Oil and Water *do* Mix: The Iraq Example for Challenges Associated with the Energy-Water Nexus

Prepared by Minority Staff for Ranking Member Lisa Murkowski
U.S. Senate Committee on Energy and Natural Resources
October 29, 2014

Introduction

Water is a necessary ingredient in energy production. With the nation's on-going boom in unconventional oil and gas production, Americans are becoming increasingly aware of this nexus between fuels production and the associated water requirements.[1] We are also witnessing this energy-water nexus in Iraq – a country where oil production is key to its economic recovery. The recent rise of ISIS brought to light (in a dark way) the strategic importance of controlling functioning oil fields which, for better or for worse, finance and facilitate gains in battle and territory.[2] The world needs a stable, democratic and prosperous Iraq. But as the latest regional conflicts rage on, one thing is clear – in order for Iraq to develop its oil reserves another resource that is rather scarce in that region must be made continuously available, and that resource is *water*.

This paper provides a concise analysis of the importance of water resources for oil production in Iraq, which is the main source of income for that country and represents some of its best future prospects for economic development, in addition to potential natural gas exports.[3] It also highlights innovative and sustainable solutions for the continuous supply of water in areas where freshwater is a scarce resource.

Water for Oil

In recent weeks, ISIS has relentlessly attempted to seize Iraq's main dams, waterways, and other critical water infrastructure.[4] If successful, ISIS will control the most basic resource necessary for sustaining the lives and livelihood of millions of Iraqis. At the same time, the conflict can also affect the availability of water for energy production purposes, specifically oil production. Indeed, Iraq has the fifth largest proven oil reserves in the world.[5] By one estimate, Iraq could gain close to $5 trillion in revenues from oil exports through 2035, which could sustain a robust

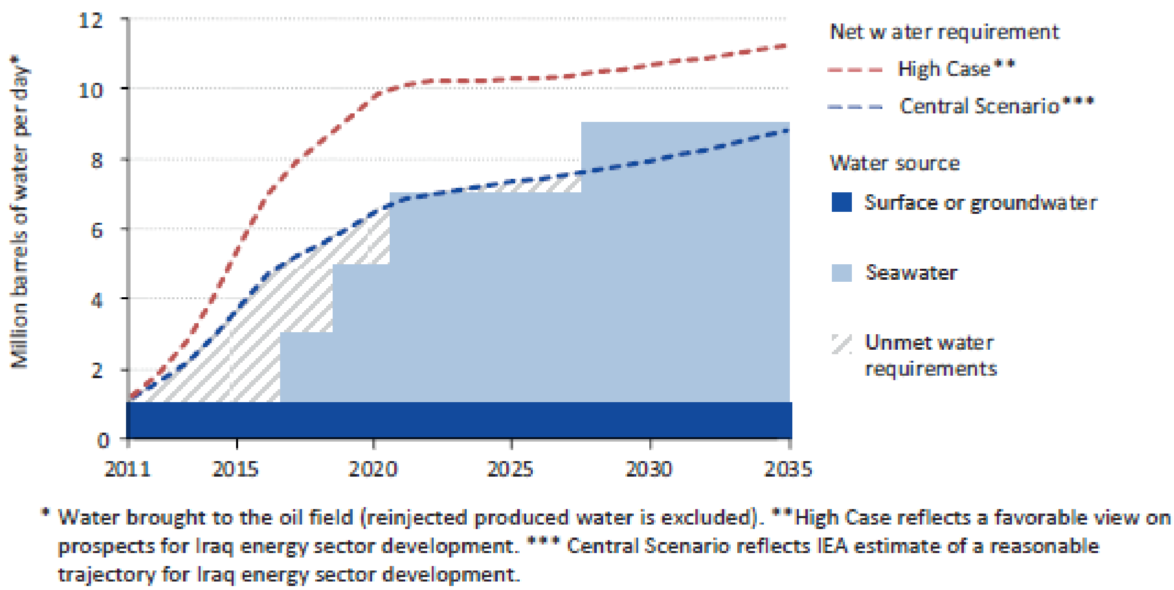
---

[1] Sen. Murkowski, *The Energy-Water Nexus: Interlinked Resources that are Vital for Economic Growth and Sustainability*, May 2014: http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=9d529812-659b-43a1-a2d1-ef0e67894636.
[2] See U.S. Senate Committee on Energy and Natural Resources (ENR) Minority Staff report, *A Dark Pool in the Middle East*, September 2014: http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=005f682a-cc3f-4bd2-91b6-d68e0527439d.
[3] The International Energy Agency (IEA), *Iraq Energy Outlook*, October 2012, pp. 11-13.
[4] http://www.washingtonpost.com/world/middle_east/islamic-state-jihadists-are-using-water-as-a-weapon-in-iraq/2014/10/06/aead6792-79ec-4c7c-8f2f-fd7b95765d09_story.html.
[5] Energy Information Administration (EIA), *Iraq Country Profile*, April 2013: http://www.eia.gov/countries/cab.cfm?fips=iz.

economic growth and enhance overall stability.[6] One government plan called for more than a three-fold increase in oil production from 3 million barrels per day in 2012 to 9.5 million barrels per day by 2017.[7] However, these goals (which already reflect a downward revision from a previous production target) have been hindered by various infrastructure constraints (e.g., deteriorated pipelines, sabotaged facilities and pipelines, and a large increase in electricity demand) and, perhaps a less known constraint – water availability.[8]

