancies, and explore market mechanisms for achieving environmental protection. The government should encourage the responsible development of the West's vast oil and natural gas resources by ensuring predictable processes for producers, thereby allowing them to create jobs and revenue for state and local governments.

From time to time, budget writers at the state and federal levels and those in the private sector undertake a zero-based budgeting exercise to make sure that current spending decisions reflect current priorities, as opposed to building budgets on a model that simply takes all previous spending decisions for granted. This kind of fresh-look analysis is desperately needed when it comes to the management of federal lands for energy development.

Moreover, the government needs a reorientation of the federal onshore oil and natural gas program. Is the government going to continue to discourage a major source of domestic energy on federal lands, either by ineffective processes burdened by layers of built-up bureaucracy or outright obstruction, or is there an opportunity to actually encourage domestic production on the nation's federal lands?



Photo: Kurt D. Brown Photography

A particular threat is the attempt to transfer control of hydraulic fracturing from the states to the federal government.

Increasing the regulatory burden further could render some western unconventional plays uneconomic.

A regulatory environment fraught with uncertainty and unpredictability is an open invitation to litigation.

Policy Recommendation 2

The existing regulatory system for oil and natural gas development and production already involves extensive red tape and redundancy, yet the federal government continues to impose and consider extensive new federal regulations at the expense of state and local control. Taken together, the current regulatory burden and new proposals could deny the potential of the West's vast energy resources. The unconventional oil and natural gas plays in the West, which are more complicated and costly than traditional reserves, and the independent producers who overwhelmingly develop them, are particularly vulnerable to cost increases through regulation. Increasing the regulatory burden further could render some western unconventional plays uneconomic.

Even at a time of slow economic growth and high unemployment, the federal government has undertaken an aggressive strategy of advancing an unprecedented number of new federal regulations. The EPA has made the oil and natural gas industry a particular target, despite the decades of real and meaningful improvement that industry has made in environmental protection and the safety of onshore development and production. A true cost-benefit analysis would reveal that the oil and natural gas industry provides huge societal and economic benefits with very low and well-managed risks to the environment.

EPA is pressing forward with new regulations on air and water quality, hydraulic fracturing, and greenhouse gas emissions. Taken together, these new regulations are extremely onerous and divert resources away from job creation, economic growth and energy production while delivering limited incremental environmental protection.

EPA is attempting to implement so many regulations at once that it is unable to manage them effectively. Companies and states are expected to comply with new rules before EPA can provide effective implementing guidelines, and implementation timelines are unrealistic given the complexity of new rules.

A particular threat is the attempt to transfer control of hydraulic fracturing from the states to the federal government. The states have already identified and implemented their own balanced regulatory approaches, and should reserve the authority to update these regulations as needed, based on science. In the meantime, broad new federal regulations on hydraulic fracturing represent a risk to energy production. An American Petroleum Institute (API) study found that if hydraulic fracturing were banned, the number of wells completed in the US would drop by 79% and gas production would fall 57% by 2018.³⁵ In 2009, the DOE published a report with Advanced Resources International that found under a scenario of future increased federal regulation, over 35% of onshore wells in the US would shut down and unconventional gas exploration work would fall by up to 50%.³⁶ Both scenarios would lead to higher natural gas prices for consumers and significant job losses in the West.

Moratorium on new federal regulations

Instead of applying moratoria on permitting and limiting availability for energy development, there should be a moratorium on new regulations.

Western Energy Alliance supports a moratorium on new regulation until the economy rebounds, unemployment drops, and new regulations are properly justified and implemented. Legislative and ad-

ministrative efforts to take jurisdiction for hydraulic fracturing away from the states and impose federal restrictions should be rejected. Efforts to expand Clean Water Act authority and impose new air quality standards under the Clean Air Act are likewise damaging to the economy and states' authority. Congress should pass legislation that requires cost/benefit analyses for new regulation and periodic re-justification of existing regulations.

States and local governments should also be aware that new regulations and fees imposed at those levels can render certain areas or entire states less economic than adjacent counties or states, thereby driving away jobs, revenue, and other associated economic benefits. Reasonable and timely access to federal lands presents an immediate and significant economic and job stimulus for the West, with the environmental benefit of clean-burning natural gas and improvements in domestic energy security and balance of trade.

Policy Recommendation 3

Compounding the uncertainty on public lands is the threat of litigation. A regulatory environment fraught with uncertainty and unpredictability is an open invitation to litigation from those seeking to stop domestic energy production. Indeed, the combination of regulatory uncertainty and litigation against virtually every decision to proceed with oil and natural gas development creates a strong bias on behalf of inaction from the federal government.

Litigation significantly drives up the cost of development and threatens job creation and economic growth in the West. Frivolous lawsuits cause the federal government to spend more time trying to insulate every development decision from litigation, further slowing the pace of decision making and permitting. Furthermore, the government then turns around and reimburses litigious groups with taxpayer funds.



