

Water-Agriculture-Energy Nexus in Central Asia Through the Lens of Climate Change

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Climate Change impacts on Water Resources and Agriculture in the CAREC Region

Tackling climate change is crucial, especially in Central Asia where water scarcity and unstable crop yields are major concerns. This region urgently needs smarter water and farming solutions for its future resilience.

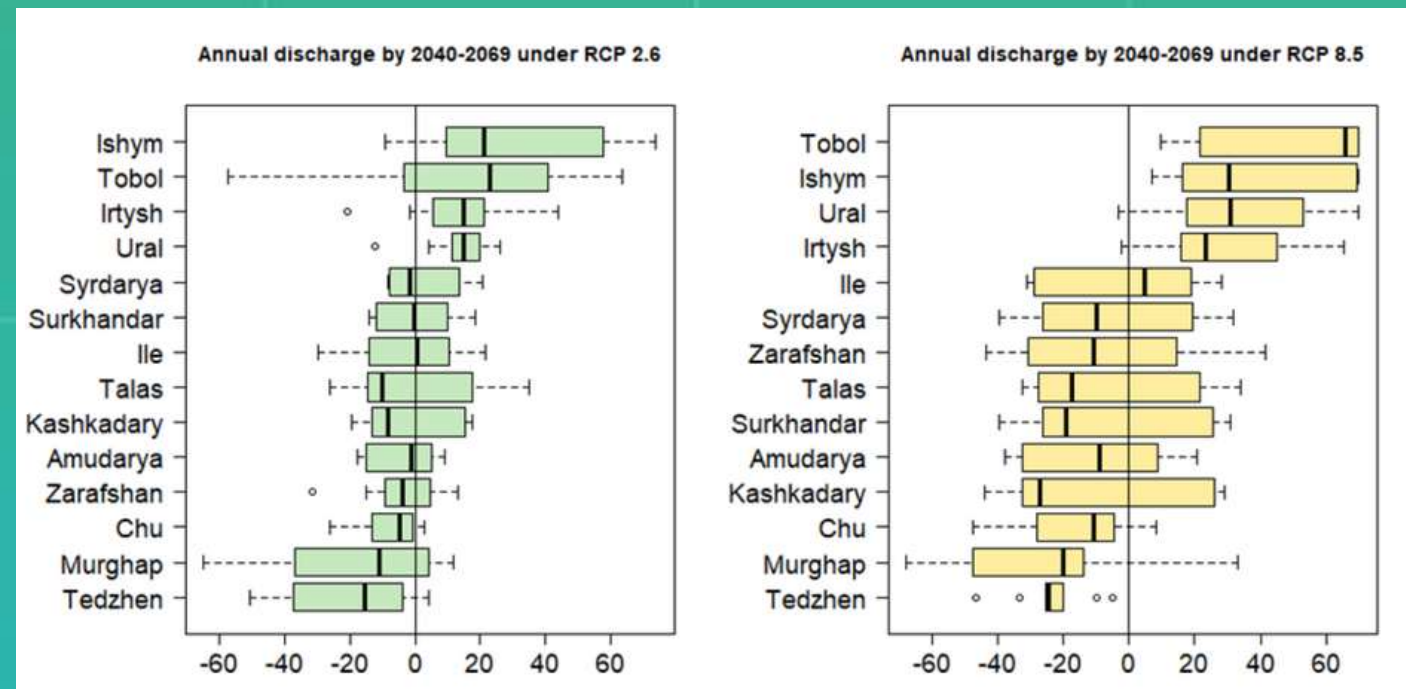
Climate scenarios & River discharge

- Under RCP 2.6 (Optimistic scenario), river flows mostly stable, except decreases in Murghap and Tedzhen and increases in Ishym and Tobol.
- RCP 8.5 (pessimistic scenario) projects wider declines in river flow, especially in southern to central regions.

Seasonal runoff changes:

- Shift to earlier peak flows under both scenarios, affecting water availability for irrigation.

Projected relative change in annual discharge of the major rivers in Central Asia by 2040-2069 with respect to 1975-2005



Differences in water supply impact:

The impact of changes in water supply varies across Central Asian countries, depending on their need for water.

