Eurasian Development Bank

Regulation of the Water and Energy Complex of Central Asia

Reports and Working Papers 22/4

Regulation of the Water and Energy Complex of Central Asia

FACTS AND FIGURES

ANALYTICAL REPORT '22

81% of the population of CA (60 million people) live in the Aral Sea basin

2,8× increase of water stress (SDG 6.4.2) by 2040 in some regions of CA, according to various climate change models

2,5 USD/m³ water use efficiency (SDG 6.4.1) in CA, while the global average is USD 19/m³ per year

POTENTIAL SOLUTIONS TO IMPROVE THE EFFICIENCY OF THE WATER AND ENERGY COMPLEX REGULATION

1 REGIONAL DIALOGUE ON A SYSTEM OF PRINCIPLES

1. Sovereign equality, territorial integrity, and mutual benefits
2. An optimal mix of the irrigation and the energy regimes
3. A market mechanism for meeting the energy needs
4. Streamlining the institutional framework of the CA water and energy complex
5. Coordinated investment policies, among other things based on co-financing
6. Science and technology cooperation

2 INTERNATIONAL FUND FOR SAVING THE ARAL SEA MODERNISATION AS A KEY FACTOR OF COOPERATION

- Having operated for over 30 years, the IFAS has established a sound legal framework and acquired an adequate status and mandate
- Improving the efficiency of the existing IFAS framework (ICWC, BWMO Syr Darya and BWMO Amu Darya, etc.) is of paramount importance
- It is appropriate to establish an arrangement for coordinating decisions on water management and electricity cross-flows in CA
- It is necessary to streamline the modalities of engagement with a financial operator(s)

3 INTERNATIONAL WATER AND ENERGY CONSORTIUM

A. INTERNATIONAL ORGANISATION

- The key function is to finance major joint investment projects
- The consortium may take the form of a legal entity established through an international treaty
- It is expected that states from outside the region and other investment and technology partners would be able to participate
- International financial institutions can act as a financial operator

B. PROJECT CONSORTIUM

- A consortium can be created in a simplified form using the BOT (build–operate–transfer) or BOOT (build–own–operate–transfer) model, etc.
- Various forms of financing major infrastructure projects are widely used in the world due to their flexibility and the option of capital syndication
- A project consortium is established through an agreement in the form of a legal entity within the framework of the national law of the host country
- Optionnaly, establishment of a project managing company

4 ENGAGING A FINANCIAL OPERATOR

- Long-term loans
- Issue of bonds and equity participation
- Creation of joint ventures
- Attraction, monitoring, and control of investment
- Syndicated financing
- Trade financing
- Payment and settlement services
- Technical assistance

5 INTERNATIONAL RESEARCH CENTRE OF THE CA WATER AND ENERGY COMPLEX

- Integrated regional management solutions for the regulation of the water and energy complex
- Interdisciplinary research to ensure water, energy, food, and environmental security in the Aral Sea basin
- Research to introduce advanced technologies in agriculture, energy, water supply, and water use

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The goal of this report is to propose comprehensive solutions for the regulation of the water and energy complex of Central Asia. The report presents an assessment of the state of water resources in Central Asia in the context of climate change. It offers a detailed analysis of the evolution of various forms of regulation of the water and energy complex of Central Asia, from the Soviet period to the present day, reviews the international experience in water basin regulation potentially applicable for the water and energy complex of Central Asia and proposes potential solutions: a system of principles of effective regulation; comprehensive modernisation of the International Fund for Saving the Aral Sea (IFAS) aimed at strengthening of the coordination between the water and energy sectors; an arrangement for creating the International Water and Energy Consortium of Central Asia under the auspices of IFAS in its various forms, etc.

Keywords: regulation, power industry, water resources, transboundary water basins, Central Asia, multilateral development banks, international organisations.

JEL: F15, F36, F55, K32, N45, Q25, Q28, Q48, Q54.

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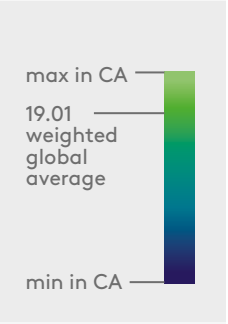
Summary

The economies of Central Asia (CA) are characterised by **a high level of energy and water intensity of the products of various economic sectors**, primarily agriculture and manufacturing. Water use efficiency (SDG 6.4.1) is low compared to global values (see Table A). In 2018, water use efficiency in the CA countries was estimated within a range of USD0.842/m³ in Kyrgyzstan to USD 7.2/m³ in Kazakhstan. The average for the CA region is estimated at USD 2.5/m³, which is extremely low — the weighted global average is USD 19.01/m³. In most (two-thirds) of countries, water use efficiency ranges from USD 5 to USD 100/m³. Based on this indicator, four out of five CA countries (except for Kazakhstan) are on the list of ten world least efficient countries (among 168 countries analysed).

↓ Table A. Water Use Efficiency Indicators in CA, 2018, USD/m³

	Turkmenistan	Kazakhstan	Kyrgyzstan	Uzbekistan	Tajikistan
Irrigated agriculture	0.146	0.035	0.102	0.458	0.227
Manufacturing	28.916	11.556	5.504	12.026	1.643
Services	19.228	31.380	17.298	14.026	5.472
Overall efficiency	1.525	7.201	0.842	1.431	0.882



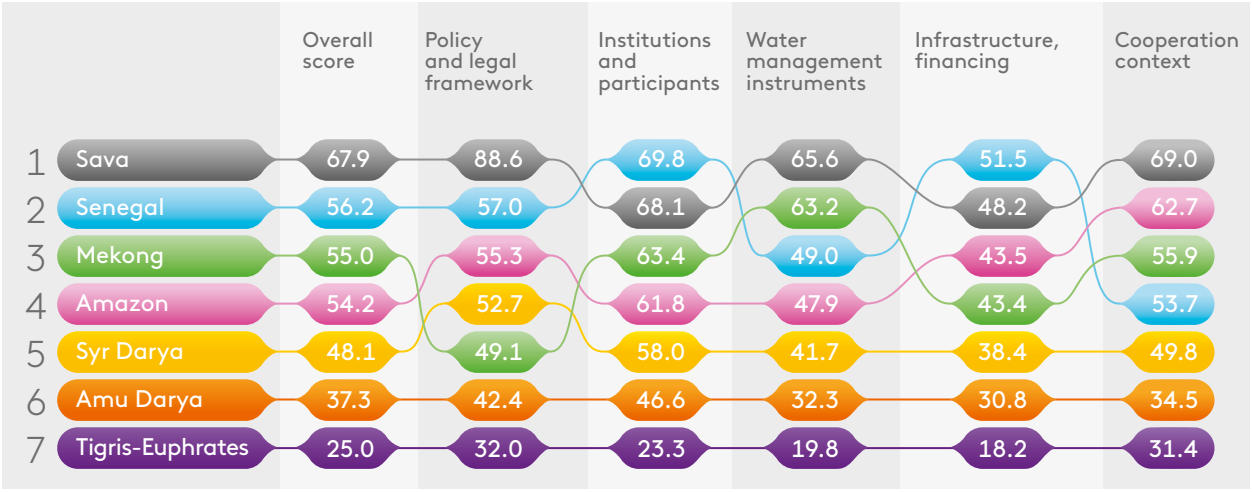
Source: compiled by the authors using UN-Water data (2021).

Coming after generally low level of investment (Vinokurov et al., 2021), the second key reason for the low efficiency of the use of water and energy resources, and thus high economic costs in the region, is **insufficient regional cooperation** among the CA countries. The current format of cooperation in the Aral Sea basin is inconsistent with the principles of effective management of transboundary water and energy resources, does not enhance the efficient use of these resources, and does not help achieve an effective water use regime and improve the environment in the basins of the Syr Darya and Amu Darya rivers (see Table B). The Economist Intelligence Unit Blue Peace Index reports poor performance of the Syr Darya and Amu Darya river basins compared to other basins: they rank respectively 5th and 6th out of 7.

Since 1992, the CA states **have made repeated attempts** to establish effective regulation of the CA water and energy complex based on multilateral regional agreements, bilateral agreements, and regional alliances (CAU, CAEC, CAC, EurAsEC) and to resolve the issue of joint management of the region's water and energy resources. However, none of those attempts achieved their goals. Planned projects, such as those to form a common market of the countries of the region, and to create a water and energy consortium for the use of transboundary water resources, failed. Despite the fact that the above alliances, as well as the International Fund for Saving the Aral Sea (IFAS), benefited from strong support from the World Bank, the Asian Development Bank (ADB), and many other international organisations and financial institutions, none of the draft agreements on water and energy cooperation prepared in 1993–2010 attained general agreement from the CA countries.

A window of opportunity may have opened for significant progress in the regulation of the water and energy complex. The processes of regionalisation have accelerated noticeably in CA given the renewed political agenda of Uzbekistan to strengthen trust among the CA countries. In 2017, Uzbekistan proposed a mechanism for holding consultative meetings of Heads of State, establishing a regional economic forum, and creating an association of heads

↓ Table B. Blue Peace Index (BPI) Indicators



		Overall score	Policy and legal framework	Institutions and participants	Water management instruments	Infrastructure, financing	Cooperation context
1	Sava	67.9	88.6	69.8	65.6	51.5	69.0
2	Senegal	56.2	57.0	68.1	63.2	48.2	62.7
3	Mekong	55.0	55.3	63.4	49.0	43.5	55.9
4	Amazon	54.2	52.7	61.8	47.9	43.4	53.7
5	Syr Darya	48.1	49.1	58.0	41.7	38.4	49.8
6	Amu Darya	37.3	42.4	46.6	32.3	30.8	34.5
7	Tigris-Euphrates	25.0	32.0	23.3	19.8	18.2	31.4

Source: EIU, 2020.

of regions and business communities of the countries of the region. A process of removing the political barriers that have long prevented the normalisation of interstate relations in the region is underway. For example, in 2017, after a 25-year break, flights between Dushanbe and Tashkent were resumed. A year later, Tajikistan and Uzbekistan abolished the visa regime, and the countries signed an agreement on strategic partnership the same year. After 30 years, Tajikistan and Uzbekistan restored railway communication: on 21 June 2022, the first train arrived from Dushanbe in Tashkent. On a bilateral basis, cooperation has intensified between Uzbekistan and Kazakhstan as well as Uzbekistan and Tajikistan (in particular, on co-financing construction of the Rogun Hydro Power Plant [HPP] and two HPPs on the Zaravshon River; and the restoration of the parallel operation of the national power systems, including through the CAPS); between Uzbekistan and Kyrgyzstan (in particular, on co-financing construction of the Kambarata-1 HPP); between Kazakhstan and Kyrgyzstan (in particular, on co-financing the construction of the Kambarata-1 HPP); and between Kazakhstan and Tajikistan (a memorandum of intent to develop energy links between the energy systems of the two countries is under development). Cooperation among the CA states within the EAEU has developed to a certain extent. Kazakhstan and Kyrgyzstan are full members of the EAEU, and Uzbekistan has had observer status since 11 December 2020. The high-level political dialogue has significantly altered the countries' positions on economic cooperation and, despite some local border conflicts in 2020–2021, is aimed at enhancing combined efforts to address the key issues of cooperation.

On 26 November 2021, **President of the Republic of Kazakhstan K. K. Tokayev** stressed the feasibility of creating an **International Water and Energy Consortium**. The issue of improving the institutional and legal frameworks for cooperation among the CA countries in the water and energy sectors has always been on the agenda of negotiations among the Heads of State and Government in the region and is also a topic for consultations with international organisations.

On 16 September 2022, the Council of Heads of State of the Shanghai Cooperation Organisation adopted the **Samarkand Declaration** (Xinhua, 2022), in which the member states recognise that lack of access to safe drinking water, basic sanitation, and healthy hygiene are major challenges of our time. The Declaration stressed the need to focus more on sustainable development and water management. Special emphasis was placed on further interaction of the UN with stakeholder states and structures in addressing major problems associated with the desiccation of the Aral Sea. The member states noted "the adoption, at the suggestion of the Republic of Uzbekistan, of the UN General Assembly resolution on declaring the Aral Sea region a zone of ecological innovations and technologies (18 May 2021), as well as, based on the positions of the parties, its initiative to launch the Multi-Partner Human Security Trust Fund in the Aral Sea region".

Amid enhanced regional cooperation in CA and increasing scarcity of water and energy resources, **an opportunity emerges to reformat the architecture of relationships in the CA water and energy complex in order to bring a joint solution to the growing shortage of water and energy resources**. The main objectives of integration and regional cooperation in CA include ensuring a sustainable supply of drinking water to the population, as well as water and energy resources to sectors of the economy based on effective functioning of the water and energy complex. Therefore, it is necessary to further improve the mechanism of cooperation for sharing water and energy resources to align it with the political, economic, financial, and environmental goals of each state.

This report suggests the following key elements of potential solutions:

First

Based on an analysis of the evolution of various arrangements for the regulation of water and energy resources in transboundary river basins in the region and around the world, we have identified the **key principles** for developing effective new solutions for regulation and ensuring productive regional cooperation.

Those key principles include:

- **Sovereign equality, territorial integrity, and mutual benefits** of equitable use of water and energy resources in the region on the basis of international water law and international principles of integrated resources management for all member states;

- Ensuring an **optimal mix of the irrigation and energy regimes** of operation of reservoir cascades, taking into account annual and long-term cycles of flow fluctuations and balances of water and energy resources. At the same time, the irrigation regime of operation of the CA water and energy complex is preferable from the point of view of economic feasibility (based on historical experience and the findings of most studies). The critical aspects include the **optimisation of water use technologies (irrigation)** in the states of the lower reaches of the Aral Sea basin (Kazakhstan, Turkmenistan, Uzbekistan) and addressing the issue of **joint maintenance of waterworks** in the upper reaches of the rivers (Kyrgyzstan and Tajikistan).

- **A market mechanism for meeting the energy needs** of the states of the upper reaches of the Aral Sea basin (Kyrgyzstan and Tajikistan), among other things **on the basis of contractual and market principles** (development of the regional market, in particular an appropriate institutional environment and connective cross-border infrastructure) and **coordinated investment policies** aimed at creating an optimal regional mix of generating capacities and ensuring reliable access to energy resources (electricity, fuel and energy resources) through joint construction, upgrading, and operation of the necessary power generation infrastructure;

- **Strengthening the existing and creating new interstate governing and executive bodies** with appropriate status to perform their functions **of coordinated and transparent regulation of the water and energy regimes of the rivers** on the basis of the basin principle; development and use of water and energy resources; regulation of interstate electricity cross-flows and energy supplies associated with the agreed water and energy regime of the rivers in the CA region;

- **An effective mechanism to create investment** incentives and attract investment (security of property rights; investment protection; and, possibly, equitable distribution of incomes and costs related to joint operation of facilities [cf. the experience of the Senegal River basin]) to implement projects (including joint ones) to renovate

existing and build new hydropower and water management facilities of interstate importance, in order to develop and effectively use the water and energy potential of the region, taking into account environmental protection requirements;

- Creating conditions for **industrial, technological, and scientific cooperation** in the water and energy sectors to enhance their export potential and introduce advanced technologies.

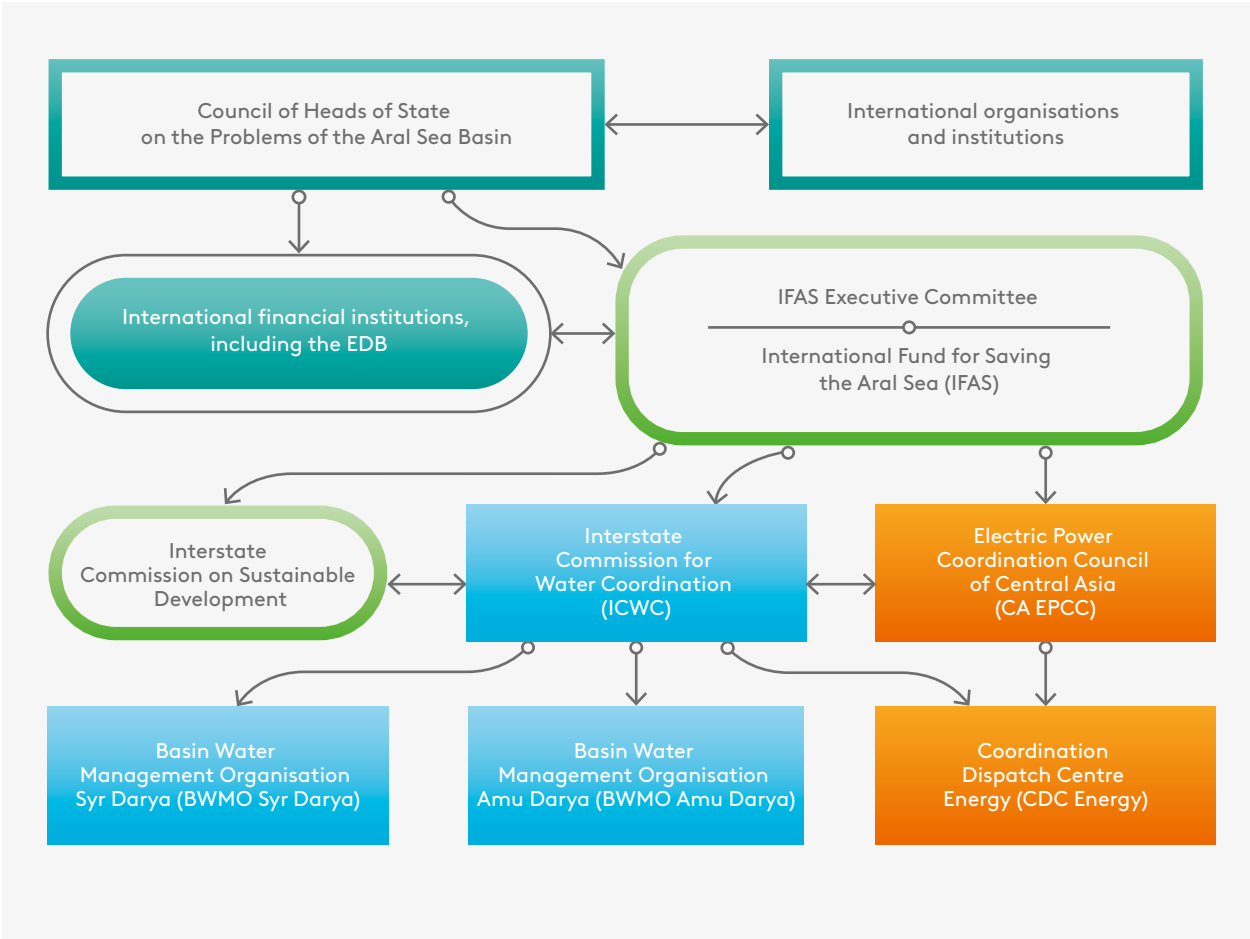
Second

A solution for regulation of the CA water and energy complex based on the identified key principles is primarily associated with **upgrading and enhancing the existing regional organisations** involved in regulation (see Figure A). This applies primarily to **IFAS**, as well as the regulatory entities of the Central Asia Power System (CAPS) — **the Electric Power Coordination Council of Central Asia (CA EPCC) and the Coordination Dispatch Centre Energy (CDC Energy).**

A separate component of the solution is a mechanism for interaction with international financial institutions (IFIs) (including the EDB) to search for financing and jointly implement investment projects.

It seems appropriate and timely **to enhance the role of IFAS** as a political platform for economic integration of the CA countries based on their common interests. Over 30 years of activity, IFAS has formed a sufficient legal framework. The basic institutions for management of transboundary resources are in place, including the Interstate Commission for Water Coordination (ICWC), Basin Water Management Organisation (BWMO) Syr Darya, and BWMO Amu Darya. There are political

↓ Figure A. Proposed IFAS Institutional Framework with Participation of International Financial Institutions



Source: EDB.

opportunities for that: IFAS is headed by one of the CA Heads of State, and the Council of CA Heads of State on the Problems of the Aral Sea Basin is operational.

It seems necessary to ensure **interaction** of the bodies involved in regional regulation of water and energy resources under the auspices of IFAS. Among them are the ICWC, BWMO Syr Darya, and BWMO Amu Darya, **as well as the CA EPCC and CDC Energy**. This would ensure coordinated development of the water and energy segments of the single complex, including through identification of regional priorities in the use of water and energy resources and the development of integrated investment policies. Such interaction, based on the development of joint solutions by the ICWC and the CA EPCC, will make it possible to coordinate annual water and electricity needs (in terms of volume and delivery time). It would facilitate the development of optimal operating regimes of HPPs and reservoirs in order to minimise operating costs and ensure maximum water supply, taking into account environmental requirements, as well as to assist in determining a schedule of needs for fuel and energy resources.

Implementation of national and regional water management programmes and projects requires **sustained investment support**. However, the countries of the region do not have sufficient financial and physical resources to achieve the goals defined for water economy and water resources management. Water management and hydropower projects are among the world's most capital-intensive. IFIs, including the EDB, could assume the **role of financial agents** to mobilise and pool funds from international donors and other stakeholders for programmes and projects and could participate in financing national and transboundary water and energy infrastructure projects in the CA water and energy complex.

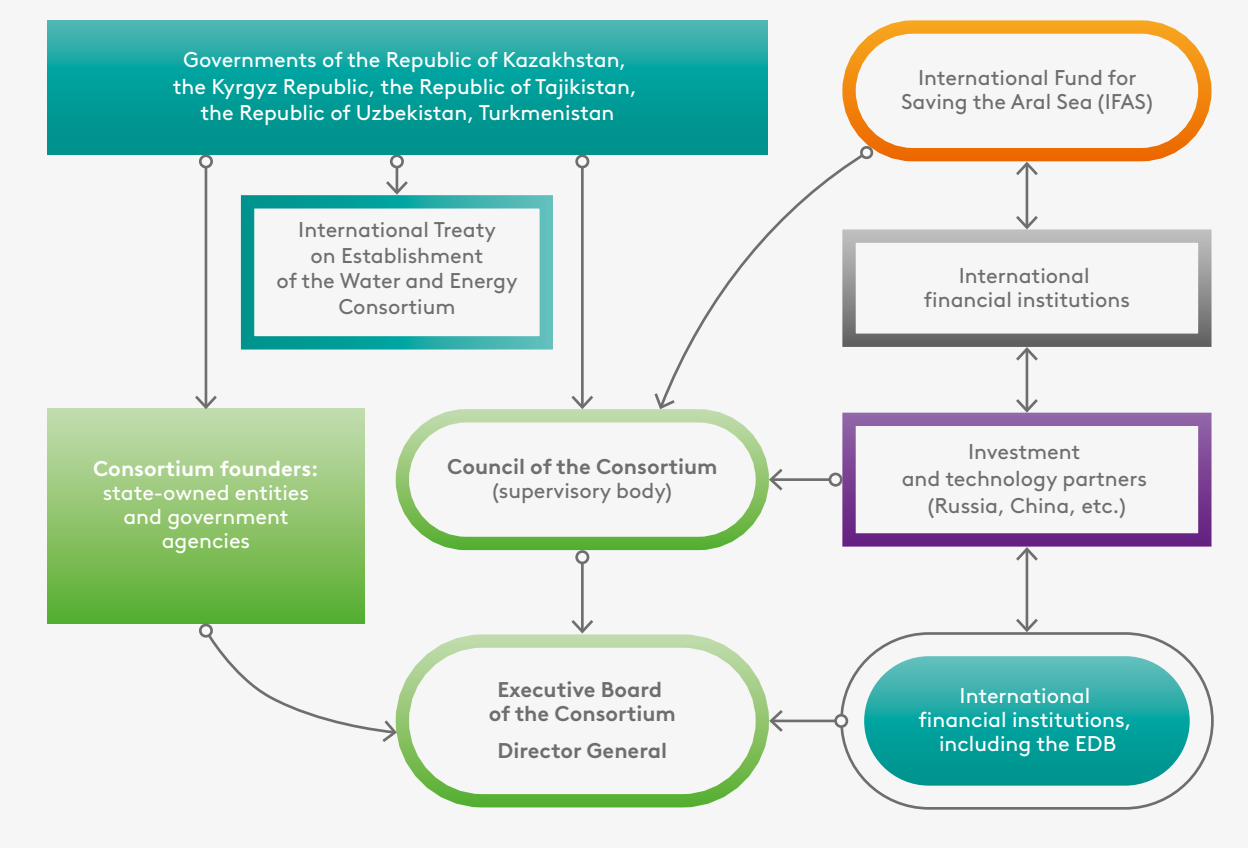
Third

Creation of a new institution — the **International Water and Energy Consortium of Central Asia on the political platform of IFAS** — would be able to take on the key function of seeking and providing financing for national and transboundary infrastructure projects in the CA water and energy sectors (see Figure B). The proposed approach is based on the economic interest of the parties in **joint implementation of new water and energy projects** and the operation of existing facilities, as well as enhancement of regional and national water and energy infrastructure. The Water and Energy Consortium should rely on the modernised existing framework: IFAS, the ICWC, BWMO Amu Darya, BWMO Syr Darya, CDC Energy, etc.

The International Water and Energy Consortium of Central Asia could exist in the form of an international organisation — a legal entity created on the basis of an international treaty. Alternatively, options could be developed for the International Water and Energy Consortium and its subsidiaries (for example, for individual water management facilities) within the framework of national law. A combination of options is possible — the International Water and Energy Consortium itself as an international organisation, and individual facilities within the framework of national law. Legal advice is needed on the issue in order to determine the most flexible and simple form.

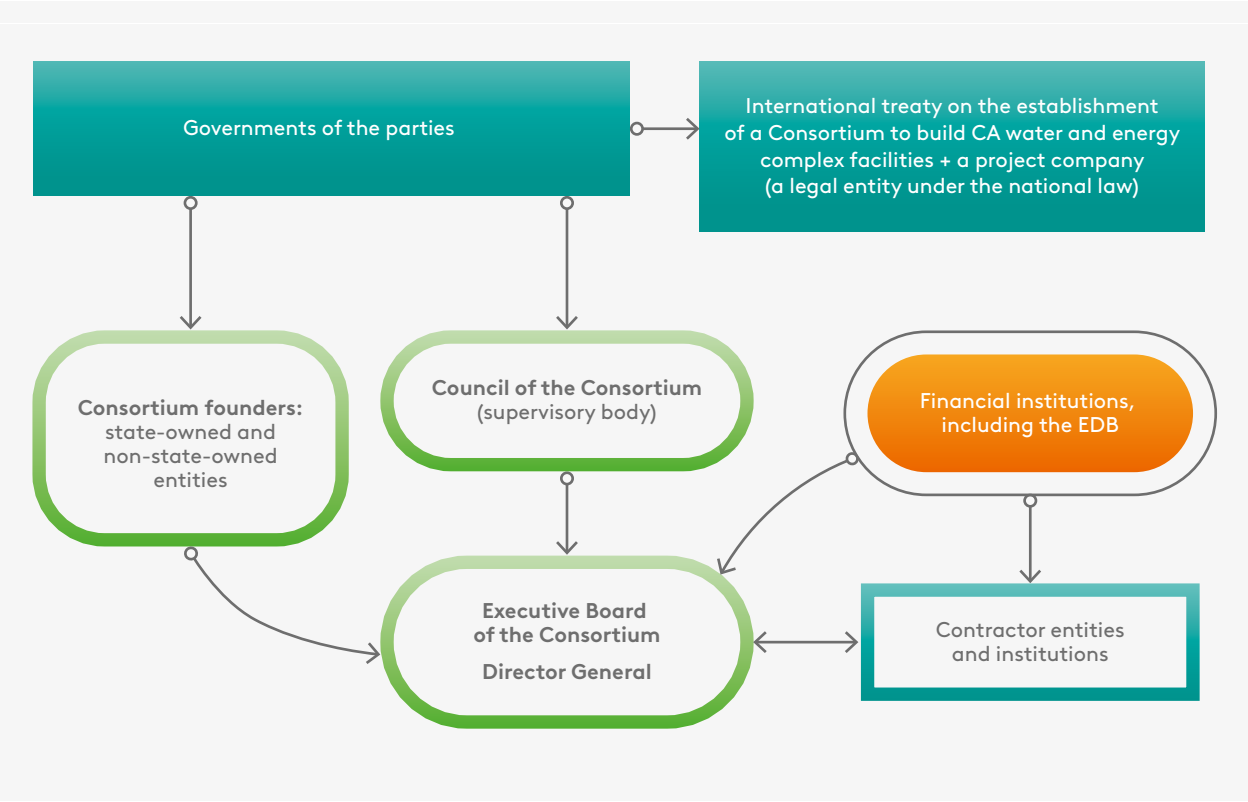
However, the creation of a water and energy consortium in Central Asia to encompass the water and energy complex of the entire region is a difficult task and is still unparalleled anywhere in the world. First of all, regulating the operation of international consortium is not covered by the national legislation of the CA states. Another obstacle to the creation of a consortium is that the CA water and energy complex consists of numerous national hydropower and irrigation facilities, with the exclusive and sovereign right to own and manage them reserved by the relevant CA states. Therefore, stakeholders could rely on simpler forms of cooperation to build major infrastructure facilities for the CA water and energy complex (for example, HPPs), such as a project consortium using the BOT (build — operate — transfer) or BOOT (build — own — operate — transfer) model and based on the principles of project financing.

