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Testimony on "HARNESSING AMERICAN RESOURCES TO CREATE JOBS AND ADDRESS RISING GASOLINE PRICES: DOMESTIC RESOURCES AND ECONOMIC IMPACTS"

March 17, 2011

Mr. Chairman and members of the Committee on Natural Resources, I am Michelle Michot Foss, Chief Energy Economist and Head of the Center for Energy Economics, based in the Bureau of Economic Geology, Jackson School of Geosciences at The University of Texas. I am pleased and honored to be selected as a witness for the Committee.

Hydrocarbons are exceptional commodities, given the number and variety of essential products manufactured from these raw materials with relative ease. These essential resources improve living standards by:

- Constituting the major sources of energy fuels for everything from heating to lighting;
- Enabling local to global transportation systems; and
- Providing molecular building blocks for an incredible array of intermediate and finished products that we use in everyday life and across all industrial and economic sectors.

By definition, a commodity is a good for which the price cannot be controlled by either buyers or sellers although prices may be impacted by actions and events. Because hydrocarbons are commodities, price is uncertain. Price risk is faced by all producers, even including members of the Organization of Petroleum Exporting Countries (OPEC), and all customers. The strong pace of growth in demand for hydrocarbons, especially from emerging markets, and challenges in finding and delivering new sources of supply, largely the result of human interventions, periodically combine to increase uncertainty about forward prices. Geopolitical events, including major economic and business cycles, work to exacerbate uncertainty. Fear about how geopolitical events *might* unfold adds momentum to price movements. When geopolitical events occur within the "Petroleum Heartland", the breadbasket for hydrocarbons extraction that stretches across North Africa and the Middle East into Central Asia and Russia, uncertainty and fear can become accelerated.

For this hearing, I offer my views on the topics intended to be covered – domestic resources, production and the economic impact of rising gasoline prices – along with some thoughts about what can be done.

What Can Be Done

- Ensure that the domestic industry and production remain competitive.

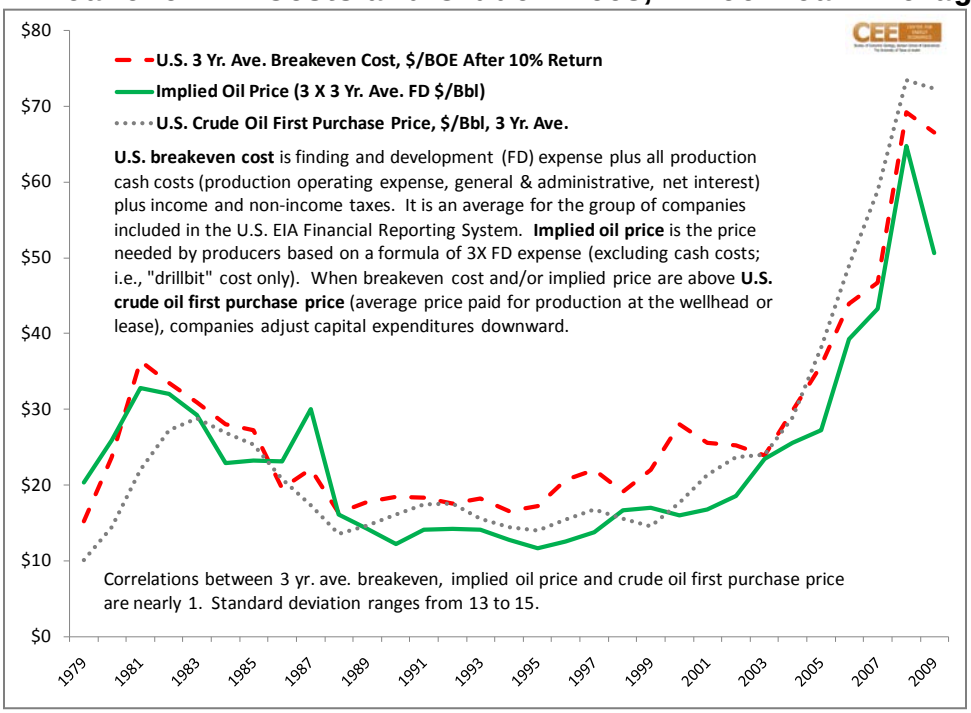
A good way to start is by gaining a better understanding of the industry business cycle and the inherent link between full finding and development costs and oil and gas prices. As prices fall, capital expenditures (CAPEX) and drilling also drop off. At some point, lower prices trigger demand growth. Rising demand relative to available supplies and deliverability signals new CAPEX. As prices rise, CAPEX is increasingly attracted to the higher marginal cost projects. During oil and gas business cycles, as price falls below marginal cost incremental sources of supply begin to drop out of the market and the next cycle is generated.

