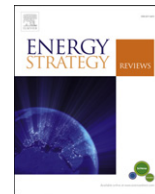


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REPORT REVIEW

Optimistic NPC report could point US energy strategy in wrong direction

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ABSTRACT

The 2011 North American natural gas assessment report by the National Petroleum Council is examined with particular focus on the impact of gas prices — both low and high—on the report's conclusions. The NPC report findings are critically compared to conclusions drawn in similar studies — by MIT, EIA, and others — on the US natural gas outlook.

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1. National Petroleum Council report

The National Petroleum Council (NPC) issued a 2011 report [1] in response to requests from U.S. Energy Secretary Stephen Chu. The NPC report assesses the potential of North American natural gas and oil resources to help direct US decision making on energy policy and strategy. The NPC was asked to examine the potential contribution natural gas can make in the transition to a lower carbon energy mix while achieving the objectives of environmental protection, economic growth and energy security. Titled *"Prudent Development: Realizing the Potential of North America's Abundant Natural Gas and Oil Resources"*, the NPC report [1] highlights the prolific oil and gas resources available in the United States that may dramatically change trends in domestic energy markets. The message is that North America, with the right public policies, could become not only energy self-sufficient, but also possibly begin exporting natural gas worldwide, while reducing the environmental impact on the economy from increased fossil fuel usage.

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The possibility of LNG exports from the United States has become a reality with the recent announcement of an agreement between Cheniere Energy, Inc. and BG Group to begin shipping gas likely starting in 2015 [2].

The NPC report contained four major conclusions regarding natural gas and oil and their impact on America's energy future. The conclusions were: 1) "the potential supply of North American natural gas is far bigger than was thought even a few years ago;" 2) "perhaps surprising to many — America's oil resources are also proving to be much larger than previously thought;" 3) "we need these natural gas and oil resources even as efficiency reduces energy demand and alternatives become more economically available on a large scale;" and 4) "realizing the benefits of natural gas and oil depends on environmentally responsible development."

The NPC study's conclusions are based on an analysis of a number of market outlooks and forecasts prepared by US researchers in recent months. After assimilating these studies, the report formulates optimistic views on the future for the North American natural gas market, and asserts that the huge domestic shale gas resources

can be exploited while keeping commodity prices low.

2. Gas resource potential

The NPC report [1] begins with a review of the growth in estimates of the technically recoverable natural gas resources in the United States over the past 12 years (Fig. 1). Since 1999, estimates of the gas resource potential have continually increased as the impact of the shale gas revolution has allowed forecasters to begin including that resource into their estimates. In the past half decade, the Potential Gas Committee at Colorado School of Mines has attributed all its increased gas resource estimates to growth in shale gas [3]. The recognition of the potential of shale resources has contributed to ever-escalating resource potential estimates. In fact, in the three latest cases analyzed in the NPC report, even the Low potential shale gas case contains an estimate that is slightly greater than the latest shale gas resource estimate issued by the Potential Gas Committee. The High resource case estimate has a shale gas projection that is more than twice as large as the most optimistic shale gas projection made earlier this year by the U.S. Energy Information Administration [4].