↓ Figure B. Proposed Institutional Framework for the International Water and Energy Consortium of Central Asia. Option of Creation of an International Organisation



Note: the diagram shows the functional interaction of IFAS with the Consortium (not reflecting the hierarchy). IFAS remains subordinate to the Council of Heads of State.
Source: EDB

↓ Figure C. Institutional Framework for a Consortium Based on the BOT or BOOT Model



Source: EDB

Fourth

The financial operator of the International Water and Energy Consortium may be an IFI (or IFIs), including the EDB, whose activities will be regulated by a special agreement with the Consortium. The modalities of the financial operator's engagement in the CA water and energy complex activities may include:

- provision of **long-term loans**, including project-related ones (and under government guarantees), to finance the construction of power generation and water management facilities;

- investment **through the issue of bonds** (green bonds in the power industry and their derivative water bonds in the water sector to finance the construction and upgrading of water pipelines and sewers), as well as acquisition of shares in facilities under construction;

- **creation of joint ventures** for the construction and operation of facilities with resources potentially mobilised from IFIs, international donors, and private investors;

- **organisation of syndicated financing** to pool financial resources from international donors and potentially mobilise additional external and domestic financial resources of the private sector;

- **trade financing** aimed at ensuring timely mutual settlements of the Consortium members for the supply of electricity, fuel and energy resources, payments for water management services, purchases of appropriate power generation equipment, etc. The Consortium can streamline the system of payments and cash flows among the CA states and thereby ensure sustainable functioning of the CA water and energy complex; and provision of **financial, technical, and advisory assistance** in the preparation of feasibility studies for the construction of facilities and enhancement of the research potential in the area of management of water and energy resources in CA.

The development of mechanisms for joint regulation of the CA water and energy complex can **serve as a basis for enhancing economic, trade, and investment cooperation** in the region. By providing a legal framework for cooperation at the regional level and incentives for combined efforts, the new approaches to the CA water and energy complex regulation may substantially simplify and accelerate the formation of an Integrated Energy Market (IEM) in the region.

Fifth

Effective regulation and development of the CA water and energy complex is a tough challenge. Other measures can and should be added to the above key proposals, building a kind of **"ecosystem" of CA water and energy complex institutions and organisations as a result**. In particular, the activities of the SIC ICWC and CDC Energy based in Tashkent could be supplemented through the creation of an **International Research Centre of the Water and Energy Complex of Central Asia**. This goal could be achieved with technical assistance from international development bank, including the EDB.

Introduction

The report *Investment in the Water and Energy Complex of Central Asia* (see Vinokurov et al., 2021) concludes that the basic principle of efficient operation of the water and energy complex of Central Asia (CA) is not being observed. The vitally important principle of priority of the irrigation water use regime in the basin of the transboundary Aral Sea rivers — the Syr Darya and Amu Darya — based on the natural geographic features of the region, has been compromised, including for objective reasons, in order to achieve energy independence, which is a goal adopted by all states of the region. For over 30 years, energy has played a dominant role in the CA water and energy complex, at the expense of water.

All large rivers in CA cross national borders and have an interstate status. In the transboundary river basins, the flow is almost entirely formed in the upper reaches and used downstream. These natural and geopolitical factors objectively predetermine the need to promote regional integration and joint management of the river basins based on international law. The lack of clear arrangements among the CA countries for water sharing in the river basins significantly diminishes the regional economic integration potential, including trade, transport, and labour markets, thereby inflating costs and hindering achievement of the Sustainable Development Goals (SDGs).

The social and economic development of the CA countries in the Aral Sea basin has been accompanied by depletion of water resources for a long time, and that factor determines the key vector of interstate relations among the countries. The water shortage in the region is largely attributable to poor management of water use in agriculture and manufacturing, the unsatisfactory state of water management facilities, and insufficient funding for their maintenance and development. Critical scarcity of water resources, their uneven distribution among the countries, and mounting environmental problems call for concerted efforts and economic integration on the basis of shared interests.

Water availability depends on many factors: natural geographic, climatic, economic, demographic, social, political, etc. It should be noted that water availability is also determined by its quality. Various water uses within a basin shape competition for water both at the local and national levels, and in the case of a transboundary river also between countries, often giving it a political cast. Since water is a vital resource for all economic activities, access to it will largely depend on effective coordination of government actions, directly or indirectly related to water resources. Political prerequisites should be created for integrated water resources management (IWRM) in general and water use by various sectors of the economy in particular (WWF, 2012).

At present, economic activity is associated with large-scale extraction and use of natural resources. Among these, water leaves behind all other natural resources in the world in terms of the volume and rate of growth of its use. As the demand for water is constantly expanding, the impact of economic activity on the terrestrial hydrological regime is also getting stronger. The flow of both small and large rivers changes substantially as a result of its regulation. The scale of such transformations is so huge that river flow is fully regulated in almost all CA countries. Anthropogenic impacts on river ecosystems and expanding construction of surface and groundwater intake facilities result in critical qualitative and quantitative changes in the river flow regime. The number of river basins whose water quality has deteriorated sharply is growing in the region. The negative impacts of economic activity generally cause water scarcity and intensify competition for water in the basins of both national and transboundary rivers, posing threats to safe water use and ecosystem sustainability. These changes by far outpace the natural processes of renewal of water resources and are particularly prominent in regions characterised by low water availability.

The increasing water stress — caused among other things by population growth, environmental degradation, and climate change — makes it more difficult to manage water and energy resources, and this makes it urgent to further improve water and energy resources management. The ongoing climate changes are increasingly manifested in changed precipitation patterns, affecting the hydrological features of rivers. This significantly worsens the situation with water reserves and the difficulty of meeting water needs. The transformation of the hydrological regime of rivers, and thus of the conditions of water use, as well as the resulting stronger competition for water in the region, highlight the importance of strategies for integrated management of land and water resources.

The declining water resource potential of river systems, and thus the deteriorating conditions of water use are among the risk factors and challenges to the security of a state. It is becoming increasingly clear that a development model focusing on economic growth that is not balanced with the potential of natural resources and their use is not suitable for overcoming modern environmental challenges and their social and economic impacts (UNECE, 2013). To address the conflicts among water supply, hydropower generation, irrigation, and environmental requirements arising in transboundary river basins, it is necessary to take a coordinated approach to the management of water bodies and water resources at the regional and national levels.

Therefore, decisions on how to allocate and use water resources among water-user sectors, including those in a transboundary context, are fundamental to sustainable development and the wellbeing of society. Balanced distribution of limited water resources among the CA countries and competing water user sectors, based on the principles of efficiency, sustainability, and equity, requires appropriate institutional and regulatory mechanisms and instruments. As noted by the OECD, the "water crisis" is largely a governance crisis (OECD, 2011).

There are various definitions of water management, and for the purposes of this report, it refers to "the political, social, economic, and administrative systems that are necessary to develop and manage water resources and provide water services to the public". Thus, water management is a set of rules, practices, and standards that determine water allocation and use. It also covers the institutions (agencies) that make water-related decisions and the processes that stakeholders use to participate in those institutions. In this regard, IWRM is of key importance, and one of the clear commitments for its promotion is the sustainable development goal dealing with IWRM (SDG 6), which seeks to ensure availability and sustainable management of water and sanitation for all. In particular, SDG 6.5 calls upon countries "[b]y 2030, [to] implement integrated water resources management at all levels, including through transboundary cooperation as appropriate" (UN, 2022).

For example, the OECD Water Governance Framework Programme covers the key principles related to the capacity, financing, stakeholder engagement, monitoring, and assessment of relevant levels of governance. Among other things, it states that water resources management depends on the specific conditions of a country or region and there is no universal solution to problems in this area. Such management is a means to an end: addressing water-related problems, which means that the forms of management should correspond to its objectives (Bertule et al., 2018).

All major rivers in the region are transboundary, and the river flow, which accounts for most of the water used, includes the flow generated within a country as well as the inflow of water from neighbouring countries. It is impossible to solve the problems of sharing transboundary rivers in the absence of a regional legal and economic framework in the water and energy sector. The lack of an effective legal framework for the countries to address issues, related to the operation of water management and hydropower facilities of interstate importance on transboundary water bodies, has become one of the main barriers to the creation of a Water and Energy Consortium in the region.

In the upper reaches of rivers, water is primarily a hydropower resource, while in the lower reaches of rivers, it is needed chiefly for irrigated agriculture. At the same time, the comprehensive nature of the problem of water use in the specific conditions of CA is overlooked. The solution of issues of interstate water use and protection of river basins from pollution and depletion — i.e. ensuring sustainable water use going forward and prospects of economic development of each country — depends on regional cooperation.

It is generally recognised that the adoption and promotion of regional policies requires a platform for stakeholders to interact, plan joint activities and their legal support, and institute cooperation instruments and mechanisms. In this regard, it seems relevant for the CA countries to enhance the key components of cooperation on the basis of regional institutions related to sharing transboundary water resources and their management. The International Fund for Saving the Aral Sea (IFAS) definitely acts as such a platform, which does not preclude other forms of cooperation in the water sector and related sectors of the economy, in particular, the creation of a Water and Energy Consortium (KazTAG, 2021).

Effective water and energy management institutions can reduce natural, economic, technical, and social uncertainties in ensuring sustainable water use and reliable power supply. The challenges are common for the CA countries that makes it possible to develop a unified approach to sharing water and energy resources.

The growing water scarcity in the basins of CA transboundary rivers necessitates measures to reinforce the water management infrastructure, save water, and streamline water use in all sectors of the economy. Addressing such issues requires significant long-term investment. The role of international financial institutions (IFIs), along with regional water and energy institutions, is increasing substantially in this important area. Taking into account the investment needs for the development of water management and energy infrastructure in the CA countries, it is necessary to develop political, legal, and economic measures to regulate relations in the water and energy sectors that would take into account the interests of each party and would be aimed at maintaining sustainable water use and efficient use of hydropower resources, while ensuring the environmental safety of transboundary rivers.

The sole objective of the report is to offer a modern comprehensive solution for regulation that would facilitate most effective — from the standpoint of national interests, environmental agenda, SDGs, etc. — use of limited water resources and ensure energy security in the region, taking into account the history of water and energy resources regulation in the CA region, the existing governance arrangements, and successful international experience. The objective has been achieved in the following way:

1. Chapter 1 presents the natural and geographic features of the runoff formation in the main basins in CA. It offers an assessment of potential impacts of the global climate change on the status of water resources in the region.

2. Chapter 2 reveals the key features of the use of water resources in the region, including sectoral ones, and helps determine the priorities and interests of all CA countries that should be taken into account when developing tailored practical solutions.

3. Chapter 3 presents a detailed analysis of the history of the CA water and energy complex regulation, from the Soviet period to the present day. That analysis is instrumental in identifying the shortcomings and the advantages of approaches used in the water and energy complex in order to define the key principles that would become the basis for an effective approach to regulation.

4. Chapter 4 takes into account the international and historical experience and primarily defines a system of principles for effective regulation of the CA water and energy complex, offering two potential approaches to regulation based thereon: 1) an option

of comprehensive modernisation of the existing framework of the CA water and energy complex regulation; 2) various arrangements for creating the International Water and Energy Consortium of Central Asia.

When looking for effective regulation mechanisms for managing the CA water and energy complex in the Aral Sea basin, designed to become a compromise solution for all states of the region, we tried take into account the need to comply with the key principle of the CA water and energy complex — an integrated water resources management. Suggested approaches are aimed at reformatting the strategic priorities of the CA water and energy complex (including investment ones), focusing on water resources. However, energy remains critical. The CA states need to further strengthen cooperation and integration processes. This will allow further the formation of a regional energy market and the regulation of water issues that would meet the interests of each country in the region.

1. NATURAL AND GEOGRAPHIC DESCRIPTION OF WATER RESOURCES OF CENTRAL ASIA

1.1 Climate of Central Asia

The territory of Central Asia (CA) represents a vast endorheic area of the landlocked Aral Sea and Caspian Sea basin. Because of this geographic feature, its river regimes are distinctive and extremely sensitive to economic activity and climate change. The natural and geographical conditions of the region (see Table 1) within the boundaries of the basin determine the specific nature of the river runoff formation, while the economic and political conditions shape its use (Yasinsky et al., 2011; Volkhonsky, 2014).

All CA states are landlocked countries. However, Uzbekistan is one of two doubly landlocked (by two states) countries in the world. The region is located in a zone of inland deserts, which occupy most of its territory. CA also receives no water inflow from outside.

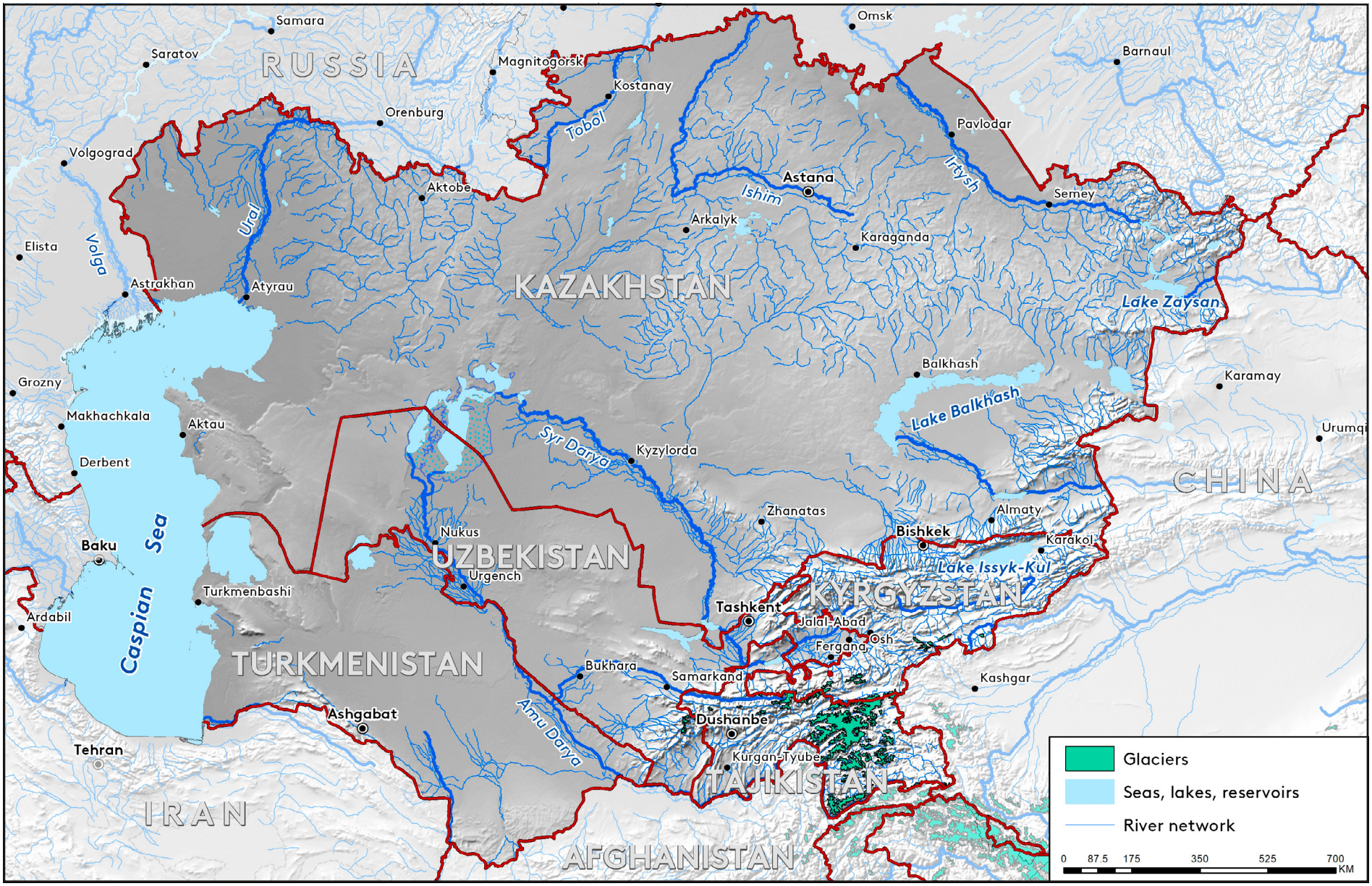
Hydrologically, the territory of CA is divided into three regions: mountainous, piedmont, and flat land. Groundwaters are fed in the mountainous region, generally transit through

↓ Table 1. Main Climatic and Geographical Features of CA Countries

Feature	Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
Territory area, 1,000 km²	2,724.9	187.5	142.6	491.2	448.9
Share of flat territory	58% desert and semi-desert	15%	7%	80% desert and semi-desert	78.8% desert and semi-desert
Share of mountainous territory	10%	85%	93%	10%	21.2%
Share of agricultural land in the total territory	23% farming, 70% animal husbandry	52%	53.6%	69.4% agricultural, 27.6% reserve lands	46.1% agricultural, 20.1% reserve lands
Maximum and minimum elevations	7,010 m -132 m	7,439 m 488 m	7,495 m 300 m	3,139 m -81 m	4,934 m -12.8 m
Maximum and minimum absolute temperatures	+49°C -57°C	+43.6°C -53.6°C	+47°C -63°C	+50°C -32.8°C	+50°C -40°C
Long-term average annual precipitation (mm/year)	250	533	691	161	-40°C
Long-term average precipitation (km³/year)	681.2	106.6	97.7	78.6	92.5

Sources: CESDRR (2020), FAO (2022).

↓ Figure 1. Main Water Basins of CA



Source: EDB

the piedmont region, dissipate and evaporate in the flat lands (Alpatyev et al., 1976). Moisture exchange is extremely intense there: significant formation of the runoff in the mountains is accompanied by its intense dissipation into the atmosphere in the plains. The runoff formed there does not leave its boundaries, evaporating back into the atmosphere (Davydov, 1947; Alpatyev et al., 1976).

The distance of CA from oceans and seas, the nature of its orographic structure, and its geological features determine the continental climate, the relevant processes of river runoff formation and distribution, and, thus, the hydrographic network and the river regime. The location of CA in the heart of the continent and lack of protection from the north determine its very dry and sharply continental climate: dry and hot summers (with the temperature reaching +50°C in deserts) giving way to relatively humid winters, sometimes with severe frosts (reaching -57°C in the northern regions of Kazakhstan and -63°C in the eastern high-mountain regions of Tajikistan in the Pamirs).

The geography of CA includes vast steppes and desert plains, valleys, high mountain peaks, and mountain plateaus. There are several major mountain systems in the region, with the Altai-Sayan massif in the north-east and the even more complex Tian Shan and Pamir-Alay system in the south-west. The total land surface taken up by mountains is 800,000 km², or 20% of the surface area of CA. More than 90% of Tajikistan (the Pamir-Alay) and Kyrgyzstan (the Tian Shan) is mountainous. Mountain ecosystems also cover Eastern Kazakhstan (the Kazakh Uplands, Dzungarian Alatau, Tarbagatai, and Altai) and South-Eastern Uzbekistan (the Western Tian Shan and Hissar Range), extending to Afghanistan (the Hindu Kush) and China. Mountains act as climate regulators and river watersheds. They produce rich biodiversity, supporting the habitats of flora and fauna. In Turkmenistan, mountains take up only 5% of the country's territory, but account for almost two-thirds of its biodiversity.

Glaciers cover 4% of Kyrgyzstan and 6% of Tajikistan. There are also glaciers in Kazakhstan and Uzbekistan. The total area of glaciers in CA is 12,000–14,000 km². The glaciers hold about 1,000 km³ of water, which is equivalent to a 10-year flow of the Amu Darya and Syr Darya rivers. Snow-, glacier-, and permafrost-melt water accounts for a significant part of the river flow balance in CA, making on average 74% of the total annual inflow in the growing season and 26% in the autumn, winter, and early spring (Ibatullin et al., 2009). Glaciers are of great importance for agricultural sectors of the region's economy, supplying water to irrigated land in the summer months, when the rainfall is low and the crop water needs are at their peak.

1.2 Main River Basins of Central Asia

In total, there are more than 89,000 rivers and almost 6,000 lakes in the CA region (see Table 2). The total length of rivers in CA is about 12 million km. The density of the river network in the mountainous part of CA is 0.617 km/km², and in the flat land part — 0.02 km/km². Most of it is fragmented due to the construction of water intake facilities, dams, reservoirs, protection dikes, etc.

There are very few watercourses on the vast plains of the north-western part of CA, and the rivers do not take a single tributary along their entire path from the exit from the mountains to the mouths. Only the largest rivers — the Amu Darya, the Syr Darya, and the Ili — reach the Aral Sea and Lake Balkhash. In contrast to flat land areas, the CA mountains are dissected by an extensive river network, including more than ten thousand watercourses (Shults, 1965; Domanitsky et al., 1971).

The glacial feeding of CA rivers is no more than 10% of the annual runoff, maximum 20%. The seasonal snow feeding of mountain rivers accounts for up to 50%, sometimes more. The rain feeding of rivers is insignificant, usually no more than 10%, rarely 20% even at altitudes from

↓ Table 2. Distribution of Rivers and Lakes by Main Basins in CA

River basin	Rivers		Lakes	
	Total	Length > 10 km	Total	Area > 1 km²
The Amu Darya River	40,999	1,787	2,619	129
The Syr Darya River	29,790	1,907	1,405	65
The Talas River	3,632	276	467	23
The Chu River	5,244	491	506	39
TOTAL IN CA	**89,018**	**4,979**	**5,961**	**321**

Source: ICARDA, 2009.

1,000 to 2,000 m, where their share in surface runoff is more notable. Groundwater (20–40%) takes a significant part in the feeding of mountain rivers in CA, with its share increasing at the foot of piedmont trails, or so-called cone deltas. In terms of their water regime, which is closely related to the climate and the altitude position of the belt, the rivers of the Aral Sea basin are grouped under the Altai and the Tian Shan types[1] (Alpatyev et al., 1976).

Rivers fed by glaciers and snow are particularly important for artificial irrigation, as they have the greatest runoff in July—August, just when crops on irrigated lands have the greatest need for water. Economic activity has a great impact on the river runoff regime. As soon as the rivers reach the plain, the water is withdrawn for irrigation, which is especially intensive during the flood, and the runoff gradually decreases. The CA rivers are characterised by extended floods and steep falls, being of great interest for both irrigation and hydropower generation (Shults, 1965).

Based on its physical and geographic conditions, the territory of CA can be divided into four major sea and lake basins:

- the Aral Sea basin;
- the Lake Balkhash basin;
- the north-eastern part of the Caspian Sea basin, the Ural and the Emba rivers;
- the Kara Sea basin.

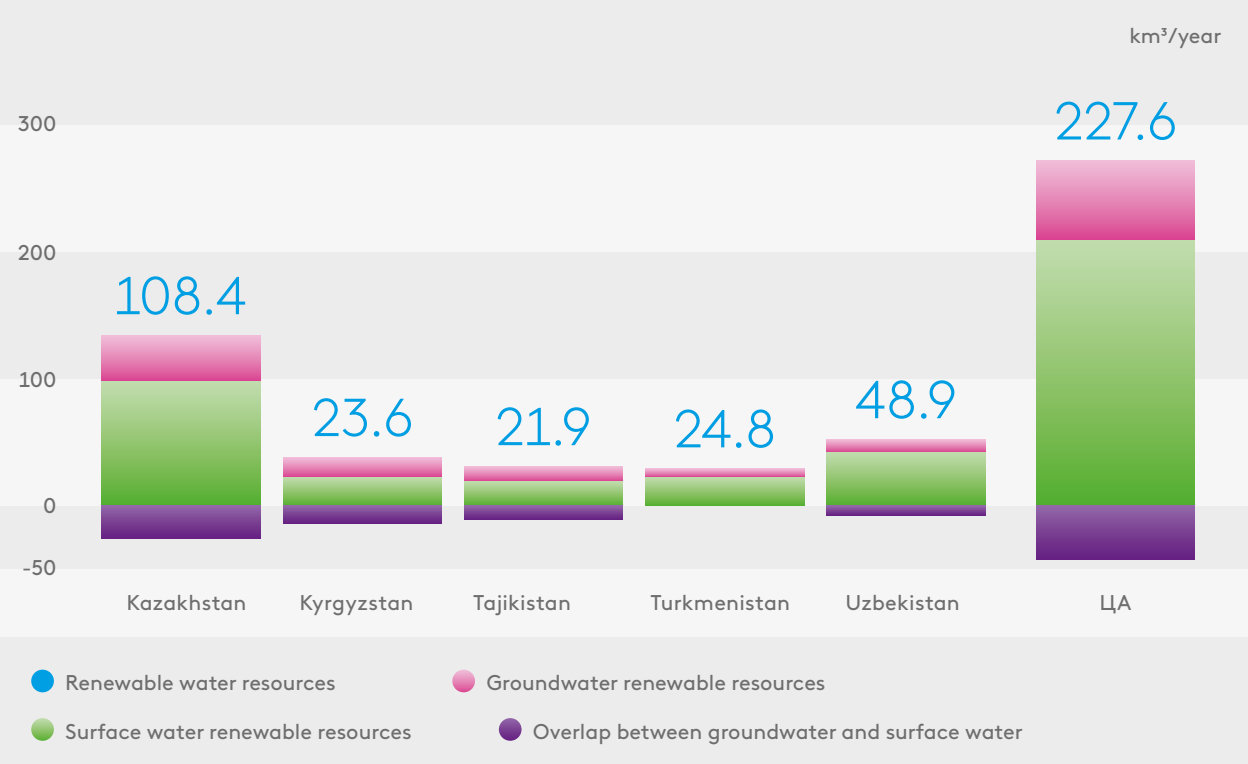
The water resources in the CA countries and, in particular, in the Aral Sea basin are characterised by significant variability. Due to the natural and climatic conditions, the surface runoff of rivers is subject to large fluctuations and is characterised by frequent recurrence of low-water years. As a rule, low-water years alternate with high-water years, with the former observed more often.

The CA water resources, including all four large sea and lake basins, as well as groundwater resources, are estimated at a total of 210 km³/year (Dukhovny et al., 2020) (see Table 3 and Annex 1) to 228 km³/year (FAO, 2022) (see Figure 1). The estimates of water resources on a regional scale are still based mainly on outdated literature. The volume of water resources was repeatedly estimated by various researchers (1949, 1955, 1967, 1969, and 1987), whose papers to this day serve as the basis for aggregate estimates of the river runoff.

In terms of geography, the water resources of CA are concentrated more in Kazakhstan (in average 108 km³/year, 107.6 km³/year in 2019 or almost 48% of the region's water resources) (BNS, 2020). All main water basins of CA to a greater or lesser extent cover

[1] The Altai type has a higher flow in summer and autumn and a low runoff in winter, while the Tian Shan type has a flow regime formed as a result of high-mountain snow and glacier melting, which is the greatest in the period of the highest air temperatures.

↓ Figure 2. Surface and Groundwater Renewable Resources in CA, 2018



Source: compiled by the authors using FAO data (FAO, 2022).

the territory of Kazakhstan, which is the ninth largest country in the world (2.7 million km²). The internal renewable resources make 64.4 km³/year (65.1 km³/year in 2019) and are formed within the country. 42.5 km³/year (44.6 km³/year accordingly to other sources) come from the neighbouring countries: China — about 42%, Uzbekistan — 34%, Russia — 17%, and Kyrgyzstan — 7%.