Because of the inherent dynamics in these cycles, I view full breakeven finding and development (FD) costs as the essential driver for oil and gas prices. Full breakeven FD costs include both "drillbit" exploration and production costs and the cash operating costs of oil and gas production. FD of incremental supplies sets the marginal cost curve for the industry and provides the best clue to customers about the direction of prices. We have been, and will remain, in a rising FD cost environment, the consequence of many factors. One is the worldwide shift toward unconventional oil and gas resources involving more complex reservoirs and advanced drilling and production technologies, with all of the attendant environment and safety considerations. Another is increasing remoteness of "frontier" resources, presenting additional logistics management constraints for both field operations and field-to-market linkages. A third, important, factor is "government gatekeeping" with respect to resource access. In the U.S. we have our own particular land management practices and costs for securing mineral rights, whether in the private or public domains. Many sovereign governments elsewhere are reticent to provide clear, transparent, competitive rules for licensing exploration rights. The end result is a "cost push" that comes both as a consequence of timing (when new supplies will come online) and an uncertainty about volumes. There are many more factors.

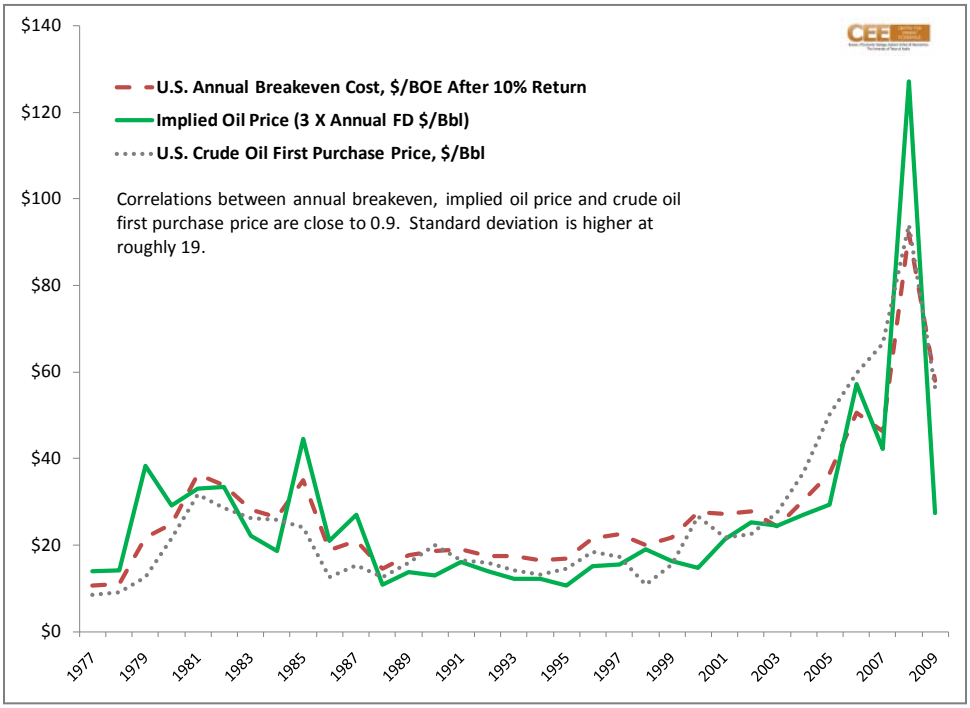
A conclusion is that as long as we have a high and rising marginal cost curve relative to strong and rising demand worldwide, price risk and uncertainty will remain substantial. Uncertainty about the future, "forward expectations", adds to variability.

The figures below illustrate the strong linkage between full breakeven FD costs expressed in dollars per barrel of oil equivalent (BOE), including both "drillbit" cost and cash costs associated with oil and gas production. The first chart provides a longer term view, using three-year averages. The second provides a shorter term illustration using annual data. In either case, full FD cost accounts for prevailing crude oil prices. The relatively small and periodic deviations up or down between the price that might be implied from FD costs and actual prices determined in the market reflect uncertainty and shifting expectations, including the force of geopolitical events.