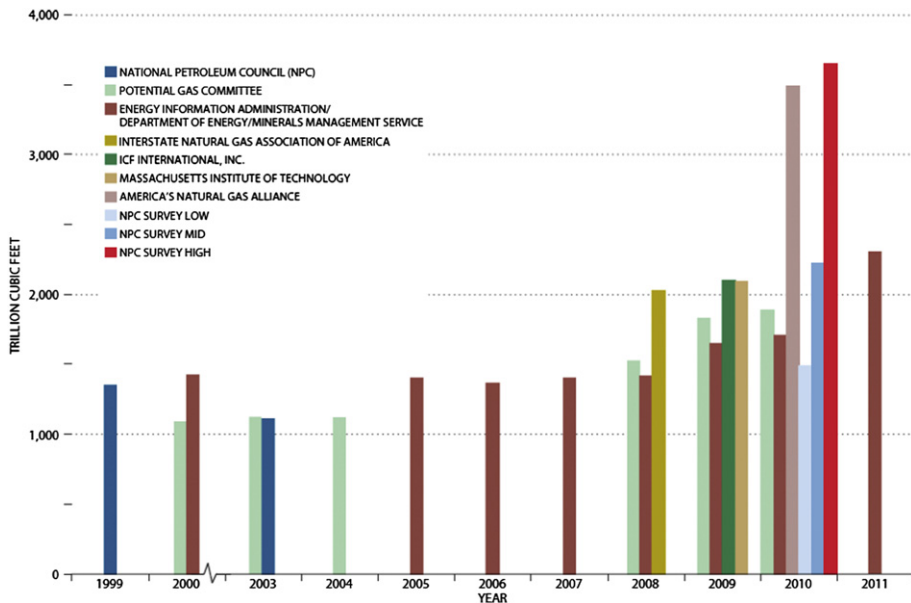


Fig. 1. Potential natural gas resource estimates have climbed as more shale gas basins have begun production supporting their inclusion [1].

3. Natural gas production scenarios

The NPC report [1] includes an examination of various future production scenarios, for both conventional and unconventional gas resources, in the United States and Canada. Using the data from the production outlook for the United States, the NPC report projects that only in the High case will the future conventional gas production succeed in surpassing 2009's production (Fig. 2).

Under all forecast scenarios, unconventional natural gas production through 2035 is projected to exceed 2009 production. The key ingredient for this projected growth in unconventional production is the anticipated increase in shale gas output in every

case. The High case, however, is the only projection in which all three unconventional gas categories – tight, coalbed methane and shale gas – are expected to significantly expand beyond the 2009 volumes (Fig. 3).

The patterns for future conventional and unconventional gas production are similar to those for the United States. When the production forecasts are combined into a North American outlook, there is a clear upward trend exhibited for nearly the entire 25-year forecast period (Fig. 4). More importantly, when projected natural gas demand is compared to the supply growth forecasts, the data shows that sometime within the next several years North American natural gas production will begin to outpace demand. This pattern is projected

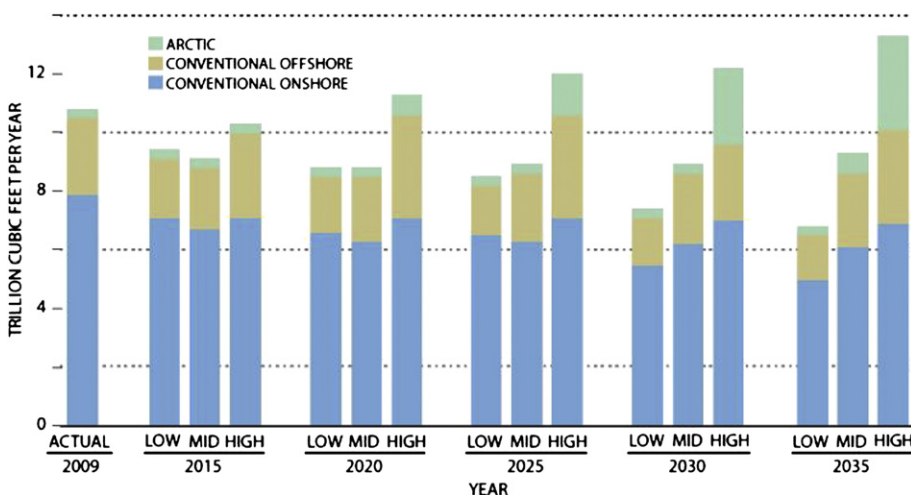


Fig. 2. Future US conventional natural gas will only exceed 2009's production in the most optimistic case, which depends on more expensive offshore and Arctic production [1]. Source: NPC Industry Aggregated Data.

to extend through the end of the 2035 forecast period. If proven correct, it would suggest there is a limit on how high domestic natural gas prices can rise in the foreseeable future.

