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American Energy Outlook: Technology, Market and Policy Drivers

Testimony of Robert McNally
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Chairman Lummis, Ranking Member Swalwell, members of the Committee, thank you for the opportunity to provide testimony to you on the technology, market and policy drivers of the American energy outlook. I approach this subject with twenty-one years of professional experience analyzing global oil markets and energy policymaking. I also served as Special Assistant to the President for Economic Policy on the White House National Economic Council from January 2001 to June 2003 and Senior Director for International Energy on the National Security Council from January 2003 to June 2003. I am currently an independent analyst and do not represent any entity. The views expressed here are entirely my own.

I would like to respectfully make five observations and suggestions for how to think about energy technology, market and policy drivers.

1. Critical importance of ample flows of energy, mainly fossil fuels, to sustain our standard of living

It is hard to overstate but often overlooked how much modern civilization depends on continuous access to the substantial flow of fossil fuels from producers to consumers. The displacement of bioenergy with coal made the industrial era possible. Subsequent use of oil and natural gas augmented coal and enabled our modern transportation and electricity sectors to develop. Concentrated and abundant energy stores of coal, gas and oil power virtually all we do at the current state of technological development. Transportation, which is critical to food supply chains and other core systems society needs to function, today runs almost entirely on oil. Electrical generation taps a more diverse suite of fuels but much of it, too, is fossil fuel powered.

"Energy," as Nobel chemist Richard Smalley noted in 2003, "is the single most important factor that impacts the prosperity of any society." Fossil-based energy or hydrocarbons – oil, gas, and coal – are far superior to other primary energy sources because they are dense, highly concentrated, abundant, and comparatively easy to transport and store. That is the case now, and it is expected to be the case in the coming decades. The latest EIA International Energy Outlook forecasts that world energy consumption will rise by 53 percent by 2035 and fossil fuels' share of total energy consumption will rise from 74 percent to 79 percent.

Personally, I regard the development of fossil fuel industry on balance as an enormous blessing that has vastly enriched the conditions of human life. However, whether one regards fossil fuels as a blessing or curse, we must recognize that our standard of living is closely and inextricably linked to fossil fuels.

2. Patience about the time it takes to transform energy systems

The pace of energy transformations depends on both the availability of economical stores of energy and the development of devices that can turn those energy stores into "work" such as light, heat, and mobility. Major energy transitions take a very long time, measured in decades if not generations. The respected energy expert Vaclav Smil has written:

> "Energy transitions" encompass the time that elapses between an introduction of a new primary energy source (oil, nuclear electricity, wind captured by large turbines) and its rise to claiming a substantial share (20 percent to 30 percent) of the overall market, or even to becoming the single largest contributor or an absolute leader (with more than 50 percent) in national or global energy supply. The term also refers to gradual diffusion of new prime movers, devices that replaced animal and human muscles by converting primary energies into mechanical power that is used to rotate massive turbogenerators producing electricity or to propel fleets of vehicles, ships, and airplanes. There is one thing all energy transitions have in common: they are prolonged affairs that take decades to accomplish and the greater the scale of prevailing uses and conversions the longer the substitutions will take. The second part of this statement seems to be a truism but it is ignored as often as the first part: otherwise, we would not have all those unrealized predicted milestones for new energy sources.[1]

[1] Smil, Vaclav, "Moore's Curse and the Great Energy Delusion," *The American Magazine*, November 19, 2008

The main reason why it would take many decades to transform our energy system is that our energy system is cololosal. Developed countries have made, and continue to make, enormous investments in recent years in fossil energy production, transportation, refining, distribution, and consumption systems and devices that could not quickly be replaced in any reasonsable scenario, even if an alternative energy source was available. Whether one regards our society's massive investment in and dependence on hydrocarbons as an addiction or a blessing, it is here to stay for many more decades.

3. Humility and restraint about predicting, much less attaining, arbitrary and aggressive energy targets

The historical record is littered with overly optimistic or scary predictions and policy targets, by experts and non-experts alike. While energy surprises can be humbling for analysts, too often leaders and observers ignore technology, geology, and economics and either predict or prescribe unachievable targets. They range from period cries of imminent peak oil, through confident predictions in the 1950s that nuclear energy would be "too cheap to meter", to President Nixon's declaration that the US would be energy independent by 1980. Widespread adoption of electric cars or deployment of renewable energy technologies has a long and sad history of failure going back over a century. Just six years ago, Congress passed a law mandating 36 billion gallons of biofuels consumption by 2022 that EIA analysts say cannot be met given economic and scientific realities. In July 2008 former Vice President Al Gore called for the US to commit to producing our entire electricity supply from renewable sources within 10 years. Though he described the goal as "achievable" and "affordable" not one energy expert I am aware of would agree this is even remotely possible.