U.S. Full Breakeven FD Costs and Crude Prices, Three-Year Average Basis



U.S. Full Breakeven FD Costs and Crude Prices, Annual Basis

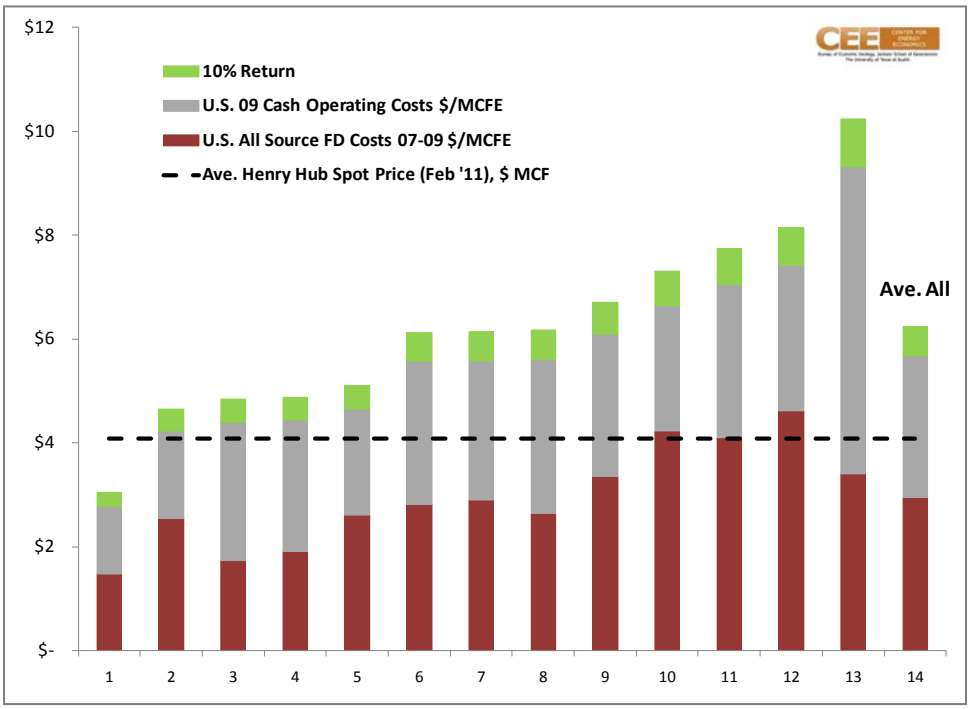


CEE-UT analysis using U.S. Energy Information Administration (U.S. EIA) and industry data.

When or if CAPEX injections yield drilling and production success – as in the case of the U.S. shale gas plays – increased production volumes can result in prices falling below marginal costs. Shale gas and liquefied natural gas (LNG) investments were made in response to extraordinarily strong natural gas price signals. Given the

current premium of crude oil to natural gas prices (nearly 22 to 1 in raw data, $/barrel and $/MMBtu or million British thermal units; nearly 4 to 1 in MMBtu equivalent terms) shale gas producers are in a flight to oil and liquids to sustain or restore profitability. In a 2007 paper for Oxford Institute for Energy Studies, I argued that U.S. natural gas prices could occupy a range of $3 to $5 per MMBtu through 2015. The preponderance of evidence always has been that the Lower 48 is a rich natural gas province. The question was always when and how would resources be converted to reserves and production, and with what cost and price conditions. Substantial LNG import terminal investments add to ***prodigious natural gas supply deliverability capacity for the U.S., a comparative advantage that requires careful thought and planning.***

Full Breakeven FD Costs for U.S. Natural Gas Producers



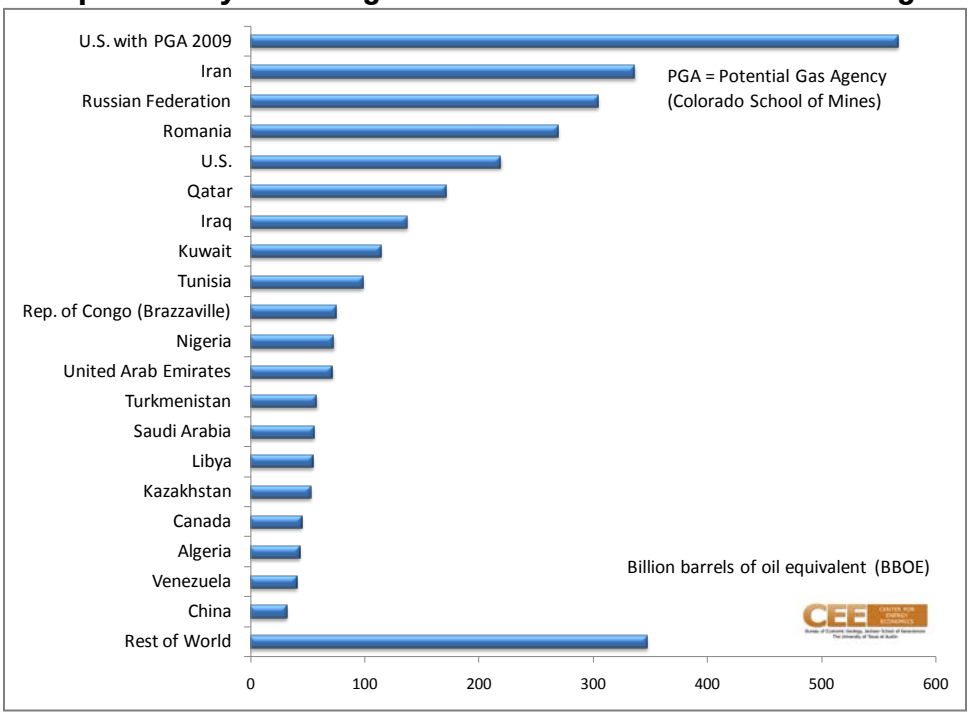
CEE-UT analysis using company financial reports.