Limit frivolous lawsuits

Measures must be taken to limit litigation that unreasonably obstructs domestic energy production. The Government Accountability Office or other credible third party should conduct a full review of the impacts of litigation on oil and natural gas production in the West.

Fiduciary responsibility, standing requirements and new administrative participation requirements for plaintiffs should be established to limit the ability of tangentially interested parties to sue. Congress should pass legislation to limit the ability of environmental groups to stop or delay domestic energy development through lawsuits. The federal government should stop reimbursing groups for lawsuits that drain taxpayer money, slow economic and job growth, and prevent the development of American energy.

Policy Recommendation 4

New discoveries of natural gas, combined with its clean qualities, leave the energy source ideally positioned to expand its market share in coming decades. Many analysts have predicted that this will occur at an aggressive rate in the coming decades because of the energy trifecta of abundance, affordability and cleanliness.

Still, the states and federal government too often create artificial barriers to entry for natural gas power in electrical generation markets. Of particular note, forty-two states and the District of Columbia have enacted renewable energy portfolio standards that require a fixed percentage of electricity generation from renewable sources, even though these energy sources are significantly more expensive and only marginally different on an emission profile ba-

sis as compared to natural gas.³⁷ Renewables are an important part of America's energy future, but they should not receive set-asides. Criteria allowing utilities and regulators to make energy decisions based on objective standards (e.g. cost and emissions profile) should take precedence over energy earmarks for one energy source over another.

Electricity competition for natural gas

Renewable portfolio standards should be amended to allow natural gas and other clean and affordable energy sources to compete for electricity generation capacity on the basis of fuel-neutral performance criteria like cost and emissions profile.

Policy Recommendation 5

The abundance, affordability and cleanliness of natural gas mean that it is now a viable alternative to gasoline as a transportation fuel. Per unit of energy, natural gas is four times cheaper than oil, yet barriers still exist which limit a greater utilization of this domestic transportation fuel. Public-private partnerships to build refueling infrastructure would quickly translate into cost saving and operational benefits for commercial and public transportation fleets that run on natural gas. As more businesses, governments and consumers take greater advantage of this clean, domestic fuel, the cost to purchase new natural gas vehicles (NGVs) and convert existing vehicles could continue to fall.

States are playing a leading role in helping America become less dependent on foreign oil. Utah, for example, has taken a markets-based approach to tearing down barriers to allow fuel-on-fuel competition in their transportation market. Utah's legisla-

tion to reduce the cost of converting vehicles to natural gas has helped spur the EPA to clarify and rewrite their regulations regarding conversion requirements.

By incentivizing the purchasing of conversion kits, refueling infrastructure, and helping to lower the financial barriers to entering the CNG market, Utah has allowed CNG vehicles to compete based on their own merits.

Other studies have shown that the first and most attractive markets for CNG conversions are taxis, government vehicles, delivery fleets (e.g. FedEx and UPS trucks), and urban buses. With 100% penetration into these markets, 3 Tcf of new natural gas demand would be created, reducing demand for oil imports by 1.5 million barrels a day.

Transportation fuels competition

Federal and state regulations that hinder competition between alternative transportation fuels and technology should be reviewed and reformed. Governments should adopt market-based alternative transportation policies that are fuel and technology neutral. When tax incentives do exist for infrastructure and vehicle purchases, governments should not assume favored technologies, but rather apply cost, emissions and other criteria equally to all options. Such policies will ensure consumers, businesses and municipalities benefit from greater access to cost competitive fuels and technology.

States should analyze the full economic and environmental benefits of incentivizing the expansion of natural gas re-fueling infrastructure, and converting bus, truck and vehicle fleets to run on natural gas.

The states and federal government too often create artificial barriers to entry for natural gas power in electrical generation markets.

Renewable portfolio standards should be amended to allow natural gas and other clean and affordable energy sources to compete for electricity generation.



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Introduction

This Appendix discusses the models and methods used by ICF to generate gas and oil drilling, production and expenditure forecasts in North America. The main sources of these data are the subscription service forecasts ICF develops quarterly using the **Gas Market Model (GMM)**, **ICF Well Vintage Forecast Model** (a play level forecast model) and the **IPM** model of North American power markets.

In addition to our standard model outputs by region and node, the WEA study required that some of the forecast data be compiled by State and that additional data such as severance tax revenues and job impacts be computed. The study includes state-level forecast of counts of new wells and drilling footage; drilling expenditures; production of crude oil and condensates, dry natural gas and natural gas plant liquids; gross wellhead revenues; severance taxes; and total oil and gas-related employment.