4. Gas supply and resource cost

The NPC report examined estimates of recoverable gas resources versus the cost of supply at the wellhead. The three scenarios analyzed show that in each case there is little additional resource potential added even when the cost of supply exceeds \$20 per million British thermal units (Fig. 5), a very high cost estimate. Using the \$20 cost figure as a cutoff, the NPC concludes that estimates of ultimately recoverable onshore gas resources, including cumulative production to date, range from 3000 trillion cubic feet (Tcf) up to 4700 Tcf. This conclusion raises the question of why that high a price was used in estimating the resource potential unless there is the expectation that such a high price is needed to bring forth the investment required to develop the potential resource.

With its optimistic outlook for natural gas supply and cost (not market price), the NPC study turned its attention to how long the ultimate recoverable gas supply cases can meet projected demand. To do that the study developed three scenarios: flat supply, supply growth and restricted supply, and compared each demand scenario against the three supply forecasts. In the flat supply case (Fig. 6), a constant 24 Tcf/year of gas supply, equal to current gas consumption (demand), is assumed. The analysis concludes that this level of supply can satisfy that demand for the next five to nine decades.

In the supply growth scenario, production is assumed to increase by 50% from 24 Tcf/year to 36.5 Tcf/year. The increase requires a decade to achieve. The study then projects that after 2020 that higher level of supply could be sustained for two to four decades. The NPC says that should market needs (demand) be greater, other supply sources such as offshore gas, Arctic gas or imported LNG would be added to the gas supply mix to meet the higher demand.

The restricted gas supply scenario analyzes the impact of supply restrictions, such as regulatory limitations on the use of hydraulic fracturing and/or restricting industry access to the resource. In an extreme limitation case, such as completely banning the use of hydraulic fracturing, the potential supply plateau would be eliminated entirely. In a moderate limitation scenario where the restrictions cut unconventional gas supply by one-third, the

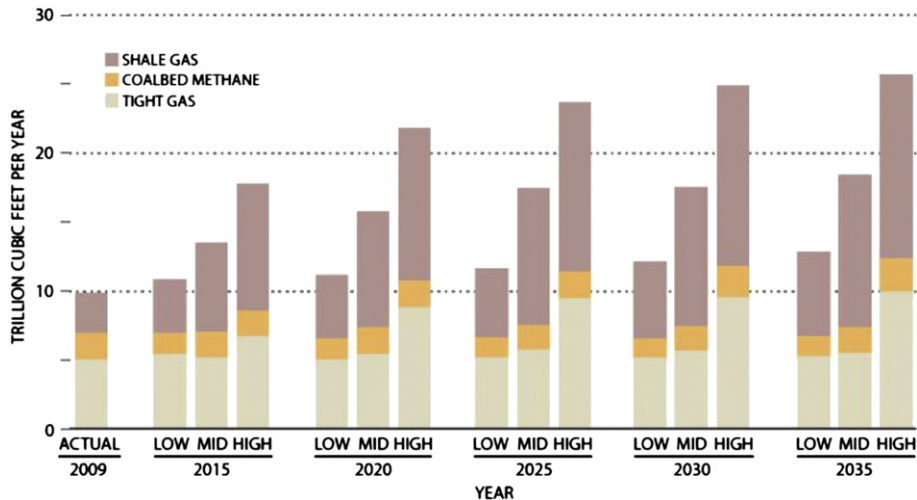


Fig. 3. Growth in unconventional gas production is highly dependent upon continued success in shale gas output [1]. Source: NPC Industry Aggregated Data.