Full FD costs are a reflection of the CAPEX surge into new projects, the more complex unconventional resource plays that are attracting interest, and the ***interactions between price-driven investment trends and component costs.*** Increased CAPEX places a "call" on materials, like steel and other metals, and services used for oil and gas drilling. ***In turn, higher energy costs impact the cost structure of materials and service providers.*** Labor also is affected – the cost of skilled workers becomes more expensive. Interactions are complex with leads and lags. Costs are "sticky downward" and can quickly build up again – as they are doing now. ***Higher costs can eventually be offset by higher production volumes, resulting in lower unit (per barrel and per cubic foot) costs and prices.*** Indeed, the impact of higher natural gas production volumes is already in evidence in the three-year and annual full breakeven FD cost charts

above. ***The 2009 $/BOE unit costs are substantially lower because of growth in oil and gas production volumes, but particularly the latter.***

Our abundant shale gas basins place the United States first among oil and gas producing countries (top chart below). For illustration purposes, I included the BOE equivalent of our shale gas resource estimates. Even without the shale gas plays, the U.S. would be a significant resource holder. ***We have a long history of successfully replenishing reserves to replace production – a key component of industry competitiveness that is absolutely essential for successful exploration and production businesses as well as for future generations of customers.*** The chart below also illustrates the impact of gatekeeping for resource access. What makes the U.S. different, what sets us apart from other natural resource rich nation states is our system of private property rights for minerals. The shale gas and many of the shale oil plays have been able to be launched largely because companies can negotiate directly with private land and mineral owners. In every other country, sovereign governments manage the subsoil as a patrimony for their citizens. It is important to recognize in these turbulent times that poor management of resource wealth is a consequence of faulty underlying systems and regimes rather than the other way around. Private property rights and "rule of law" are essential for economic growth and development. These linkages are well understood and documented in political economic literature. ***Protection of property rights in both the private and public domains is critical to sustaining domestic oil and gas industry and production competitiveness.***

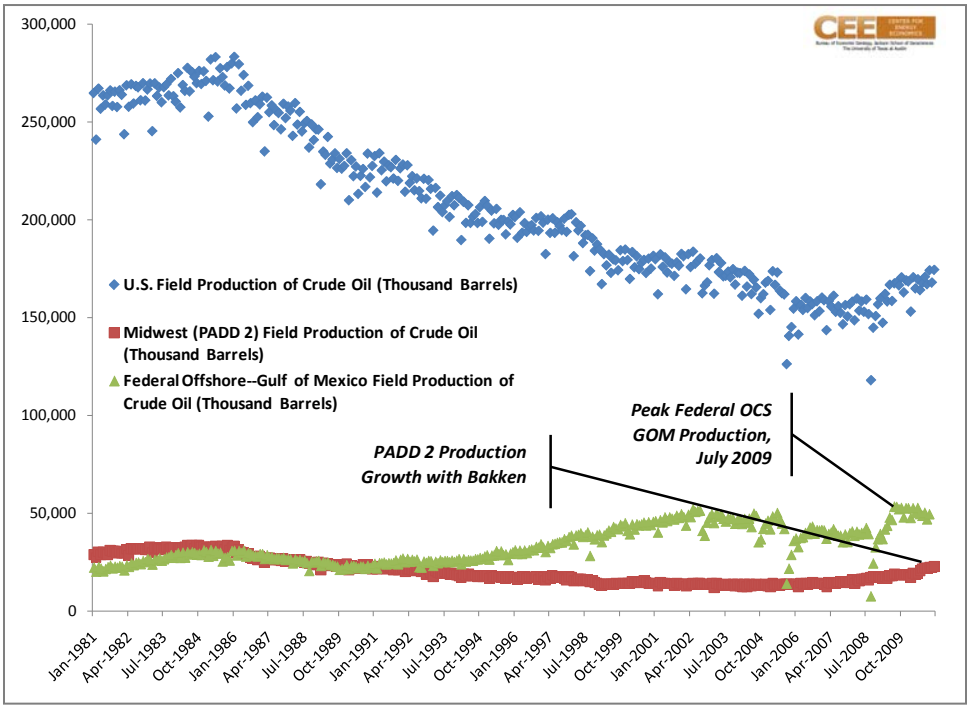
Top Country Rankings Based on BOE Reserve Holdings



CEE-UT analysis based on BP Annual Statistical Review, Potential Gas Agency and industry reports.