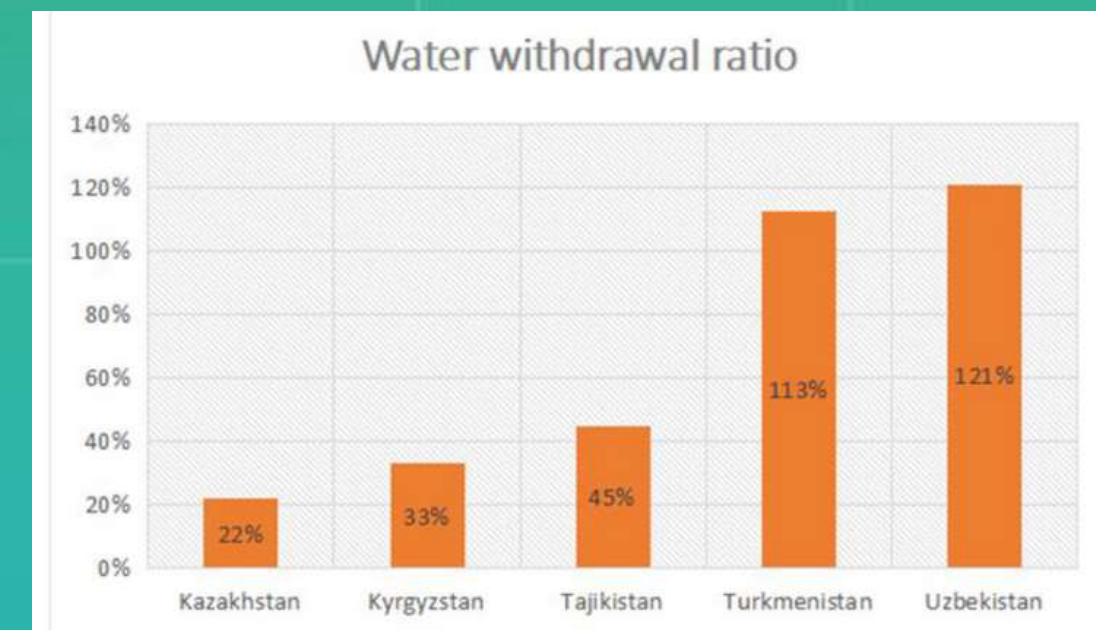
Kazakhstan's Position:

- Limited need for water in its industries.
- Plenty of water available, especially in the northern regions.
- Has the region's lowest rate of water use compared to availability.

Challenges Faced by Turkmenistan and Uzbekistan:

- Intense dependency on water for agricultural activities.
- Consumption of water exceeds the annual renewal of surface water resources.
- Depend on external sources for their water supply.

Intensity of water use among the Central Asian states.