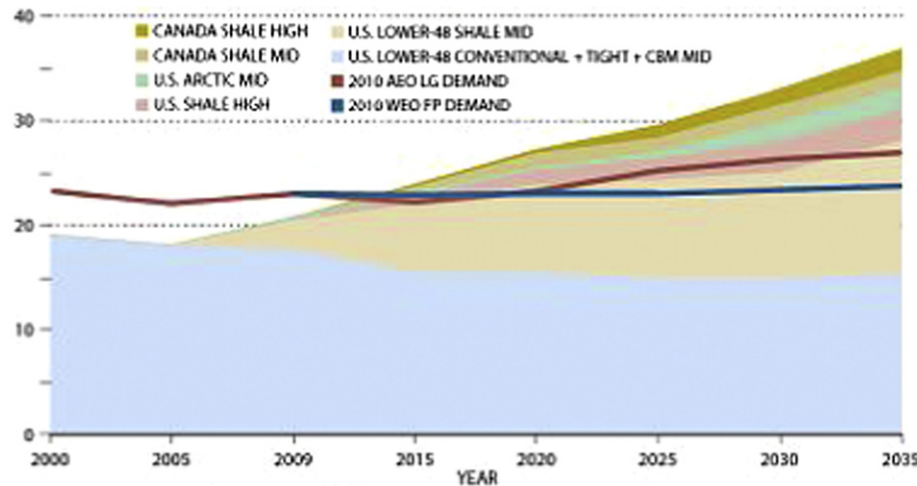


Fig. 4. Industry estimates of potential natural gas production from North American supply sources. Natural gas production is forecast to outstrip gas demand throughout most of the 25-year period [1].

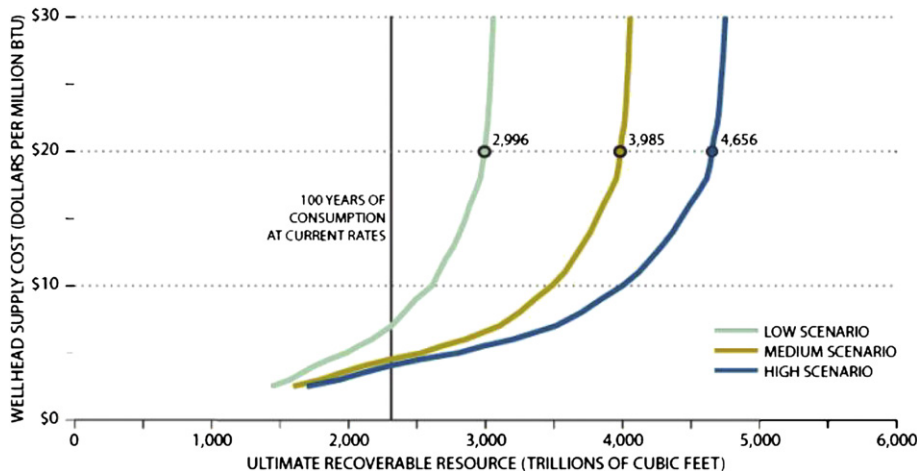


Fig. 5. Estimates of the potential for supply and the cost to develop it (not the market price) suggest that North America has more than sufficient gas to meet 100 years of current demand [1].

plateau would be reduced from 80–90 years duration to only about 40–50 years.

The NPC report combined all three scenarios into one chart showing how the North American gas market might develop (Fig. 6). As Fig. 6 demonstrates, energy development policy decisions have the potential to dramatically impact the domestic energy market. This is why the NPC report highlighted the need to develop unconventional resources in an environmentally responsible manner in order to minimize the risk of a regulatory backlash that could significantly limit the contribution. This “IF” issue is extremely important for those companies that have built their business model on the aggressive exploitation of North American shale gas resources, because they need high well flows in order to generate cash flows to support their businesses.

5. The economics of natural gas supply

There is little doubt in reading the NPC report that its authors believe in a positive long-term outlook for North American natural gas and oil markets. The report describes the game-changing outlook for these markets due to the identification of huge shale resources combined with the development of drilling and completion technology enabling the industry to tap them. The optimism about the impact of shale gas on the North American natural gas market may be justified. However, the absence of any discussion about gas prices or an examination of the claims by critics of shale gas well and reservoir performance leaves the reader questioning the appropriateness of basing energy policy decisions on the report’s conclusions. The existence of the shale gas resource is not questioned, nor is the technical ability to extract it, but the economics of shale plays needs greater analysis.

