

Impact of future energy policy on water resources in Kazakhstan

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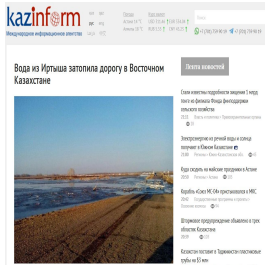
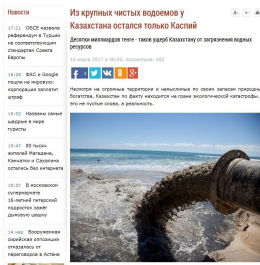
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European Geosciences Union General Assembly 2017

Press coverage of water resources in Kazakhstan



Widespread pollution¹

Flooding²

Water scarcity³

Transboundary issues⁴

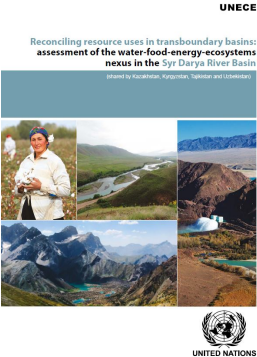
¹ <http://mk-kz.kz/articles/2017/03/15/iz-krupnykh-chistyykh-vodoemov-u-kazakhstana-ostalsya-tolko-kaspiy.html>, Mar 2017

² http://www.inform.kz/ru/pavodkovye-vody-zatopili-dorogu-v-vostochnom-kazahstane_a3015579, Apr 2017

³ <http://mk-kz.kz/articles/2017/03/28/vodnaya-zavisimost-kazakhstana-ot-kitaya-uisilivaetsya-s-kazhdym-godom.htm>, Mar 2017

⁴ <http://www.bbc.co.uk/news/magazine-37755985>, Oct 2016

International reports on water and energy in Kazakhstan



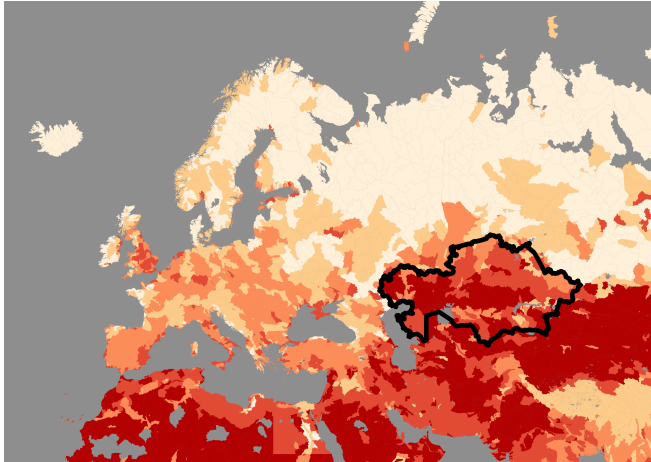
Several international reports exist on water resources, energy sector, and agriculture sector. However, there is a **lack of national-level studies integrating water, food, and energy.**

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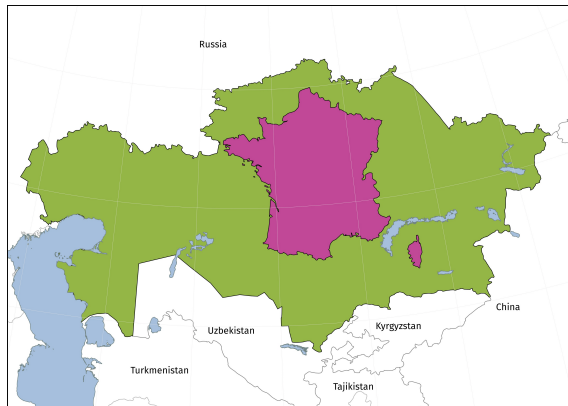
Context and main challenges in water resource management

Overall water risk



Water-risk data source: World Resources Institute, Aqueduct Global Maps, 2014

Context and challenges in water resource management



Context and challenges in water resource management



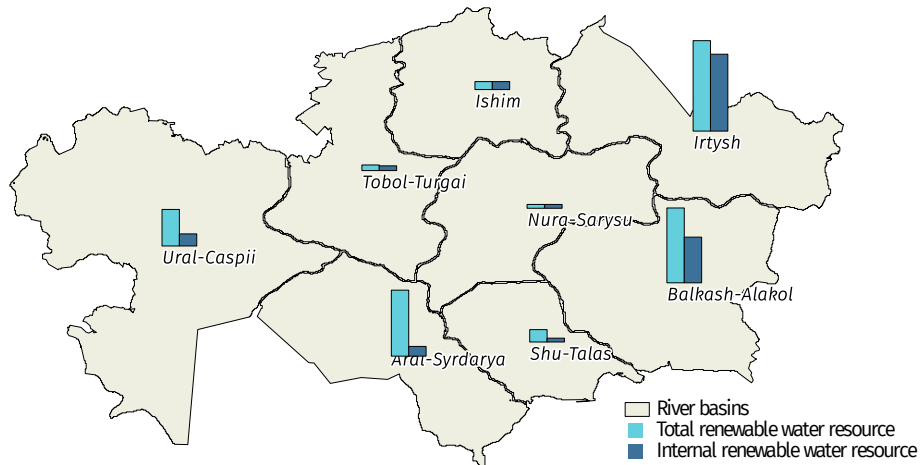
- ▶ Agricultural sector has a very high demand for water resources;
- ▶ Water resources unevenly distributed in the country;
- ▶ Potential for transboundary issues (Syrdarya region, Balkhash, Irtysh);
- ▶ Population growth and urbanisation;
- ▶ Highly ambitious targets for developing alternative energy generation, reducing greenhouse gas emissions, as well as improving agriculture and other sectors of the economy