Thus, 52% of renewable water resources are distributed among the remaining CA countries, mostly within one basin of the Aral Sea, formed by two largest rivers in CA — the Amu Darya and the Syr Darya. Kyrgyzstan (23.6 km³/year) and Tajikistan (21.9 km³/year) are located in the upper reaches of river basins and are characterised by low water dependence and large volumes of river runoff passing to the downstream countries of the basins — Uzbekistan (48.9 km³/year) and Turkmenistan (24.8 km³/year). The southern areas of Kazakhstan are also part of the Aral Sea basin. Therefore, the main regional problems of water management in CA are concentrated in this basin.

1.3 Aral Sea Basin

The Aral Sea basin plays a major role in water supply in CA. Its share in total renewable water resources of the entire region, taking into account all main basins of Kazakhstan, is about 108.4 km³/year or 48%. It covers almost the entire territory of Tajikistan, Uzbekistan, a large part of Turkmenistan, four regions of Kyrgyzstan, the southern part of Kazakhstan, taking up an area of about 2.4 million km²; and, with the northern provinces of Afghanistan and north-eastern Iran included, its area is about 2.7 million km².

The water resources of the Aral Sea basin mostly belong to the basins of the Syr Darya and Amu Darya rivers. Separate basins (endorheic but gravitating towards the Amu Darya River) are formed by the Kashka Darya, Zeravshan, Murghab, and Tejen rivers, which lost their connection to the main river a long time ago. Disposable water resources of the Aral Sea basin consist of renewable surface and groundwaters of natural origin and return waters of anthropogenic origin.

↓ Table 3. Comparative Assessment of River Flow in the Aral Sea Basin

Rivers in the Aral Sea basin	SPECA, 2000, km³	OECD, 2018, km³
The Naryn — inflow to the Toktogul Reservoir	14.5	13.7
The Kara Darya — inflow to the Andizhan Reservoir	3.9	3.8
The Chirchiq — inflow to the Charvak Reservoir	8.0	6.9
Total interstate rivers	26.4	24.4
Fergana Valley rivers	7.8	8.2
Rivers of the Chirchiq, Ohangaron, and Keles basins (excluding the Chirchiq), middle and lower reaches	3.0	3.7
Total in the basin	**37.2**	**36.3**
Amu Darya River basin		
The Vakhsh — inflow to the Nurek Reservoir	20.0	21.3
The Panj — the Lower Pyanj section	34.3	33.5
The Kunduz — the Askarkhana section	4.5	4.4
The Kafirnigan — accounted surface inflow	5.5	5.1
The Surkhan Darya — accounted surface inflow	3.3	3.3
Total for the Amu Darya River	67.6	67.6
The Kashka Darya — accounted surface inflow	1.2	1.2
The Zerafshan — Dupuli bridge + the Magian Darya — Sudji station	5.1	5.0
Rivers in Turkmenistan		
Rivers in northern Afghanistan	2.2	2.1
Total in the basin	**79.3**	**78.8**
Grand total in the Aral Sea basin	**116.5**	**115.1**

Source: Dukhovny et al., 2020

As of 2020, 60 million people, or almost 80.7% of the population of the region, lived on the territory of the Aral Sea basin, which covers 60% of the area of CA. In the recent past, in the 1960s, the Aral Sea was one of the biggest endorheic water bodies on Earth and one of the great lakes of the world[2]. Only two rivers — the Amu Darya and the Syr Darya — flow into the Aral Sea.

The **Amu Darya** is the largest river in CA: its length from the head of the Panj River is 2,540 km, and its basin area is 309,000 km². After the confluence of the Panj and the Vakhsh, the river is called the Amu Darya. The Amu Darya's flow is formed mostly in Tajikistan. Then the river flows along the border between Afghanistan and Uzbekistan, traverses Turkmenistan, returns to Uzbekistan, and discharges into the Aral Sea. In the middle reaches, two large right tributaries — the Kafirnigan and the Surkhan Darya — and one left tributary — the Kunduz — discharge into the Amu Darya. It has no other tributaries downstream from that point to the Aral Sea. The river is fed mostly by melted snow and glacier water, with the maximum flow rate observed in summer, and the minimum in January and February. The Amu Darya is among the rivers with the highest sediment load in the world.

The **Syr Darya** is the longest river in CA, with the second largest amount of water. Its length from the source of the Naryn River is 3,019 km, and its basin area is 219,000 km². The source of the Syr Darya is situated in the Central (Inner) Tian Shan. From the point of confluence

[2] It is generally accepted that the largest lakes of the world are those water bodies whose surface area is more than 1,000 km². They are divided into very large — from 1,000 to 10,000 km² — and great ones — more than 10,000 km² (Rumyantsev et al., 2014).

of the Naryn and the Kara Darya, the river is called the Syr Darya. It is a glacier- and snow-fed river, with snow being the dominant source. The water regime is characterised by spring and summer flooding, which starts in April. The maximum flow is registered in June. The Syr Darya's flow is formed mostly in Kazakhstan. Then the Syr Darya traverses Uzbekistan and Tajikistan, and discharges into the Aral Sea in Kazakhstan.

The rivers of the Aral Sea basin are fed by all sources of surface and groundwater: permanent and seasonal snow, glaciers, rain — with the share of each changing, depending on the river basin's position in a certain altitudinal belt — as well as return waters of anthropogenic origin. The hydrographic network of the Aral Sea basin is characterised by an extremely uneven distribution of bodies of water, including the river network, due to climatic and hydrological features of the region (Sokolov, 1964).

There is also an extensive river network in the piedmont plains skirting the mountains of the Aral Sea basin. However, it has a quite unique character: for the most part, these are irrigation canals that divert the flow from the river network and distribute it on irrigated land within their command area. Due to intensive water withdrawal for irrigation purposes, most of the tributaries do not discharge to the Syr Darya. As the Syr Darya emerges from the Fergana Valley, it takes in several right tributaries (the Ohangaron, the Chirchiq, and the Keles), with the last right tributary (the Arys) flowing into the Syr Darya below Shardara.

The flow of the main tributaries of the Syr Darya — the Naryn, the Kara Darya, and the Chirchiq — is regulated by the Toktogul, Andizhan, and Charvak reservoirs. The Kairakum and Shardara reservoirs are operated on the Syr Darya River itself. The main regulator of the Syr Darya flow is the Toktogul Reservoir, which is used for long-term control of the Naryn River flow and compensates for disposable water resources of the Lower Syr Darya.

The flow of the Amu Darya River is regulated with in-stream reservoirs — two on the Vakhsh River (Nurek and Baipazin Reservoirs) and one on the Amu Darya (Tuyamuyun Reservoir) — as well as a number of intra-system, off-stream reservoirs at canals — four at the Karakum canal, one at the Karshi canal, and two at the Amu Bukhara canal, with an overall volume of more than 6 km^3 (Dukhovny et al., 2020). There are 121 reservoirs used for season-adjusted control of the river flow and partial over-year storage of a total capacity of 148.4 km^3 and active spare capacity of 105.3 km^3.

The degree of flow regulation is high on the Syr Darya River — 96%, i.e., the natural flow is almost entirely regulated — and slightly lower on the Amu Darya — 78%, i.e., there is still spare capacity for further regulation, although it will be exhausted in the coming years due to active development of the hydropower resources of the river and its tributaries. The flow of the rivers and their tributaries is expected to be fully regulated by 2030.

The main burden of seasonal regulation falls on complex hydroengineering systems built in the Soviet era to regulate the river flow for irrigation purposes. Seven such hydroengineering systems are located on interstate watercourses with a total design reservoir volume of 51.44 km^3 and a regulation capacity (useful volume) of 34.8 km^3. The regulation capacities are 25.1 km^3 in the Syr Darya basin and 9.7 km^3 in the Amu Darya basin.

1.4 Impact of Global Climate Change on Water Resources in Central Asia

CA is characterised by a variety of climatic conditions; however the climate across its territory is high continental, so the magnitude of variation in temperature within a year is large and the precipitation is low (Yasinsky et al., 2010).

In the context of current global climate changes, the arid climate is manifested through high rates of increase in the average temperature in the CA region, which were recorded throughout the 20th century. Since the 1970s, the average annual rate of warming has accelerated from 0.18°C to 0.42°C per decade, which is almost twice the global average (Chen et al., 2009). The temperature increase was uneven across the region. The highest rates of increase in average annual temperature were recorded in flat land areas. In mountainous areas, the rate of warming is lower, and, in some cases, there was even some cooling. In most parts of CA, the highest rates of temperature increase were registered in winter.

The observed changes in both temperature and precipitation in CA are caused by region-specific anthropogenic factors. In particular, the drying of the Aral Sea and the increased wind erosion of the dry bed are considered to be significant anthropogenic causes of local climate changes and glacier destruction in mountainous areas of the region, affecting the formation of water resources and the river feeding regime (Rakhimov, 2020).

Among the main region-specific indicators of climate change in CA are the state of glaciers and snow cover and the increased desertification. The rate of glacier shrinking by volume is 0.2–1% per year in CA. Some 14–30% of the Tian Shan and Pamir glaciers has melted over the past 50–60 years. The Fedchenko Glacier in the Central Pamir Mountains, in Tajikistan, as well as the Inylchek Glacier, another major one, in Eastern Kyrgyzstan, continue to retreat. The Fedchenko Glacier, which is more than 70 km long, 2 km wide, and 1 km thick, receded 1 km during the 20th century. Almost all of its right tributaries are now separated from the bulk of the glacier, and the lower part is covered by numerous cracks and lakes. The area of the glaciers of the Akshiyrak massif in Central Kyrgyzstan — which includes about 170 glaciers and is 300 km², with the country's largest gold mine Kumtor located there — shrank by 4% from 1943 to 1977 and by 9% from 1977 to 2003. The total volume of ice in the Akshiyrak massif has declined by 10 km³, and the thickness of the glaciers has significantly decreased. The Petrov Glacier (69 km²) in the northern part of the Akshiyrak massif retreated by 1.8 km from 1957 to 2007. There is a large and still growing glacial lake on top of its terminal moraine. In 2006, the lake's area exceeded 3.8 km², with its water volume reaching 60 million m³. The Abramov Glacier, one of the World Glacier Monitoring Service's reference glaciers located on the Alay Range in Southern Kyrgyzstan, near the border with Tajikistan, has retreated by at least 500 m and lost 20% of its ice mass since the 1970s. The Zeravshan Glacier, which gives rise to the Zeravshan River, supplying water to 500,000 ha of irrigated land in densely populated oases near Penjikent, Samarkand, and Bukhara, retreated by 2.5 km during from 1927 to 2009. In Kazakhstan, the surface area and volume of the Central Tuyuksu Glacier — another World Glacier Monitoring Service reference glacier, located in the Zailiyskiy Alatau mountains, in the north-west of the Tian Shan — have decreased by more than 30% over the past 50 years. The glacier has receded 1 km and lost more than 40 million m³ of ice (Zoi Environment Network, 2009).

An important reason for the melting of glaciers in CA is their pollution with dust — up to 20 g/m2 of dust settles on the glaciers per year — which is carried by dust storms from Iran, Afghanistan, China, and other desert areas, and in recent years from the dry Aral Sea area (Ibatullin et al., 2009). Thus, due to the pollution of the snow cover with aeolian fine earth (dust and salts), the intensity of snow melting is increasing by 20% (Alibekov, Alibekova, 2007). About 94% of black carbon[3], which is part of the dust and causes 60% of the darkening of glaciers and snow in the CA region (Schmale et al., 2017), is of anthropogenic origin.

In CA there is a widespread retreat of glaciers: small glaciers are disappearing, and large ones are disintegrating. During 1957–1980, the glaciers of the Aral Sea basin lost 115.5 km³ of ice (≈104 km³ of water), which is almost 20% of the ice reserves that existed in 1957.

[3] Black carbon (BC) has recently become a major contributor to global climate change, perhaps second only to CO_2 as the main driver of the change. BC particles absorb sunlight and give soot its black colour. BC is formed both in nature and as a result of human activity as a product of incomplete combustion of fossil fuels, biofuels, and biomass. Its primary sources include emissions from diesel engines, cookers, wood burning, and wildfires.

↓ Table 4. Main Projected Climate Changes in CA

Heat and cold	
Mean surface temperature	High-confidence increase
Extreme heat	High-confidence increase
Cold spells	High-confidence decrease
Severe frost	High-confidence decrease
Wetness and dryness	
Mean precipitation	High-confidence increase
River flooding	Medium-confidence increase
Heavy precipitation and pluvial flood	High-confidence increase
Fire weather	Medium-confidence increase
Wind	
Mean wind speed	Medium-confidence decrease
Snow and ice	
Snow and glaciers	High-confidence decrease
Permafrost	High-confidence decrease
Lake, river, and sea ice	High-confidence decrease
Other	
Atmospheric CO_2	High-confidence increase

Source: IPCC, 2021b

Over the entire observation period, starting from 1930, the total glaciation area of the Pamir-Alay decreased by about one third. Changes in the glaciation area are particularly large in basins with extensive glaciation (Bartang, Muksu, Fedchenko glacier system), in the central and southern parts of the region, and are not so marked in basins with less glaciation (south Fergana Valley, the Surkhan Darya River and the Kashka Darya River), in the northern and western parts. Over the past century, Tajikistan's glaciers have shrunk by 20–30% on average. The glaciers of Afghanistan, on the left bank of the Pyanj River, have decreased by 50–70%.

In the long term, all five CA countries will remain vulnerable to global climate change. During the 21st century, CA is expected to have a faster rate of temperature rise than global averages (Jiang et al., 2020). Based on running 36 models, by 2100, the average median annual temperature may increase by 2.6% (by up to 3.3°C in summer) against the pre-industrial level under the most optimistic of the four scenarios used globally at present to model global climate change, and by 6.8°C (up to 8.7°C in summer) under the most pessimistic scenario (IPCC, 2021a).

It is expected that under all standard scenarios of global climate change (IPCC, 2021a), the average annual precipitation in CA will increase on average by 14.4% (from 9.6 to 21.3%) under the most pessimistic scenarios, SSP3–7.0 and SSP5–8.5. Under the other two scenarios, a more modest increase in average temperature and, accordingly, precipitation, is expected (Jiang et al., 2020). The greatest increase in precipitation is expected over the Tian Shan Range and in the northern regions of CA.

Higher temperatures in most parts of CA and greater average annual precipitation are expected to be accompanied by stronger inter-annual variability of the flow and a change in its intra-annual distribution compared to the current situation (Huang et al., 2014). The temperature and precipitation are expected to increase more in winter than in summer. We may expect growing frequency and depth of hydrological drought (Mannig et al., 2018), as well as intensified desertification.

The glaciation area in CA will continue to decrease. The Tian Shan glaciers are expected to lose up to 50% of their mass by 2050 (Farinotti et al., 2015). For example, in Tajikistan, if the current rate of glaciation degradation persists, many small glaciers will completely disappear in the next 30–40 years, but large glaciers and glaciation nodes will remain. The glacial runoff of the Pyanj, the Vakhsh, and the Amu Darya rivers in general may initially increase due to the active melting of glaciers, although later on, it will decrease due to the depletion of the glacier mass.

Water resources in mountain areas will decline by 10–12%, in part as a result of the degradation of mountain glaciation expected in the last decades of the 21st century. As the water reserves in glaciers decrease, the runoff in summer (July—September) will decline, and the runoff in the spring and summer will increase. Going forward, as the water reserves in glaciers shrink and losses in the ice-freed surfaces of river basins increase, the inflow of water to rivers due to the degradation of mountain glaciation will decrease (Ibatullin et al., 2009).

Taken together, the climate changes will contribute to changes in the hydrological regime of the rivers of the Aral Sea basin. However, the pattern of changes in floodplain and delta ecosystems and landscapes that depend on the hydrological regime of the rivers to the maximum possible extent may show slightly different trends arising from the overall impact of climate change and anthropogenic activity (excessive regulation of river flow) (Kuzmina et al., 2019).

The ongoing changes in the climate system of the region are diverse, and their implications are wide-ranging in all aspects of social conditions for the population and economic activity. They have a substantial impact on the ecosystem of the region and areas related to the use of water and land resources (UN, 2011). The variability and intensity of precipitation are increasing in many areas. Changes in the amount of precipitation occur unevenly across the territory and seasons of the year. The increased irregularity of precipitation during the year, when periods of heavy rain alternate with periods of drought, negatively affects crop yields and intensifies soil erosion.

Current and future climate changes will be accompanied by increased inter-annual variability and will result in growing frequency and depth of hydrological drought. Melting glaciers and changing river flows exacerbate many water-related and environmental problems and can have a destabilising effect on food security, the supply of quality drinking water, and the operation of hydropower plants (HPPs).

Climate change is closely related to drought and desertification processes in the territory of the Aral Sea basin states, which cause degradation of agricultural lands and worsen their ameliorative situation. Land degradation hinders sustainable development, leading to weaker food security and intensified social tensions and unemployment (Alibekov, Alibekova, 2007). Drought, desertification, and degradation force people to flee their land, lead to the emergence of economic migrants and environmental refugees, and are among the greatest barriers to achieving the SDGs in developing countries.

2. USE OF WATER RESOURCES IN CENTRAL ASIA

2.1 Water Use Features

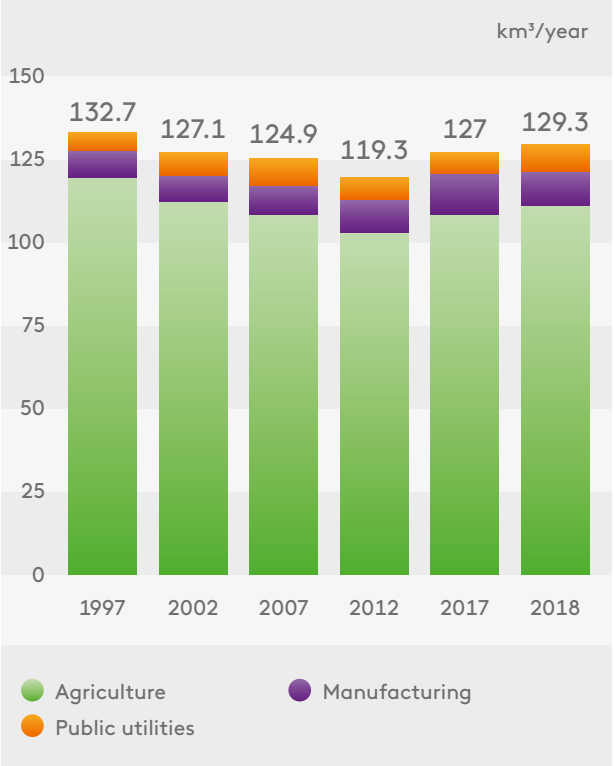
The use of water resources in CA, especially since 1960, has been characterised by high growth rates due to demographic factors and the development of manufacturing and agriculture, particularly irrigation. By the time of the dissolution of the USSR in 1991, the social and economic development of the five CA states in the Aral Sea basin was accompanied by depletion of water resources (Vinokurov et al., 2021). The volume of resources used exceeded the volume of disposable resources, and that factor determined the nature of interstate relations among the countries of the region. While the natural river flow in the Aral Sea

↓ Table 5. Status of Water Resources in CA, 2018

	RK	KR	RT	TM	RU	CA
Resources						
Renewable water resources, km³/year	108.4	23.6	21.9	24.8	48.9	227.6
Internal renewable water resources, km³/year	64.4	48.9	63.5	1.4	16.3	194.5
External renewable water resources, km³/year	44.1	-25.3	-41.6	23.4	32.5	33.1
Renewable water resources, m³/person/year	5,917.7	3,746.5	2,407.5	4,232.7	1,504.8	3,158.5
Water use						
Total water withdrawal, km³/year	25.0	7.7	9.8	28.0	58.9	129.3
Agriculture, km3/year	15.8	7.1	7.4	26.4	54.4	111.0
including irrigation, km³/year	12.3	n.a.	7.4	26.3	53.7	
Industry, km³/year	5.5	0.3	1.6	0.8	2.1	10.4
Municipal water withdrawal, km³/year	3.7	0.2	0.8	0.8	2.4	7.9
Total water withdrawal, m³/person/year	1,366.3	1,215.1	1,074.0	4,777.7	1,813.6	1,540.7
For reference						
Pressure on water resources* (%)	32.7	50.0	64.5	143.6	168.9	81.4
Water dependence ratio (%)	40.6	1.1	17.3	97.0	80.1	
Population, 1,000 people	18,319.6	6,304.0	9,100.8	5,850.9	32,476.2	72,051.6

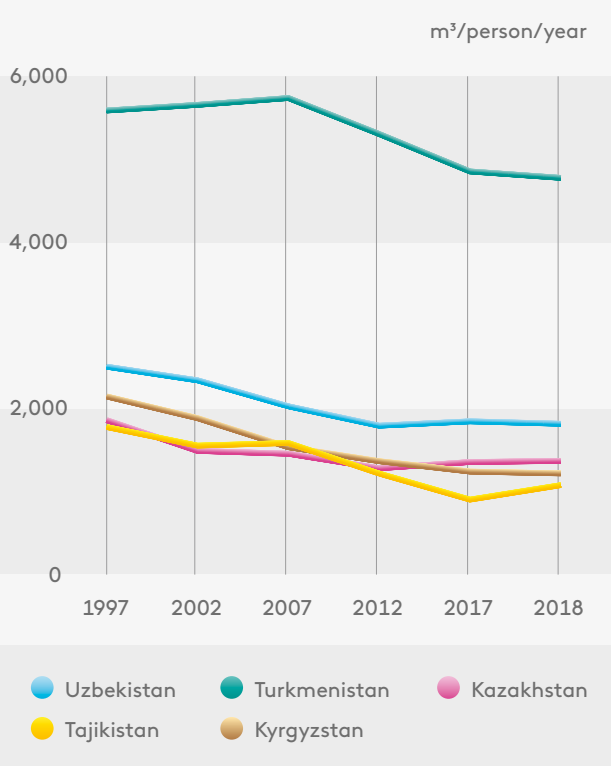
Note: * total withdrawal by major economic sectors as a proportion of total renewable freshwater resources, after taking into account the environmental water requirements. The indicator is also known as the level of water stress; it measures progress towards SDG 6.4.
Source: compiled by the authors using the AQUASTAT database, FAO

↓ Figure 3. Pattern of Water Withdrawal in CA, 1997–2018



Source: compiled by the authors using the AQUASTAT database, FAO

↓ Figure 4. Water Withdrawal in CA, m³/person /year, 1997–2018



Source: compiled by the authors using the AQUASTAT database, FAO

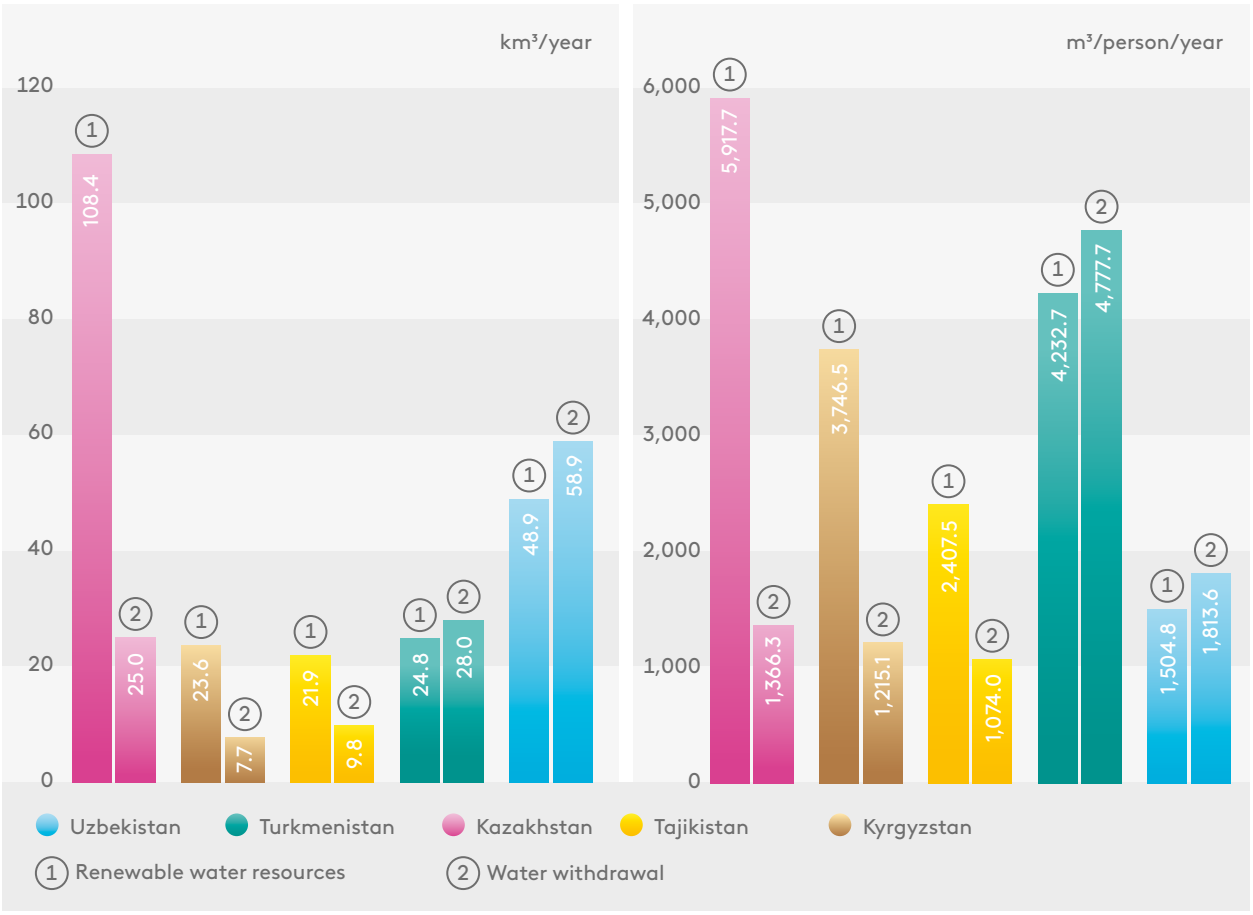
basin was 116.021 km³/year at that time, total water withdrawal reached 116.27–120.69 km³/year in the 1980s—1990s[4]. The elevated demand for water for irrigation was supported by reused water.

After the dissolution of the USSR, CA countries faced significant structural economic and demographic changes, which affected the nature and patterns of water consumption in the region. The transition to a market economy in CA countries was characterised by a significant transformational GDP decline in the 1990s, followed by steady growth after 2000, which continued until 2008 and was interrupted by the global financial and economic crisis, and then by the COVID-19 pandemic, which affected the development of the countries of the region. In terms of industrial production, the mining industry has developed actively. The shares of production of fuel and energy resources and metallurgical production have grown. In 1992–2020, generating capacities in the region increased by 27% to 53.8 GW, including those of HPPs rising by 36% to 14.6 GW (Vinokurov et al., 2021). Agriculture retained its strategic importance for the economy of the region, but its structure and organisation went through radical institutional changes at the grassroots level: large collective and state farms were replaced by smaller farms, making irrigated agriculture less important. The service sector expanded significantly in all countries.

In terms of the use of water resources, important aspects of CA development in the post-Soviet period included persistently high population growth, accompanied by urbanisation. In 1990–2020, the average annual population growth rate in CA was more than 2%, and the population increased by 24.4 million, from 50.3 million to 74.4 million. In urban areas, this combination of demographic factors resulted in a higher load on the social infrastructure, including water supply and sewage facilities.

[4] The water withdrawal in the Aral Sea basin accounts for about 90% of the total water withdrawal in the entire CA region, which includes all four main river basins.