ICF Gas Market Model (GMM)

ICF's *Gas Market Model (GMM)* is an internationally recognized modeling and market analysis system for the North American gas market. The GMM was developed in the mid-1990s to provide forecasts of the North American natural gas market under different assumptions. Subsequently, GMM has been used to complete strategic planning studies for many private sector companies. The different studies included analysis of the impacts of:

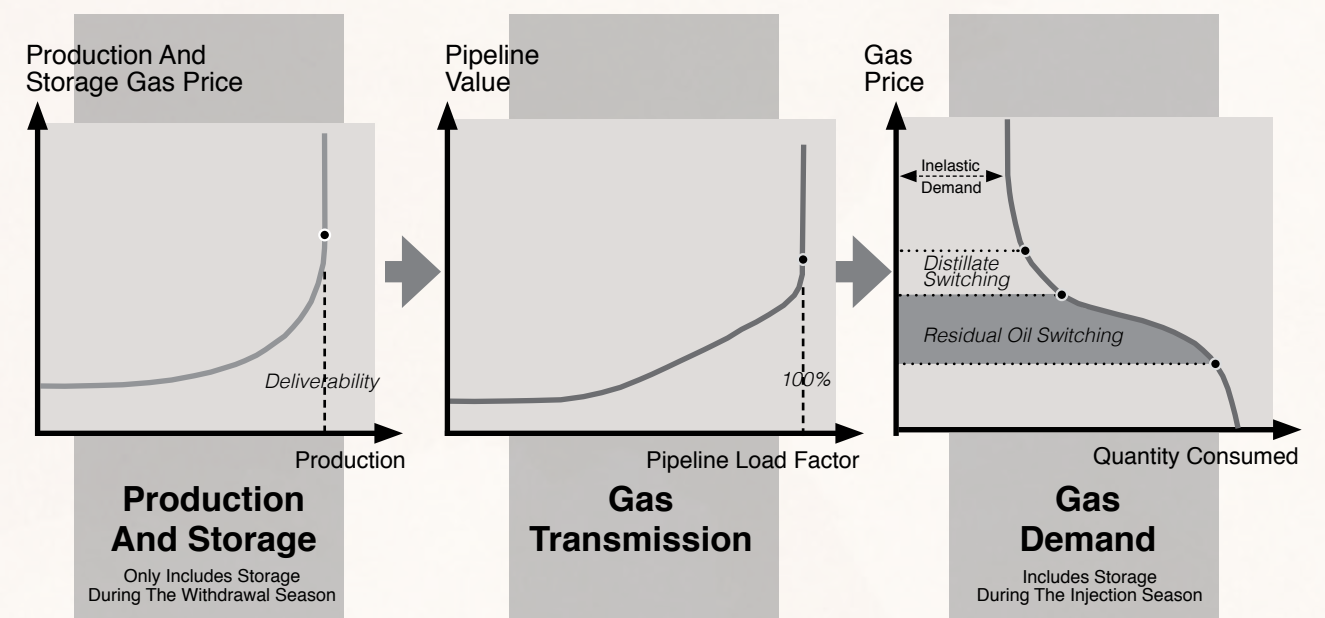
- Planned gas pipeline and storage projects on locational and seasonal prices
- Gas-fired power generation growth and other enduses demand trends
- Changing gas supply patterns
- Proposed regulatory changes

In addition to its use for strategic planning studies, the model has been widely used by a number of institutional clients and advisory councils, including Interstate Natural Gas Association of America (INGAA), who relied on the model for the market and infrastructure analyses completed in 1998, 2004, 2009 and 2011.^{1,2} The model was also the primary tool used to complete the widely referenced study on the North American Gas market for the National Petroleum Council in 2003, as well as multiple studies conducted over the past decade for the American Gas Association, America's Natural Gas Alliance and others.³

GMM is a full supply/demand equilibrium model of the North American gas market. The model solves for monthly natural gas prices throughout North America, given different supply/demand conditions, the assumptions for which are specified by the user.

Overall, the model solves for monthly market clearing prices by considering the interaction between supply and demand curves at each of the model's nodes. On the supply-side of the equation, prices are determined by production and storage price curves that reflect prices as a function of production and storage utilization (**Figure 1**). Prices are also influenced by pipeline discount curves, which reflect the change in basis or the marginal value of gas transmission as a function of load factor. On the demand-side of the equation, prices are represented by a curve that captures the fuel-switching behavior of end-users at different price levels. The model balances supply and demand at all nodes in the model at the market clearing prices determined by the shape of the supply and demand curves. Unlike other commercially available models for the gas industry, ICF does significant backcasting (calibration) of the model's curves and relationships on a monthly basis to make sure that the model reliably reflects historical gas market behavior, instilling confidence in the projected results.