Earlier this year, an interdisciplinary study group at the Massachusetts Institute of Technology (MIT) published a report titled “The Future of Natural Gas” [5]. That report was drawn on by the NPC for its report. In the MIT report, the study group addressed some of the economic issues with the shale gas resource, although without addressing the truly critical issue of profitability given the pace of drilling and current low gas prices. A chart (Fig. 7) was presented in the report showing the estimated breakeven gas price versus the resource base for each type of gas supply – conventional, shale, tight and coalbed (CBM). The discussion in the report ignored CBM and tight gas and focused exclusively on the interplay between the shale and conventional gas resource. The low cost for

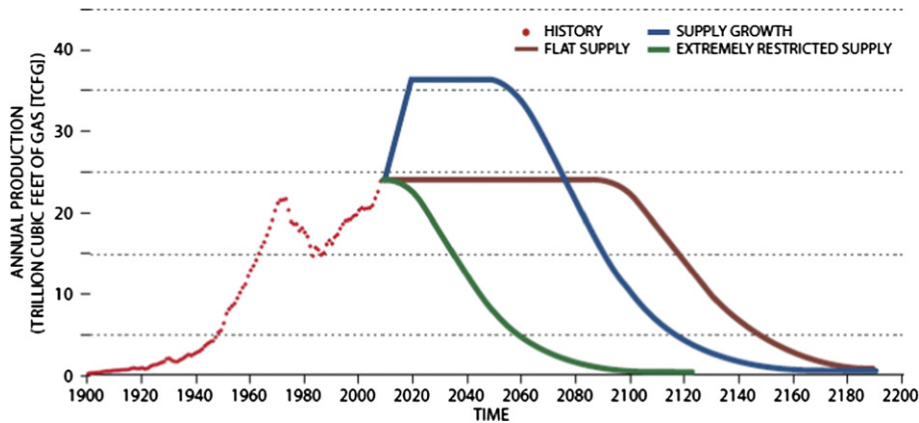


Fig. 6. Comparison of three supply scenarios: Mean Resource Base, Advanced Technology, and 2007 Cost Index. Environmental issues surrounding the development of the shale gas resource could lead to a very rapid shrinkage of future gas supply [1].

developing shale gas would allow it to undercut the development of conventional gas putting downward pressure on overall natural gas prices. That scenario can be seen by observing the spread between the shale gas price-volume curve and that for conventional gas. Eventually a point is reached at which the cost for shale gas rises vertically without bringing forth additional gas, while on the other hand, conventional gas prices continue rising, but more gradually, while bringing forth additional supply. A question is how long the industry will or can tolerate gas-on-gas price competition, which depresses overall natural gas prices and producer profitability.

The MIT study [5] generated a table containing data on initial production per well and estimated breakeven prices for dry

gas in five of the major shale basins of the United States assuming different confidence levels of the existence of the resource (Table 1). Focusing on the P50 case, the Marcellus shale has the lowest breakeven price at \$4.02 per thousand cubic feet (Mcf) of production. The Haynesville, a highly prolific shale gas basin, has the next lowest breakeven price at \$5.12/Mcf, while the Barnett basin, the oldest and most mature basin has the highest cost at \$6.53/Mcf. At the time the interim report was prepared (during the second half of 2010) [5] the average of the six monthly average prices for gas at the Henry Hub terminal was \$4.04/Mcf [6]. For the first six months of 2011, the Henry Hub average price was \$4.27/Mcf [6]. These prices are marginally above the estimated breakeven