↓ Figure 5. Water Balance, km³/year, 2018

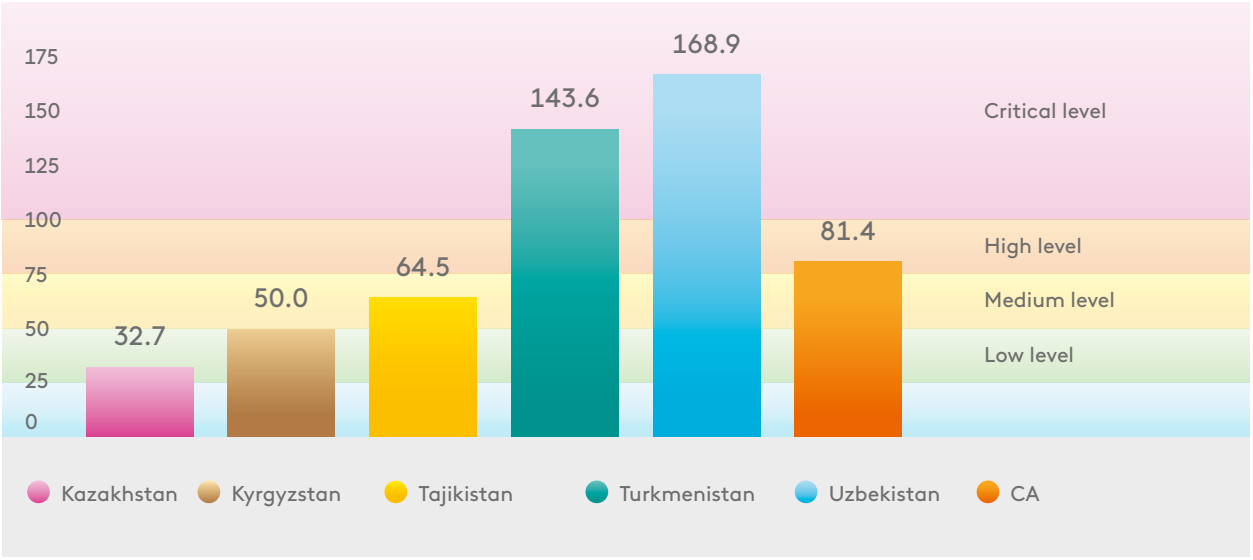


Source: compiled by the authors using the AQUASTAT database, FAO

↓ Figure 6. Water Balance, m³/person /year, 2018

Source: compiled by the authors using the AQUASTAT database, FAO

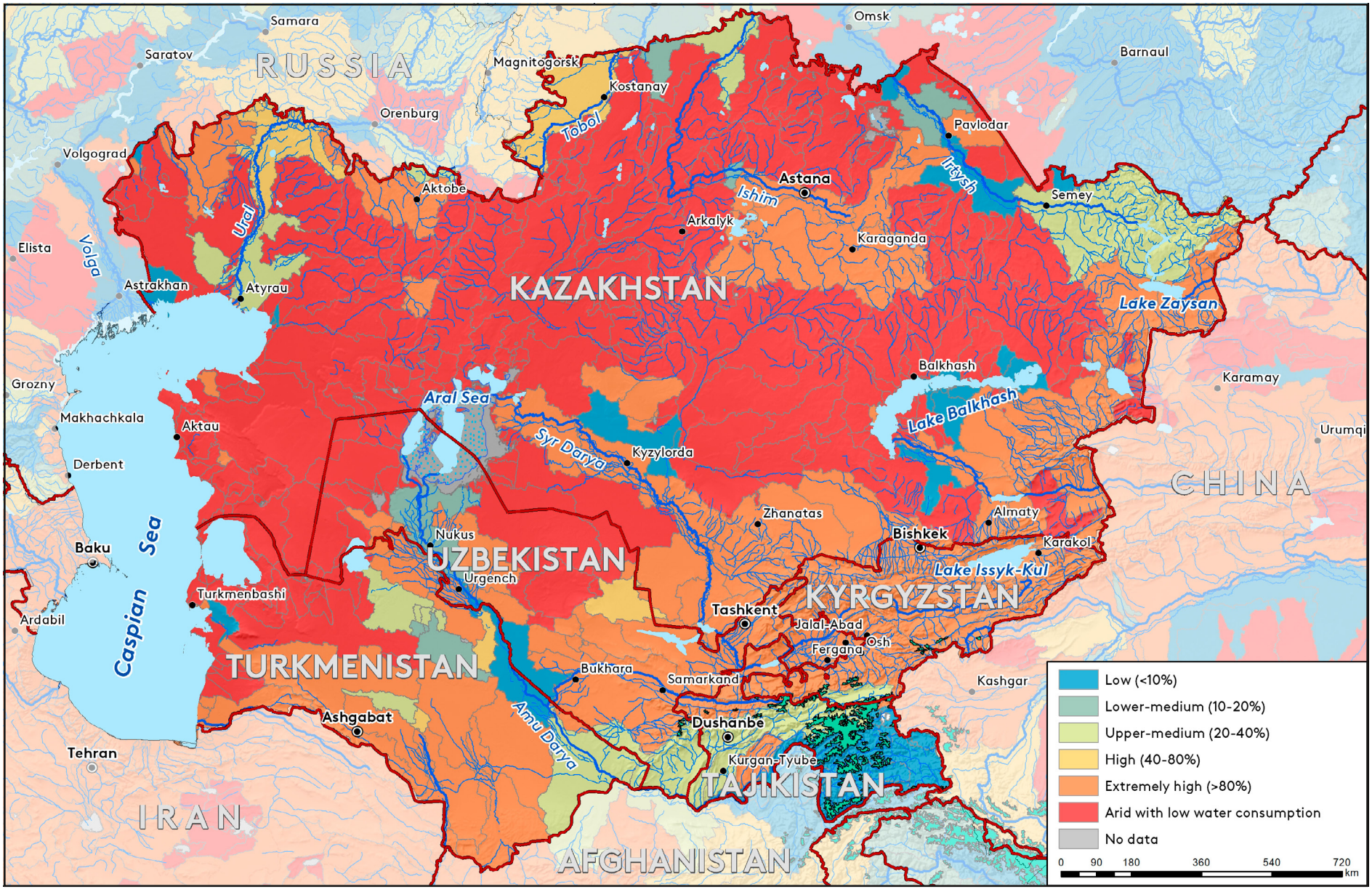
↓ Figure 7. Level of Water Stress (SDG indicator 6.4.2.) in CA, 2018



Source: compiled by the authors using the AQUASTAT database, FAO

The economic and demographic changes during 1997–2018 (see Figure 3) were accompanied by changes in the volume and pattern of water withdrawal by sector. After falling from 132.7 km³/year in 1997 to 119.3 km³/year in 2012, total water consumption increased again to 129.3 km³/year in 2018 — a decrease of 2.6% from 1997 to 2018. The patterns of water consumption have changed markedly. The volume of water withdrawal related to the needs of agriculture in CA decreased by 8.5 km³/year to 111 km³/year, or by 7.1% during the period. At the same time, a significant increase was recorded in industrial and municipal water

↓ Figure 8. Baseline Estimates of Water Stress in CA (SDG Indicator 6.4.2.) up to 2040



Source: EDB based on WRI Aqueduct 3.0

supply, by 32.2% to 10.4 km³/year and by 48% to 7.9 km³/year, respectively. There is no standardised metering of water used for electricity generation in CA, which complicates the analysis of water needs associated with the energy sector. It should be noted that, along with the needs of various economic sectors, the amount of water in the rivers was also critical for determining the scale and the direction of water withdrawal dynamics in the region.

In 1997–2018, the patterns of water consumption also changed significantly at the country level. Four out of five CA states reduced their water consumption. The largest decrease in absolute terms was recorded in Kazakhstan (by 3.6 km³/year, or by 12.5% over the period) and Kyrgyzstan (by 2.4 km³/year, or by 24% over the period). In Tajikistan and Uzbekistan, water consumption fell slightly and generally remained nearly unchanged. In all four countries, the decrease was mainly due to lower water withdrawal for agricultural purposes.

Turkmenistan is the only CA country where the volume of water withdrawal increased from 1997 to 2018 — by a total of 3.6 km³ /year, or by 14.4% over the period — in all sectors of the economy. The largest increase was in agriculture (by 2.7 km³/year). It should be noted that Turkmenistan remains a country with extremely limited volumes of internal renewable water resources (1.4 km³/year) and is, therefore, characterised by the highest water dependence (97%) and an extremely high level of water stress, above the critical level taken as UN SDG 6.4.2. As a result of active consumption of water resources with a relatively limited population, Turkmenistan recorded the highest water withdrawal per capita in CA — 4,777.7 m³/person/year. Turkmenistan, like Uzbekistan, faces severe water scarcity.

As noted above, water withdrawal per capita has generally halved in CA since the Soviet period, going down from 3,500 m³ to 1,540.7 m³ in 2018. The CA countries continue to experience water shortages, and, under the international classification, they fall in the category of "water stressed" countries, with a threshold of 1,000 to 1,700 m³/person /year.

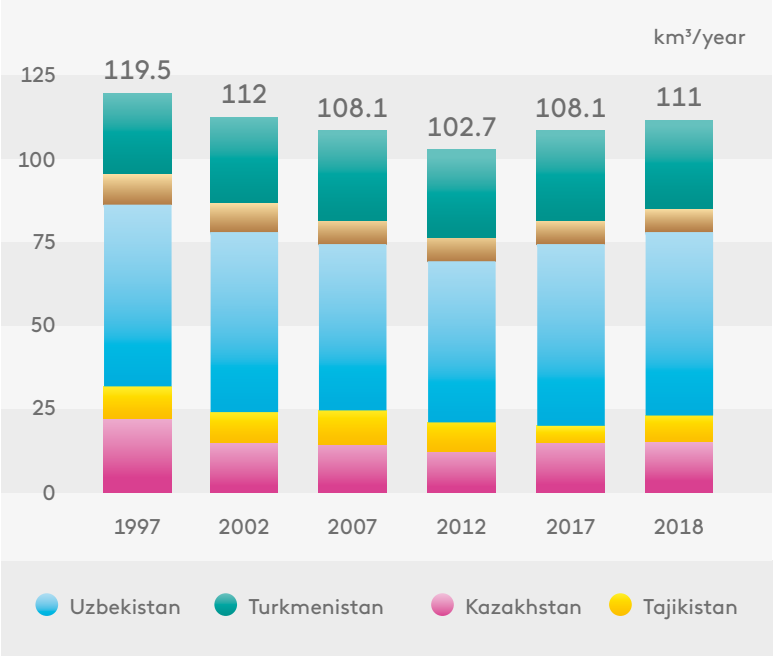
Under the moderate scenario of developments in CA, this trend will persist over the long term. In case of insufficient regional economic cooperation, including unsatisfactory water and energy integration, CA countries may approach a state of "water scarcity" by 2050 (1,296 m³/person/year, while the threshold is 1,000 m³/person /year) (Vinokurov et al., 2021). Two countries with the largest internal renewable water resources — Kyrgyzstan and Tajikistan — have practically reached that state.

The water situation will continue to deteriorate due to demographic factors, assuming continued high population growth and increasing urbanisation, as well as due to potential expansion of irrigated lands. Climate change already has an adverse impact on water resources. Under all scenarios of climate change, by 2040 water scarcity may increase significantly — by a factor of more than 2.8 for some regions — in the lower reaches of the Aral Sea basin (Turkmenistan, Uzbekistan, and southern regions of Kazakhstan, as well as some northern regions of Kazakhstan) (see Figure 8) (Luck et al., 2015).

2.2 Agriculture

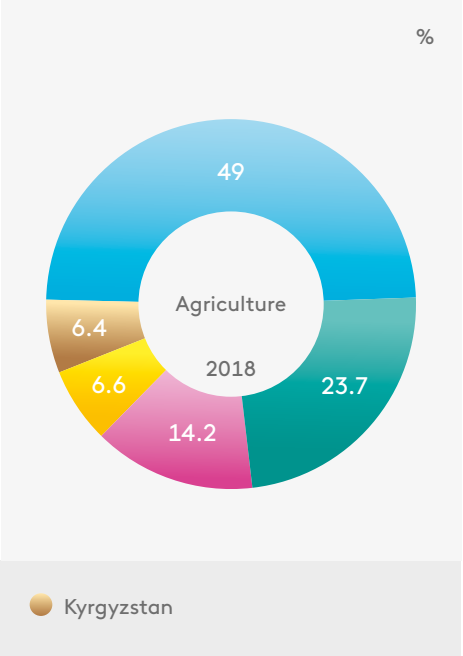
The water policies of the CA countries are subordinated to the interests of agriculture and the supply of irrigated land with irrigation water: 86% of the water used in the region goes to irrigation (111.0 of 129.3 km³/year in 2018). As noted above, the volume of agricultural water withdrawal decreased in 1997–2018. Such trends were observed in all CA countries, except for Turkmenistan. In terms of water consumption for irrigation by country, Uzbekistan (49%) and Turkmenistan (23.7%), historically specialising in cotton cultivation, hold the leading positions. They are followed by Kazakhstan (14.2%), Tajikistan (6.8%), and Kyrgyzstan (6.4%).

↓ Figure 9. Agricultural Water Withdrawal in CA, km³/year, 2018



Source: compiled by the authors using the AQUASTAT database, FAO

↓ Figure 10. Composition of Agricultural Water Withdrawal in CA, 2018



Source: compiled by the authors using the AQUASTAT database, FAO

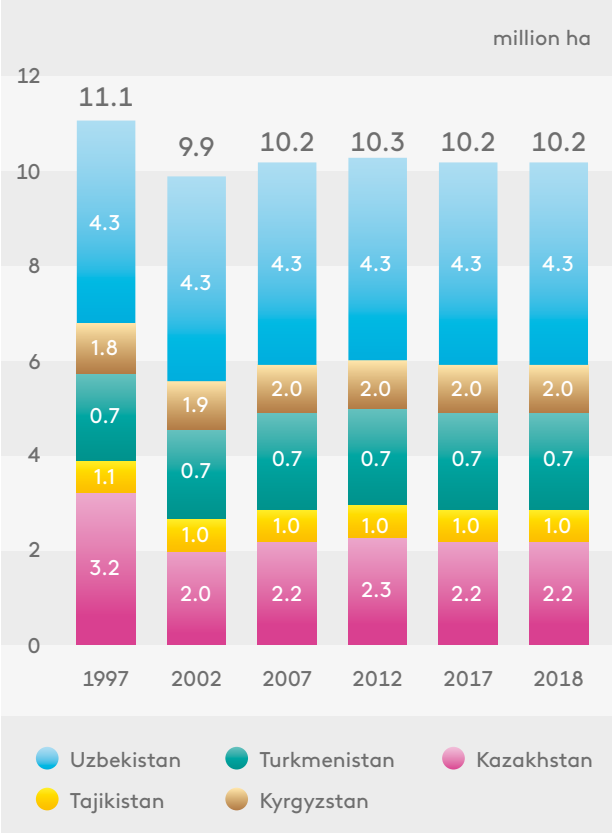
After the dissolution of the USSR, one of essential contributors to lower demand of agriculture for irrigation water (down by 7–9 km³/year) was a reduction of the total area of irrigated land[5] in CA, down to 10.2 million hectares in 2018 — 0.8 million ha less than in 1997. On the one hand, the reduction was due to a change in the mix of cultivated crops in favour of less water-intensive ones. Irrigated agriculture in CA has adjusted to the change in the flow regulation regime in the Aral Sea basin from irrigation to irrigation plus energy generation, and, at times, fully energy generation. On the other hand, during the period of market reforms, a significant amount of irrigated land was withdrawn from use (mainly in Kazakhstan) and land degradation occurred in the region.

The area under cereals cultivation was expanded due to a reduction in the area under cotton and fodder crops, corn, rice, etc. Irrigated areas under wheat increased in all countries, in total by more than 1 million ha, or 58% in 1997–2018. During the same period, the area of irrigated land allocated for cotton cultivation decreased by 123,500 ha. Uzbekistan, which accounts for 57% of the irrigated areas under cotton in CA, was the only country that reduced its area. The total reduction in that country was 200,000 ha. Other CA countries, including Turkmenistan, tried to expand their area of irrigated land under cotton, but that increase was not enough to offset the reduction in Uzbekistan. Irrigated land under fodder crops, corn, other cereals, and rice decreased significantly.

The change in the mix of cultivated crops was caused by the adoption of national food security policies in all CA countries and a modification of the water use regime in the Aral Sea basin. As part of these policies, all countries assigned priority to ensuring grain independence and, therefore, focused on cereals, especially wheat. On the one hand, the choice of less water-intensive crops could be seen as a potential factor contributing to lower water consumption; however, given the scarcity of arable land, the achievement of national food security priorities promotes the development of new, low-fertility lands to cultivate grain crops in the context of still-limited water resources.

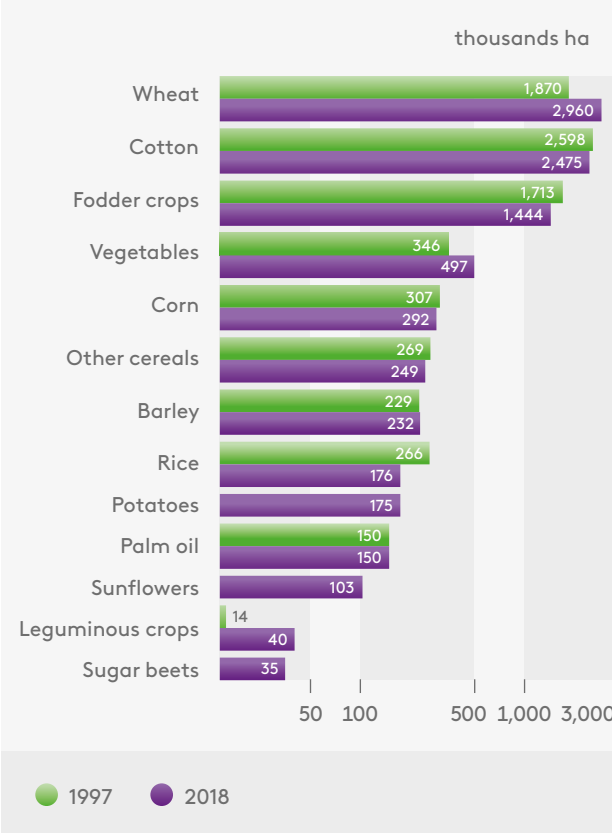
[5] Irrigated land means the area of all land equipped for irrigation, as well as all land with other forms of agricultural water use: areas under crops but unequipped for irrigation and making use of flooding; unequipped cultivated wetlands and floodplain valleys.

↓ Figure 11. Changes in Irrigated Land in CA, million ha



Source: compiled by the authors using the AQUASTAT database, FAO

↓ Figure 12. Irrigated Land under Main Crops in CA, 1,000 ha, 2018



Source: compiled by the authors using the AQUASTAT database, FAO

The food programmes of the countries in the region do not adequately consider the opportunities for regional specialisation and food trade. Such policies do not contribute to efficient use of land and water resources, taking into account their natural and climatic features. The low level of regional specialisation in agriculture results in higher expenses and costs of production, lower product quality, and thus weaker competitiveness both on external and domestic markets (ICARDA, 2009).

These agricultural policies are one of the reasons for the further increase in water scarcity and competition for water. For example, Kazakhstan, which specialises in high-quality grain production, is able to meet the demand of the CA countries for cereals. Moreover, Kazakhstan, which has large pasture areas, could become the main supplier of high-quality livestock products to the region. This would help other CA countries release significant areas of land under cereals, reduce water withdrawal for irrigation of such lands, and grow feed for livestock. Those countries could benefit from their favourable natural and climatic conditions, specialising in the cultivation and processing of highly profitable crops, such as fruit and vegetables.

The effects on water consumption of changes in the range of crops were mixed. The non-use of a significant amount of irrigated land (723,1 thousand ha in 2018) (BNS, 2020), for example, in Kazakhstan can be seen as one of the key factors contributing to a decline in agricultural water withdrawal in 1991–2018. During the transition from a planned to a market economy, there was little investment in the water economy, which led to significant deterioration of irrigation and drainage systems and also of the environmental and ameliorative status of the land. The process of urbanisation, accompanied by expansion of urban areas, often at the expense of agricultural land, also played a role. As a result, large plots of land were withdrawn from irrigated land rotation.

In addition to the reduction of the area of irrigated land, the problems of land degradation should be noted, as well as intensive wear and tear on irrigation and drainage systems, as these have a significant impact on the efficiency of water use in the region. Drastic deterioration of the environmental situation in the Aral Sea region led to degradation of natural ecosystems, accelerating desertification, and intensified soil salinisation (Pankova et al., 1996).

The desiccation of the Aral Sea exposed vast areas of the seabed with high content of salts, fertilizers, and pesticides, a potent mixture that is dangerous for humans and the environment. Each year, an estimated 70 million tons of salts escape the Aral Sea basin and settle on an area of 1.5–2 million km². Sandy and saline deserts formed as a result of the sea desiccation have turned into one of the major sources of dust and mineral salts that are transported to the area around the Aral Sea and contribute to further desertification (Alibekov, Alibekova, 2007).

Desertification processes in the region are caused by unsustainable water use in irrigation systems (UN, 2011). Aerospace data show that virtually all drainless depressions are filled by discharge of collector-drainage water. In CA, such water has flooded about 800,000 ha of land and affected more than 930,000 ha where pasture fodder plants were replaced by low-value plants.

The irrigation infrastructure has reached the limit of its service life and needs to be renovated and modernised. The countries of the region need to implement large-scale technical renovation and modernisation of water management and irrigation facilities, which should change the trend of growing demand for water in this sector of the economy. The poor state of repair of irrigation infrastructure leads to substantial loss of water, causing waterlogging and salinization of irrigated lands whose agricultural use then has to be discontinued (FAO, 2011).

In 2001–2009, the overall annual damage from land degradation, caused by unsustainable land use and deterioration of the quality of arable land and pasture areas, amounted to about USD 5.85 billion in the region. In Kazakhstan, it exceeded USD 3.06 billion, in Turkmenistan USD 0.87 billion, in Uzbekistan USD 0.83 billion, in Kyrgyzstan and Tajikistan USD 0.55 billion each. The losses from land degradation in the region as a whole reach 3% of GDP.

In Tajikistan and Kyrgyzstan, the region's mountainous countries with extremely limited arable land resources, the economic losses are close to 11% and 10% of GDP, respectively. In Turkmenistan, the damage from degradation is 4% of GDP, and in Kazakhstan and Uzbekistan it is 3% of GDP each. Most of the damage, about USD 4.6 billion, is due to the loss of the productivity and environmental functions of pastures accompanied by their conversion to less valuable and barren lands. During that period, the area of degraded pastures reached 14 million ha.

The damage from soil devegetation, i.e., from the loss of productive vegetation and the formation of barren lands, amounts to USD 0.75 billion and is especially high in the areas close to the Aral Sea. Annual damage from deforestation reaches USD 0.32 billion, and that from withdrawal of arable lands from economic turnover exceeds USD 110 million. Per capita annual damage from land degradation varies depending on the country: it is the highest in Kazakhstan — USD 1,782; it amounts to USD 1,083 in Turkmenistan, USD 822 in Kyrgyzstan, USD 609 in Tajikistan, and is the lowest in Uzbekistan — USD 237.

Studies show that the future costs of combating land degradation represent only a small part of the losses in the event of inaction. The costs of combating land degradation are estimated to be about USD 53 billion over a 30-year period; but if nothing is done, the losses could reach USD 288 billion in the same period. It means that every dollar invested in combating land degradation can bring about USD 5 in return. Therefore, given the realities of the market

economy in the countries of the region and the fact that private landowners and small farmers are unable and insufficiently motivated to combat desertification, the governments should finance measures to combat desertification and land degradation from their national budgets (Mirzabaev et al., 2015).

The search for opportunities to reduce water shortage in the region should be aimed at further optimisation of water use in agriculture. This requires coordination and collaboration of water management entities with agricultural enterprises of various forms of ownership, as well as strict compliance with agrotechnical requirements, improvement of the ameliorative status of irrigated lands, use of advanced methods for their maintenance, and modernisation of irrigation infrastructure.

2.3 Manufacturing

Manufacturing is a prerequisite for economic growth, and it needs sufficient quantities of quality water. In 2018, industrial water withdrawal[6] in the region amounted to 10.4 km³/year out of the total of 129.3 km³/year, or 8.1%. In 1997–2018, the total demand of the manufacturing sector for water increased by 32% from 7.9 km³/year to 10.4 km³/year. The upward trend has been observed in all CA countries since the 2000s, with the highest rates of growth recorded in Tajikistan and Turkmenistan. These countries have contributed most to higher industrial water consumption in the region over the period. In terms of water consumption by country, their shares are 15.4% and 8%, respectively. Kazakhstan (52.9%) and Uzbekistan (20.4%) are in the lead. In Kyrgyzstan (3.2%), the level of industrial water consumption has not changed much.

Water is used by industry for product manufacturing and to cool equipment. Process water is used for the manufacture, treatment, washing, dilution, cooling, or transportation of products. Metallurgical enterprises, oil refineries, and enterprises producing chemical, food, and paper products need water. In the power industry, water is essential to generate steam, as well as to cool systems. Intensive industrial water consumption is accompanied by generation of wastewater containing specific pollutants, which leads to high costs of water treatment and calls for special water treatment methods and technologies.

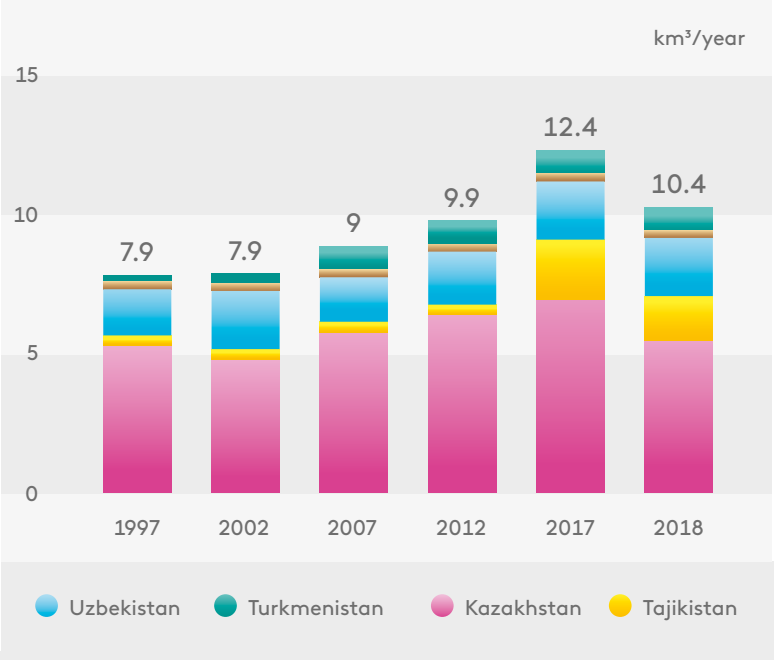
The pattern of industrial water consumption in CA is determined by the general economic situation in the region, as well as structural factors that are leading to changes in the aggregate sectoral composition of industrial production. At present, the dominant positions are held by industries that are water-intensive and depend on sufficient availability of water. The following sectors have the largest shares in the total industrial output in CA:

- mining, including all types of energy resources;
- processing industries, including production of refined petroleum products and processing of other energy resources, as well as metallurgy and the food industry;
- electric power.

The energy sector, broadly defined, including all types of energy resources, is a major consumer of water and plays a special role in CA. Its development is as crucial for water management in the region as agriculture. After the dissolution of the USSR, national energy security in CA became as important as food security. Difficulties in the distribution of energy resources at that time led to a change in the water use regime in the Aral Sea basin from irrigation to energy.