Figure 1 Gas Quality and Price Response



There are ten different components of the model, as shown in **Figure 2**. The user specifies input for the model in the drivers spreadsheet. The user provides assumptions for weather, economic growth, oil prices, and gas supply deliverability, among other variables. ICF's market reconnaissance keeps the model up to date with generating capacity, storage and pipeline expansions, and the impact of regulatory changes in gas transmission. This is important for maintaining model credibility and confidence of results.

The first model routine solves for gas demand across different sectors, given economic growth, weather, and the level of price competition between gas and oil. The second model routine solves the power generation dispatch on a regional basis to determine the amount of gas used in power generation, which is allocated along with end-use gas demand to model nodes. The model nodes are tied together by a series of network links in the gas transportation module. The structure of the transmission network is shown in **Figure 3**. The gas supply component of the model solves for node-

level natural gas deliverability or supply capability. A separate module solves for LNG imports and exports. The last routine in the model solves for gas storage injections and withdrawals at different gas prices. The components of supply (i.e., gas deliverability, storage withdrawals, supplemental gas, LNG imports, and Mexican imports) are balanced against demand (i.e., end-use demand, power generation gas demand, LNG exports, and Mexican exports) at each of the nodes and gas prices are solved for in the market simulation module.

Figure 2 GMM Structure

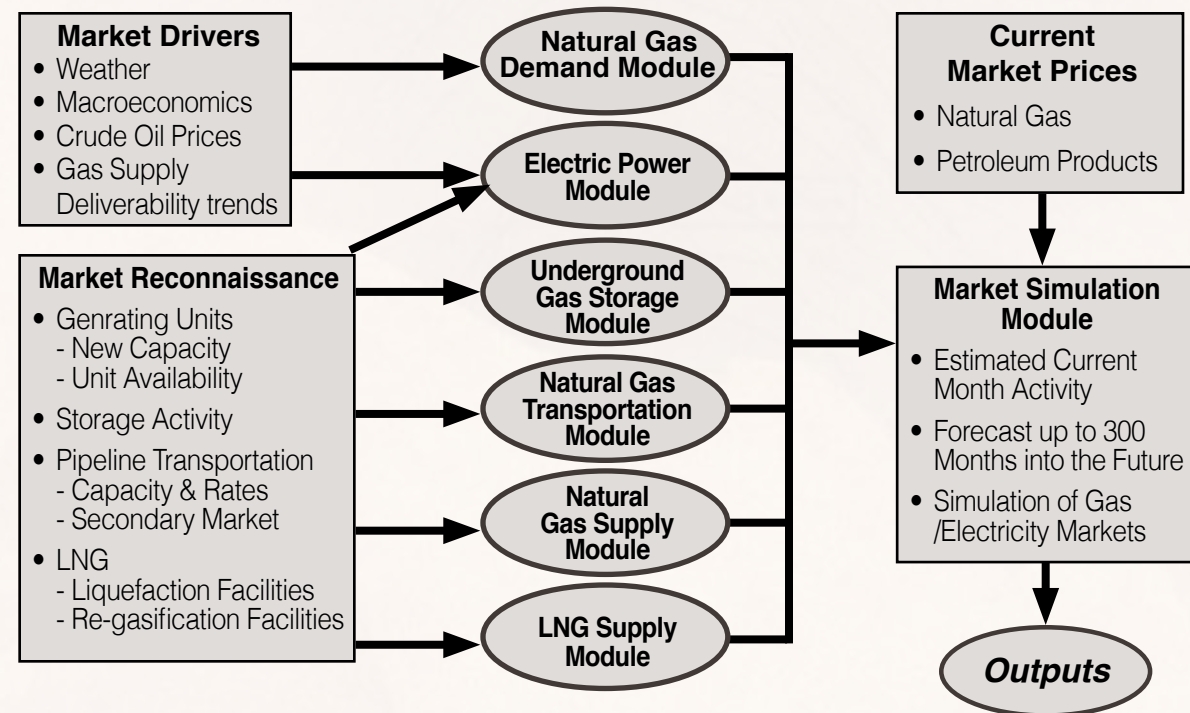
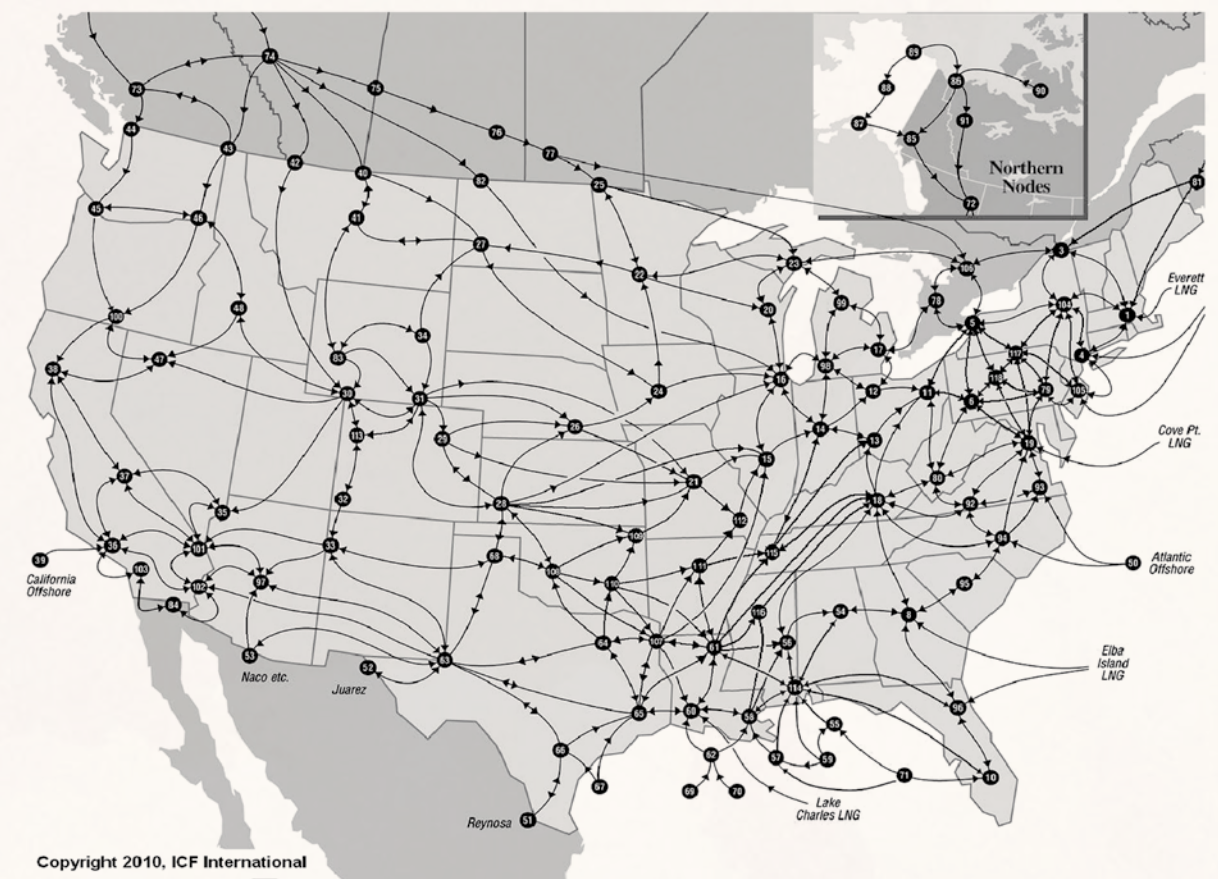