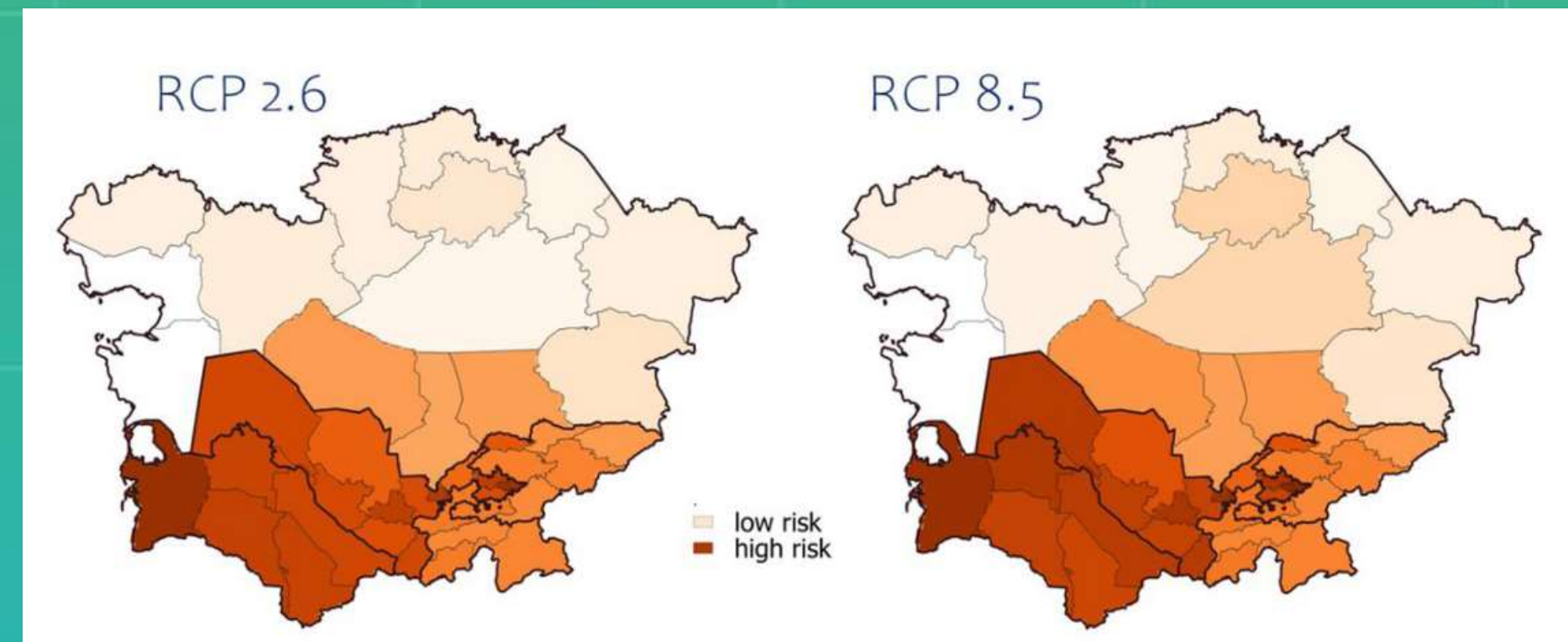


Strategic Response to Water Vulnerabilities: Mapping Central Asia's Hotspots and Future Challenges

Identifying vulnerability hotspots based on climate scenarios is crucial for implementing effective mitigation and adaptation strategies in Central Asia, addressing the pressing challenges of water scarcity and unstable crop yields head-on

- **High Risk in Turkmenistan and Uzbekistan:** These countries face significant risks across all provinces because of expected reductions in water during certain seasons, along with their current high rates of water use and dependency.
- **Moderate Risk in Tajikistan and Kyrgyzstan:** While not as vulnerable as Turkmenistan and Uzbekistan, Tajikistan and Kyrgyzstan still face moderate to high water stress. This is due to their lesser ability to adapt to climate-related issues.
- **Vulnerability in Southern Kazakhstan:** The southern part of Kazakhstan is as at risk as Tajikistan and Kyrgyzstan because it's downstream of transboundary rivers, affecting its water supply.
- **Steady Distribution of Vulnerability by 2050:** Despite different climate scenarios (RCP 2.6 and RCP 8.5), the vulnerability map doesn't change much by 2050. The southern areas continue to be at a higher risk.

Figure: Vulnerability of Central Asian provinces to projected climate-induced stress under the two RCPs



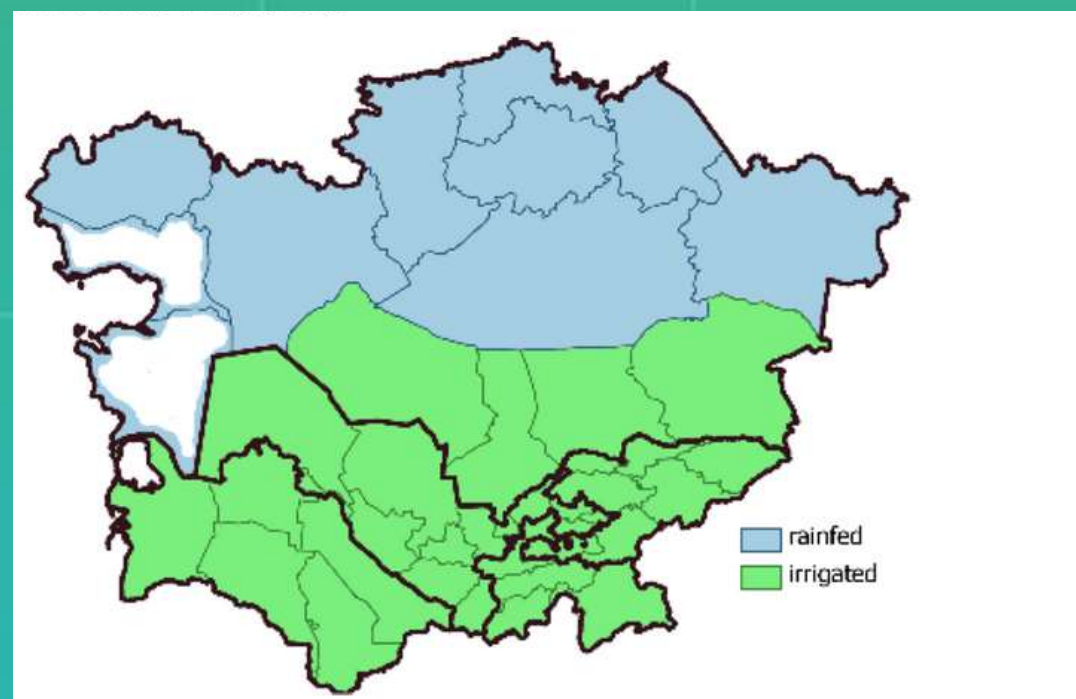
Climate Change impacts on Water Resources and Agriculture in the CAREC Region