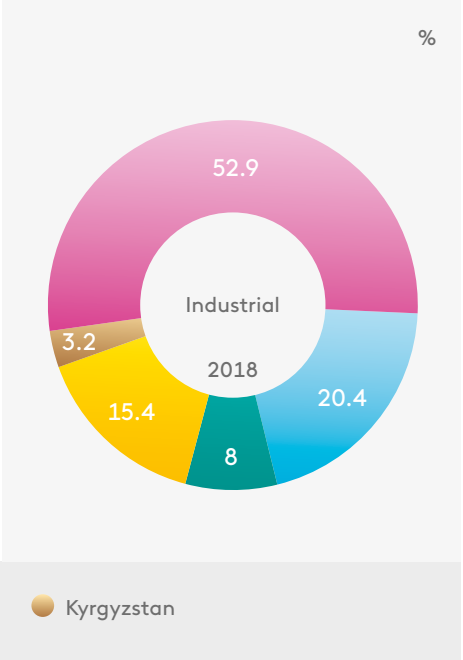
[6] The statistics include the volume of water that industries abstracted independently from various sources, outside the public water distribution network. They also include the water used to cool CHPs and NPPs, but not to generate hydroelectricity. The water used by industrial enterprises from the public water supply network is included in statistics reflecting the needs of the municipal sector

↓ Figure 13. Industrial Water Withdrawal in CA, km³/year, 2018



Source: compiled by the authors using the AQUASTAT database, FAO

↓ Figure 14. Composition of Industrial Water Withdrawal in CA, 2018



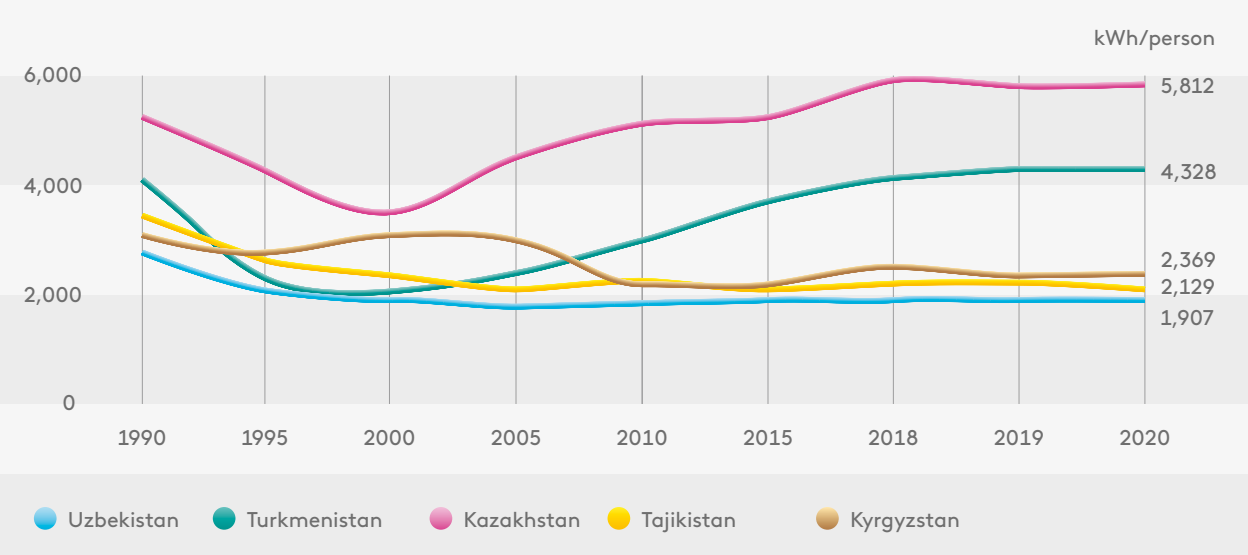
Source: compiled by the authors using the AQUASTAT database, FAO

The availability and accessibility of fuel and energy resources in the CA countries determine the pattern of their consumption. Gas, coal, and oil hold the dominant positions in the mix of primary energy resources in CA. During the Soviet era, a fuel and energy complex with a high degree of regional integration was created in CA, taking into account local features. The Central Asia Power System (CAPS) ensured stable operation, reliable inter-republican energy supplies, and a water use regime regulated by HPPs of the countries of the region. The CAPS, which included the power systems of Uzbekistan, the southern regions of Kazakhstan, Kyrgyzstan, Tajikistan, and Turkmenistan, was designed based on uniform criteria for the operation of the system at minimum costs. The regional energy infrastructure in CA, which, in turn, was part of the USSR's Unified Energy System (UES), was built as an integrated system making optimal use of the fuel, energy, and hydropower resources of the region.

In 1990–2000, the total output of fuel and energy resources in the CA countries fell sharply, and their consumption also decreased. The main reasons for that included a general economic downturn, weakening economic and thus energy links, and limited access to foreign energy markets. The countries of the region managed to overcome the protracted decline in production in the fuel and energy sector, and, since 2000, there has been an increase in the production, processing, and export of coal, gas, and oil, which enabled an upturn in the region's national economies.

Per capita electricity generation differs significantly in the CA countries. For instance, in 2020, it amounted to 5,812 kWh/person in Kazakhstan, 4,328 kWh/person in Turkmenistan, 2,369 kWh/person in Kyrgyzstan, 2,129 kWh/person in Tajikistan, and 1,907 kWh/person in Uzbekistan (see Figure 15). Despite a significant increase in power generation capacity, the countries of the region are expected to enhance their national energy security by expanding the construction of new power plants, primarily in Uzbekistan, Tajikistan, and Kyrgyzstan. At the same time, despite the variety of approaches to developing the power industry, hydropower generation is expected remain a priority for these countries (Vinokurov et al., 2021).

↓ Figure 15. Per Capita Electricity Generation in CA Countries, 1990–2020, kWh/person



Sources: CIS Stat; EEC

Positive trends in the fuel and energy sector of the CA countries were facilitated by reforms and structural transformations in the sector and the formation of new economic relations based on market principles. This enabled a shift in focus to subsoil use, taxation, and pricing issues, as well as objective estimates of production costs, rent payments, and consolidated budget revenues.

The high energy prices up to 2016 stimulated the work of the fuel and energy sectors of the countries in the region after 2021; however, the infrastructure of the power systems of the CA countries needs capital repairs, modernization, and technical renovation. Moreover, unresolved issues of synchronising the energy and the irrigation regimes of reservoir operation reduce the energy and water security of the region, hindering the trust in interstate cooperation and integration processes in general.

The strategy of independent energy and water policy followed by each of the CA countries results in lower interstate energy cross-flows within the region and poorer coordination of the operation of power systems. The CAPS is becoming practically unable to serve its purpose of ensuring reliable operation of power systems. Expert estimates show that such a scenario may lead to large losses for all countries in the region. Under this scenario, the social and environmental impacts and overall economic damage faced by the states could substantially outweigh the benefits of selling electricity outside the region, thereby intensifying political tension among the CA states and weakening regional security.

Projections show that energy consumption is expected to increase in the CA countries in 2020–2050, driven by trends in economic development and population growth. This period overlaps with the forecast of intensified climate change and a phase of persistent decline of water availability in the Syr Darya and Amu Darya river basins. If reservoirs are not sufficiently filled, their use for energy generation could lead to a decline in electricity generation, shortage of water during the growing season, loss of the over-year storage capacity of reservoirs, and a deterioration of interstate water use conditions.

The uneven geographical distribution of different types of fuel and energy resources across the countries of the region suggests that there is both an opportunity and a need to enhance regional cooperation in oil, gas, and electricity use. Each country faces a need for fuel and energy resources that can be more efficiently supplied by other countries in the region. The use of hydropower resources in the CA countries is accompanied by a number of problems, the most significant of them being the limited capacity of the energy transport infrastructure. A long-term strategy for water use in transboundary river basins

should be jointly developed to ensure a coordinated operating regime of HPPs and reservoirs, taking into account irrigation needs. Geopolitical features of the region call for consolidated approaches to the implementation of coordinated energy policies in foreign energy markets (Sarsembekov et al., 2004; Yasinsky et al., 2010).

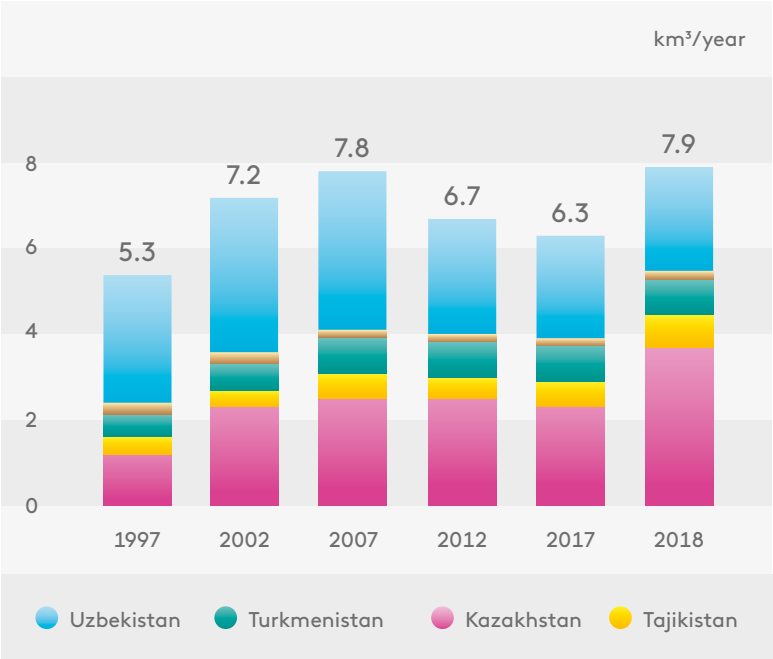
Manufacturing is also vulnerable to the risk of water scarcity, although to a lesser extent than irrigated agriculture. Its lower dependence is explained by the fact that the country generates a lot of energy using fossil fuels. However, the risk of water scarcity in manufacturing can be further mitigated by improving transboundary water cooperation and the regional electricity trade.

2.4 Municipal sector

In 1997–2018, the municipal sector's demand for water resources in CA increased by 48%, or 2.6 km³ /year — from 5.3 to 7.9 km³/year — which is 6.1 % of total water withdrawal. A significant increase in consumption was recorded in Kazakhstan and Tajikistan. Taking into account Kazakhstan's high specific weight in the region, that country generated much of the increase in water consumption (46.9%) by the municipal sector in CA. Upward trends were also observed in Turkmenistan. In Kyrgyzstan and Uzbekistan, on the contrary, consumption declined. In terms of the breakdown by country, Kazakhstan is followed by Uzbekistan (30.6%), then Tajikistan (10%), Turkmenistan (9.6%), and Kyrgyzstan (2.8%).

A relative and absolute growth of the urban population and populated areas has been observed in CA since 1990. This demographic trend, as well as the development of manufacturing using water supplied through the public water distribution network, were the main drivers of the growth of water consumption by the municipal sector in CA. Improved access to clean water and related water infrastructure has also contributed to higher water withdrawal. These trends should persist in the long term. A significant increase in the population in CA is expected to be accompanied by intensified urbanisation: by 2050, 65% of the population will live in cities (48.45 in 2021).

↓ Figure 16. Municipal Water Withdrawal in CA, km³/year, 2018.



Source: compiled by the authors using the AQUASTAT database, FAO

↓ Figure 17. Composition of Municipal Water Withdrawal in CA, 2018

Source: compiled by the authors using the AQUASTAT database, FAO

↓ Table 6. Drinking and Household Water Supply in CA Countries

	Access to water, % (2018)	Water consumption, l/day/capita (2016)	Water losses, %* (2016)	Tariff, USD/ m³ (2016)	Fee collection rate, % (2016)
Kazakhstan	92.9	220	30	0.10–0.58	85
Kyrgyzstan	90.0	140	50	0.07–0.11	65
Tajikistan	73.8	180	45	0.4–0.8	75
Turkmenistan	60.4	320	55	0.5	70
Uzbekistan	87.3	290	45	0.11–0.25	85

Note: * Water losses include both technological losses (leakage in distribution networks and unavoidable losses) and commercial losses (unauthorised use, etc.).
Sources: Dukhovny et al., 2020; AQUASTAT

Despite the improvements in the water supply sector achieved over the last decade, the problems of reliable water supply and sanitation in rural areas remain unresolved and difficult for the CA countries. In the absence of an arrangement to mobilise investment in this area, public-private partnerships to finance rural infrastructure have failed to develop in any country in the region. It should be noted that water supply and sanitation have a high degree of economic efficiency: for every USD 1 invested in this sector, there is a return of USD 3 to USD 4 due to reduced morbidity and improved quality of life and labour productivity (UN WWAP, 2009).

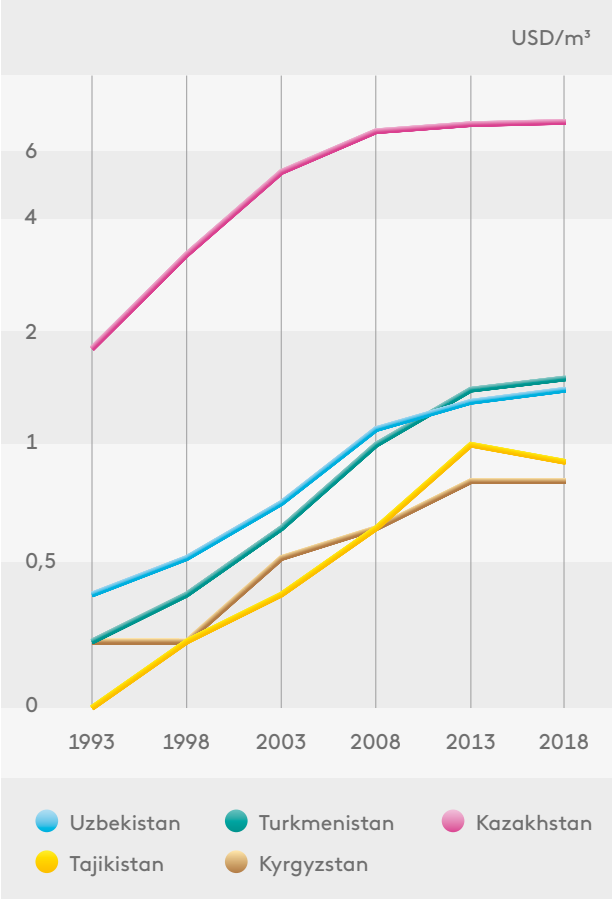
The infrastructure of municipal water supplies and sanitation is in the same condition: the lack of investment prevents significant improvements in the supply of drinking water to the population. Investment in these important sectors is still characterised by low growth rates and weak private investment inflows.

2.5 Improving Efficiency of Water Resource Use in Central Asia

The CA economies are characterised by a high level of energy- and water-intensive products in various economic sectors, primarily agriculture and manufacturing. The water intensity of GDP describes the degree of sustainable use of water and the availability of water-saving technologies, as well as the engineering and technical condition of water management facilities and the level of water losses during transportation. There are also objective factors affecting water consumption, such as the climate of a country and its regions — the level of precipitation, average temperature, etc. The countries of the region are exposed to the impact of climate change on economic development, in the form of longer droughts and low water periods, and is exacerbated by water management and nature conservation challenges.

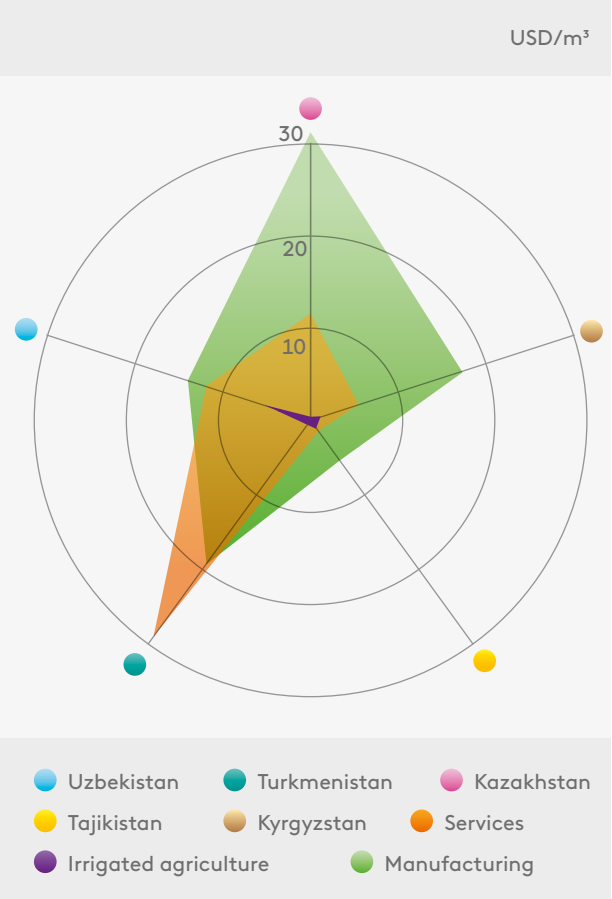
Despite some progress in 1993–2018, water use efficiency (SDG 6.4.1) is extremely low in CA compared to global values. In 2018, water use efficiency in the CA countries was estimated within the range of USD 0.842/m³ (in Kyrgyzstan) to USD 7.2/m³ (in Kazakhstan). On average for the CA region, the indicator is estimated at USD 2.5/m³ — one of the worst in the world. By comparison, the weighted global average is USD 19.01/m³. It ranges from USD 0.2/m³ in countries whose economies are heavily dependent on agriculture, to USD 1,096/m³ in industrialised countries with service-oriented economies that are less

↓ Figure 18. Water Use Efficiency in CA (SDG 6.4.1), USD/m³, 1993–2018



Source: compiled by the authors using UN-Water data (2021)

↓ Figure 19. Components of Water Use Efficiency in CA (SDG 6.4.1), USD/m³, 2018



Source: compiled by the authors using UN-Water data (2021)

↓ Table 7. Water Use Efficiency Indicators in CA, 2018, USD/m³

	Turkmenistan	Kazakhstan	Kyrgyzstan	Uzbekistan	Tajikistan
Irrigated agriculture	0.146	0.035	0.102	0.458	0.227
Manufacturing	28.916	11.556	5.504	12.026	1.643
Services	19.228	31.380	17.298	14.026	5.472
Overall efficiency	1.525	7.201	0.842	1.431	0.882

max in CA
19.01 weighted global average
min in CA

Source: compiled by the authors using UN-Water data (2021)

dependent on natural resources. In most (two-thirds) of countries, water use efficiency ranges from USD 5 to USD 100/m³. Four out of five CA countries (except for Kazakhstan) are on the list of ten world least efficient countries (among 168 countries analysed).

The efficiency of agricultural water use in CA, as well as globally, is much lower than in other productive sectors of the economy. The indicators of this particular sector, taking into account its high importance in the economy and in the sector composition of water consumption, pull down the overall indicators of the region's water use efficiency. Irrigated agriculture in CA is the largest consumer of water, but it is characterised by extremely low added value.

Therefore, an important component of enhancing the efficiency of water use in CA is to improve the efficiency of water use in agriculture. This would free up water for other uses, such as environmental protection or for higher value-added sectors. Other important

measures include a reduction of water losses by eliminating leaks in municipal water distribution networks and streamlining the processes of cooling industrial and power engineering equipment. A balance should be found between food security, sustainable water use, and economic growth.

In the coming decades, water resources management in CA will be complicated by additional problems that will be exacerbated by interrelated global changes and regional social and economic trends, including demographic growth, economic development, and climate change. The population in the region is growing at a medium but steady pace: the projected growth from 2015 to 2050 ranges from 22% for Turkmenistan to 68% for Tajikistan (24% for Uzbekistan, 27% for Kazakhstan, and 39% for Kyrgyzstan) (based on UN DESA data, 2015). This puts additional pressure on water resources — food and electricity will have to be produced for a growing number of people. Therefore, increasing competition among agricultural, industrial, and municipal water uses is inevitable.

Because of natural, geographic, and geopolitical factors and high transboundary water dependence in the region, further development of the CA countries will be determined by the level and nature of their economic collaboration and cooperation. At the same time, it should be noted that the region's economy is developing in a context of extreme exhaustion of water resources and lands suitable for irrigation in the Aral Sea basin. Long-term social and economic impacts of the current situation can be overcome only through strengthened partnership and mutually beneficial economic cooperation (Frenken, 2013).

The historically established structure of the economy is also important. This means primarily the ratio of manufacturing and agriculture, including irrigated agriculture, and urbanisation, when a significant part of the population has access to central water supply systems. Although each CA country has adopted long-term development strategies, they do not reflect mechanisms and tools for improving the coordination and interaction between government bodies while implementing policies that mitigate impacts of climate change on water use at both the national and regional levels.

Due to insufficient food security, the distribution of crops is expected to be reviewed, and the area of irrigated land under food crops will increase. Therefore, taking into account the development of irrigation, as well as hydropower generation and urbanisation in the region, we should expect a further increase in competition for water. New cooperation mechanisms and instruments based primarily on deeper economic integration of the countries of the region will be required to address water use issues in the transboundary river basins. Effective management of land and water resources, and implementation of joint programmes and projects for irrigated land rehabilitation, are pressing problems and important areas of cooperation among the states to ensure water, food, energy, and environmental security.

The key objective of the water sector of the CA countries is to ensure efficient operation of irrigation systems, which include a large number of different infrastructure facilities, located both within and outside the boundaries of irrigated lands, and are intricately connected with main and inter-farm canals, reservoirs, pumping stations, and natural watercourses.

The solution of food security problems in the region largely depends on enhancing the efficiency of the use of irrigated lands and on the opportunities for cooperation among the countries in the area of agriculture. Such factors as an increased number of droughts and low water periods, changes in the hydrological regime of rivers, and the conditions for groundwater feeding create threats and high risks for food supply. In the countries of the region, the technical capacity of irrigated lands is insufficiently advanced; they are poorly equipped with modern means of irrigation water distribution and control.

Therefore, one of the urgent objectives of the CA countries in ensuring food security is to improve the technical and engineering capacity of irrigation systems, assimilate water-saving technologies, and cultivate high-yield food crops. For the low-income countries, the problem of mobilising external investment in irrigation development has come to the fore. At the same time, the specific area of cultivated land per capita continues to decline. In this context, rapidly growing urbanisation, accompanied by an expansion of urban areas and withdrawal of agricultural land for this purpose, poses a major challenge to food security.

3. REGIONALISATION AND ITS ROLE IN ADDRESSING WATER AND ENERGY PROBLEMS OF CENTRAL ASIAN COUNTRIES

3.1 Inter-Republican Management of Water and Energy Resources in Transboundary River Basins of Central Asia during the USSR Period

Approaches to Water Allocation

Until 1992, the inter-republican regulation of the use of water and energy resources in CA and southern Kazakhstan had been performed at the Union level by the Ministry of Water Resources of the USSR (State Agro-Industrial Committee, State Committee for Emergency Situations) and the Ministry of Energy of the USSR, taking coordinated actions. The dispatch schedule and the operating regime of regulation reservoirs and HPPs were established centrally, in agreement with the Union Republics. Operational long-term control of river flow addressed primarily irrigation issues of supplying water for the purposes of irrigated agriculture and safe passage of water in the winter and spring period to the lower reaches of the rivers.

The Union ministries were supranational bodies that supported inter-republican relations in the water and energy sector, maintained an optimal fuel and energy balance in each republic, thereby creating conditions for regulating energy supplies, and thus allocation of water resources to the republics. That sectoral interaction at the Union and republican levels in the use of water, fuel, and energy resources can be called a scheme for water and energy exchange.

Schemes of Integrated Use and Protection of Water Resources (SIUPWR) played an important role in the planning and implementation of water management measures, including water allocation at the local, national, and interstate levels (Ratkovich et al., 2014). In the USSR, if a river basin did not go beyond the borders of a republic, the SIUPWR was prepared by the republic's leading water management design institute. If a river basin was located on the territory of two or more republics, the schemes were developed by regional or Union design institutes.

Syr Darya and Amu Darya River Basins

In the Syr Darya and Amu Darya river basins, water allocation is based on the following provisions:

- the updated Scheme of Integrated Use and Protection of Water Resources of the Syr Darya River, approved by Resolution of the State Expert Commission (SEC) of the State Planning Committee of the USSR No. 11 dated 5 May 1982;
- the updated Scheme of Integrated Use and Protection of Water Resources of the Amu Darya River, prepared by Sredazgiprovodkhlopok Institute in 1984 and endorsed by the Scientific and Technical Council (STC) of the Ministry of Water Resources of the USSR on 10 September 1987 (Minutes No. 556).

These schemes and provisions served as a basis for the current water allocation arrangements among the countries of the basin. The schemes include data of hydrometric stations, located near the outlet of rivers from the mountains, which were used to determine the main water resources of the basin (including surface runoff). Based on the availability of water and its use in various sectors of the economy of the CA Union Republics, the schemes used an option that met the needs of the population for food.

The schemes establish the volumes of water resources for withdrawal directly from the stem stream of the Syr Darya and Amu Darya in a long-term average and low-water year (90% of availability) at a level equivalent to complete exhaustion of water resources. In a low-water year, the water allocation arrangement envisages water withdrawal from the stem stream of the Syr Darya and Amu Darya in the amount of 84.19 km³ (63% of disposable water resources) in the following proportions: Kazakhstan 10.01 km³ (11.9%), Kyrgyzstan 0.79 km³ (0.9%), Tajikistan 11.31 km³ (13.4%), Turkmenistan 22.0 km³ (26.1%), and Uzbekistan 40.08 km³ (47.6%) (Pulatov, Mukhabbatov, 2021).

The procedure for the distribution of the transboundary flow between the Union Republics was established by the Ministry of Water Resources of the USSR, issuing relevant departmental regulations or protocol decisions on the basis of schemes approved by the State Planning Committee of the USSR and appraisal reports of the Expert Commission of the State Planning Committee of the USSR. For example, in addition to the two main

↓ Table 8. Water Withdrawal Limits (Water Allocation) for Countries of the Region* (1984)

	Amu Darya basin		Syr Darya basin		Total	
	billion m³	%	billion m³	%	billion m³	%
Kazakhstan	0.0	0.0	10.0	44.1	10.0	11.9
Kyrgyzstan	0.4	0.6	0.4	1.7	0.8	0.9
Tajikistan	9.5	15.4	1.8	8.0	11.3	13.4
Turkmenistan	22.0	35.8	0.0	0.0	22.0	26.1
Uzbekistan	29.6	48.2	10.5	46.2	40.1	47.6
Total	61.5	100.0	22.7	100.0	84.2	100.0

Note: * The limits of water withdrawal (from the stem streams) are given for a low-water year (90% availability). Below the Kerki stream gauge, the Amu Darya River flow is divided equally between Uzbekistan and Turkmenistan – 22 km³ each.
Source: Pulatov, Mukhabbatov, 2021

schemes, the Ministry of Water Resources of the USSR adopted the following documents: the "Approval of Principles of Inter-Republican Water Allocation in the Syr Darya River Basin, Minutes of the STC of the Ministry of Water Resources of the USSR No. 413 dated 29 February 1984" and the "Approval of Principles of Inter-Republican Water Allocation in the Amu Darya River Basin, Minutes of the STC of the Ministry of Water Resources of the USSR No. 566 dated 10 September 1987".

In order to ensure compliance with the regulations and other instructions on inter-republican water allocation, the Ministry of Water Resources of the USSR issued Order No. 300 dated 27 August 1987 to create, from 1 September 1987, under the auspices of the Automated Dispatching Complex for regulating the use of water resources of the Syr Darya River (ADC Syr Darya), the Syr Darya Basin Department of inter-republican distribution of water resources and operation of water intake facilities and hydroengineering systems (Uprvodkhoz Syr Darya), based in Tashkent and subordinate to the Ministry of Water Resources of the USSR. Uprvodkhoz Syr Darya was entrusted with the inter-republican and inter-sectoral distribution of water resources; operation of the water intake facilities and hydroengineering systems were transferred to its account; operation of the Kirov Canal and inter-republican collectors; and functioned as the customer for the design, construction, and implementation of the Syr Darya automated basin management system (ABMS).

On 1 September 1987, the Amu Darya Basin Department of inter-republican distribution of water resources and operation of water intake facilities and hydroengineering systems (Uprvodkhoz Amu Darya), based in Urgench and subordinate to the Ministry of Water Resources of the USSR, was created by another Order of the Ministry of Water Resources of the USSR, No. 301 dated 27 August 1987. Uprvodkhoz Amu Darya was entrusted with the inter-republican and inter-sectoral distribution of water resources; operation of water intake facilities and hydroengineering systems transferred to its account; operation of the inter-republican Amu Darya irrigation canals and inter-republican collectors; and functioned as the customer for the design, construction, and implementation of the Amu Darya ABMS.

Head water intake facilities on the above rivers and their main tributaries with a flow rate of more than 10 m^3/s were transferred to the jurisdiction of these basin water management departments (BWMDs). The BWMDs ensured the distribution of water resources by ten-day periods and months within a water management year (non-growing and growing seasons), based on the rules and schedules agreed between the republics and approved by the Ministry of Water Resources of the USSR.

Talas and Chu River Basins

At present, the inter-state allocation of water resources in the Talas and Chu river basins is based on provisions approved by the Ministry of Water Resources of the USSR.