Domestic oil and natural gas reserves and production have grown with new investments in key plays. Along with the shale gas basins, new prospective areas for oil resource plays are under development. The Bakken shale in the U.S. Midwest region is yielding substantial and growing volumes of oil from favorable reservoir layers within the shale. Oil and liquids are being targeted in formations like the Eagle Ford in Texas that had originally been magnets for shale gas CAPEX. Current thinking is that a number of locations around the Lower 48 could be prospective for significant new – if challenging to develop – oil finds. A key question for domestic industry and production competitiveness is forward strategy for the U.S. Gulf of Mexico (GOM). ***To retain the huge science and technology edge associated with our offshore industry, a workable and streamlined framework simply has to be achieved in a timely fashion.*** Already, CAPEX and research and development (R&D) spending is exiting the GOM for more attractive locations abroad. ***Safety and security cannot be compromised, but industry and government must move quickly to restore competitiveness.***

The U.S. Crude Oil Production Renaissance

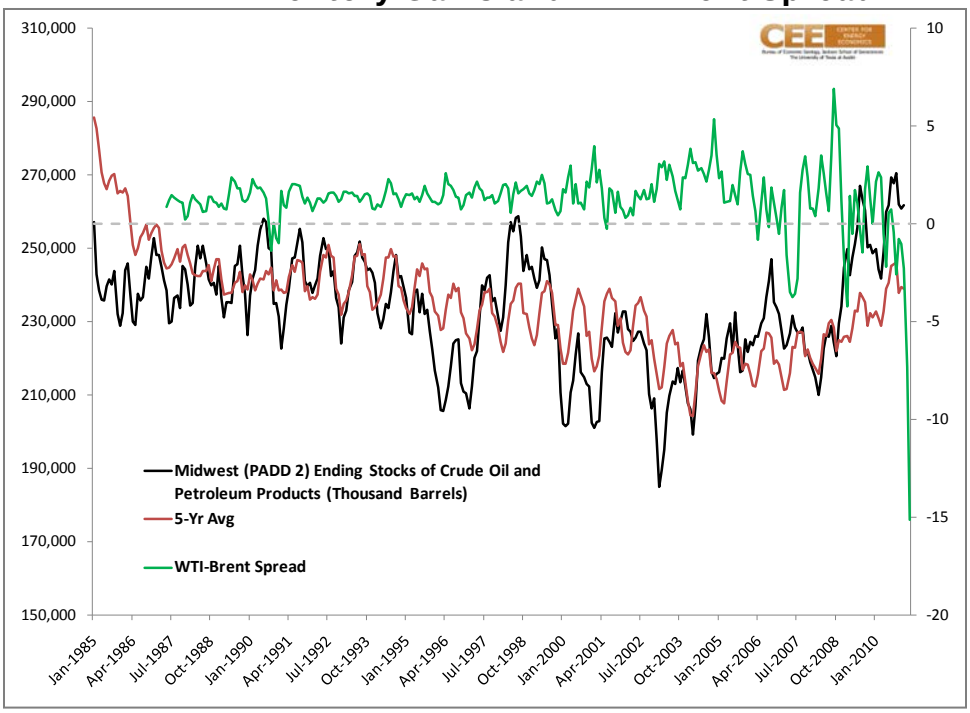


CEE-UT analysis based on U.S. EIA survey data.

U.S. crude oil stocks have reached recent highs because of both production gains and slack demand. Domestic oil production gains in plays like the Bakken and shipments of oil to the U.S. from Canada have resulted in a price disparity not unlike the low price phenomenon for natural gas at Henry Hub. However, U.S. consumers are not able to benefit fully from lower U.S. crude oil prices. One of the main locations for oil aggregation, Cushing, Oklahoma, in Petroleum Administration Defense District (PADD) 2, is well above five-year norms in inventories (see chart below). Because the marker crude for this location, West Texas Intermediate (WTI, also the crude for the main traded futures contract) is landlocked with insufficient

pipeline takeaway capacity, the "spread" between WTI and Brent (North Sea) has widened to historic differentials. Refiners that have access to WTI are benefitting from a lower cost domestic crude price than refiners that only have access to imports. Consumers served by refiners with WTI supplies are able to benefit. But the overall market is not impacted by cheaper U.S. crude oil. This disparity points to a distinct need: as new domestic and Canadian plays and projects yield increased production and growing reserves, new infrastructure is needed to ensure deliverability into the market. Already, major natural gas pipeline and storage investments are underway to support the emerging shale gas plays. The same need must be met for crude oil and petroleum product shipments. ***"Debottlenecking" the oil and gas transportation and storage system requires transparent, sensible, and timely certification of facilities – in short, "access" for right of way to build infrastructure is just as critical as access to oil and gas resources in order to sustain domestic industry and production competitiveness.*** Debottlenecking would have sustained and long term influence on the energy marketplace. Communication on debottlenecking and meaningful strategies for GOM production and other key issues would be much more impactful than using the Strategic Petroleum Reserve (SPR).