Prioritizing water conservation and enhancing irrigation efficiency in arid zones are crucial steps towards ensuring the region's food security and maintaining its economic stability.

Water Constraints and Crop Production:

- Northern Central Asia: Predominantly rainfed cereal production.
- Southern Central Asia: Crop production relies on irrigation due to an arid climate, with significant water scarcity already affecting areas like Turkmenistan and Uzbekistan.
- Climate change is expected to exacerbate water scarcity, especially in the southern provinces, potentially limiting agricultural productivity.

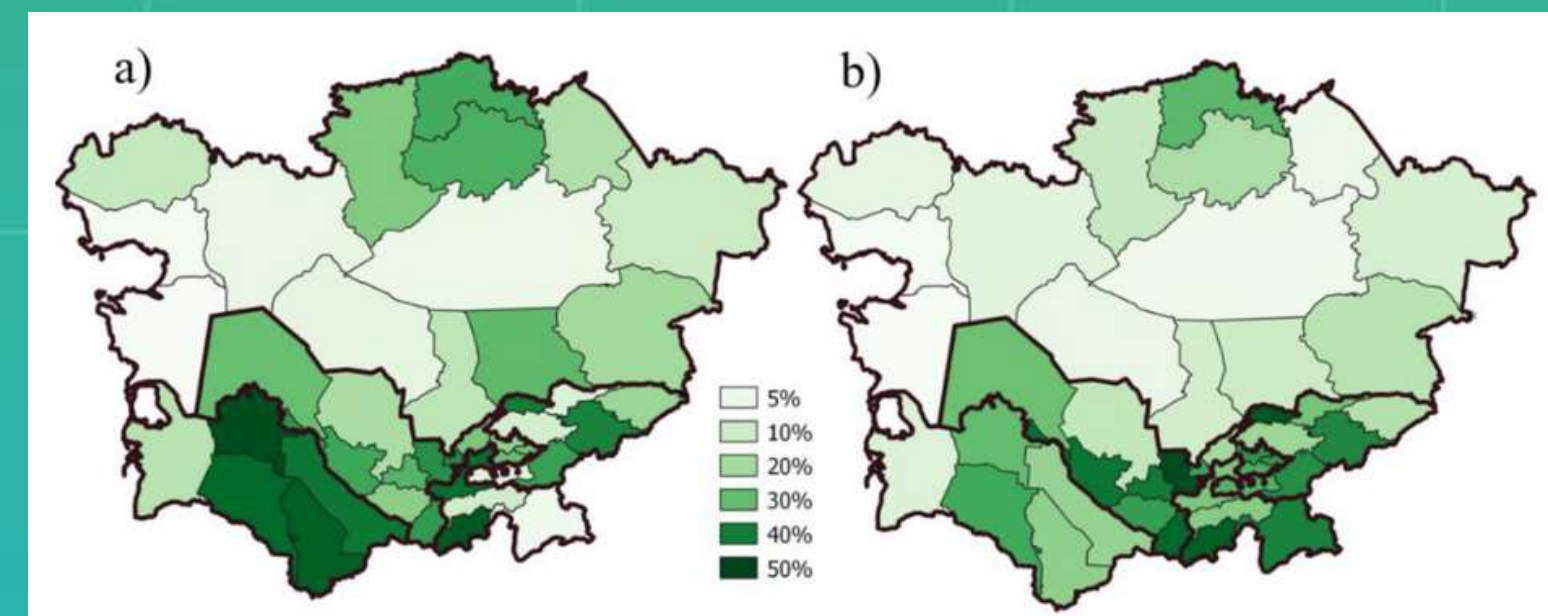
Central Asia in terms of rainfed vs irrigated crop production zones