At best, arbitrary and aggressive targets can mislead the public about the complexities and uncertainties involved in energy market transformations and at worst when such targets are married to costly mandates or subsidies, they can become expensive policy errors. Just as we in the analytical community must be cautious in making bold predictions about circumstances in energy markets even several years ahead, I would respectfully recommend policy makers abjure from basing policy on arbitrary, unrealistic targets, much less basing mandates or subsidies on them. Energy transformations are more akin to a multi-decade exodous than a mutli-year moonshot, as pretending otherwise misleads citizens and distracts from serious debate about real circumstances and solutions.

4. We live in a *global* oil market, no matter how little oil we import

Amid our jubiliation over the surprising production boom, we are also reminded that enegy markets can deliver unpleasant surprises. Last year, Americans paid record levels for gasoline at the pump in nominal and real terms, even though consumption was declining and production was surging. The average U.S. household spent $2,912 on gasoline in 2012, or 4 percent of its before-tax income, which is tied with 2008 as the highest household expenditure on gasoline in nearly 30 years.

The combination of rising oil production and prices can be befuddling. Moreover, large gasoline price swings have become more frequent in recent years and consumers are wondering why this is the case. As Michael Levi and I recent wrote:

> For most Americans, from the late 1970s until just a few years ago, following the price of gasoline was like riding the Disney World attraction It's a Small World: a shifting but gentle, basically unremarkable, experience. But since 2005, it has felt more like Space Mountain--unpredictable, scary, gut-wrenchingly volatile. Between January 2007 and July 2008, the price of a barrel of oil rose from $50 to more than $140; by the end of 2008, it had crashed to just over $30; less than a year later, it had breached $80 again. In early 2011, on the back of strong global demand and the political turmoil in the Middle East and North Africa, oil sold for over $120 a barrel. Today, as prices continue to swing wildly, most Americans are wondering why they are on this ride and how to get off. [2]

Crude oil prices are rising mainly because of global supply and demand fundamentals, which are tight, especially outside the United States, as well as actual and threatened geopolitical disruption risks. OPEC spare capacity, almost entirely held in Saudi Arabia and which in the past has been used to stabilize global oil prices and reassure market participants that geopolitical disruptions could be offset, has been and will likely remain too low to do so. With spare capacity tight, global crude oil prices – and therefore domestic pump prices – will inexorably rise when global demand growth exceeds net supply growth. And when there is even a relatively minor disruption or even threat of a disruption in oil supply anywhere in the world, crude and gasoline prices can shoot higher fast. We saw this in February 2011 after a disruption in Libya, and one year later, Iranian threats to close the Strait of Hormuz (where over a third of the world's waterborne oil transits) contributed to a 10 percent hike in oil prices.

Unfortunately, there are no effective short-term policy options to counter the short-term crude and gasoline price volatility caused by a fundamentally tight and fearful global oil market. There are policies that can

[2] "Crude Predicament: The Era of Volatile Oil Prices," Foreign Affairs, July/August, 2011, see attachment.

reduce future price volatility and enable our consumers to adjust to it in the medium and longer term. They range from improving the quality of data in order to reduce the uncertainty that contributes to volatility to improving the funding and focus of energy-related research and development.

A crucial step is to increase oil supply everywhere: In a tight market, and especially when spare capacity is low, every extra barrel of supply on the margin counts and can help reduce future price volatility. If North America succeeds at increasing oil supply by some 6 mb/d or more, then it would free up more Middle East oil to go to growing Asian markets or remain in spare capacity to offset a disruption.

Higher US and hemispheric oil and gas production is great news for our economy and energy markets. If the investment and regulatory climate allows industry to realize the full supply potential, it will mean more jobs, improved resilience to supply disruptions, and a lower current account deficit. Our companies and workers will have opportunities to take advantage of these same techniques and technology to unlock unconventional oil and gas resources globally, where there appears to be much potential.

However, the good news must be viewed in perspective. Even if we were entirely self-sufficient in oil, our pump prices would still move up and down with global crude oil prices. Oil is fungible, widely traded, and priced in a global market. A crude price shock anywhere is transmitted to pump price changes everywhere.

Therefore, our gasoline prices are and will remain strongly linked to trends and developments in the global oil market, not our import share. As leading oil expert Daniel Yergin wrote "[t]here is only one world oil market, so the United States – like other countries – will still be vulnerable to disruptions, and the sheer size of the oil resources in the Persian Gulf will continue to make the region strategically important for the world economy."[3]

5. Technology and innovation unlock the energy we require while protecting the environment and habitat

Not all surprises in the energy sector are unpleasant. One of the happy surprises is continuous improvement in innovation and technology that enables the energy industry to find and produce enormous reserves while protecting the environment and conserving natural resources.