PADD 2 Inventory Gains and WTI-Brent Spread



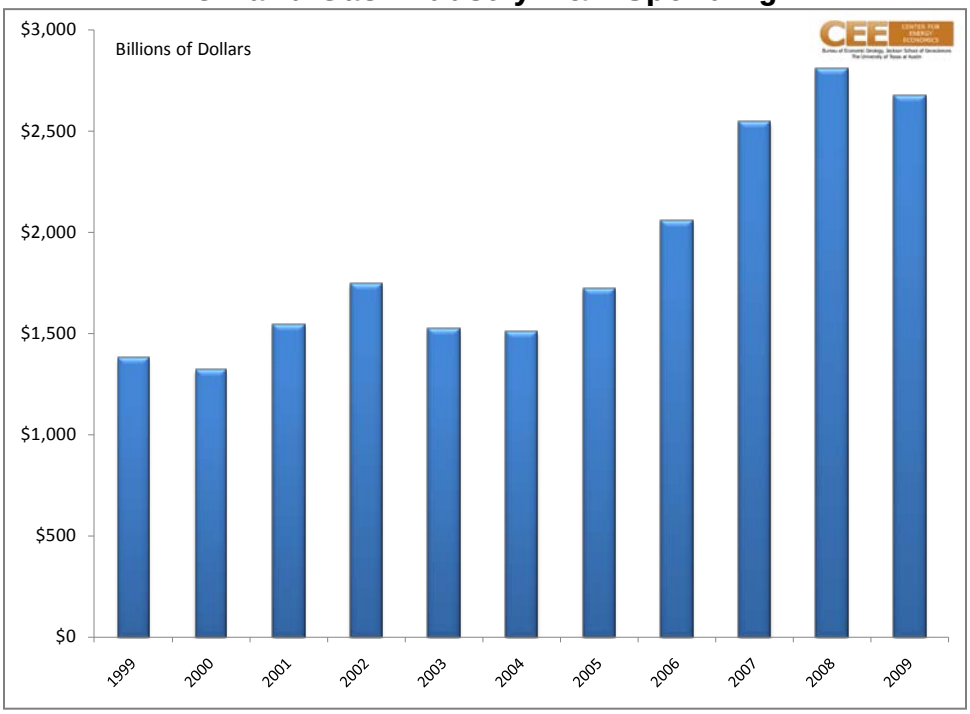
CEE-UT analysis using U.S. EIA and market data.

- Many socioeconomic benefits are derived from domestic resource production and utilization.

Sustaining these socioeconomic benefits will require a competitive tax and business environment. Total industry employment growth ***averaged six percent per year*** from early 2000s until recently with recession and soft natural

gas prices. ***In many states with established oil and gas production businesses, economic conditions have been somewhat better than for the nation as a whole.*** Employment and other economic benefits are derived not just from direct oil and gas industry activity but many indirect and ancillary activities as well. After many years of slack spending, R&D investments by industry (which provides nearly all R&D investment in oil and gas) surged, a reflection of the deep technology and human resource needs in the shale oil and gas plays, deepwater GOM and other frontiers. ***R&D spending is a vital component of competitiveness and generates a wealth of connected economic benefits.***

Oil and Gas Industry R&D Spending

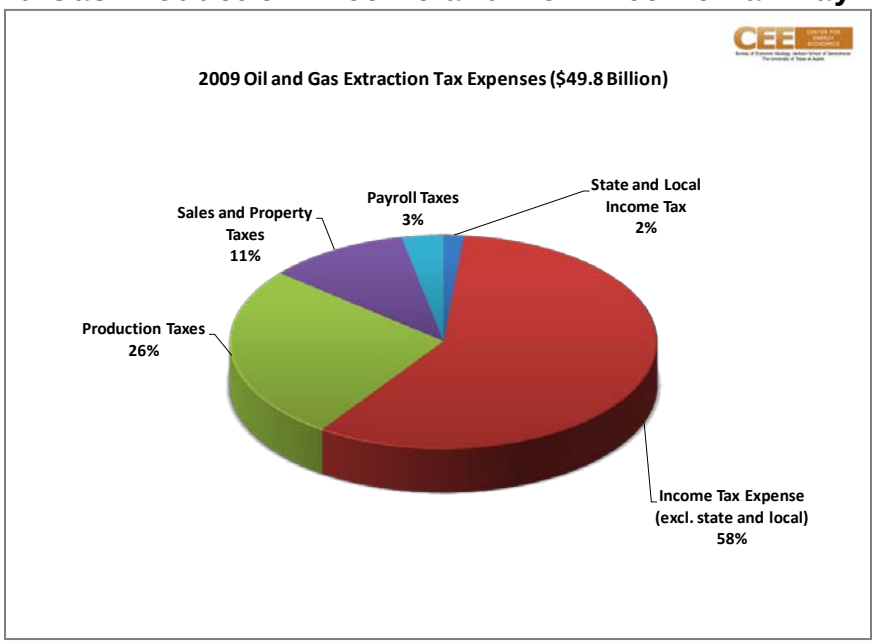


CEE-UT analysis based on U.S. EIA and industry reports. For information on R&D investment in the energy industries and sources of funding, see CEE-UT co-authored reports http://www.api.org/aboutoilgas/upload/Emerging_Technology_Report_Oct_2008.pdf and http://www.api.org/ehs/climate/new/upload/T2_Investments_in_GHG_Mitigating_Tech_6_2009.PDF.