Aim of work

To estimate the current water withdrawal due to the energy sector (electricity generation, extraction, and refining) and how it evolves in the future under different policy scenarios.

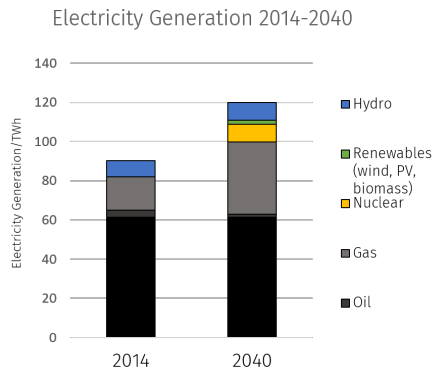
Water resources in Kazakhstan

River basins and water availability



Overview of electricity production in Kazakhstan

Current electricity generation and scenarios for 2040



2014:

- ▶ 90% of electricity generation from fossil fuels (68% coal)

2040:

IHS¹ analysis projects limited changes in electricity sector:

- ▶ Total fossil capacity to remain approximately the same
- ▶ Share of gas to increase to 31% and coal to decrease to 50% of total generation;
- ▶ Additional capacity mainly from nuclear (1.2GWe), gas and wind;
- ▶ New gas units to be built around Astana (to reduce air quality impacts);
- ▶ Demand in the south to increase.

We assume that current cooling technologies are used in power plants.

¹ Source: "The National Energy Report 2015", Kazenergy, 2015. Retrieved from: <http://www.kazenergy.com/en/analytics/the-national-energy-report.html>

Overview of electricity production in Kazakhstan

Scenarios for nuclear generation by 2040

Two scenarios for future nuclear plant location:

1. 2040 **Ulken** (south, Balkhash-Alakol basin)

- ▶ 1.2GWe nuclear power plant built on the western shore of Balkhash – strategically placed in the vicinity of north-south 500kV transmission ;
- ▶ Would reinforce generation capacity in the south;
- ▶ Additional natural gas generation in Almaty region.

2. 2040 **Kurchatov** (northeast, Irtysh basin)

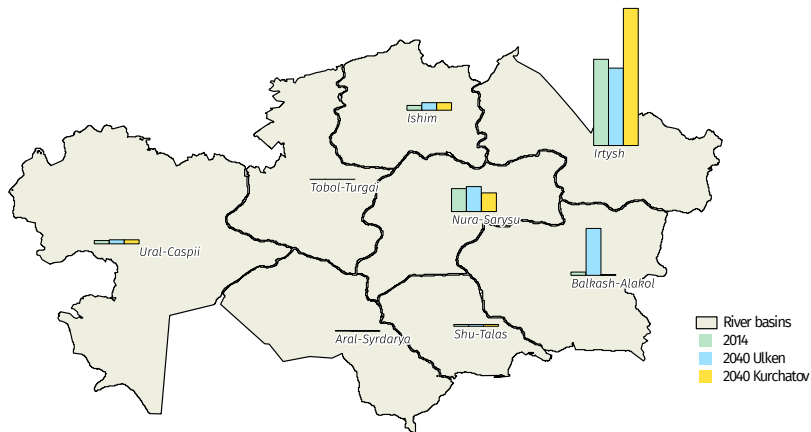
- ▶ 1.2GWe nuclear power plant in former nuclear testing site in Eastern Kazakhstan oblast

Extraction and oil refining

- ▶ Onshore oil production to decrease by 12% by 2040, most onshore production occurs in the western region
- ▶ Coal production to decrease by 20% by 2040, mainly in the north-eastern and central regions
- ▶ Uranium production assumed same as 2014 levels (23.1Mtonnes of U)
- ▶ Three main refineries in Kazakhstan assumed to be same operating in 2040, capacity to increase by 20%
- ▶ Water for natural gas was not estimated as most natural gas is extracted in tandem with crude oil