Figure 3 GMM Transmission Network



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Assessment of Remaining Oil and Gas Resources in the Rockies

A key part of this study is the assessment and characterization of the remaining oil and gas resources of the Rocky Mountain Region. ICF maintains a base case resource base of recoverable oil and gas by Hydrocarbon Supply Model region. The HSM regions included in the current study are shown in **Figure 4**. The model regions in the Rockies are based primarily on AAPG province boundary definitions. In some cases, minor basins are combined with major basins as shown on the map.

For gas resources, the major resource categories of undeveloped resource are as follows:

- Old field appreciation
- New undiscovered conventional fields
- Shale gas
- Coalbed methane
- Tight gas sands
- Low Btu/other gas

For oil, the resource categories are as follows

- Old field appreciation
- Enhanced oil recovery (EOR)
- Shale oil (tight oil)
- New undiscovered conventional fields

The ICF Rockies resource base used in the study is documented in **Tables 1 through 3**. Remaining resources are as of year end 2009. The following is a description of the approach used by ICF for each resource component.

Proved Reserves (Oil and Gas)

Proved reserves are those quantities of oil and gas that will be recovered from existing wells assuming current technology and current oil and gas prices. This information is derived from an annual U.S. Energy Information Administration survey-based publication.⁴

Old Field Appreciation (Oil and Gas)

ICF gas developed a rigorous quantitative analysis of appreciation in existing oil and gas fields. Most assessments of reserve appreciation are based upon so-called growth curves. A growth curve is a representation of the historic increase in ultimate field recovery through time. This increase is due to extensions to existing reservoirs, new reservoirs, and infill

drilling. The USGS uses growth curves for their assessment of reserve appreciation. The current ICF resource base relies upon a different method, developed by ICF in 2003. This method looks at changes in the recovery per well through time by so called field vintage, or year of field discovery. The concept is that for a given group of fields that were discovered at approximately the same time, well recovery through time will decline, and will eventually decline to the point where new wells are uneconomic. The resource in these remaining wells is our assessment of reserve appreciation potential.