Another major socioeconomic benefit derived from domestic industry activity is tax payments. As shown in the first chart below (for exploration and production only), the oil and gas industry incurs both income and non-income tax expenses including Federal, State and Local income tax payments; production taxes (severance taxes and other); sales and property taxes; and payroll taxes. In addition, beneficiaries of domestic industry payments for surface access and mineral rights (royalties and bonuses) incur their own and separate tax expenses. Companies that provide materials and services to the industry contribute separate income, payroll and other non-income tax streams. Finally, companies with foreign operations provide large and extensive tax streams. Tax payments fluctuate with commodity prices and profitability; tax payments for 2009 were lower than previous years. When producers face operating losses, as many do now in the face

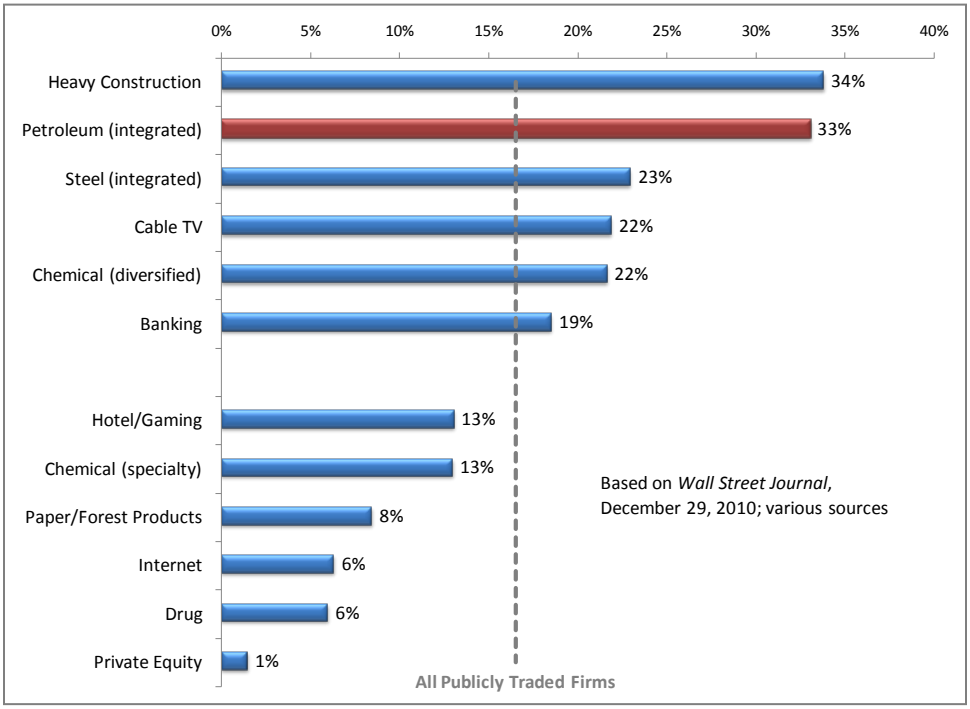
of low natural gas prices relative to full breakeven FD cost, tax payments are nil. ***Importantly, the oil and gas industry is typically the highest effective tax payer among U.S. corporate contributing roughly 33 percent of total U.S. federal tax take (and ignoring all other tax expense streams).***

Oil and Gas Production Income and Non-income Tax Payments



CEE-UT analysis using industry data compiled by U.S. EIA.