The Regulations on Division of Flow in the Talas River Basin between the Kazakh SSR and the Kyrgyz SSR were prepared based on the inter-republican division of the river flow, No. 1/1–36-427 (428), dated 27 April 1981, established by the Ministry of Water Resources of the USSR, with 50% allocated to each republic. The water resources taken for allocation are the long-term average annual surface runoff of the Talas River and its tributaries, return and discharged underground waters (minus losses in the riverbed and the Kirov Reservoir) in the amount of 1,616 million m^3. The water use of the Kazakh SSR in the amount of 808 million m^3 was provided by releases from the Kirov Reservoir in the amount of 716 million m^3 and the runoff formed on the territory of the republic in the amount of 92 million m^3. The intra-annual runoff distribution (by month, ten days, five days) and the operating regime of the Kirov Reservoir were determined by a joint decision of the Ministries of Water Resources of the republics within the established annual limit.

The Regulations state that "further development of irrigation in the Talas River basin or improvement of water availability can be implemented only within the share of the flow that is allocated to each republic by these Regulations, by saving water through measures of technical refinement of irrigation systems. Control over the allocation of the Talas River flow, in accordance with these Regulations, shall be performed by the Department of the Kirov Canal Operation of the Ministry of Water Resources of the USSR (inter-republican sector for the distribution of the Chu and the Talas river flow between the Kazakh SSR and the Kyrgyz SSR). With the entry into force of these Regulations, the Regulations on Water Allocation for the Talas River and its tributaries, the Kenkol and the Urmaral, between the Kazakh SSR and the Kyrgyz SSR (1948–1949) and part II 'For the Talas River' of the Protocol of the Joint Commission of the Councils of Ministers of the Kyrgyz SSR and the Kazakh SSR on the Inter-Republican Distribution of Water Resources of the Talas River and the Chu River, dated 26 March 1976, shall cease to be in force".

The Regulations on Division of the Chu River Basin Flow were prepared based on the inter-republican division of the flow, established by the Ministry of Water Resources of the USSR on 27 April 1981, No. 1/1–36-427 (428). The Kazakh SSR was allocated 42% and the Kyrgyz SSR 58% of the total volume of water. All water resources of the Chu River basin are subject to allocation, regardless of the area of their formation and use. In a medium-water year, they add up to 6,640 million m^3, including natural water at 4,863 million m^3 and return water at 1,777 million m^3. The distribution of water resources in the basin in general took into account the supply of water to all water consumers of both republics. Operational inter-republican flow distribution is carried out only along the stem stream of the Chu River on the following sections: Orto—Tokoy—Dzhilaryk, Dzhilaryk—Tokmak, Tokmak—Chumysh, and Chumysh—Tashutkul. The flow of mountain rivers is used by the republics on whose territory the rivers flow. The volume of flow withdrawn from mountain rivers is taken into account in the total volume of flow withdrawn by the republics in the Chu River basin. The intra-annual flow distribution (by month, ten days, five days) and the operating regime of the Orto-Tokoy Reservoir were determined by a joint decision of the Ministries of Water Resources of the republics within the established annual limit. Further development of irrigation in each republic could be implemented within the volumes established by these Regulations, through sustainable water use. Control over the allocation of the Chu River flow, in accordance with the Regulations, was performed by the Department of the Kirov Canal Operation of the Ministry of Water Resources of the USSR (inter-republican sector for the distribution of the Chu and the Talas river flow between the Kazakh SSR and the Kyrgyz SSR).

Distribution of Energy Resources

Most of the electricity generated by the Naryn HPP cascade (Syr Darya River basin) and the Vakhsh HPP cascade (Amu Darya River basin) in summer, during irrigation releases, was transmitted to neighbouring republics, while, in return, Kyrgyzstan and Tajikistan received electricity, natural gas, coal, and fuel oil from the Union reserve of material and technical resources for the operation of thermal power plants (TPPs) in autumn and winter. That mechanism of mutual exchange operated in Soviet times and was based on the Scheme of Integrated Use and Protection of Water Resources of the Syr Darya River. The scheme imposed water withdrawal limits on each republic for both the vegetation period (from April through September) and the non-vegetation period (from October through March) and defined the prospects for further development of hydropower generation in the basin of the river, including the construction of the Kambarata-1 HPP, the Kambarata-2 HPP, and the Upper Naryn HPP Cascade. The construction of the Kambarata-1 HPP (which needed to be higher than the Toktogul HPP) was planned to guarantee a water supply that would meet agricultural needs, regardless of water availability during any particular year. The Rogun HPP, with an over-year storage reservoir, was designed for the same purpose.

The Central Asia Power System (CAPS) was created in the 1970s to streamline the utilisation of water and energy resources and enhance the reliability of power supply and irrigation water

supply. It operated on a territory of approximately 2 million km² and covered the entirety of Uzbekistan, Tajikistan, Kyrgyzstan, and Turkmenistan, and five adjacent regions of Southern Kazakhstan. Its network consisted of 83 power plants of different types (TPPs 70%, HPPs 30%), owned by the power systems of the region's countries and connected by 220 kV and 500 kV power transmission lines (PTLs). The Unified Dispatch Office of Central Asia (CA UDO) managed the CAPS.

Long-term planning of CAPS regimes took into consideration the mix of the generating capacities of each power system and sought to minimise fuel consumption and power losses in the system networks. Power system regimes and CAPS HPP reservoir regimes were aligned by the CA UDO, as well as by Basin Water Management Organisation (BWMO) Syr Darya and BWMO Amu Darya. The CA UDO, based in Tashkent, went live in April 1960 and was responsible for operational and technical management of the CAPS.

A unique integrated power system was created in CA that ensured reliable electricity supply, as well as seasonally adjusted and long-term control of river flow for irrigation purposes, taking into consideration the low-water periods in the Syr Darya and Amu Darya basins. Notably, even though the CAPS was isolated from the USSR UES, the CA UDO reported to the USSR UES Central Dispatch Office and was financed by the Ministry of Power Industry and Electrification of the USSR.

3.2 Interstate Management of Water and Energy Resources in Transboundary River Basins of Central Asia after 1992

After the dissolution of the USSR and the formation of independent CA states, the Union bodies that had participated in the management of the region's water and energy resources and in solving the Aral Sea problem ceased their operation, including the Union-Republican Consortium "Aral". Centralised logistics support and funding of the CA water and energy system stopped.

The CAPS operating regime took into account both power generation and irrigation needs. The operating regime of the power system facilitated the minimisation of fuel costs and electricity losses in the networks on the scale of the entire energy association, not just one power system. At the same time, the operating regime of the unified power system was aligned with the irrigation regime of reservoir operation. Since electricity generation in Kyrgyzstan and Tajikistan is mainly concentrated at HPPs, with the termination of the old procedure for the redistribution of energy resources (coal, oil, and electricity) within the Union, the states had to switch to domestic electricity supply, using in winter the long-term reserves of water that were intended to cover the irrigation needs of Uzbekistan and Kazakhstan in summer. The measures taken to achieve the energy independence of the new states led to an imbalance in energy and fuel supply, radically changing the irrigation and energy regimes of reservoirs and other regulating facilities.

Violation of the established rules of the water and the energy regimes of reservoirs and HPPs led to huge economic losses and created high political risks for regional cooperation and safety. The impending threat of loss of control over the water and energy complex called for a decision to overcome the crisis. Therefore, on 19 November 1991, the heads of the power systems of the countries of the region got together in Ashgabat and signed the Agreement on Parallel Operation of Power Systems of the Republic of Kazakhstan, the Kyrgyz Republic, the Republic of Tajikistan, Turkmenistan, and the Republic of Uzbekistan, and established the CA UDO financed by the parties to the Agreement on a cost-sharing basis.

In 1994, the CA UDO changed its name to the Unified Dispatch Centre — UDC Energy. The CAPS Council, consisting of the heads of power systems of the countries of the region, became the governing body charged with management and coordination of parallel operation of the CAPS component systems.

A similar situation developed in the water management sector. The countries of the region decided to perform interstate water allocation on the conditions and principles of water distribution on a cost-sharing basis, approved by the former Union bodies (Petrov, 2015).

The heads of the water management sector of the region decided to assume the functions of an alliance to regulate water use. On 18 February 1992, the "Agreement among the Republic of Kazakhstan, the Republic of Kyrgyzstan, the Republic of Tajikistan, Turkmenistan, and the Republic of Uzbekistan on Cooperation in the Field of Joint Management of the Use and Conservation of Water Resources in Interstate Sources" was signed in Almaty. According to the Agreement, the functions of the former Union bodies in regulating inter-republican water allocation were transferred to the ICWC, established by the parties, and its executive bodies — BWMO Syr Darya and BWMO Amu Darya.

According to the Charter of BWMO Syr Darya, approved by a decision of the ICWC (6 April 1992, Ashgabat), the BWMO is an interstate body, financed by relevant ICWC members on a cost-sharing basis. BWMO Syr Darya supplies water in the Syr Darya River basin within the water limits established by the ICWC in order to meet the needs of the national economies and populations of the relevant states. It operates the water intake facilities, hydroengineering systems, shared reservoirs, canals, and other facilities on its account, while complying with environmental requirements and implementing measures to improve the environmental situation. BWMO Syr Darya is guided by the current legislation of the relevant ICWC member states, agreements, protocols, other regulations, decisions of the ICWC, and its Charter.

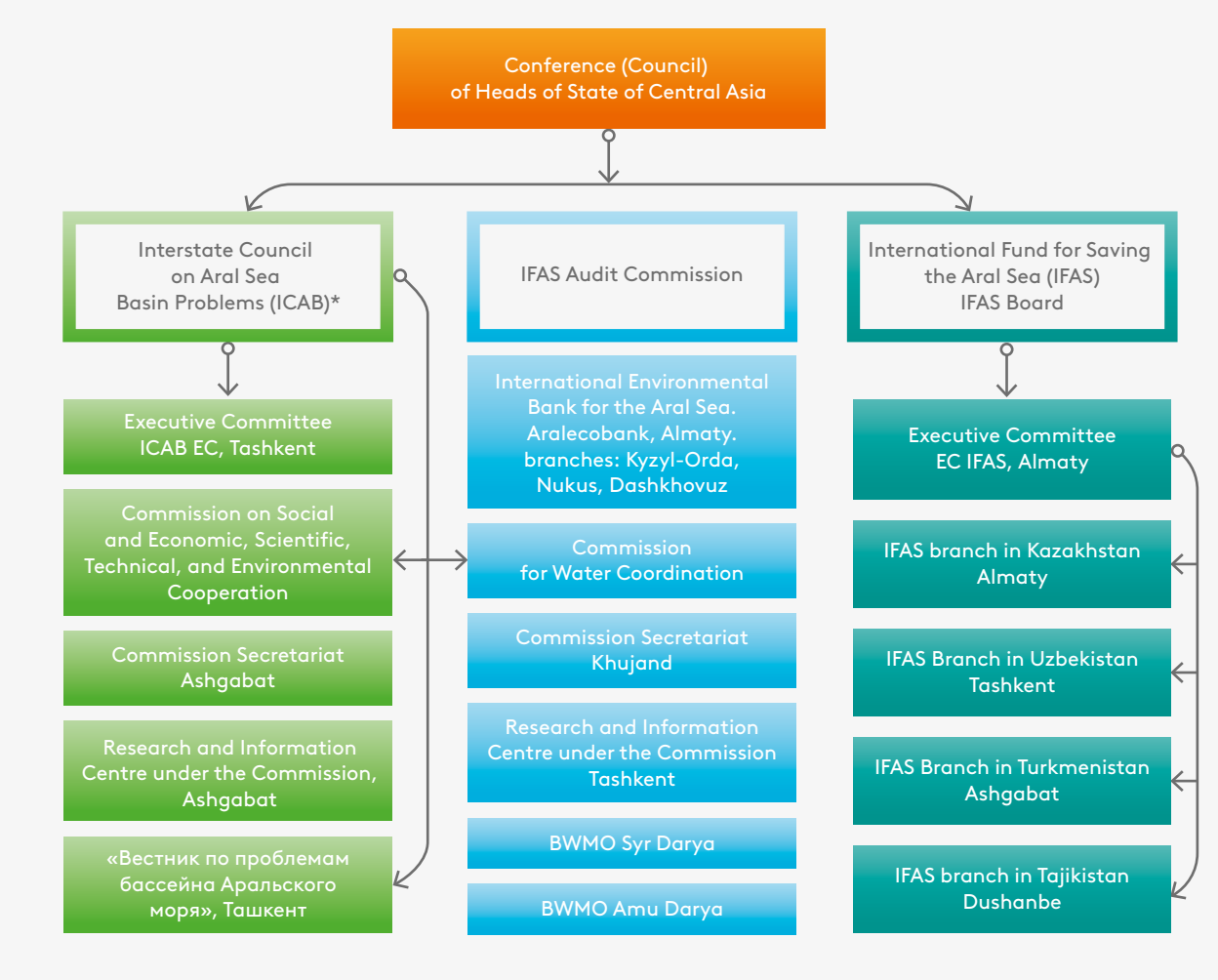
At the same meeting (6 April 1992, Ashgabat), the ICWC approved the Charter of BWMO Amu Darya, based in Urgench, Khorezm region. According to the Charter, BWMO Amu Darya is the executive and interdepartmental control body of the ICWC, operating on the basis of an intergovernmental agreement and funded by relevant ICWC members. The main objectives of BWMO Amu Darya are generally the same as those of BWMO Syr Darya.

The agreement, adopted on 18 February 1992 in Almaty, served as a legal framework for enhancing and expanding bilateral and multilateral cooperation among the CA countries going forward. It lay the groundwork for bilateral agreements between Turkmenistan and Uzbekistan, Tajikistan and Uzbekistan, and Kazakhstan and Kyrgyzstan.

Kazakhstan, which is located in the lower reaches of the Syr Darya and suffers most from the huge social and economic losses caused by the Aral Sea crisis, appealed to the Heads of State of Russia and the CA countries, putting forward a proposal (letter No. 23–17/I-238 dated 5 October 1992) to hold a meeting and discuss the following drafts documents:

- an Agreement on Joint Actions to Address the Problem of the Aral Sea and the Aral Sea Region;
- a supplementary document on implementation of the provisions of the draft Agreement on Joint Actions to Address the Problem of the Aral Sea and the Aral Sea Region;
- proposals for developing a concept document on the preservation, stabilisation, and rehabilitation of the Aral Sea;
- an appeal to the UN by the Heads of State of Central Asia, Kazakhstan, and the Russian Federation.

↓ Figure 20. Organigram of Main Water Management Bodies in CA until 1997



Note: *In 1997, at a regular meeting of the Heads of State of the CA countries on the problem of the Aral Sea, the Interstate Council was abolished, with its functions transferred to the Board of the Fund and a new institutional framework proposed for IFAS.
Source: EDB

Kazakhstan's appeal was supported by the Heads of Russia and CA countries, and an intergovernmental working group was created to prepare the documents on the Aral Sea problem.

One of the main results of these efforts was the meeting of the Heads of State of CA countries, held on 4 January 1993 in Tashkent, which adopted a number of decisions on the structural transformation of their economies and affirmed the need to establish interstate multilateral sectoral commissions: for grain and oil in Almaty, for cotton in Tashkent, for gas in Ashgabat, for electricity in Bishkek, and for water in Dushanbe. The parties adopted a decision to establish the International Fund for Saving the Aral Sea and agreed to hold its meetings alternately in Kyzyl-Orda, Nukus, and Tashauz.

Pursuant to the agreements reached at the meeting in Tashkent, the parties arranged a conference of the Heads of State of the CA countries and Russia on the problems of the Aral Sea basin, held on 26 March 1993 in Kyzyl-Orda. The "Agreement on Joint Actions to Address the Problem of the Aral Sea and the Aral Sea Region, Improving the Environment, and Ensuring Social and Economic Development of the Aral Sea Region", the structure of the Interstate Council of the Central Asia States on the Aral Sea Basin Problems (ICAB), and "Regulations on the International Fund for Saving the Aral Sea" (IFAS) were approved there, and an appeal to the UN was adopted. The Russian Federation did not join IFAS as a founder (EC IFAS).

The Kyzyl-Orda Agreement (1993) noted the urgency of "consolidating physical and financial resources to overcome the crisis and create an environmental security system in the region and, first of all, in the Aral Sea region" and affirmed "a commitment to the principles of international water law, respect for the mutual interests of each of the sovereign member states in the use and protection of the water resources of the basin, taking into account the need to preserve the sea". According to Article 3, the Russian Federation "takes part in the work of the ICAB as an observer in addressing the problem of the Aral Sea and the Aral Sea region...". The objectives of the ICAB included: coordination of joint actions to address the problems of the Aral Sea; selection of priority areas, programmes, and projects related to water resources management and environmental protection; and improvement of the social and environmental situation in the region. The ICAB was established on a parity basis, with its permanent working body, the Executive Committee (EC), based in Tashkent. In addition, the Commission on Sustainable Development (CSD) was established under the ICAB, and the ICWC (EC IFAS) became part of the ICAB framework.

By 1995, the practice of concluding interstate protocols and agreements, establishing the scope of compensatory fuel and energy supplies and the volume of water released from the Toktogul Reservoir to cover the needs of irrigated agriculture in the middle and lower reaches, had developed in the Syr Darya basin. Under the agreements, Uzbekistan and Kazakhstan received electricity generated in Kyrgyzstan in summer, based on the agreed regimes of water release from the Toktogul Reservoir, in exchange for energy cross-flows to Kyrgyzstan in winter with some part compensated to Kyrgyzstan with gas and coal supplies.

The new arrangement for interaction among the states and sharing of the water and energy resources in the Syr Darya River basin served as the basis for the intergovernmental "Agreement on the Use of Water and Energy Resources of the Syr Darya River Basin", among Kazakhstan, Kyrgyzstan, and Uzbekistan — and later Tajikistan — dated 17 March 1998 (Ziganshina, 2017).

In the absence of a clear economic arrangement for water and energy exchange and due to regular violations of the obligations assumed, that agreement de facto ceased to operate in 2005. Intergovernmental protocols were particularly ineffective in low-water and high-water years. In high-water years, the irrigation needs of Kazakhstan and Uzbekistan are mainly met by lateral inflows, so that these countries are interested in obtaining less electricity than is provided for in the intergovernmental agreements. In parallel, there is a decline in supply of energy resources to Kyrgyzstan in the subsequent winter period, which, in turn, has to release more water from the reservoir in the winter in order to cover its own energy needs. Moreover, the issues of price coordination took a lot of time, so the annual agreements were executed in the midst of the growing season (SIC ICWC, 2021).

Despite efforts to maintain the integrity of the CAPS, in June 2003, Turkmenistan withdrew from the parallel operation of the power system, which severely impaired the operating conditions in the western part of the system and reduced the reliability of power supply to end consumers.

In October 2004, the CAPS member countries entered into an "Agreement on Coordination of Relations in the Central Asian Electric Power Industry" and established the Electric Power Coordination Council of Central Asia (CA EPCC) as an advisory body.

In September 2006, the CA EPCC established a coordination and dispatch centre — CDC Energy. The key functions of that non-governmental not-for-profit organisation were to maintain operation in the parallel mode and coordinate operation and dispatch activities of CA power systems. CDC Energy reports to the CA EPCC, which acts as its supreme governing body.

After the practice of intergovernmental agreements was discontinued in 2005, the CA states resumed the practice of concluding annual agreements and protocols on arranging

energy cross-flows and supplies of coal and gas in exchange for water (Petrov, 2015). That format of bilateral relations does not imply any coordination, does not contribute to meeting the demand of all countries in the region for water and energy resources, and cannot be considered optimal. The costs associated with the lack of an appropriate regional water and energy management mechanism prompted Kyrgyzstan to first call on partners to reform IFAS in 2009, and then, in the absence of the expected response, to "freeze" its participation in the activities of IFAS from 18 May 2016.

The experience of interaction among the countries of the Syr Darya basin based on an agreement that was used from 1995 to 2003 indicates the possibility of multilateral water and energy cooperation. So, back in 2009, in Almaty, Kyrgyzstan called for improving the mechanism of mutually beneficial cooperation and for its resumption precisely within the framework of the Agreement of 17 March 1998, executed outside the IFAS. This requires addressing a number of problems:

- private ownership of fuel and energy facilities in some countries and state ownership in other countries in the Aral Sea basin;
- inconsistent and non-transparent tariff policies of the states of the region in the context of mutual supply and transportation of electricity and energy resources;
- different rates and models of social and economic development of the basin countries, and thus different conditions for the transition to market relations, especially in the agricultural and energy sectors;
- uncertain legal status of interstate bodies responsible for the management of water and energy resources;
- lack of a clear delineation of functions and responsibilities among interstate water executive bodies, national water management bodies, and local authorities in the joint management of transboundary water bodies;
- incomplete transfer by the states of the region, except for Uzbekistan, of their water management facilities of regional importance to interstate water management bodies, and the resulting issue of managerial personnel of interstate bodies staffed with specialists from only one state;
- lack of arrangements for information exchange in the area of joint management of transboundary water resources, and the resulting lack of open information on water withdrawal from interstate canals, especially from the stem streams of transboundary rivers;
- uncertainty of downstream states and water consumers about whether they will obtain the agreed volumes of water within the required time, etc. (Petrov, 2015).

The following pending issues should be noted among the main reasons that Kyrgyzstan discontinued its multilateral cooperation within the framework of IFAS in 2016 (Official website of the President of the Kyrgyz Republic, 2018):

- lack of a compensatory mechanism for the accumulation of water resources in the countries of the upper Aral Sea basin and an arrangement for providing these countries with energy resources;
- unbalanced priorities of IFAS activities, with a bias towards the irrigation needs of agriculture in the countries of the lower Aral Sea basin;

- discrepancy between the principles of water allocation developed during the Soviet period, and modern realities in terms of sustainable development of the region;
- inconsistencies in IFAS regulatory legal instruments;
- inefficient structure of IFAS executive bodies;
- lack of transparent reporting mechanisms on mobilised financing;
- weak interaction of IFAS statutory bodies with national ministries and departments participating in the implementation of projects and programs in the Aral Sea Basin (ASBP);
- order of the IFAS's Executive Committee and secretariat location, which does not provide for their permanent stay on the territory of one or another IFAS member state;
- lack of rotation of IFAS managers for a long period, etc.

It takes time to address these and other issues that affect the discharge by the countries of the region of their obligations under the agreements they have signed, as related to political, social, and economic conditions, as well as to the evolution of the environmental situation in each state. First of all, every state should have a clear understanding of the benefits and losses that it should expect when discharging its obligations. This refers to both economic and, importantly, social benefits and losses. So far, no state of the basin has made such calculations.

3.3 Management of Water and Energy Resources in Basins of Aral Sea Rivers: From Union Centralisation to Regional Cooperation

Since regionalisation processes in CA are closely interrelated with cooperation in the water and energy sector, the unresolved problems faced by the sector affect the political dialogue and economic cooperation among the countries of the region. This is evidenced by the track record of water and energy cooperation over the past 30 years. Despite the long period of cooperation in this area and the initially high intensity of integration processes, the countries have not yet come to agreed decisions. The main problem related to transboundary water resources management and power generation — that of compliance with the operating regimes of reservoirs and HPPs — is still relevant. None of the regional integration alliances created during this period have been able to achieve their goals, and the unresolved water and energy issues should be seen as one of the reasons for that.

Therefore, the problems of using water and energy resources in CA should be considered in the context of regionalisation. In turn, integration should be based on effective mechanisms for water and energy cooperation among the countries of the region. In our view, water and energy resources should be considered the basis of cooperation, while regional water and energy organisations should act as a common link in this process — much like the European Coal and Steel Community did in the processes of European integration.

The creation of the CA UDO and the ICWC immediately after 1992 marked the beginning of wider regional integration processes in CA and further cooperation in the water and energy sectors, as well as in other sectors of the economy. Considering the role and importance of the ICAB and IFAS in regionalisation, it should be noted that these are collective instruments of cooperation that can influence political and economic processes in the region. The ICAB and IFAS undertook to solve the problems of shared water resources of the transboundary

rivers in the Aral Sea basin, as well as social and economic issues and combined integration efforts. At that time, the two regional organisations essentially contributed to significant consolidation of common economic interests related to the use of water and energy.

Early integration processes in the region also included the "Agreement between Kazakhstan and Uzbekistan on Deepening Economic Integration for the Period 1994–2000", which enabled the adoption of the "Treaty on Common Economic Space" (CES) on 10 January 1994. Kyrgyzstan joined the Treaty at a later stage (April 1994), and the first regional international organisation, known as the Central Asian Union (CAU), was created in July. It took the European model of integration as a basis. The CAU included Kazakhstan, Kyrgyzstan, and Uzbekistan, its governing bodies were the Interstate Council and the standing Executive Committee. However, the CAU member states did not seek to abandon cooperation within the CIS format. Among the reasons for the creation of the new organisation, the 1994 Agreement stated "the need to take measures to implement the provisions of the Treaty on Establishment of the CIS Economic Union" (Baskakova, Machabeli, 2019).

In March 1998, with the accession of Tajikistan to the CAU, the countries identified priority areas of economic cooperation in the agro-industrial, water and energy, transport and logistics complexes and stressed the need to form a free trade zone in the region. The CAU was renamed the Central Asian Economic Community (CAEC).

In December 2001, in Tashkent, the CAEC Interstate Council (at the level of Heads of State) reviewed the results of integration in CA since 1993. The parties stated that "in the context of the changed international situation, the predominantly economic basis of regional cooperation is unable to ensure achievement of the goals of a genuine integration arrangement". To further deepen the integration processes, it was decided to transform the CAEC into the Central Asian Cooperation Organisation (CAC).

In fact, the alliance became a forum to advance the political dialogue of its members "to deepen mutual understanding on the formation of a single security space, joint actions to maintain stability in the region". At the CAC summit in Almaty on 28 February 2002, the decisions of the Tashkent meeting were officially enshrined in the Agreement (Treaty) on Establishment of the Central Asian Cooperation Organisation.

The processes of CAC-based regionalisation in CA slowed down considerably under the influence of external and internal factors; the intensity of interaction and cooperation between its members (at the level of Heads of State and Governments) fell to one meeting per year. The activities of the CAC working bodies became nominal, emerging issues and forward-looking objectives scarcely considered (Meshcheryakov, 2013).

Against this background, the merger of the CAC with the EurAsEC was fully justified. The decision on that was made at the summit of the Heads of State of the CAC and the EurAsEC member countries (St. Petersburg, 6–7 October 2005). The integration of the two regional organisations must have been one of the reasons that Uzbekistan — a key state in CA — joined the EurAsEC in 2006[7].

The CA states have made repeated attempts to create free trade zones, customs, monetary, and payment unions in the format of regional alliances, such as the CAU, the CAEC, and the CAC. However, none of them have achieved their goals, and no planned project, such as to form a common market or to create a water and energy consortium for the use of transboundary water resources, was successful (Shumsky, 2010).

[7] The Protocol on Accession of Uzbekistan to the Treaty on Establishment of EurAsEC, dated 10 October 2000, was signed at an extraordinary meeting of the EurAsEC Interstate Council in St. Petersburg on 25 January 2006. In October 2008, Uzbekistan issued a notification about the suspension of its EurAsEC membership, which served as a basis for the EurAsEC Interstate Council (at the level of Heads of State) to adopt a relevant decision on 12 December 2008. Uzbekistan has had observer status in the Eurasian Economic Union (EAEU) since 11 December 2020.