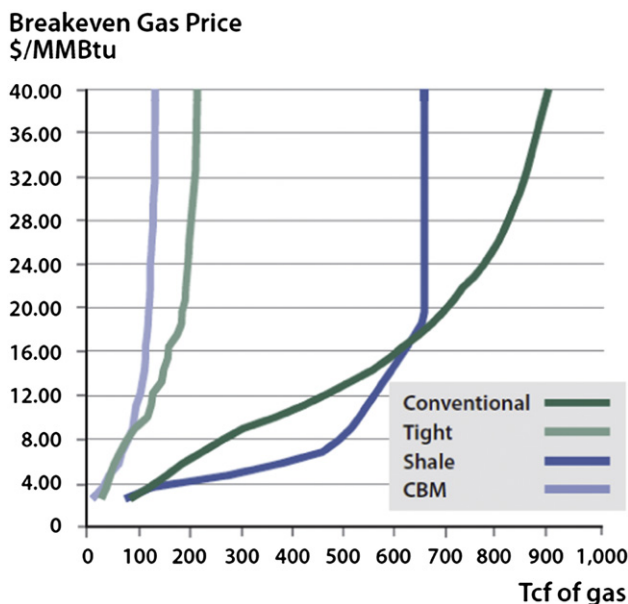


Fig. 7. Shale gas development will create gas-on-gas price competition with conventional gas for an extended period of time [5].

price for the low-cost Marcellus shale gas, but considerably below the breakeven prices required for the balance of the shale basins.

The problem for gas shale economics is highlighted by the comparison of breakeven prices and current spot prices for gas. A key reason why spot prices are depressed is the growth in shale gas production, which has increased fourfold since 2000 and today accounts for nearly a fifth of total U.S. production. Shale gas is projected to grow nearly threefold between now and 2035 and represent nearly half of all gas production in the United States [7]. To understand the potential long-term challenge for the natural gas market, one need only look at a forecast from the MIT study showing what could happen to production from the five top shale gas basins if the industry continues drilling at its 2010 pace and the mean production rate for the wells is sustained. From about 14 billion cubic feet per day (Bcf/d) in 2010, production from these five basins is forecast to more than double to 29 Bcf/d by 2030 at which time the basins are expected to become mature and new drilling and production will largely offset declining production from earlier wells (Fig. 8).

Gas prices for the first six months of 2011 were boosted by a colder than normal winter and a very hot summer in certain regions of the United States. Through the first nine months of this year, the gas price has averaged only about five percent greater than it did during the second half of 2010 [6]. Until the gas demand dependent upon economic activity begins to grow and more gas-fired electric generating capacity comes on stream, natural gas prices will remain at the mercy of the weather. The forward strip for natural gas futures prices shows that the \$5.00/Mcf threshold will not be reached before January 2014 and then only for that month during the height of the winter season [8]. It is not until 2015 that gas futures prices are consistently above \$5.00/Mcf [8]. Even then, gas prices will only exceed breakeven prices for two of the five major shale basins.

6. Impact of LNG exports

The recent announcement of a contract for BG Group [2,9] to purchase LNG exported from a Gulf of Mexico receiving terminal owned by Cheniere Energy Partners is raising questions about whether the natural gas market is about to change. The contract calls for BG to purchase 3.5 million tons per annum (mtpa) at 115 percent of the Henry Hub price plus a fixed fee of \$2.25 per million British thermal units (mmbtu). The contract has a life of 20 years following the

Table 1

At Henry Hub 2011 spot gas prices only the Marcellus shale is profitable (at P50 or higher), especially if the Pennsylvanian mark-up wellhead prices are taken into account [5] (IP = initial production; BEP = breakeven price.).

	Barnett		Fayetteville		Haynesville		Marcellus		Woodford	
	IP Mcf/d	BEP \$/Mcf	IP Mcf/d	BEP \$/Mcf	IP Mcf/d	BEP \$/Mcf	IP Mcf/d	BEP \$/Mcf	IP Mcf/d	BEP \$/Mcf
P20	2700	\$4.27	3090	\$3.85	12630	\$3.49	5500	\$2.88	3920	\$4.12
P50	1610	\$6.53	1960	\$5.53	7730	\$5.12	3500	\$4.02	2340	\$6.34
P80	860	\$11.46	1140	\$8.87	2600	\$13.42	2000	\$6.31	790	\$17.04

date of the first shipment. Cheniere is reportedly in discussions with other buyers, primarily Asian companies, for initially an equal volume of LNG. Once it has contracts for 7 mtpa, Cheniere will be able to raise the money to build the first phase of the liquefaction facilities. Assuming the contract receives approval from the regulatory authorities, construction could begin in 2012 with first shipments in 2015–2016.