Effective Tax Rates for Selected Industries and Businesses

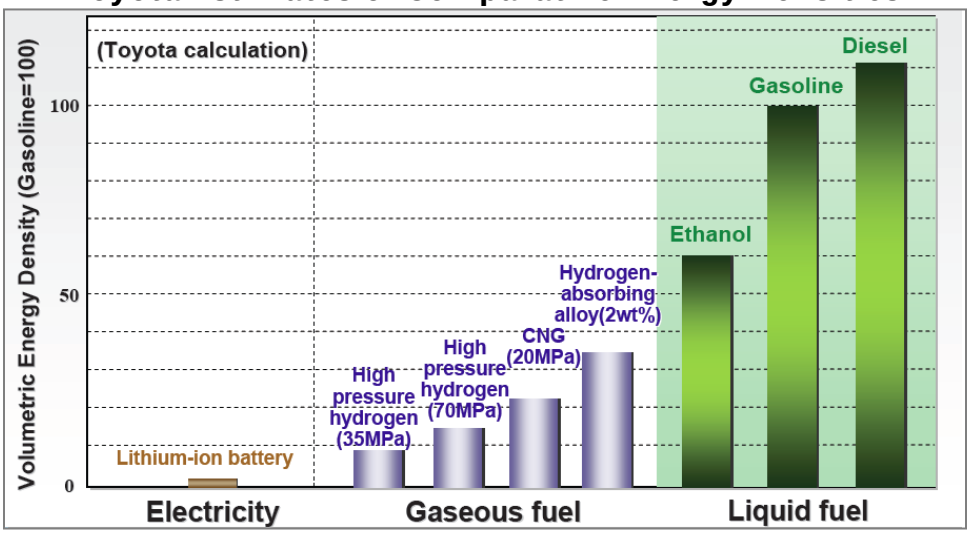


Currently, consumer pocketbooks are benefitting significantly from lower natural gas prices, which help to offset higher gasoline costs. ***We learned during the 2002-2008 rise in oil prices that the most heavily affected energy customers are those for whom energy costs are a larger share of their disposable incomes.*** Consumer and household debt are declining as Americans work to bolster their disposable incomes and build post-recession resiliency. ***Competitive energy supplies and prices help enormously in household budget management. Consequently, a distinct and important benefit of domestic industry and production activity is felt right at home and in the pocketbook of every energy consumer and customer.*** The same process needs to happen for the U.S. economy. ***Prevailing views are that U.S. sensitivity to higher oil and petroleum fuels prices is a consequence of our own fiscal house not being in order.*** To the extent that we continue to incur deficits in our current (international trade) accounts and deficits and debt in our national fiscal accounts, we are much more likely to suffer consequences. Strong connections exist between oil prices, the relative value of our dollar, inflation, interest rates and fiscal and monetary policies associated with these measures. Competitiveness of the domestic oil and gas industry is tied to overall health of the U.S. pocketbook and economy. Likewise, competitive domestic industry and production can make direct contributions toward improved economic and fiscal health by making our energy system more resilient, reliable and cost effective.

- Gasoline is the highest energy density system – with substantial consequences for prices and forward strategies.

Demand for crude oil is derived from our demand for the useful products we make from crude – gasoline and other fuels and materials. At a time when calls are increasing to mandate shifts away from gasoline and oil-based fuels, we should be cautious about expected benefits and unintended consequences. The chart below, provided by Toyota, offers a vivid illustration of the challenges in diversifying transportation fuels and systems as well as for meeting environment targets.

Toyota Estimates of Comparative Energy Densities



Lower energy density fuels and systems pose great hurdles for commercialization. Not only do they yield less energy delivered for "work", they also require comparatively larger resource inputs. Together, these constraints mean fewer environmental and economic benefits than are achieved when higher energy density transport fuels and systems are deployed. Lithium-ion battery designs and similar approaches not only rank lowest in energy density, but also bear many difficulties when it comes to securing the additional raw materials to manufacture and replace batteries and other components. Plug in hybrid and other electric vehicle concepts that would rely on renewable energy systems are further complicated by the low energy density characteristics of renewable energy technologies and resources. Emerging research using life-cycle measurements and other full cost analysis has introduced many questions into conventional thinking about alternative energy designs.

A current argument is that abundant domestic natural gas supplies should be utilized for vehicle transport (CNG or compressed natural gas as shown in the Toyota chart above). The current steep discount for natural gas relative to petroleum products has spurred both thinking and action. Natural gas vehicles or NGVs face the low energy density challenge for commercialization. More success can be gained with truck fleets so long as engine performance is not compromised. An alternative question also could be raised: should natural gas be used to reinvigorate the U.S. industrial base? This debate is currently underway in the National Petroleum Council's study on use of domestic oil and gas resources to achieve low carbon objectives. ***A natural gas-led industrial and manufacturing renaissance in the U.S. would create enormous socioeconomic benefits as well as helping to "right the ship" of the U.S. economy by increasing exports, boosting trade flows and contributing to fiscal recovery. As with domestic oil and gas industry competitiveness, a U.S. industrial renaissance would require favorable business and economic conditions and sensible policy and regulatory approaches for success.***

- Many other options exist to seize control of the future and manage oil price risk and uncertainty.

The energy density challenge should send a strong message for R&D: it would be much wiser to consolidate spending and invest in basic materials science research rather than alternative technology giveaways. The Federal system of energy R&D could be overhauled with much more productive approaches. Pre-commercial and emerging technologies that have benefitted from Federal seed funds could be auctioned instead of supported with additional public financing. Market tests of new technologies could happen more quickly this way. And while the focus of this hearing and deliberations are on our domestic oil and gas industry and production, ***it is important that we protect free trade and encourage free trade in oil and gas and other critical raw material commodities.*** As I stated earlier, bad political systems lead to bad results from resource wealth. Resource rich nations need to produce and sell and invest their returns wisely, preferably through private capital, in economic development and diversification. Wealth from resource sales may feed information technologies and democratization.