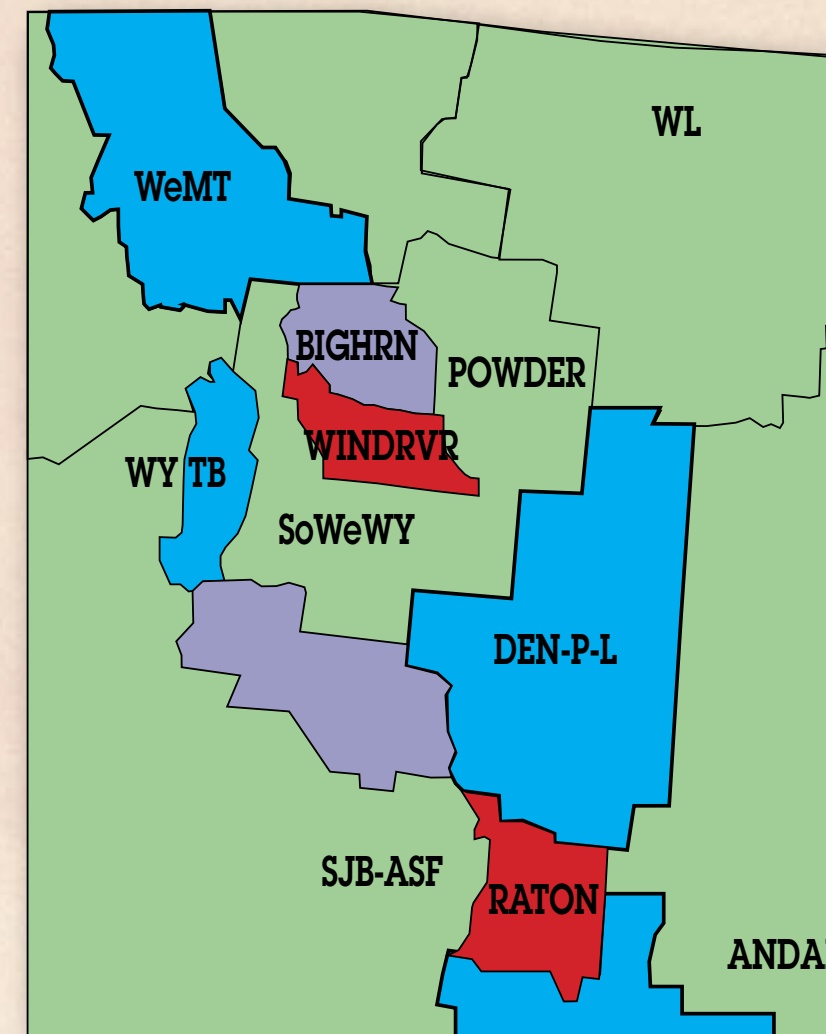


Figure 4
Map of Study Area
Colorado, Wyoming,
Utah, NW New Mexico,
Montana, and
North Dakota

New Conventional Fields (Oil and Gas)

ICF has developed a model to evaluate the USGS assessment of undiscovered fields by USGS size class.⁵ The method includes the addition of the so-called small field component that is excluded by USGS. The assessment also includes adjustments made by industry experts in the most recent comprehensive National Petroleum Council assessment.⁶ The economics of new fields are based upon the underlying distribution by field size in each region and depth interval, as well as the finding rates of new field wildcats which are calculated from historical new field wildcat and field discovery data.

Shale Gas

ICF has evaluated approximately 25 shale gas plays in North America using GIS methods and in-house gas-in-place and recovery models. All of the major shale plays such as the Marcellus, Haynesville, Barnett, and Fayetteville are included. In the Rockies, the Mancos Shale in the Uinta Basin was evaluated, as were the Hilliard and Baxter Shales in the Green River Basin. (The summary tables include only a small fraction of the total technical recovery from these plays, as the great majority of this resource is uneconomic in the foreseeable future.) The method is based upon the creation of depth, net thickness, organic content, and thermal maturity maps. This map data is aggregated at the township level for gas-in-place determination. The models include either maps or assumptions about pressure and temperature gradients, porosities, and water saturations and the results for both gas in place and recovery are checked against published industry information. A very important aspect of shale gas is the liquids content, which has been evaluated by ICF for each play.

**Table 1
Rockies Proved Oil and Gas Reserves**

	Dry Gas Tcf	Crude and Condensate MM Bbls
Colorado	23.1	376
Wyoming	35.3	855
Utah	3.1	488
Montana	1.0	343
North Dakota	1.1	1,058
NM - West	11.5	32
	75.1	3,152

As of year end 2009

Source: U.S. Energy Information Administration Reserves Report

Coalbed Methane

The ICF coalbed methane assessments are derived from three decades of work conducted for the natural gas industry using a variety of sources for geologic data and resource assessment of the active US plays. ICF has evaluated the San Juan Fruitland coalbed methane using the same GIS methods described above for shale gas that incorporates mapped data at the township level. The Powder River CBM has been assessed using maps of coal thickness and GIP by major coal unit and historical data on well recoveries by unit and area.