Agriculture's Economic Importance:

- Agriculture is a key sector for employment and GRP (Gross Regional Product) in many provinces, especially where it constitutes a significant portion of the economy.
- The vulnerability of agriculture to climate change could have substantial economic impacts, particularly in provinces reliant on irrigated crop production.

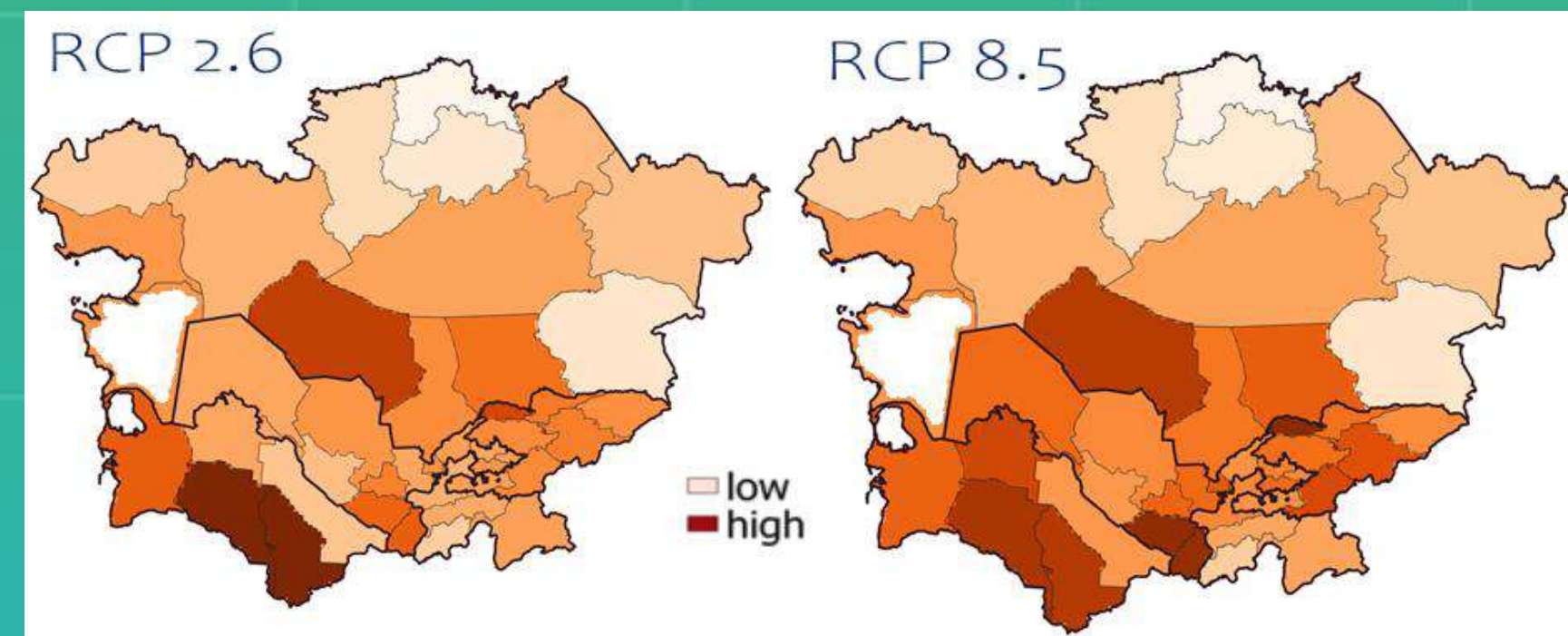
Share of the agricultural sector in a) total employment and b) GRP (excludes fossil fuel extraction and procession industry)



