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Skiffergas och –olja i USA – En underlagsrapport till Näringsdepartementet

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1 Overview

In less than ten years, shale gas has gone from being a marginal energy source to providing 40 % of all US natural gas, and gas in turn constitutes more than a quarter of US energy consumption. From 2007-8, when the possibilities for profitable application of directional drilling and hydraulic fracturing technologies (fracking) started to be widely recognised, shale gas has revolutionized the US energy scene, with potential repercussions on the global energy and security outlook.

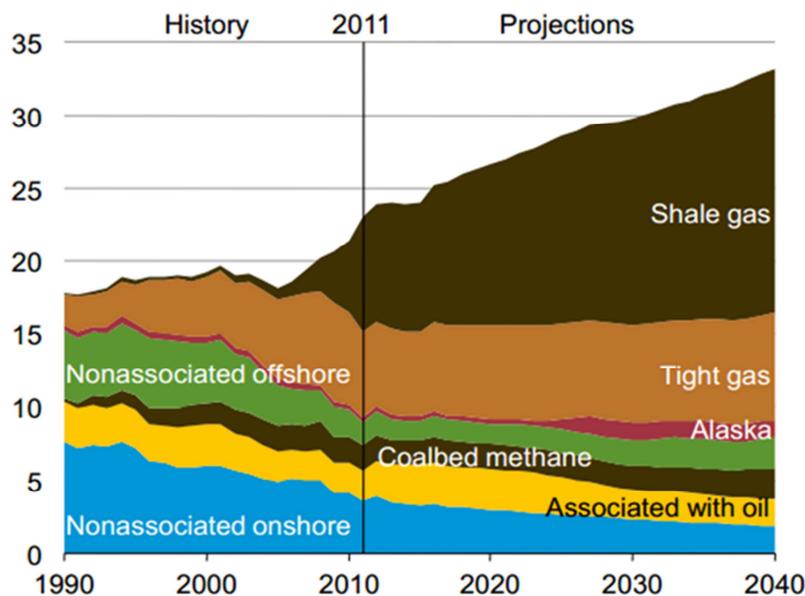


Figure 1 U.S. natural gas production, 1990-2011 + Projections, trillion cubic feet. EIA, Annual Energy Outlook 2013.

Although there is a lively debate on the environmental aspects of shale gas production and the need for more regulation, and the long term economics of extraction are still uncertain, it seems clear that shale gas is poised to occupy an important role on US energy markets over the coming decades. While gas prices the past year have resurfaced from their historic low of April 2012, they are still at a competitive level, with a substantial price differential to e.g. European gas prices. Sparked by the low prices, and strengthened by pending stricter emissions regulations, there has been a large coal-to-gas switch in US electricity generation; in part structural, reflecting retirement of older coal plants and construction of new natural gas plants, in part cyclical, responding to current coal/gas prices and other factors. Apart from the traditional uses, gas is now also increasingly considered for different transport solutions.

A similar development is taking place for tight oil/shale oil (the broader term *tight oil* which encompasses unconventional oil from shale as well as from other low permeability bedrock is commonly used in the US). Domestic oil production has increased fast over the last years, due primarily to tight oil production, which