Tight Gas Sands

Many of the ICF national tight gas assessments are based upon USGS assessments, as adjusted during the 2003 NPC study and later modified by ICF based on more recent well recovery data. This approach relies on estimates of number of well locations remaining in each play and the average recovery expected from those wells. For some of the major active tight plays in the Uinta Basin, Green River Basin, and Anadarko Basins, ICF has conducted recent detailed GIS analysis to estimate gas in place and recoverable gas quantities. In all instances the liquids content of each tight gas play has been evaluated and included in the economic analysis.

Table 2 — ICF Unproved Rockies Gas Resource Base

Region Number	Region Name	Old Field Appreciation	New Fields	Shale	*Coalbed	Tight	Low-BTU/ other	Total Unproved
8	Williston, Northern Great Plains	2.1	3.4	12.0	0.0	7.7	0.0	25.1
9	Uinta-Piceance Basin	3.8	2.1	39.3	*5.9	99.1	0.0	150.1
10	Powder River Basin	1.0	1.5	7.8	23.1	0.8	0.0	34.1
11	Big Horn Basin	0.5	0.4	0.0	0.0	0.0	0.0	0.9
12	Wind River Basin	2.0	1.6	0.0	0.4	1.8	0.0	5.9
13	Southwestern Wyoming (Green River Basin)	7.3	4.7	18.4	*2.0	156.6	14.5	203.5
14	Denver Basin, Park Basins, Las Animas	2.0	1.7	10.1	0.0	2.0	0.0	15.8
15	Raton Basin-Sierra Grande Uplift	0.0	0.0	2.0	1.9	0.0	0.0	4.0
16	San Juan and Albuquerque-Santa Fe Rift	5.4	0.7	1.0	13.0	21.0	0.0	41.1
17	Montana Thrust Belt and SW Montana	0.0	8.3	0.0	0.0	0.0	0.0	8.3
18	Wyoming Thrust Belt	1.4	12.0	0.0	0.0	0.0	0.0	13.4
19	Great Basin and Paradox	1.0	2.7	32.1	0.0	0.0	0.0	35.8
	total	26.5	39.0	122.8	46.3	289.0	14.5	538.1

Technically recoverable resource as of 1-1-2010; existing technology; includes no-access areas Tcf dry total gas ICF International May 27, 2011
 * Tens of Tcf of technically recoverable resources of shale gas have been assessed in the Green River and Uinta Basins for the Baxter, Hilliard, and Mancos shales. However only a fraction of the resource in those formations is economic. The Niobrara shale has been assessed for the Green River and Piceance basins and is included in the table. The shale column includes shale gas and associated gas from shale oil. Shale plays that appear to have oil and gas potential but are not included are the Big Horn Niobrara oil play and the Paradox Gothic/Hovenweep Shale.

Low-Btu Gas

ICF includes in the assessment the very large accumulation of low-Btu gas in Western Wyoming along the Moxa Arch. This gas has a high CO₂ component and has been produced for many years. A large area of the resource remains undrilled.

Enhanced Oil Recovery

In oil fields, in addition to normal reserve appreciation, there is the potential for CO₂ enhanced oil recovery. This potential exists in under certain reservoir conditions and has been extensively assessed by the U.S. Department of Energy.⁷

Shale Oil (Tight Oil)

ICF has evaluated many of the emerging tight oil plays, including the Bakken, several areas of the Niobrara (Denver Basin, Powder River, Green River, and Piceance Basin), and several West Texas shale oil plays. This analysis is based upon mapped data that is used to define the key geologic characteristics within subareas or cells within the plays. ICF maps depth, net organic shale thickness, thermal maturity, and other factors to determine hydrocarbons in place per square mile, and then estimates recovery factors using engineering assumptions and calculations. Risk factors are then applied based on the degree of historical development in the subareas. The projected well recoveries are based upon explicit well design assumptions and are calibrated to historical production data, if available; published industry information on expected well recovery; and/or production characteristics of more mature analog areas. The ICF models determine economics on cost per BOE basis. There is much less uncertainty in the Bakken assessment than in the other Rockies formations, as it has been heavily developed, while the others are still in more of an early stage of development.

State Level Drilling and Production Forecast

The ICF natural gas market forecasting framework is the GMM model, which projects natural supply and demand by model node. Underlying these projections are ICF's detailed resource base descriptions and resource economics by region, basin, and play. We track drilling activity and historical production by state and district and for major oil and gas plays and develop play level forecasts for approximately 50 plays using the ICF Well Vintage Forecast Model.