An analysis of the economics of the contract, based on current Henry Hub prices, suggests that there is a \$2.10 cost advantage for U.S. LNG to Asian markets and a \$1.36 advantage to Europe [9]. Based on information in the Navigant Consulting report that accompanied Cheniere's application for permission to build the terminal and export LNG, supplying 7.5 mtpa, the equivalent of 1 Bcf/d of natural gas from Henry Hub could boost prices by \$0.20/mmbtu in 2015. Supplying 15 mtpa, or 2 Bcf/d, could have the impact of raising spot prices by \$0.35/mmbtu [10]. If those price increases do occur, they will reduce the cost advantage of U.S. LNG.

The contract still requires the approval of the Federal Energy Regulatory Commission (FERC) to construct the liquefaction facilities and ongoing approval to export the natural gas from the Department of Energy.

That latter approval requirement is the safety valve for a shift in domestic natural gas markets from loose (low prices) to tight (high prices). That safety valve provides greater protection for BG as the buyer who, under the contract terms, is accepting the risk of rising Henry Hub spot gas prices eroding the market potential for this gas supply.

7. Natural gas outlook for North America

It would appear that the optimism of the NPC report may be premature as its outlook for strong production (supply) growth while maintaining low prices will be difficult to achieve without inflicting serious financial harm on producing companies. Recent energy company merger and acquisition activity suggests that some shale gas players may already have reached the limits of their financial resources and are being forced to sell out. While many of these transactions are being hailed as confirmation of the success of the shale gas revolution, they may actually point out weakness in company business models.

The NPC report ignored supply and demand dynamics currently setting natural gas prices at levels well below the true

economic cost to develop shale gas resources [11]. As long as natural gas producers are willing to continue subsidizing consumers at the expense of shareholders, production will continue to grow and profitability will be restricted. Until that equation changes, it is difficult to see how the extensive potential North American shale gas resources can be tapped on a sustained and profitable basis. At some point, economics dictate higher natural gas prices. While producers will benefit, consumers who were lulled into believing that cheap and abundant gas supplies could be sustained for long periods of time will suffer. Higher gas prices will limit demand growth with negative price elasticity implications for the gas market. By completely ignoring current market dynamics, natural gas prices and well economics, the NPC report [1] may be pointing the US and Canada in the wrong strategic direction on energy policy.

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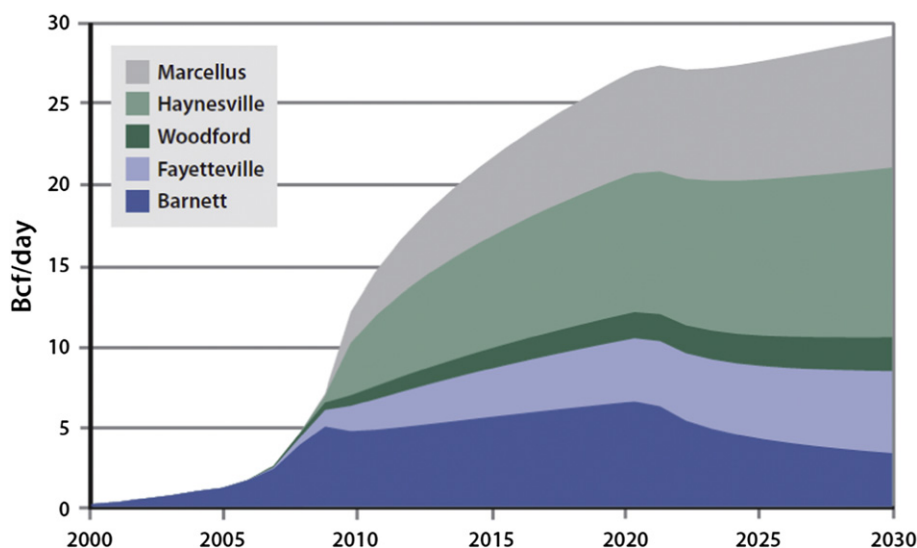


Fig. 8. At the pace of 2010 drilling, future production from the five top shale gas basins is forecast to more than double by 2030 [5].