Climate Change impacts on Water Resources and Agriculture in the CAREC Region

- **Climate Vulnerability in Agriculture:**
 - Focus on changes in agricultural productivity and its economic role.
 - Assumes current agricultural practices continue.
- **Identification of Vulnerability Hotspots:**
 - Dominated by provinces reliant on irrigated crop production.
 - Seasonal water availability expected to decrease, impacting agriculture as a key employment sector.
- **High Risk:**
 - Ahal and Mary in Turkmenistan.
 - Surkhandarya and Kashkadarya in Uzbekistan.
 - Kyzylorda and Dzhambul in Kazakhstan.
 - Talas in Kyrgyzstan.
- **Consistent Vulnerability Across Climate Scenarios:**
 - These regions remain susceptible to climate change impacts, underlining the need for targeted adaptation strategies.

Relative vulnerability of agriculture to climate change at provincial level



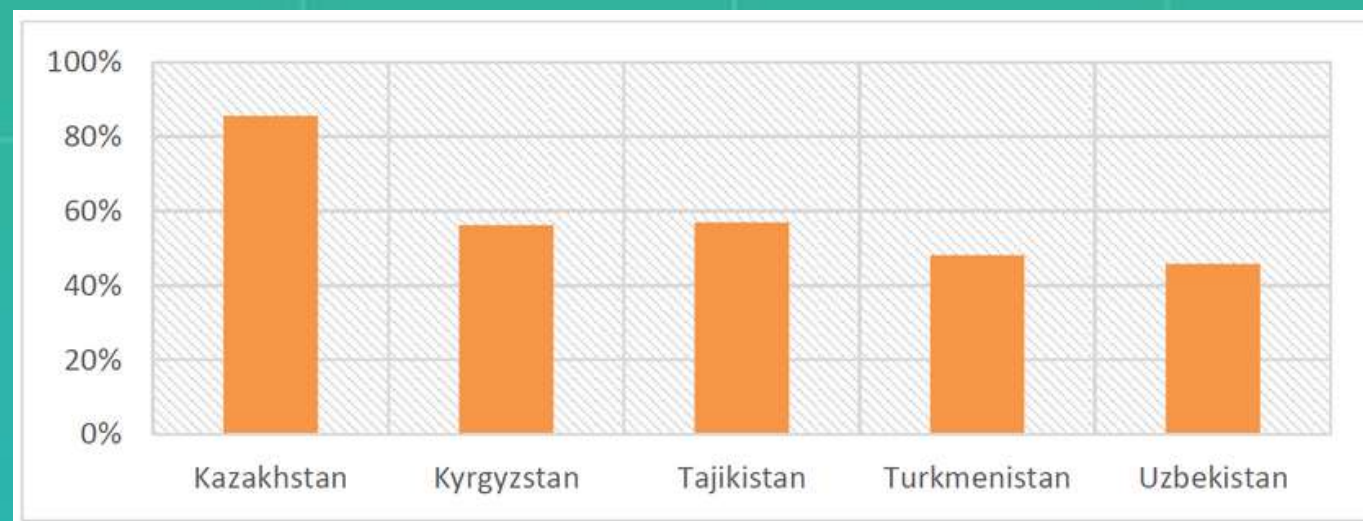
Navigating energy vulnerability in Central Asia

Central Asia faces increasing electricity demand due to growth and development, alongside the imperative to reduce GHG emissions per the Paris Agreement.