In the projection, ICF builds up a vintage production stack in which the production from each well vintage (i.e., all wells drilled in a given year) is forecast, and all vintages are stacked to create the forecast. Sources of historical data include commercial well level production data and state agency websites. The peak annual production for a play and the total forecast production and reserve additions are evaluated to be within an expected range relative to resource size.

For the current study, it was necessary to develop forecasts of oil and gas drilling and production at the state level for the Rockies. This was done by allocating the forecasted wells within each play to states based the play or subplay area intersected by each state with the near term drilling adjusted to match current drilling patterns.

Footage Drilled Forecast

A forecast of drilling footage was developed for oil, gas, and dry holes. For historical data by state the primary source of information was the API Quarterly Completion Report, which reports annual oil, gas, and dry holes and footages drilled.⁸ The footage forecast was developed by application of an average forecast drilling depth times the number of annual wells for each state.

Energy Content of Forecast Production

An energy forecast was developed from the hydrocarbon forecast which contains assumptions for the hydrocarbon mix (crude oil, condensate, dry gas and natural gas plant liquids) from each play and subplay. The total energy content of production was computed by multiplying the average energy content for crude, natural gas, and plant liquids times the volumes by hydrocarbon type and by state.

Oil and Gas Price Forecast

A forecast of oil and gas prices used to compute gross wellhead revenues came from the 2011 Annual Energy Outlook produced by the U.S. Energy Information Administration at the US Department of Energy.⁹ Adjustments to the AEO prices reflecting regional and quality differences were made to produce the crude oil and natural gas prices for each state. The natural gas plant liquids prices were estimated using historical relationships of Mont Belvieu, Texas prices (for ethane, propane, butanes, and pentanes plus) to crude prices minus fractionation and transport costs.

Table 3 — Rockies Unproved Oil Resource Base

ICF International April 25, 2011		Billion bbls of crude oil				
Region Number	Region Name	Old Field Appreciation	EOR	Shale Oil	New Fields	Total Unproved
8	Williston, Northern Great Plains	1.3	2.5	12.0	0.8	16.6
9	Uinta-Piceance Basin	0.2	0.5	0.7	0.1	1.5
10	Powder River Basin	0.2	0.7	4.6	1.0	6.6
11	Big Horn Basin	0.2	0.5	0.0	0.2	0.9
12	Wind River Basin	0.1	0.2	0.0	0.1	0.3
13	Southwestern Wyoming (Green River Basin)	0.1	0.3	1.9	0.1	2.4
14	Denver Basin, Park Basins, Las Animas Arch	0.2	0.4	3.1	0.4	4.1
15	Raton Basin-Sierra Grande Uplift	0.0	0.0	0.0	0.0	0.0
16	San Juan and Albuquerque-Santa Fe Rift	0.2	0.7	0.0	0.2	1.1
17	Montana Thrust Belt and SW Montana	0.0	0.0	0.0	0.0	0.0
18	Wyoming Thrust Belt	0.1	0.2	0.0	0.1	0.4
19	Great Basin and Paradox	0.1	0.4	0.0	0.5	1.0
total		2.7	6.4	22.2	3.5	34.8

Technically recoverable resource as of 1-1-2010; existing technology; includes no-access areas

Wellhead Revenue Forecast

Wellhead revenues are calculated as average wellhead price times production. This requires a forecast of crude and condensate, dry gas, and gas plant liquids annual production and average product prices for each state.

Severance Taxes

Historical data on severance taxes were compiled from IPAA data¹⁰ and data from state government web sites. The projected severance taxes were computed by assuming that the percent of gross wellhead revenues paid to the state between now and 2020 would stay the same as the percent of the last few years.

Industry Outlays for Drilling and Completion Forecast

A forecast of industry outlays for drilling and completion was developed. The number of oil, gas, and dry holes forecast for each state was multiplied times average drilling and completion cost per well in each category to develop the forecast. The main source of historical drilling and completion cost information was the API Joint Association Survey of Drilling Costs as published in summary form by IPAA.¹¹ For forecast costs, ICF also used internal databases of cost per well. An assumption was made that drilling and completion costs (for any given well) would increase 3% per year in the future. Total costs rise faster than this in the forecast because wells are becoming more complex as more horizontal wells with multi-stage hydraulic fractures will be drilled.

Job Impacts

Historical data for the number of direct, indirect and induced jobs that could be attributed to the oil and gas sector in each state were taken primarily from two PriceWaterhouse Coopers studies for the American Petroleum Institute that covered the years 2007 and 2009.^{12,13} Additional data on employment in other years was estimated from the online databases of Bureau of Labor Statistics web site.¹⁴ The projected number of jobs was computed by assuming that job counts would scale up or down to match changes in the projected physical unit measures of feet drilled per year (for direct jobs related to new wells) or annual production volumes (for direct jobs related to production, processing, transport or refining), so that the ratio of indirect plus induced jobs to direct jobs would remain the same as it was in 2009.

Appendix Footnotes

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