Since the beginning of the hydrocarbon industry, research and development has been essential to increasing proved reserves, while increasing the efficiency and lowering the cost of production of energy resources. In fact, as the US National Petroleum Council said, the oil industry has been "supercharged by innovation and technology"[4] and has a long record of outstanding breakthroughs that has enabled our consumers and business to enjoy increasing amount of affordable energy. Early major inventions such as the rotary rig and blow out preventer greatly increased production for oil. Since the 1950s, the introduction of computer technology played an even bigger role in unlocking previously inaccessible supplies. Latest innovations include 3-D and 4-D microseismic imaging and extended reach and horizontal drilling technology reaching depths and distances measured in miles instead of feet.

As technology and innovation enabled industry chemists, geologists, and physicists to find and produce more oil and gas, production itself also become much cleaner and required a smaller footprint. A report issued by the Clinton-Gore Department of Energy in 1999 but that is still relevant today found advanced oil and gas exploration and production technologies enable the energy sector to produce energy while protecting ecology and environment, if public awareness of these benefits remained "limited."[5] The report noted[6]:

- 22,000 fewer wells are needed on an annual basis to develop the same amount of oil and gas reserves as were developed in 1985.
- Had technology remained constant since 1985, it would take two wells to produce the same amount of oil and natural gas as one 1985 well. However, advances in technology mean that one well today can produce two times as much as a single 1985 well.
- Drilling wastes have decreased by as much as 148 million barrels due to increased well productivity and fewer wells.
- The drilling footprint of well pads has decreased by as much as 70 percent due to advanced drilling technology, which is extremely useful for drilling in sensitive areas.
- By using modular drilling rigs and slimhole drilling, the size and weight of drilling rigs can be reduced by up to 75 percent over traditional drilling rigs, reducing their surface impact.

[3] Daniel Yergin, "Oil's new world order," *Washington Post*, October 28, 2011.

[4] "Oil and Gas Technology Development," Working Document of the NPC Global Oil & Gas Study, July 18, 2007

[5] ttp://www.fe.doe.gov/programs/oilgas/publications/environ_benefits/Environmental_Benefits_Report.html

[6] Summarized here: http://www.naturalgas.org/environment/technology.asp#advances

- Had technology, and thus drilling footprints, remained at 1985 levels, today's drilling footprints would take up an additional 17,000 acres of land.
- New exploration techniques and vibrational sources mean less reliance on explosives, reducing the impact of exploration on the environment.

Innovations since the that report include Measurement-While-Drilling systems that improve efficiency, accuracy and reduce odds of blowouts. Slimhole drilling, as the name implies, requires a smaller drill bit that improves efficiency while reducing environmental impact, and advances in developing improved fracturing fluids and flowback water treatment and recycling.

The most pleasant surprise in energy – if not for our entire economy in the last few years – has been the ability of oil and gas producers to unlock previously unproducible resources through multi-stage, horizontal hydraulic fracturing of oil and gas reserves trapped in deep shale rock formations. Last week Dan Yergin testified before your colleagues on the House Energy and Commerce Committee and called the boom in unconventional oil and gas production the most important energy innovation so far in the 21st century. Dr. Yergin elaborated:

> The United States is in the midst of the "unconventional revolution in oil and gas" that, it becomes increasingly apparent, goes beyond energy itself. Today, the industry supports 1.7m jobs – a considerable accomplishment given the relative newness of the technology. That number could rise to 3 million by 2020. In 2012, this revolution added $62 billion to federal and state government revenues, a number that we project could rise to about $113 billion by 2020. It is helping to stimulate a manufacturing renaissance in the United States, improving the competitive position of the United States in the global economy, and beginning to affect global geopolitics. This revolution has also engendered two debates -- about the environmental impact of shale gas development and about the role of U.S. energy exports.[7]

Looking to the future, one transformational development that is currently out of reach but in my view plausible would be to unlock scalable production of methane hydrates, which are natural gas crystals trapped in deeply buried ice formations. Globally the resource has been estimated to be as high as 700,000 trillion cubic feet[8], well over 100 times the current proven reserves. Like shale gas several years ago – we know the resource exists and we have the capability to quickly use it in our existing energy systems but have not yet discovered how to retrieve if from the earth's crust.

[7] http://docs.house.gov/meetings/IF/IF03/20130205/100220/HHRG-113-IF03-Wstate-YerginD-20130205.pdf

[8] Charles Batchelor, "Fire Ice: Gas Source is Little Understood," *Financial Times*, 1 June 2012, http://www.ft.com/intl/cms/s/0/506686c4-a4d0-11e1-9a94-00144feabdc0.html#axzz1y968sb2w.