Senator Murkowski's recent white paper, *The Energy-Water Nexus: Interlinked Resources that are Vital for Economic Growth and Sustainability*, explores the indispensable interlinks between energy production and water resources, and the challenges faced by regions that lack the latter.[9] In Iraq, water is needed to maintain the pressure of oil reservoirs for continuous oil production. It is estimated that on average 1.5 barrels of injected water are required to fill oil reservoir voids created by the extraction of 1 barrel of oil.[10] The International Energy Agency (IEA) estimates that the amount of water needed to maintain oil production in two major fields in Iraq will increase from 1.6 million barrels per day in 2011 to over 12 million barrels per day in 2035.[11] In southern Iraq alone, where water injection needs are highest, approximately 9 million barrels per

Figure 1: Estimated Net Water Requirements in Southern Iraq Oil Fields by Source



Source: Adapted from data in IEA's Iraq Energy Outlook (Oct 2012).

[6] IEA, *Iraq Energy Outlook*, October 2012, p. 11.
[7] *Ibid*.
[8] *Ibid*.
[9] Sen. Murkowski, *The Energy-Water Nexus: Interlinked Resources that are Vital for Economic Growth and Sustainability*, May 2014: http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=9d529812-659b-43a1-a2d1-ef0e67894636.
[10] IEA, *Iraq Energy Outlook*, October 2012, p. 67.
[11] *Ibid*.

day of water would be required by 2035 according to the Central Scenario (see Figure 1).

Oil, Oil everywhere but Water – Not so Much

As illustrated in Figure 1, the amount of surface and groundwater currently available for oil production is far below the amount needed for production expansion – and this is only for the southern oil fields. This deficit is exacerbated by Iraq's limited freshwater sources; its poor water infrastructure; its position as a downstream nation reliant on multi-national rivers; and the region's drought susceptibility. Absent concrete and sustainable solutions for emerging chronic water shortages, oil production and with it Iraq's future economic and overall well-being, are in real jeopardy.

So what can be done? The Role of Technological Innovation

Technological innovation and advanced engineering are key to finding alternatives to freshwater injections. Two potential solutions could go far in augmenting or even replacing the required scarce freshwater resources:

- use of natural gas that is produced as a byproduct along with the oil, i.e., associated gas; and/or
- use of treated seawater.[12]

For the most part, the associated gas from oil production is being flamed once the gas is co-produced. While Iraq experimented with the use of this type of gas re-injection to pressurize oil reservoirs, it was not pursued as common practice.[13] The other option would involve the pumping of large amounts of treated seawater from the Gulf coast to the oil reservoirs, a distance of more than 60 miles. The latter option – the Common Seawater Supply Facility (CSSF) – seems to be the solution of choice according to recent analyses,[14] although its construction has experienced some delays. The plan is for the CSSF to be built in phases, with an initial capacity of 2 million barrels of water a day by 2017 and a total capacity of 10 to 12 million barrels a day by the late 2020s.[15]

The specific case of water needs for fuels production in Iraq provides an excellent example of the importance of reliable, forward-looking planning for energy-water nexus related activities. In water-starved regions such as the Gulf and the Middle East, every drop of freshwater counts.

[12] EIA, *Iraq Country Profile*, April 2013: http://www.eia.gov/countries/cab.cfm?fips=iz.
[13] *Ibid*. In Alaska, for example, nearly all of the associated natural gas is being re-injected into the oil reservoir for re-pressuring purposes (see EIA: http://www.eia.gov/state/print.cfm?sid=AK: Natural Gas).
[14] IEA, *Iraq Energy Outlook*, October 2012, p. 68.
[15] *Ibid*.

Optimizing use of water resources for any purpose, and especially for the production of energy, is vital not only for healthy and sustained economic growth but for ensuring the basic well-being of the local population. Developing, identifying and using cost-efficient and reliable technologies to overcome water constraints require the best available data accompanied by research and development.

Conclusion

The use of non-potable, treated water for energy production is increasingly being employed around the world. For example, in a few U.S. unconventional energy formations, up to 80 percent of the water brought to the surface during well development and fuel extraction is reused in subsequent hydraulic fracturing operations.[16] In countries such as Iraq and others in the Middle East, the use of non-potable water could mean the difference between economic growth and decay or even war and peace. In recent years, many have been seeking substitutes for freshwater in energy operations – and rightfully so. But in order to transition away from freshwater, some energy has to be expended as well.

Indeed, the pumping of treated seawater from coastal to inland locations in Iraq, or for that matter desalting seawater to provide potable water along other Middle Eastern coastal regions, requires energy and often lots of it.[17] Advanced technological solutions that are based on the best available data, research, development and demonstration are crucial to ensure that these industrial and public water supplies are sustainable and guaranteed for many years to come. Public and private stakeholders around the world should work together to ensure the application of water treatment, reclamation and reuse to stretch limited freshwater supplies.

[16] Sen. Murkowski, *The Energy-Water Nexus: Interlinked Resources that are Vital for Economic Growth and Sustainability*, May 2014: http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=9d529812-659b-43a1-a2d1-ef0e67894636.

[17] The energy intensity of seawater desalination plants could be anywhere between 2.2 and 8.5 kWh per cubic meter (1 cubic meter equals about 264 gallons) of electrical energy for large reverse osmosis desalination plants and between 1 and 5 kWh per cubic meters and around 9 to 80 kWh per cubic meter of thermal energy when thermal desalination (i.e., water evaporation) is used. See BP, *Water in the energy industry*: *An introduction* (2013), p. 98.