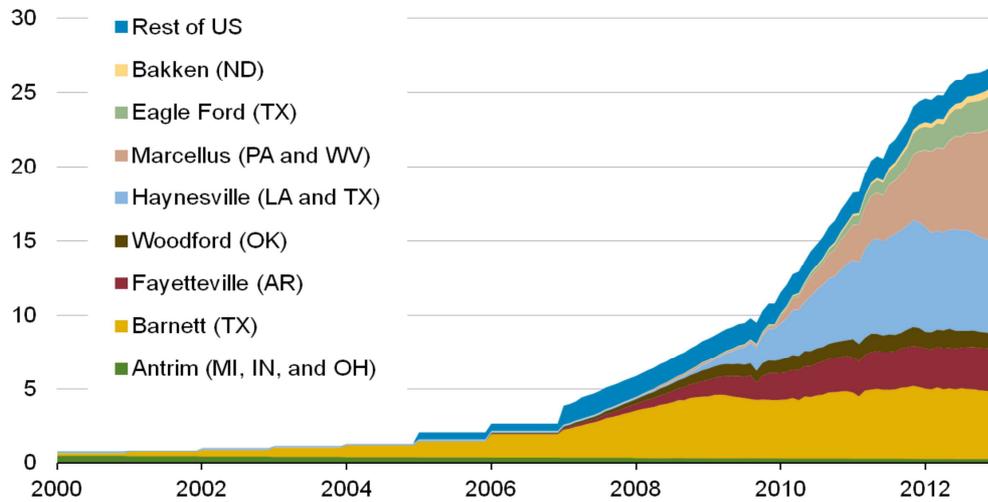


Figure 3 US Shale gas production by shale play. EIA 2013/NREL

Estimates of the recoverable shale gas reserves differ, but in all cases the resource base is very large. The most recent estimates compiled by EIA put the *technically* recoverable shale gas reserves at 665 trillion cubic feet. Industry estimates tend to be higher. For comparison, the US consumes approximately 25 trillion cubic feet natural gas yearly. The total US gas reserves, including conventional and other sources, constitute more than 100 years of supply at current consumption levels. EIA corresponding estimates for US tight oil reserves are 58 billion barrels, or 26% of aggregate oil reserves¹.

Oil and natural gas production is fully in the hands of private enterprises, even though about four-fifths of the country's recoverable resources are on federal land or in federally controlled offshore waters. There several thousand operating companies active in oil and gas exploration and production, including many foreign companies, and there is little vertical integration. In the gas sector, even the largest companies have only a limited share of the market.

The natural gas market is dynamic and competitive, with an active spot and futures market. Regional U.S. markets are highly integrated, thanks to an extensive national network of high-pressure transmission pipelines, market centres and hubs. The large number of drilling rigs, a well-established oil and gas industry and widespread pipeline and other infrastructure for gas has been a decisive factor in the quick ramp-up of shale gas in the US. The fast increasing production and the regional/domestic markets and limited exports has led to falling gas prices. After hitting a historic low in 2012, prices have now risen again to 4\$/MBtu a level which is probably more consistent with profitable production.

¹ <http://www.eia.gov/analysis/studies/worldshalegas>

There is in fact also a proto-debate regarding the *real* profitability and energy turn-out of shale gas production, with hints that the wells are not as profitable or long term productive as alleged by the industry, but it is yet hard to probe the substance of this. At any rate, the industry is still in a development phase. The knowledge regarding production processes, how different plays and bore holes behave over time, reserve estimates etc. is evolving, while the industry continues to deliver increasing amounts of gas.

2.1 Shale gas/oil consumption

The shale gas and oil industry produces natural gas (methane), different types of gas liquids (butane, propane, ethane, natural gasoline) and crude oil.

The natural gas goes into the ordinary US gas market. Gas is used pre-dominantly for heating and cooking in residential and commercial markets, as an industry energy source/feedstock in chemical industry and for electricity generation. Gas is also to a smaller degree used in transport.

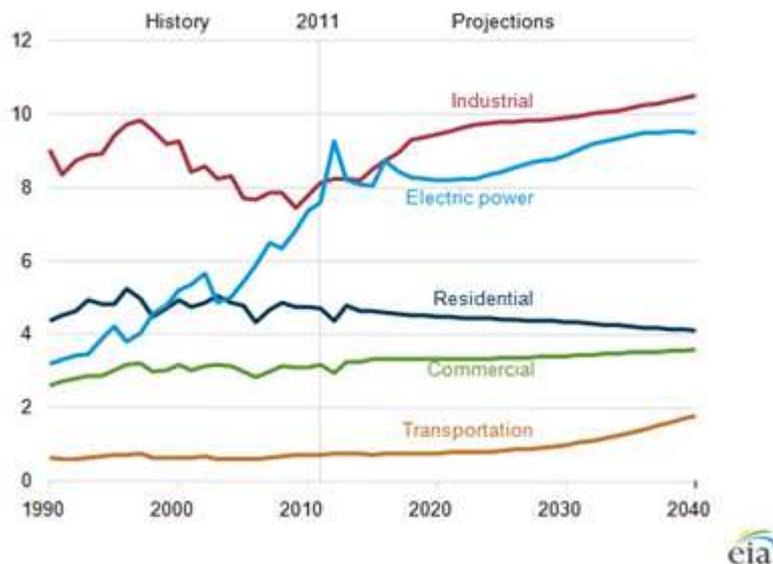


Figure 4 Natural gas consumption per sector, 1990 -2040. EIA 2013

Low gas prices have led to a conversion from coal to gas in electricity production, and to correspondingly lower electricity prices. Gas now accounts for approximately 30-35% of electricity production, up 10 percentage points over 5 years.