Results

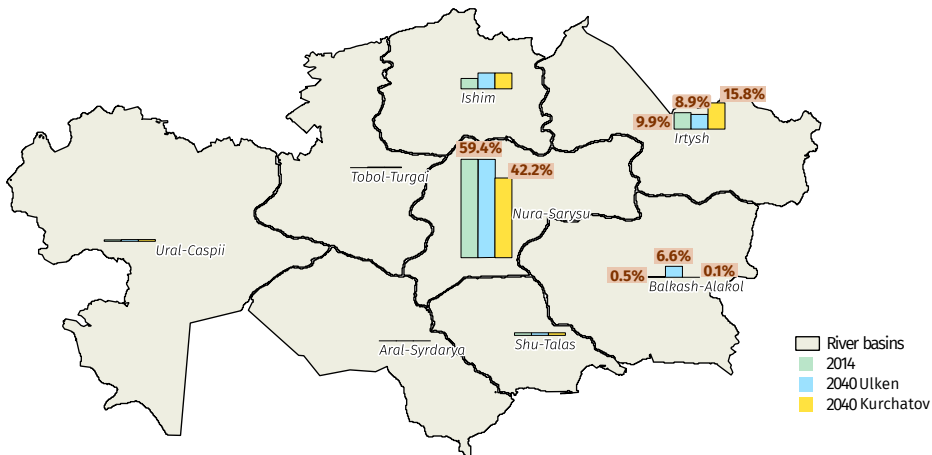
Total water withdrawal by the energy sector (electricity production, extraction, and refining)



Over 90% of withdrawal in the energy sector is due to electricity generation.

Results

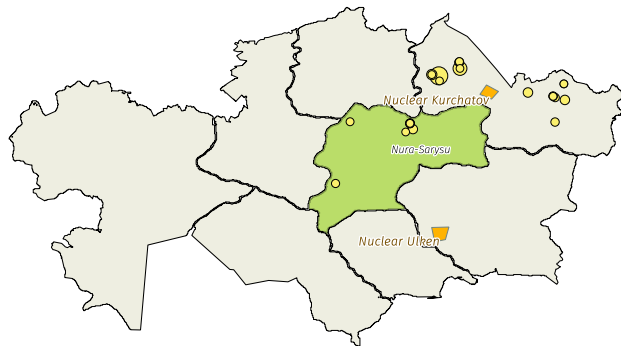
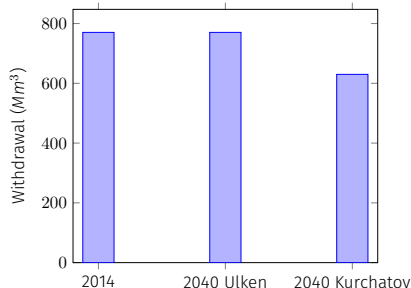
Total water withdrawal as a percentage of renewable water resource



Results

Effect of nuclear siting on water for energy in Nura-Sarysu basin

Water withdrawal for electricity production in Nura-Sarysu



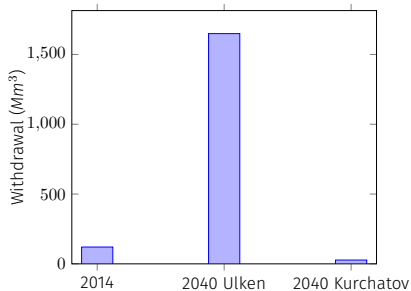
- ▶ Electricity generation already withdraws over 50% of total available resource in the basin.
- ▶ If nuclear is in the north, water withdrawal in Nura-Sarysu decreases significantly (partly due to the assumption that most of the cooling technology will remain as once-through).

Results

Transboundary issues

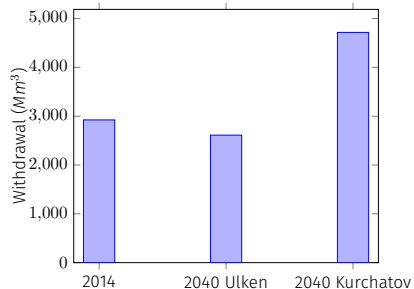
Balkash-Alakol

Water withdrawal for electricity production in Nura-Sarysu



Irtysch

Water withdrawal for electricity production in Nura-Sarysu



- ▶ Either the Balkash-Alakol or Irtysch basin will experience a significant increase in water withdrawal, due to the introduction of nuclear power in the electricity system
- ▶ Both these basins are highly dependent on transboundary water inflows

Summary and concluding remarks

- ▶ Kazakhstan faces a challenging situation regarding water resource management in a context of rapid economic and demographic growth.
- ▶ Nuclear power will be part of the future energy mix and will have a significant impact on the water resources of the country.
- ▶ The siting of nuclear plants can have an impact across different river basins.
- ▶ Transboundary water agreements will need to take into account the energy policy of the country.

Future work

- ▶ Re-evaluate scenarios and energy policy assumptions in collaboration with partners from Kazakhstan.
- ▶ Study the impact of different types of cooling technologies
- ▶ Quantify consumption and link sources to sinks
- ▶ Include future scenarios for the agricultural and industrial sectors.

Thank you for your attention!

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