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The Shale Gas Revolution

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The notion of "energy independence" has been part of the American political dialogue at least since the Nixon administration, over forty years ago. Now there seems to be some possibility that the United States will actually achieve energy independence, or come close to it, within the next 20 years – at least according to the recent world energy outlook to 2035 produced by the Paris-based International Energy Agency. Just a few years ago the United States imported 10 million barrels of oil a day (roughly 500 million metric tons a year), over half US oil consumption. How is this radical prospective change possible?

The answer lies mainly in "shale oil," a term that was hardly known outside circles of specialists a few years ago. Thanks to advances in technology that have taken place over the past two decades – both in collecting and interpreting seismic information, and in drilling horizontally from deep wells –gas that has been locked in dense rock – and known about for over a century – has become economically accessible. The process is call "fracking," whereby a combination of water, sand, and certain chemicals is injected at high pressure into the shale, cracking it and releasing the trapped gas to flow up the well-pipe for human use.

Shale gas now accounts for over a third of total US gas production, which has risen by a third since 2005 and is expected to rise by a further 25 percent by 2030. US production of petroleum liquids– a similar process can also produce oil from previously inaccessible formations, and some of the gas contains petroleum liquids—has risen by over a million barrels a day since 2005, after having fallen for over a decade. The IEA expects the United States briefly to overtake Saudi Arabia as the world's largest producer of petroleum in the early 2020s. Along with conservation, especially in automobiles, US imports of oil are expected to drop significantly, from 60 percent of total consumption in 2005 to 41 percent in 2012 to an estimated 34 percent by 2020.

In the United States over half the natural gas is used as a feedstock for the petrochemical industry. It is also used for heating and cooking, but its main use as a fuel is for generating electricity, where it has accounted for 77 percent of incremental power generation capacity since 1990. Much coal is also used for power generation, but in 2012 gas briefly reached coal as the major source of electricity for the first time. Over time the two fuels will compete closely on the basis of relative cost (possibly inclusive of CO2 emission charges in the future). More gas will help reduce pollution from power generation – although coal-fired plants are already subject to extensive environmental regulation. And gas will release only about half of the amount of carbon dioxide, an important greenhouse gas, as does coal for the same amount of electricity generated. US coal production may as a result decline, or alternatively it might be directed into foreign markets since it has become relatively cheap.

Thus "energy independence" in the US context does not mean that the United States ceases to import oil, which has been the main source of concern about security of supply, but rather that US exports of coal and natural gas will contain the energy equivalent of US imports of oil, which have already declined from their peak. It is possible, however, that US imports of oil in twenty years can be fully satisfied from Canada and Mexico, both of which have unexploited oil resources. If so, North America as a whole would be self-sufficient in oil, and a net exporter of energy. US market prices, however, would still be tied to world oil prices, giving the United States a continuing interest in world oil developments.

In addition to substituting for coal in electricity generation, and thereby reducing air pollutants and greenhouse gas emissions, the shale gas revolution has a number of other implications. First, it will provide a cheap (and sometimes alternative to oil) feedstock for the petrochemical and plastics industries. Just how cheap will depend on decisions yet to be made about permitting the export of gas (beyond Canada and Mexico, which are covered under the North American Free Trade Agreement), and the investments required to do so. While only one liquefied natural gas (LNG) export facility has formally been permitted, it is likely that many of the other 20-odd applications will be approved, since failure to do so would open the Americans to the charge of restricting exports in order to favor the domestic chemical industry, which would not be acceptable in Europe and other parts of the world. Export of gas, particularly to Northeast Asia, should be profitable, since prices there exceed $15 per million Btu (British thermal units, a unit for measuring energy), compared with $4 in the United States – more than enough to cover the $5-6 cost of moving the gas to the West Coast, liquefying it, shipping it across the Pacific, and re-gasifying it in the destination countries – Japan, South Korea, and perhaps China. With exportation, gas prices would rise in the United States, but still remain well below the effective prices in Europe and Asia.

Second, it is possible that cheap gas will substitute for expensive oil not only in home heating, where fuel oil is still extensively used, but also in transportation, particularly where fleets of vehicles can be serviced in central locations, such as city buses, taxi cabs, and delivery and refuse trucks. It would take much longer for gas to substitute significantly for oil in individual passenger vehicles, although that too is technically possible (as demonstrated currently in Iran); and it could be accelerated by a charge on CO2 emissions and by introduction of small scale gas-to-liquid conversion plants. China is already substituting expensive LNG for diesel fuel in trucks and buses, to reduce air pollution.

Third, cheap gas will probably set back for a few decades the further development of nuclear power in the United States, given the serious public reservations about nuclear power on other grounds, re-enforced by the accident at Fukushima in Japan. Finally, cheap gas for generating electricity will also set back the development and installation of renewable sources of power (wind, solar, and biomass), except insofar as costs of those sources decline significantly, or subsidies are raised significantly, although wind (with current subsidies) will be competitive in some areas.

What of the rest of the world? Significant deposits of shale gas seem to be available in Russia, but if developed they would compete with conventional Russian gas which is already highly priced for delivery in Europe; indeed, the potential for exporting gas from the United States is already putting

downward pressure on Russian gas export prices. China too seems to have promising geology for shale gas, although at present it lacks the technology for developing it efficiently; it is remote from the main consuming areas; and its heavy requirements for water may limit development in parts of China, where water is already scarce, even over the longer term.