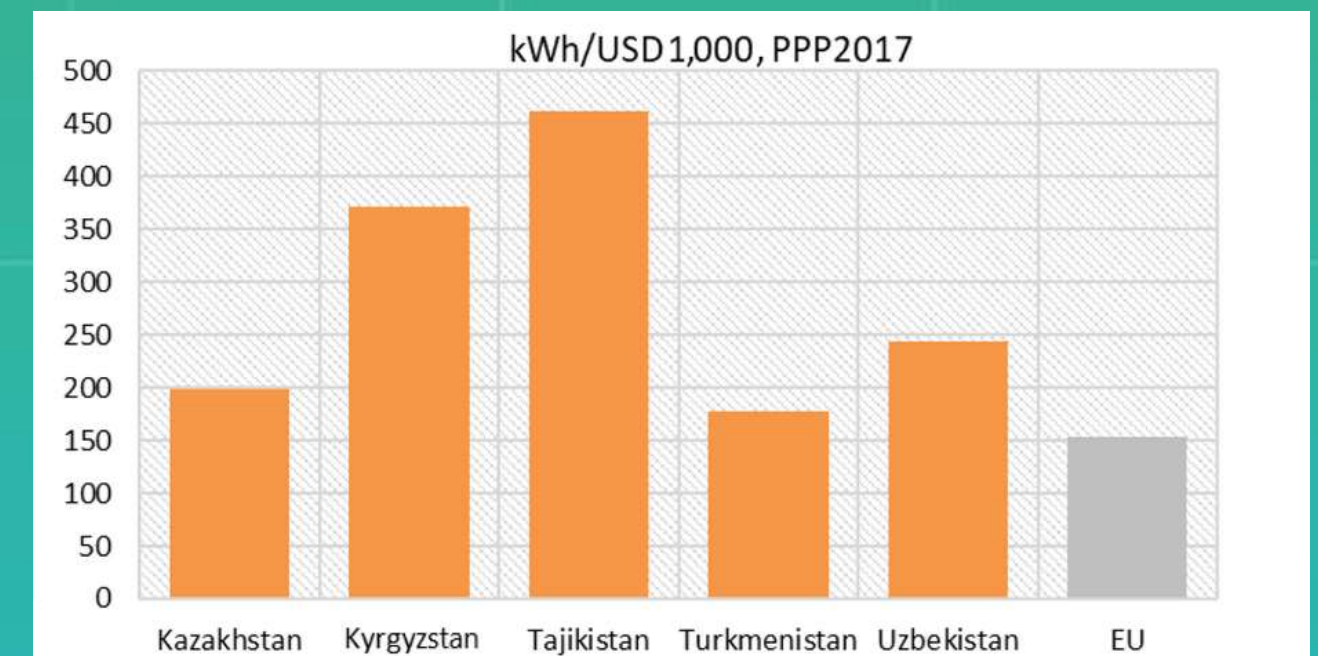
- **Demand Surge by 2050:** Electricity demand expected to rise by at least 50%, with up to a 90% increase in Kazakhstan.
- **Renewable Energy Transition:** Essential for sustainable demand meeting, aligning with 2030 climate pledges and 2050-2060 carbon neutrality goals.
- **Fossil Fuel Dependency:** Kazakhstan, Turkmenistan, and Uzbekistan heavily reliant on fossil fuels, posing transition challenges.

- **Hydropower Advantage:** Tajikistan and Kyrgyzstan benefit from low GHG emissions due to predominant hydropower usage.
- **Efficiency Disparities:** Electricity use per GDP notably higher in Central Asia compared to the EU, especially in Tajikistan and Kyrgyzstan.
- **Diversification Strategy:** Emphasizes the need for diversified power sources and low-carbon technologies to secure energy future and mitigate imbalances.

Projected increase in electricity in Central Asia by 2050 with respect to 2020



Energy and Carbon intensity. Electricity consumption per GDP (kWh/USD1,000 PPP2017)



Empowering Central Asia: Building Capacity for Climate Resilience and Sustainable Development



Skills development for climate-smart solutions:

Promote education and training for climate-smart agriculture and water management to enhance local expertise and implement innovative technologies. This critical investment in human capital will be key to adapting to climate change and securing sustainable agricultural and water systems in the region.



Cultivating Awareness and Behavioral Change for Sustainability:

Boost climate change awareness and sustainable practices through targeted educational programs and public campaigns. This approach seeks to shift societal behaviors towards environmental stewardship, reinforcing climate resilience in Central Asia

Fostering Resilience Through Regional Cooperation in Central Asia

Integrated Transboundary Management:

Prioritize a unified approach for managing water resources across borders, balancing electricity generation and irrigation needs to support sustainable development in Central Asia.

Enhanced Agricultural Productivity:

Facilitate timely water releases from upstream countries to boost crop yields, particularly for wheat and cotton, leveraging increased CO₂ fertilization.

Strategic Electricity Exchange:

Develop collaborative frameworks for electricity trade, optimizing seasonal energy distribution and supporting the transition to renewable energy sources.

Climate Change Adaptation

Strengthen regional collaboration to address vulnerabilities to climate-induced water variability, enhancing energy security and economic resilience.