Industry benefits from the influx of cheap gas; generally from lowered electricity prices and specifically for industries that uses gas in their production processes or as a feedstock. A number of cases of planned re-establishment of energy intensive industry in US have been noted.

New uses for natural gas in transport are also underway, including shifting from diesel engines to natural gas in trains and light and heavy duty commercial trucks.

2.2 Technology and institutional factors/innovations which influence development

Shale gas production is still a young activity and fracking not a mature technology. The industry will probably be dependent on continuous innovation in production techniques/processes and related infrastructure, in order for gas production to continue proliferating and spreading to more complex bedrock formations and lesser yielding plays, as well as to tackle environmental and other challenges.

Potentially large, negative local environmental impacts of gas production means that both better technology and better ways of engaging with local communities will probably be important for the industry to continue developing.

The US Environmental Protection Agency is at the request of Congress currently undertaking an inventory of environmental aspects of shale gas production, with concern over ground water effects at the forefront. Critics mean that gas production is currently neither obliged to live up to existing environmental legislation, nor is there sufficient state or federal regulation in place.

Since many shale plays are located on public lands, leasing and permitting by the authorities is another issue.

3 Political aspects and tendencies, motives for extraction

Shale gas development is largely driven by market forces (even though early R&D in fracking techniques was helped by federal support). However, the gas and oil boom is by and large embraced by many politicians, as it helps securing cheap energy for the US and produces income and jobs. Gas is also by many seen as clean, at least in relation to coal. President Obama, who focused a lot on renewables and the climate issue in his first years, has redefined his policy to supporting all domestic energy production. Still, there is criticism from republicans that the administration is not as active as it should be in permitting oil and gas production on federal land.

At the same time there is also a widespread opposition to the shale gas extraction; from environmental groups, from diverse politicians as well as from local groups, in particular in regions where the negative side effects of fracking and gas extraction have been apparent. There are concerns over the long term effects on groundwater, local air quality/smog and seismic effects of fracking. And the possible climate benefits of gas in relation to coal are uncertain and debated, with respect to fugitive methane. Environmental groups tend to highlight that the industry is under-regulated. But overall, the debate is mostly on which regulation, development of technology and R&D in general that are needed in order to maximise the benefits of the shale gas revolution and secure a long term and sustainable development of the sector, rather than on whether shale gas should at all be a part of the US energy portfolio.

During the first months of his second administration Obama again lifted the climate issue, for example in the State of the Union address. The recent summit agreement with the Chinese president on tackling HFC's may be step in this direction. There is now speculation in the press that the president will unveil a climate strategy sometime during the summer. To what extent such a strategy would mean a push for more gas (for example by phasing out coal-fired power generation, the single largest US source of carbon dioxide emissions) or put in place measures that might rein in long term growth in gas and oil (for example a carbon tax) of course remains to be seen.

4 The Future; strategies and trade-offs out going forward

The large perceived benefits to industry, consumers and the economy at large point towards the US trying to develop a regime that enables a continued development of the gas sector. A number of the issues at hand - the regulatory landscape, environmental concern, the availability of public land for exploration - have been discussed above.

A specific medium term issue concerns gas exports. Today, only limited amounts of gas are exported, mainly by pipeline to Mexico and Canada, and to a smaller degree in liquefied form to Japan, South Korea and a few others. Given the large price differentials between the US and other gas markets, there is a lot of interest from the energy industry side in increasing exports. Politically it is sensitive though, since large scale exports would risk a backlash in the form of higher domestic energy prices. On the other hand exports would sustain jobs in the gas industry, help the current account and can be of geopolitical importance. A number of applications for export permits are handled by the administration at the moment.

4.1 Geopolitical perspective, international relations

As mentioned, the gas and oil boom has fundamentally altered the US energy outlook, with the diminishing dependence on imported fuel as a major factor. A number of de facto and potential aspects of international relations linked to this development are present and to a lesser or higher degree debated. US companies are already present in China, assisting in attempts to develop the Chinese shale deposits, which are huge but not necessarily as easily extracted as in the US. The possible future exports of large amounts of US and other shale gas will have repercussions, with in particular Russia and the Middle East standing to lose. Another issue for speculation is whether a diminished dependence on imported oil from the Persian Gulf also turns into a less active US military presence in that region.