↓ Table 9. Quasi-Integration and Integration Alliances in CA, 1991–2022

Regional organisation	Legal framework
Unified Dispatch Office of Power Systems of Central Asia (CA UDO) **Members:** Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan	Agreement on Parallel Operation of Power Systems of the Republic of Kazakhstan, the Kyrgyz Republic, the Republic of Tajikistan, Turkmenistan, and the Republic of Uzbekistan (Ashgabat, 19 November 1991)
Interstate Commission for Water Coordination (ICWC) **Members:** Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan	Agreement on Cooperation in the Field of Joint Management of the Use and Conservation of Water Resources in Interstate Sources (Almaty, 18 February 1992)
International Fund for Saving the Aral Sea: — Executive Committee, — Interstate Commission for Water Coordination (ICWC), — Commission on Social and Economic, Scientific, Technical and Environmental Cooperation **Members:** Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan	Joint communiqué of the Heads of State of CA countries and the decision to establish the International Fund for Saving the Aral Sea (Tashkent, 4 January 1993). Agreement on Joint Actions to Address the Problem of the Aral Sea and the Aral Sea Region, Improving the Environment, and Ensuring Social and Economic Development of the Aral Sea Region (Kyzyl-Orda, 26 March 1993)
Interstate Council on Aral Sea Basin Problems **Members:** Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, and Russia (observer) Note: dissolved by decision of the Heads of State of CA, Ashgabat, 9 April 1999.	Agreement on Joint Actions to Address Problems of the Aral Sea and the Aral Sea Region, Improving the Environment, and Ensuring Social and Economic Development of the Aral Sea Region (Kyzyl-Orda, 26 March 1993)
International Fund for Saving the Aral Sea: — Executive Committee, — Interstate Commission for Water Coordination (ICWC). — Commission on Sustainable Development (CSD). **Members:** Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan	Regulations on the International Fund for Saving the Aral Sea and Intergovernmental Agreement on the Status of the International Fund for Saving the Aral Sea and Its Organisations Approved by decisions of the Heads of State of CA, Ashgabat, 9 April 1999.

Regional organisation	Legal framework
Common Economic Space Central Asian Union (CAU) **Members:** Kazakhstan and Uzbekistan since 10 January 1994, Kyrgyzstan since 30 April 1994. Russia. Tajikistan since March 1998.	Agreement between the Republic of Kazakhstan and the Republic of Uzbekistan on Establishment of a Common Economic Space dated 10 January 1994 (Tashkent, 10 January 1994). Agreement among the Kyrgyz Republic, the Republic of Kazakhstan, and the Republic of Uzbekistan on Establishment of a Common Economic Space (Cholpon-Ata, 30 April 1994).
Central Asian Economic Community (CAEC) **Members:** Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan since March 1998	Protocol on Accession of the Republic of Tajikistan to the Treaty on Establishment of a Common Economic Space between the Republic of Kazakhstan, the Kyrgyz Republic, and the Republic of Uzbekistan, dated 30 April 1994 (Tashkent, 26 March 1998)
Central Asian Cooperation Organisation (CAC) **Members:** Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan, Russia since October 2004	Agreement among the Republic of Kazakhstan, the Kyrgyz Republic, the Republic of Tajikistan, and the Republic of Uzbekistan on Establishment of the Central Asian Cooperation Organisation (Almaty, 28 February 2002).
Merger of CAC and EurAsEC **Members:** Belarus, Kazakhstan, Kyrgyzstan, Russia, Tajikistan, Uzbekistan from January 2006 (suspended its membership in the organisation in December 2008)	Decision of the Heads of State of CAC and EurAsEC members (St. Petersburg, 6–7 October 2005) Protocol on Accession of Uzbekistan to the Treaty on Establishment of EurAsEC, dated 10 October 2000 Decision of the EurAsEC IC (at the level of Heads of State) (St. Petersburg, 25 January 2006) Decision of the EurAsEC IC (at the level of Heads of Government) (Moscow, 12 December 2008)

Source: prepared by the authors

Despite the great support of those alliances, as well as IFAS and the ICWC, from the World Bank, Asian Development Bank (ADB), and many other international organisations and financial institutions, none of the draft agreements prepared in 1993–2010 attained general agreement from the CA countries to deal with:

- creation of a water and energy consortium;
- enhancement of the institutional framework for the management, protection, and development of transboundary water resources in the Aral Sea basin;

- formation and operation of national, basin, and regional databases for the integrated use and protection of water resources of the Aral Sea basin;
- protection of transboundary waters, rules for monitoring their quality and ensuring environmental sustainability in the region;
- other issues.

The states of the region were not ready to adapt the management of water and energy infrastructure to the changed political and economic environment and jointly develop a management mechanism for the conditions of a transition economy (changing from a centrally planned to a market economy). Instead of concerted actions and harmonised development strategies, each country chose its own interests, which seems inherently unproductive for a confined region with a shared water basin and limited water and land resources (Zhiltsov, 2016).

With the formation of the EurAsEC (Belarus, Kazakhstan, Kyrgyzstan, Russia, and Tajikistan) and until the creation of the EAEU, there were quite vigorous efforts to form mechanisms for interaction among the member states of the Community and joint development of the hydropower potential of the Syr Darya and Amu Darya river basins. The supreme bodies of the Community adopted decisions on construction of the Rogun HPP and the Sangtuda-1 HPP in the Republic of Tajikistan, and the arrangement of energy cross-flows in summer from Tajikistan and Kyrgyzstan to Kazakhstan and Russia.

The objectives of organising interaction among the EurAsEC member states in the joint development and use of water and energy resources of the Syr Darya and Amu Darya river basins in 2003–2006 were considered by the EurAsEC IC (at the level of Heads of State) on the basis of the approved "Plan of Joint Actions of the EurAsEC Member States to Form a Common Energy Market, Develop Electrical Networks, and Create New Ones for 2003–2005". In accordance with the Plan, the Heads of State of the Community adopted a number of decisions: No. 104 dated 28 February 2003; No. 131 dated 27 April 2003; No. 149 dated 28 October 2003; No. 169 dated 18 June 2004; No. 224 dated 22 June 2005; No. 269 dated 25 January 2006; and No. 315 dated 16 August 2006. The decisions dealt with organisational, technical, financial, and environmental issues of cooperation in the water and energy sector and completion of the Sangtuda-1 HPP in the Republic of Tajikistan and the Kambarata-2 HPP in the Kyrgyz Republic.

In pursuance of these decisions, the EurAsEC IC (at the level of Heads of Government) took practical steps to develop cooperation in power generation, including the use of hydropower resources of the Republic of Tajikistan and the Kyrgyz Republic, the integrated use and joint development of water and energy resources of CA, reflected in its decisions No. 149 dated 28 October 2003, No. 157 dated 27 February 2004, and others. Those include Decision No. 332 of the EurAsEC EC dated 28 April 2004 "On Interaction among EurAsEC Member States on Efficient Development of Water and Energy Resources of the Syr Darya and Amu Darya River Basins", dealing with the creation of the Community Working Group on Water and Energy Regulation, which convened its first meeting in June 2004 in Almaty.

The EurAsEC IC (at the level of Heads of State) adopted Decision No. 169 dated 18 June 2004, instructing the EurAsEC EC, in cooperation with stakeholder states, to draft an agreement on participation of the states in the development of the hydropower resources of the Syr Darya and Amu Darya river basins and a mechanism for regulating the region's water and energy regime as a result of the development of those resources, while the Secretary General of the EurAsEC was instructed to appeal to the leadership of the Republic of Uzbekistan with a proposal to participate in preparation of the document. In order to avoid duplication of activities with the CAC, the EurAsEC IC (at the level of Heads of State) adopted Decision No. 224 dated 22 June 2005 to establish a joint high-level group (HLG), including heads of national water management and energy authorities.

Pursuant to decision No. 169 of the EurAsEC IC (at the level of Heads of State) dated 18 June 2004 "On Interaction between EurAsEC Member States on Efficient Development of Water and Energy Resources of the Syr Darya and Amu Darya River Basins", a Feasibility Report on "Prospects for Integration in Development of Energy and Water Resources of Central Asia" (hereinafter referred to as the Report) was prepared. The main objective of the Report was to explore approaches to drafting the Agreement on Participation of States in Development of Hydropower Resources of the Syr Darya and Amu Darya River Basins and the Mechanism for Regulating the Region's Water and Energy Regime as a Result of Development of those Resources.

The EurAsEC significantly intensified its work on water and energy issues and, in order to organise systematic work to achieve the goals set by the Community bodies, the Secretariat of the EurAsEC EC prepared the "Roadmap for Development of Cooperation Mechanism for EurAsEC Member Countries in the Field of Water and Energy Regulation in Central Asia". The eighth meeting of the Energy Policy Council under the EurAsEC EC (20 April 2006) generally endorsed the document and recommended further cooperation in that area.

The EurAsEC/EurAsEC IC summit (at the level of Heads of State), held in Sochi (2006), reviewed the progress in drafting the Concept Document on Efficient Use of Water and Energy Resources of the Central Asian Region (hereinafter referred to as the Concept Document). The draft Concept Document was developed by the HLG at its second meeting (23 October 2006) and was recommended for adoption. Despite repeated invitations, Turkmenistan did not participate in the HLG. The meeting of the EurAsEC EC, held on 25 October 2006, adopted the draft Concept Document as a basis by majority vote. Uzbekistan did not support the decision.

The third meeting of the HLG (December 2006) also considered the issues of EurAsEC involvement in the preparation of the draft Model National Law on Safety of Waterworks and the draft Regional Agreement on Cooperation in the Area of Safety of Waterworks, developed within the framework of the UN project "Dam Safety in Central Asia: Capacity Building and Regional Cooperation". Taking into account the common objectives pursued by the documents and the HLG, it was decided to support the proposal of the UNECE for the EurAsEC bodies to review the documents. The fourth meeting of the HLG (March 2007) largely endorsed the draft documents and the Secretariat of the EurAsEC EC was invited to submit them to the EurAsEC bodies for review. The draft Model Law on Dam Safety was reviewed by the EurAsEC Inter-Parliamentary Assembly and recommended for application (EurAsEC Resolution No. 9–10 dated 4 April 2008). Due to diverging and inconsistent positions of the parties, the EurAsEC bodies recommended further revision of the draft regional Agreement on Dam Safety.

In January 2007, the EurAsEC Commission of Permanent Representatives reviewed the draft Concept Document finalised by the HLG in December 2006. The fifth meeting of the HLG, held on 21 May 2007, largely endorsed the draft. The document defines the principles of effective use of water and energy resources in the CA region and interaction among Community member states in this area; the goals, objectives, and areas of interaction; the key stages, the time-frame, and the mechanism for implementation of the Concept Document. It was expected to serve as a basis for drafting an agreement on cooperation among the EurAsEC member states for efficient use and protection of the region's water and energy resources.

However, the positions of the parties on certain issues remained discrepant. For example, Uzbekistan proposed replacing the phrase "water and energy resources" in the title of the draft Concept Document and throughout the text with "water and hydropower resources"; not linking the principle of continuity of water and energy regulation and electricity supply with the supply of fuel and energy resources and investment in the construction and renovation of hydropower and water facilities of interstate importance on a mutually beneficial basis. Kyrgyzstan objected to the proposal. Tajikistan considered it necessary to exclude the principle of no-harm to neighbouring states. At the 35th meeting of the EurAsEC EC, held

on 7 June 2007, the HLG was instructed to review and finalise, in cooperation with the EurAsEC Permanent Representatives, the draft Concept Document, taking into account the existing differences between the parties, and submit it to the 36th meeting of the EurAsEC EC (2007).

As a result of lengthy coordination of the positions of the parties and the lack of consensus among them, further joint work in the format of integration alliances to resolve water and energy issues virtually ceased and the initiative in this area was completely ceded to the USA, the EU, the World Bank, and the ADB (Likhacheva, 2014).

3.4 International Cooperation of Central Asian Countries on Management of Water and Energy Resources in the Region

Given the divergence of irrigation and hydropower interests of the CA countries, cooperation in the water and energy complex is evolving within the framework of regional initiatives financed by international organisations, development institutions, international donors, and multilateral development banks (see Vinokurov et al., 2021 for details on the financing of initiatives in the CA water and energy complex by multilateral development banks).

Multilateral development banks, being international financial institutions (IFIs), include organisations such as the World Bank, the European Investment Bank, the Islamic Development Bank, the Asian Development Bank, the European Bank for Reconstruction and Development, the Development Bank of Latin America, the Inter-American Development Bank, the African Development Bank, the New Development Bank supported by the BRICS, and the Asian Infrastructure Investment Bank. Unlike commercial banks, IFIs do not seek to maximise returns for their shareholders and often lend at low or no interest rates and for longer maturities than those normally offered by commercial banks. Therefore, IFIs play an important role in supporting developing countries and emerging market economies by offering advice, financing development projects (among other things, issuing guarantees to attract private sector investment, including foreign direct investment), and providing assistance in project implementation. Although IFIs operate independently of each other, they share a common set of goals: to reduce poverty and improve living conditions and standards; to support sustainable economic, social, and institutional development; and to promote regional cooperation and integration. Projects supported by IFIs are usually implemented by the borrowing government (or state-owned special purpose companies).

Bilateral development agencies also fund projects that contribute to the economic and social development of recipient countries. Unlike IFIs, bilateral agencies report to the government and are often part of a ministry. Among the most prominent bilateral development agencies engaged in financing hydropower project are the French Development Agency (AFD), the Japan International Cooperation Agency (JICA), and the Norwegian Agency for Development Cooperation (NORAD). The German Development Bank (KFW), acting on behalf of the German Federal Ministry for Economic Cooperation and Development, is engaged in developing countries (Markkanen, Plummer Braeckman, 2019).

The best-known regional initiative is the Central Asia Regional Economic Cooperation Programme (CAREC). The most prominent regional initiative is the Central Asia Regional Economic Cooperation Programme (CAREC), established in 1997 by the ADB. The goal of the Programme is to promote the economic development of the countries of the region, as well as poverty reduction. The partner IFIs of the Programme are the ADB (acting as the CAREC Secretariat), the World Bank, the EBRD, the IMF, the Islamic Development Bank,

and the UNDP. Work under the CAREC Programme is aimed at advancing regional energy integration. The CAREC Programme covers 11 participating countries: Afghanistan, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, China, Tajikistan, Turkmenistan, and Uzbekistan.

In the area of water resources, the CAREC Programme is currently developing a new CAREC Water Pillar (CAREC, 2021). The CAREC Water Pillar Scoping Report is expected to be the basis for regional water cooperation that would meet the growing demand for water amid mounting uncertainty about the climate. Initially, the CAREC Programme plans to focus on cooperation in the Aral Sea basin, with the expectation that its scope would gradually expand to other CAREC subregions (to Afghanistan). The CAREC Programme is designed to complement the role played by existing regional institutions, national agencies, and development partners. As a new component of the CAREC Programme, the Water Pillar will take a step-by-step approach to enhancing regional cooperation.

The strategic document of the CAREC Programme in the area of power generation is the CAREC Energy Strategy 2030. On 20 September 2019, in Tashkent, the Ministers of Energy of the CAREC member countries signed a Joint Declaration on the development and implementation of a common energy strategy by 2030. The 18th Ministerial Conference on CAREC, held on 14 November 2019 in Tashkent, endorsed the "CAREC Energy Strategy to 2030". In terms of its ideology, goals, contents, implementation mechanism, and participation, the CAREC Programme is close to the SPECA (Special Programme for the Economies of Central Asia [UN]). The main goal of the SPECA European initiative is to establish close economic ties between Europe and the CA countries, and to step up investment mobilisation from IFIs to the region. In 1998, five priority projects were approved in Tashkent, covering transport, power generation, environmental protection, and assistance to small and medium business development — areas that are important for the region and play a critical role in the social and economic development of the CA states.

Each of the five countries coordinates one of the priority projects. These include: transport infrastructure and border-crossing (lead country — Kazakhstan); sustainable and efficient use of energy and water resources of CA countries (Kyrgyzstan); *the international economic conference on Tajikistan*, a common strategy for regional development and attraction of foreign investment (Tajikistan); regional cooperation in the development of a multivariant approach to determining routes for the supply of hydrocarbon compounds to world markets using pipelines (Turkmenistan); efforts to reform the industrial capacity of the region in order to create competitive international industrial enterprises (Uzbekistan).

The main sources of funding for the Programme are the ADB, the EBRD, and the UNDP. The UN regional commissions are not directly involved in financing; they assist SPECA bodies in developing project documentation and seeking funding (Vartanyan, 2001).

All the five CA states participating in SPECA are also members of the UN regional commissions — the UNECE (United Nations Economic Commission for Europe) and the ESCAP (Economic and Social Commission for Asia and the Pacific). The UNECE carries out activities in transport, statistics, power generation, trade, environmental cooperation, and economic integration. The UNECE, as a regional forum for the development of conventions, norms, and standards, makes a major contribution to conservation and protection of the environment, including transboundary watercourses and international lakes, sustainable management of water resources and enhancement of bilateral and multilateral cooperation in this area.

UNECE initiatives in the CA water and energy complex are implemented within the framework of the European Union (EU) Water Initiative for the countries of Eastern Europe, Caucasus, and Central Asia (EECCA). The European Union Water Initiative Plus for Eastern Partnership Countries (EUWI+) commenced in late 2016. It is aimed at addressing challenges in both designing and exercising efficient management of water resources

in the Eastern Partnership countries. With the support of the EU and other donors, a number of water policy reforms are being implemented in the EECCA countries under the EUWI+ Programme in the following areas:

- managing water to improve the institutional and regulatory framework in order to converge with the Water Framework Directive and related legislation;
- contributing to water, food, and energy security and economic development;
- ensuring access of the poor to essential water and sanitation services as a basic human right;
- encouraging investment in water supply and sanitation and ensuring the financial viability of water and sanitation utilities;
- safeguarding public health;
- transboundary cooperation to contribute to safety by developing inter-state cooperative structures for water management.

The EUWI+ Programme, together with the OECD and the UNECE, supports and contributes to the National Policy Dialogues (NPD). The NPD is a platform for discussing and promoting reforms in water policy. In 2019, the European Parliament and the Council approved a new EU strategy for Central Asia, "The EU and Central Asia: New Opportunities for a Stronger Partnership". Section 1.3 "Enhancing Environmental, Climate, and Water Resilience" says that "Central Asia is facing increasingly severe environmental challenges. As these challenges are transboundary in nature and require mutual trust and cooperative solutions, the EU will continue to pursue a regional approach to cooperation in the field of the environment, water, and climate change (EC, 2019). The EU will use its financial instruments, grants and guarantees, in particular those provided by the European Investment Bank (EIB), and in cooperation with the EBRD and other multilateral development banks, to mobilise public and in particular private capital for environmental projects and environmentally sustainable economic activities. The promotion of a sound regulatory framework will be of crucial importance to attract private investment".

In addition to the UNECE, the Organisation for Economic Cooperation and Development (OECD) also acts as a strategic partner in CA for the EUWI Programme in the EECCA countries. Since 2010, the OECD has devoted a large series of publications to ensuring the integration of basin water resources management and water resources management in various sectors of the economy (agriculture, manufacturing, utilities, etc.) in order to support the implementation of the SDGs, in particular Goal 6, "Ensure availability and sustainable management of water and sanitation for all".

OECD research shows that there is no universal solution to water problems; rather, there is a wide variety of situations within and between countries (OECD, 2011). Therefore, the choice of solutions to the problem should be adapted to the basin-territorial specifics of each country and the international river basin as a whole. Water management is a complex mechanism, it includes processes and institutions used to achieve the goals to be sought based on the principles of water management (OECD, 2015b). Among the latter, 12 Principles of Water Governance endorsed by the OECD member countries should be noted. The principles can be grouped into three categories:

I. Enhancing the effectiveness of water governance (Principles 1–4). The parameter of **effectiveness** is instrumental in assessing the contribution of governance to defining clear, sustainable water policy goals and targets at all levels of government, to implementing those policy goals and meeting expected targets. Principles 1–4 are aimed at creating incentives for

governing bodies in their efforts to coordinate water governance, enhance policy coherence, and ensure appropriate capacities available within responsible authorities.

II. Enhancing the efficiency of water governance (Principles 5–8). The efficiency aspect relates to the contribution of governance to maximising the benefits of sustainable water management and welfare at the least cost to society. Efficient governance implies the accumulation of reliable and usable data on water resources (water), allocation of financial resources in an efficient and transparent manner, implementation of a sound water management regulatory framework, and promotion of innovative governance practices.

III. Enhancing trust and engagement in water governance (Principles 9–12). These relate to the contribution of governance to building public confidence and ensuring inclusiveness of stakeholders through democratic legitimacy and fairness for society at large. Principles 9–12 are aimed at mainstreaming the integrity (ethics) and transparency of governance, encouraging stakeholder engagement in water policy design and implementation, as well as promoting the development and implementation of a balanced approach to governance, taking into account the interests of users, the environment, and future generations, and supporting regular monitoring and evaluation of the current water policy.

Those principles are recommended for application by all stakeholder states, regardless of whether they are members of the OECD. The OECD principles are expected to contribute to improving the "Water Governance Cycle", from policy design to its implementation. They can be applied to all branches of water management, including municipal and industrial water supply, irrigation, hydropower generation, water transport, etc. (OECD, 2015a).

The World Bank is the leading institution under the Central Asia Water and Energy Programme (CAWEP). CAWEP is a partnership among the World Bank, the EU, Switzerland (through SECO), and the United Kingdom (through the UK Department for International Cooperation [DFID]) to strengthen the enabling environment to promote energy and water security at the regional level and in the beneficiary countries. The programme is structured with three pillars: energy security; the energy-water nexus; and water security. The Programme has pursued three components since its inception in 2009: data and diagnostic analyses; institutions, capacity, and dialogue; and supporting investment. Another World Bank instrument is the CAEWDP (Central Asia Energy and Water Development Programme) initiative, which aims at providing technical assistance in the area of energy and water resources for Kazakhstan, Kyrgyzstan, Tajikistan, and Uzbekistan, and facilitates the involvement of Turkmenistan and Afghanistan in regional projects.

In addition, the World Bank promotes a project to develop the regional electricity market in Central Asia and South Asia (CASA-1000). The project has also been supported by the Islamic Development Bank, the United States Agency for International Development (USAID), the US State Department, DFID, and the Australian International Development Agency (AusAID).

Other initiatives aimed at developing cooperation in the CA water and energy complex include: the GIZ Programme "Transboundary Water Management in Central Asia" (German Federal Foreign Office); the project "Transboundary Water Management Adaptation in the Amu Darya River Basin to Climate Change Uncertainties" (USAID); the Central Asia Partnership within the Energy Regulatory Partnership Programme (ERPP) (USAID); the regional energy programme "USAID Power Central Asia" (USAID together with the Ministries of Energy of the CA countries).

Along with the participation of the CA countries in the initiatives of the EU, the USA, and other leading powers on a bilateral as well as multilateral basis, a new format of cooperation, described as "5+1", has been developing in the region since the 2000s. Such multilateral

formats are developed in the region by the USA, the EU, Japan, and South Korea. Taking into account the differences in the social, economic, and political development of the CA states, their diverging national interests, which affect their interaction with third countries, it is impossible to appraise the success of these formats in an unambiguous way. The formats differ in their stated goals, contents, and cooperation mechanisms and promote various interests of the participating countries (Alekseenkova, 2017).

A similar format of interaction was proposed by China, which, on 16 July 2020, held its first meeting in the "5+1" format at the level of Foreign Ministers of the CA countries and China. On 8 June 2022, Nur-Sultan hosted the third China—Central Asia meeting of Foreign Ministers. Section I, "Political and Diplomatic Cooperation", of the Joint Statement of the meeting says that "the parties confirm their willingness to continue mutually beneficial cooperation in order to further expand relations in such areas of interaction as the political dialogue, sustainable development, trade and economic relations, investment, finance, research and development, transport and communication, water and energy, information technology, environment, cultural and humanitarian efforts, and green energy sources". In Section IV, "Cooperation on Environmental Protection, Water and Energy Resources, and Green Development", the parties note "the urgency of strengthening cooperation in the area of environmental protection, combating climate change and adaptation to it; combating desertification, land degradation; sustainable use of water and energy resources; environmental protection and ecology; conservation of glaciers; rehabilitation of lands subjected to nuclear tests and reclamation of uranium tailing dumps; as well as implementing projects and programmes aimed at introducing resource saving and green technologies, including the development of renewable energy sources".

The same section highlights the importance of joint promotion of the draft Resolution of the 77th session of the UN General Assembly on the initiative of the Kyrgyz Republic to declare 2023–2027 Five Years of Action for the Development of Mountain Regions and the idea of establishing the Mountain Countries Development Fund, as well as the significance of the proposal of the Republic of Tajikistan to declare 2025 the International Year for Preservation of Glaciers and to set up an International Glacier Conservation Fund. The parties stressed the importance of supporting international activities to conserve glaciers; address environmental problems in a holistic way; save the Aral Sea; protect biodiversity; develop cooperation on technology transfer, financing, and exchange of experience, taking into account own advantages. The parties noted the importance of the special Resolution of the UN General Assembly initiated by the Republic of Uzbekistan on declaring the Aral Sea region a zone of environmental innovations and technologies that would contribute to overcoming the negative consequences of the Aral Sea crisis, ensuring the rehabilitation and improvement of the environment, preservation of natural resources, and improvement of the quality of life of the region's population. The Chinese side will explore the options of participating in projects aimed at improving the environmental, social, and economic situation in the Aral Sea region within the framework of the UN Multi-Partner Human Security Trust Fund for the Aral Sea Region. The parties expressed their readiness to work together in these areas to improve the mechanisms of long-term and mutually beneficial cooperation to achieve the SDGs in the region. In connection with the statement made in the China + Central Asia format, it seems possible for China to participate in water and energy projects of CA regional organisations.

4. UPDATED PLATFORM FOR REGIONAL COOPERATION IN CENTRAL ASIA

4.1 Assessment of Transboundary Cooperation in the Aral Sea Basin

The level of cooperation of the CA countries remains extremely insufficient to address the problems of the basin, improve the environmental situation, and efficiently manage the region's transboundary water resources. The Economist Intelligence Unit (EIU) Blue Peace Index (in fact, an index of water cooperation) recognises the need to strengthen the legal, institutional, financial, and infrastructure mechanisms and instruments used by the CA countries to manage water resources and the water sector (EIU, 2020). The indicators for both the Syr Darya and Amu Darya basins are below average compared to other basins: they rank respectively fifth and sixth out of the seven basins covered by the study.

In terms of transboundary resources management, the top-ranking basin according to the Blue Peace Index is the transboundary basin of the Sava River (the Danube sub-basin) connecting Albania, Bosnia and Herzegovina, Croatia, Montenegro, Serbia, and Slovenia. The current priority for the riparian states of the Sava River and its basin is to realise the economic benefits of IWRM in various sectors, including water transport, hydropower generation, tourism, and agriculture. Ensuring the operation of water transport and the restoration of water infrastructure, including that damaged as a result of military conflicts in the region, are the priorities set for the International Sava River Basin Commission. Despite all the efforts, the Sava River has not yet become an economic corridor for trade, supply chains or optimal resource sharing in the way it was when it was part of Yugoslavia, reflecting the depth of the post-conflict fragmentation in the region.

The second ranking in the Blue Peace Index is the transboundary basin of the Senegal River, which is shared by Guinea, Mali, Mauritania, and Senegal. The experience of integrated management of water and energy resources implemented by the Senegal River Basin Development Organisation (OMVS, in French: *Organisation pour la mise en valeur du fleuve*

↓ Table 10. Blue Peace Index (BPI) Indicators

		Overall score	Policy and legal framework	Institutions and participants	Water management instruments	Infrastructure, financing	Cooperation context
1	Sava	67.9	88.6	69.8	65.6	51.5	69.0
2	Senegal	56.2	57.0	68.1	63.2	48.2	62.7
3	Mekong	55.0	55.3	63.4	49.0	43.5	55.9
4	Amazon	54.2	52.7	61.8	47.9	43.4	53.7
5	Syr Darya	48.1	49.1	58.0	41.7	38.4	49.8
6	Amu Darya	37.3	42.4	46.6	32.3	30.8	34.5
7	Tigris-Euphrates	25.0	32.0	23.3	19.8	18.2	31.4

Source: EIU, 2020

Sénégal) is one of the most interesting and useful for CA. The Senegal basin is the best among those included in the Blue Peace Index in terms of many key components of the index that are of particular interest to the Aral Sea basin: Institutions and Participation, Infrastructure and Financing.

The OMVS was founded in 1971 as a joint commission with a head office in Dakar, the capital of Senegal (Yasinsky et al., 2015). The regional cooperation is based on the understanding that the water resources of the Senegal River are common property of all countries in the basin.

The agreements underlying the OMVS establish the international status of the Senegal River and its tributaries, as well as the corresponding infrastructure, as "joint, indivisible property of the member states". That means:

- joint lending for development purposes;
- joint guarantee of repayment of borrowed funds and payment of interest rates;
- joint management of common infrastructure and assets.

In developing a formula for distribution of the economic burden, the member countries of the OMVS used an economic model that shares the (infrastructure) costs and benefits obtained by each country. The costs are borne by the relevant sectors of the economy and the country according to the benefits obtained. Water is divided among the countries concerned, not by volume, but rather by development sectors, but the whole basin is treated as a single economic unit. The system aims to maximise benefits for the sectors involved.

This approach led to a unique evolution of the situation. The countries formed a common vision for development of the Senegal River basin; a sustainable management framework (six permanent bodies with clear powers and functions); and a legal framework. All decisions are based on consensus and are taken collectively.

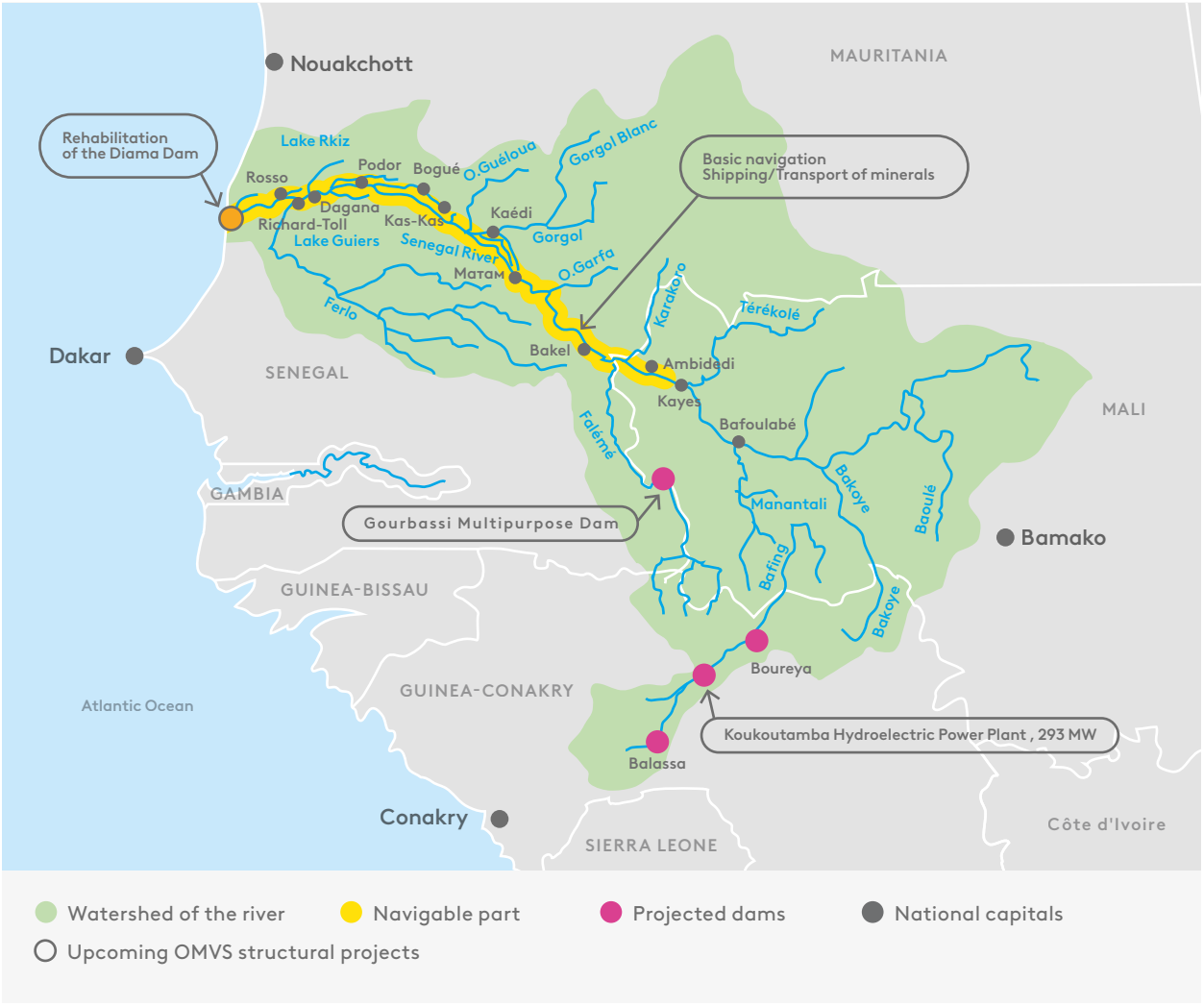
4.2 International Practice of Water and Energy Resources Management in the Basin of a Transboundary River

Integration processes in Africa have generally developed since the early 1960s. In the first stage, river basin organisations were created to fit African conditions: the OMVG (Gambia River Basin Development Organization), the OMVS (Senegal River Basin Development Organisation), the organisation for the operation and development of the Katera River basin, the Mano River Union, etc. (Polyak, 2020). Despite the fact that integration in Africa presents its own difficulties of an objective and subjective nature, there are 55 integration alliances of various formats and covering various areas of activity (Kostyunina, 2016).

The countries of the Senegal River Basin have achieved the greatest success. The basin, with an area of about 483,000 km², is located in the arid zone of West Africa. The sources of the Senegal River, which is 1,800 km long, are located in Guinea and south-western Mali. For 810 km of its length, the river forms the border between Senegal and Mauritania and flows into the Atlantic Ocean, creating a vast delta.

Most of the hydropower potential of the Senegal River basin is concentrated in Guinea. The lower flat land reaches of the river are divided between Mauritania (26%) and Senegal (10%). The river flow varies sharply from 7 to 41 km³/year, depending on water availability during the year, and is estimated at an average of 20 km³/year, or 640 m³/sec. The volume

↓ Figure 21. Senegal River Basin



Source: EDB using OMVS information

of the river flow depends mainly on the rainfall in the upstream part of the basin located in Guinea, which ranges from 1,120 to 2,100 mm/year. The total flow of the three main tributaries — the Bafing, the Bakoye, and the Falémé, flowing from the mountains of Guinea — accounts for more than 80% of the flow of the Senegal River. In the lower reaches of the basin, rainfall rarely exceeds 500 mm/year, and in dry years, it can be several times less. Most of the rainfall occurs during the rainy season, from May through September. Prior to the construction of the Manantali Dam in the upper reaches of the basin, the river used to overflow and flood the vast alluvial plain during that season, bringing silt and making the soil fertile, which made it possible to grow rice and other crops in the zone.

The population of three countries — Senegal, Mauritania, and Mali — exceeds 24 million and is represented by different ethnic groups. More than 10.3 million people live within the basin of the Senegal River. All countries in the basin are developing economies, experiencing food, energy, and electricity shortages (Niasse et al., 2004).

The first water management studies in the Senegal River basin were performed in 1925–1930 by a private company, L'Union Hydroélectrique Africaine (UHEA). Based on the findings of those studies, a number of projects were proposed to build HPPs with reservoirs, but they were rejected by the colonial administration, which considered them too expensive with questionable profitability.

In 1934, Senegal, Mauritania, and Mali jointly established the Senegal River Research Mission (in French: *La Mission d'Etudes du Fleuve Sénégal, MEFS*), and in 1938, it was changed

to the Senegal River Development Mission (in French: *La Mission d'Aménagement du Fleuve Sénégal, MAS*). In 1960, the three riparian countries — former French colonies — gained independence, and in 1963, together with Guinea, they created an interstate committee (in French: *Le Comité Inter Etats, CIE*) on the basis of the MAS. The parties adopted the Convention on the Integrated Development of the River, according to which the river with its tributaries was declared an international watercourse. The CIE had great powers to jointly develop the water and land resources of the basin, up to approving specific projects to be implemented and obtaining financial and technical assistance for their execution.

In 1968, all four countries in the Senegal River basin signed an agreement establishing the Senegal River Riparian States Organisation (in French: *Organization des Etats Riverains du Senegal, OERS*) with the aim of extending cooperation to almost all sectors of the economy and social development. However, the organisation did not have the funds to implement an extensive work programme. For these reasons, Guinea withdrew from the OERS, which did not achieve any of its goals and ceased to function by the early 1970s.

Nevertheless, Mauritania, Mali, and Senegal decided to resume cooperation on the development of the Senegal River's resources. In 1968–1973, there was a severe drought that reinforced the need for cooperation among the riparian states. After extended phases of coordination and diplomatic efforts, the countries of the river basin launched joint efforts. The work covered the following areas:

- development of the hydropower potential in the upper reaches of the Senegal River basin;
- development of irrigated agriculture in the Senegal River Valley;
- support of river navigation for Mali, which is a landlocked country.

The legal framework for cooperation through the basin organisation included two treaties signed by Mauritania, Mali, and Senegal on 11 March 1972 (Yasinsky et al., 2011).

The first treaty on the status of the Senegal River (in French: *Convention relative au statut du fleuve Senegal*) declared the watercourse an international river, affirmed the intention of the member states to cooperate closely in the development of its resources, guaranteed freedom of river navigation, and provided for a separate agreement to be signed to establish an organisation for cooperation on all issues related to development within the basin.

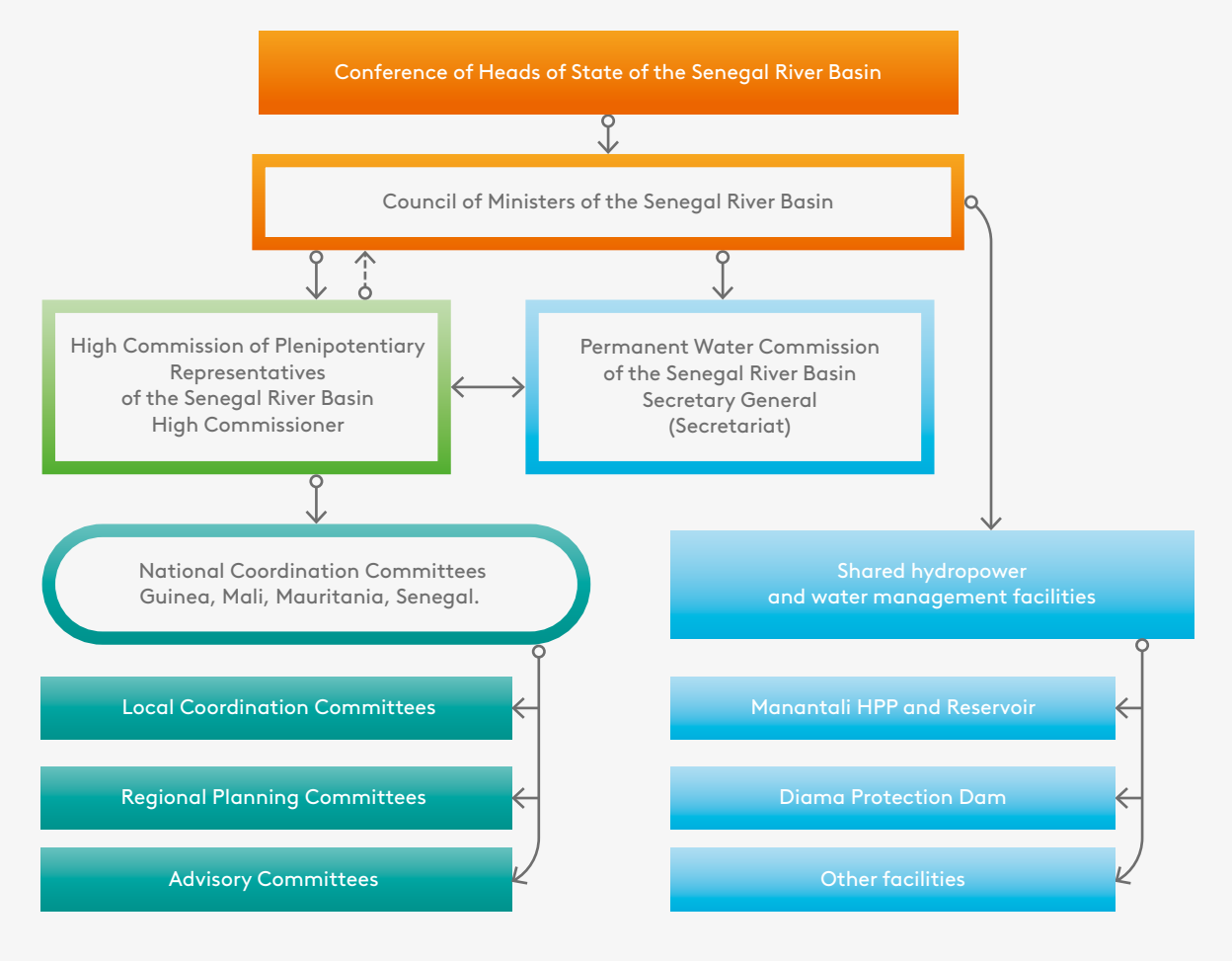
The second treaty (in French: *Convention portant creation de l'Organization pour la mise en valeur du fleuve Senegal*) established a basin organisation called the Senegal River Basin Development Organisation (in French: *Organisation pour la mise en valeur du fleuve Sénégal, OMVS*). The goals of the treaty were to implement the provisions on the status of the Senegal River, to support and coordinate research and development within the river basin, to undertake technical and economic studies requested by member states, and to create a legal entity with the legal capacity to achieve those objectives.

Guinea — the fourth country in the Senegal River Basin — did not sign the Treaties in 1972, but joined the OMVS as an observer in 2006, 34 years after the establishment of the organisation.

In accordance with the 1972 Treaties, three OMVS member states decided that cooperation would be based on the principle of equitable and reasonable utilisation of water resources. They undertook to enter into negotiations in case of disagreement and inform other basin countries of any planned project that could change the flow characteristics.

The OMVS member states gave up their sovereign management of river resource utilisation and entrusted it to the basin organisation — a dedicated body with significant powers

↓ Figure 22. Organigram of the Senegal River Basin Development Organisation (OMVS)



Source: IUCN, 2010

to implement integrated management of both non-navigational and navigational uses of the international watercourse.

The 1972 Treaties created a legal framework for the adoption and implementation by the member states of decisions related to economic development in the Senegal River basin, and formed an institutional framework for joint actions. The documents became a step towards the creation of water management facilities in the Senegal River basin necessary to achieve the goals of cooperation in the development of the hydropower potential, irrigation, and river navigation.

The OMVS basin organisation includes:

- a supreme political body — the Conference of Heads of State and Government;
- a political executive body — the Council of Ministers;
- a technical executive body — the High Commission;
- a working body of the Council of Ministers — the Permanent Water Commission.

The **Conference of Heads of State and Government** (in French: *Conférence des Chefs d'Etat et du Gouvernement, CCEG*) is the supreme political body that designs common economic and social policies within the basin, as well as guidelines for cooperation on the development of the basin resources. The body includes one representative from each state, one of whom is President of the basin organisation appointed on a rotational basis

for a two-year period. Decisions are taken on the basis of unanimity and are binding for the member states.

The **Council of Ministers** (in French: *Conseil des Ministres, CM*) implements the policies determined by the Conference of Heads of State, adopts binding decisions on the principle of unanimity, and entrusts the High Commission with their implementation. The Council of Ministers, which includes one representative from each country, has the right to seek and receive funds to finance projects, as well as to oblige the member states to repay loans and credits it borrows. The Council also prepares and approves the OMVS budget and determines the size of contributions of the member states in accordance with their shares of benefits.

The **High Commission** (in French: *Haut Commissariat, HC*) is an executive body that arranges the implementation of decisions of the Council of Ministers, receives proposals from the member states to implement technical projects, and forwards those to the Permanent Water Commission for examination and preparation of recommendations on implementation.

The **Permanent Water Commission** (in French: *Commission Permanente des Eaux, CPE*) is a working body of the Council of Ministers responsible for developing the principles and rules for water allocation among the member states and water use sectors in the Senegal River basin to be approved by the Council of Ministers.

Each of the member states has created bodies responsible for interaction with the basin organisation: OMVS National Coordination Committees, Local Coordination Committees, Regional Planning Committees (in French: *Comités Régionaux de Planification, CRP*), and Advisory Committees (in French: *Comités Consultatif, CC*).

The three member states contribute funds to cover the operating costs of the OMVS bodies. In January, each state makes an annual contribution of one third of the funds planned for the organisation's budget. A few years ago, the annual contribution amounted to almost USD 0.5 million.

The 1972 Treaties were supplemented by Treaties of 21 December 1978 on the legal status of common facilities (in French: *Convention relative au statut juridique des ouvrages communs*) and of 12 March 1982 on the financing of common facilities (in French: *Convention relative aux financements des ouvrages communs*).

The Treaty signed by the OMVS member states on 21 December 1978 contributed to the creation of a legal framework for common ownership of several other engineering facilities in the Senegal River basin. The 1978 Treaty declared the Manantali and the Diama Dams, as well as the river/seaport of Saint-Louis in the lower reaches of the Senegal River, the river port of Kayes in Mali, harbours, and navigation equipment on the navigable part of the river to be common and indivisible property of the member states.

In accordance with the Treaty, each of the co-owner states received equal rights of ownership of all the above facilities and a collective right to use and manage the common property. The member states also committed themselves to taking appropriate legislative, legal, and administrative measures to provide the OMVS with plots of land for the construction of facilities that are common property, and to imposing no taxes on related construction works and joint ventures.

The 1982 Treaty defined the financial obligations of the member states regarding the construction and operation of the common facilities. Investment and operating costs are distributed among the co-owner states depending on the benefits that each co-owner gets from the operation of the facilities. The sharing arrangement can be reviewed regularly according to changes in benefits. Under the 1982 Treaty, Mauritania covers 22.6%

of the cost of the common infrastructure, receives 15% of the electricity, and will have 33.6% of the irrigated land out of 375,000 hectares planned for irrigation in the Senegal River basin. Mali covers 35.3% of the costs, receives 52% of the electricity generated, and has 24.4% of the irrigated land, as well as obtaining the greatest benefits from the development of river navigation. Senegal contributes 42.1% of the cost of the common facilities, receives 33% of the electricity, and has 42% of the irrigated land. To finance the construction of common facilities, the states can borrow funds directly or through the basin organisation. In the latter case, each co-owner state guarantees repayment of loans taken by the OMVS and warrants the repayment of its share of the loans.

The founding of such an interstate body as the OMVS, which has a broad mandate of powers and competencies, facilitated the transition to practical actions. As a result of cooperation, the three countries jointly constructed the two largest water facilities in the Senegal River basin — the Diama Dam in the lower reaches of the Senegal River and the multi-purpose hydroengineering system of the Manantali Dam on the Bafing River in Mali. The facilities were built to regulate the flow in order to maintain the minimum water level required for year-round irrigation in the Senegal River Valley and year-round navigation from the port of Saint-Louis, located at the mouth of the river and capable of receiving marine vessels, to the inland river port of Kayes in Mali.

The low-pressure **Diama Dam** is located 27 km upstream of the outlet of the Senegal River into the Atlantic Ocean and upstream from the port of Saint-Louis. The main purpose of the dam is to prevent the movement of seawater upstream during dry seasons and maintain the water depth in the river sufficient for navigation. The dam was completed in 1986.

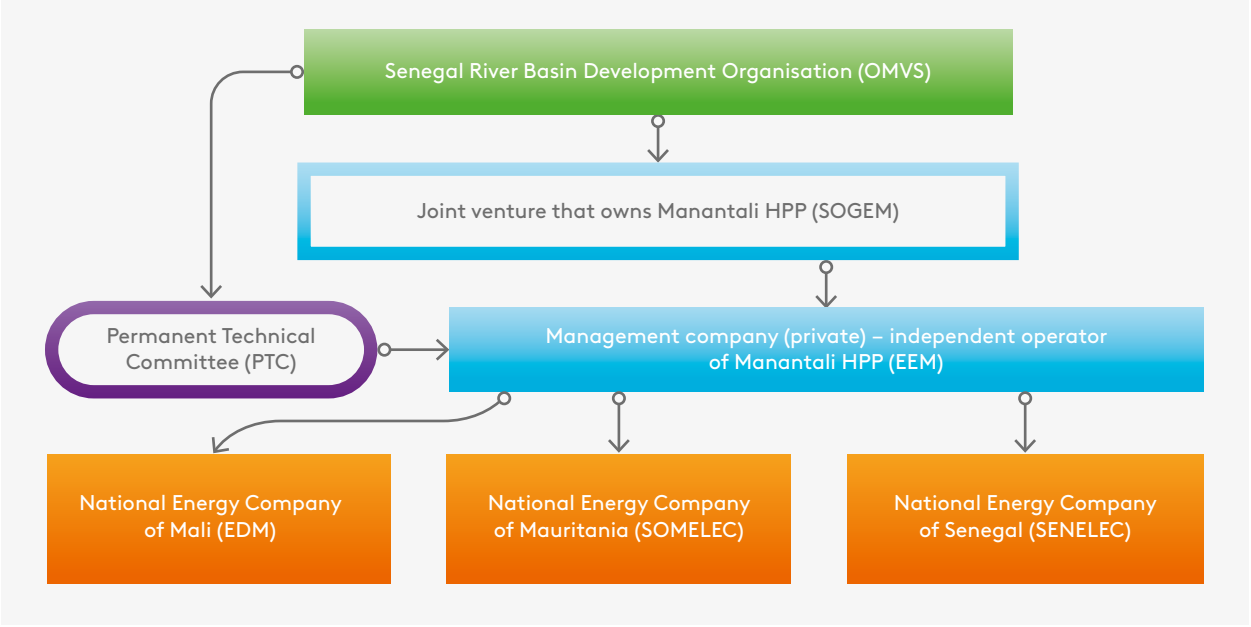
The OMVS is entrusted with management of the common property and can exercise contracts for the construction or operation of certain facilities. For instance, in 1997, two operating companies were established — one for the Diama Dam (in French: *Société de gestion et d'exploitation du barrage de Diama, SOGED*), and the other for the Manantali Dam (in French: *Société de gestion de l'énergie de Manantali, SOGEM*).

The **Manantali Dam** is a key element of the infrastructure developed as a result of cooperation among the states of the Senegal River basin. Its hydroengineering system includes a reservoir with a surface area of 477 km² and a capacity of 11.3 km³, and ensures long-term control of the flow for irrigation, river navigation, and power generation purposes. Construction of the main elements of the hydroengineering system was completed in 1988, but the hydropower equipment (turbines, generators, transformers, and other equipment and apparatuses) was not installed as there was a lack of funds at the time.

The cost of building the hydroengineering system, including the dam, which was 1,460 m long at the crest and 65 m high, and a number of other facilities, amounted to about USD 500 million. The funds were provided by the Governments of several Arab countries, the Islamic and the African Development Banks, as well as by the European Community, the Canadian International Development Agency, and financial agencies in Italy, France, and Germany. It should be noted that at one time the World Bank refused to finance the construction of the Manantali Dam, as the Bank did not see it as a reasonable investment and ceased financial support of the OMVS in 1979. USAID provided financial and technical assistance for environmental assessment of the impacts of the hydroengineering system's construction and the resettlement of the population from the flooded zone of its reservoir.

Although the Manantali Dam was commissioned in 1988, it generated no income, since its HPP — the main potential source of income — was not completed and there were no funds left to equip it. The Senegal River could not yet be used for commercial navigation. There were political tensions between Senegal and Mauritania, among other things because of the Manantali Dam, which brought the work of the basin organisation to a standstill for several years.

↓ Figure 23. Manantali HPP Operational Management Chart



Source: Yasinsky et al., 2011

The borrowing states did not have the funds to repay the loans they had taken, and European governments, which had financed about 40% of the cost of the project, had to forgive their outstanding loans. In 1992, the OMVS member states and donors met again and decided to take appropriate actions to put the HPP into operation by 1996.

The cost of completing construction of the HPP at the Manantali Dam and a total of 1,600 km of high-voltage PTLs to connect the HPP and the capitals of the three member states was estimated at USD 433 million. Initially, the OMVS tried to attract private investors. Then, after a long period of negotiations, **a consortium of state-owned financial agencies** was formed. France provided USD 95 million, Germany USD 66 million, the European Investment Bank USD 46 million, the European Community USD 37 million, the Arab Fund for Economic and Social Development USD 29 million, Canada USD 27 million, the African Development Bank USD 26 million, the Islamic Development Bank USD 21 million, the West African Development Bank USD 20 million, and the Nordic Investment Bank USD 8 million. This time, the World Bank took part in financing the project and allocated USD 39 million in June 1997. Part of the funds was intended for measures to mitigate the negative impact of the already completed facilities of the Manantali and Diama dams. Following the creation of the consortium, the construction of the HPP, consisting of four units 50 MW each, was resumed in 1998 and was completed in 2001.

The Manantali HPP, with an installed capacity of 200 MW and designed annual electricity generation of about 800 million kWh, is of strategic importance, as it is the main source of power for all three OMVS member states. Some 1,600 km of high-voltage PTLs connect the Manantali Dam to the capitals of the three states — 300 km to Bamako (Mali), 400 km to Nouakchott (Mauritania), and 900 km to Dakar (Senegal).

The electricity generated at the Manantali HPP is owned by all member states, which use their national energy companies (EDM — Mali, SOMELEC — Mauritania, and SENELEC — Senegal) to deliver it to consumers. Under the interstate agreement, the generated electricity is shared as follows: 52% goes to Mali, 33% to Senegal, and 15% to Mauritania.

In 2001, management of the Manantali HPP and the energy infrastructure, which, in addition to the HPP, includes 12 substations, 1,600 km of PTLs, and the power grids of the three national energy companies, was delegated to ESKOM Energie Manantali (EEM), branch of the South African ESKOM. A 15-year contract for the management and operation

of the Manantali HPP and related infrastructure was concluded between EEM and SOGEM, a joint venture of the OMVS member states that owns the hydroengineering system of the Manantali Dam.

The legal framework for the functioning of the unified energy grid in the Senegal River Basin (OMVS Interconnected Network, RIO) was a Tariff Protocol with a validity period of 30 years. The provisions of the Protocol are binding for the OMVS member states, SOGEM, and the national energy companies of the states. In accordance with the Protocol, the member states act as guarantors of its implementation, SOGEM undertakes to supply electricity to the national companies through a private operator (EEM), and the national companies are responsible for the supply of electricity generated by the Manantali HPP to consumers. The Protocol also contains provisions regarding the methodology for calculating electricity tariffs, their indexation and revision. The dispatch centre of the unified power system is located at the Manantali HPP.

Construction of the Diama Dam and the creation of the Manantali over-year storage reservoir changed the hydrological regime of the river, which affected both the environment and farming, traditionally based on the annual flooding of cultivated land in the Senegal River Valley. There was no assessment made of the potential impact of the facilities on the environment, public health, and employment prior to their construction. The impacts came to light and attracted attention after the dam and the reservoir were put into operation.

Downstream from the Diama Dam, salt marshes formed on the site of wetlands with diverse vegetation, and some species of fish, whose migration routes were blocked by the dam, disappeared upstream from the dam. Eutrophication in the lower reaches of the river intensified, and new algae appeared and multiplied, degrading the water quality. Many other unforeseen changes have taken place, both in the ecosystem of the basin and in the lives of its population. The incidence of certain diseases, primarily schistosomias, increased due to the degraded quality of water taken from the river for domestic needs.

After the construction of the Manantali Dam, there were no more river floods, and thus the cultivated lands in the valley in the middle reaches of the river were no longer flooded, which led to a decline of traditional farming in the area. The indigenous population, unable to pay the costs of introducing machine irrigation, was displaced by those who bought their land and invested in irrigation systems. That caused social unrest, often on ethnic grounds, as the poor rural people in Senegal were driven out by wealthier Mauritanians. Relations between Mauritania and Senegal deteriorated in all areas to the point that the basin organisation did not function for several years. The situation began to return to normal when they started making water releases from the Manantali Reservoir in order to create artificial floods, leading to flooding of land. This helped revive traditional agriculture to some extent. However, the coordination of water releases from the reservoir and allocation of the river flow among water users in a way that would be acceptable to all member states, remains a challenge, as their interests in the use of water resources diverge. Mali, an upstream country, is primarily interested in maintaining the water depth in the Senegal River sufficient for navigation and power generation at the HPP. Mauritania and Senegal, located downstream, intend to use the flow to irrigate agricultural land. Nevertheless, the countries have made significant progress in joint management of the transboundary river. They have accumulated extensive experience in financing, building, and operating a hydroengineering system of regional importance, which is located on the territory of one country, but is jointly owned by the states of the river basin.

In 1997, under the pressure of the severe environmental, social, and economic problems that arose after the construction of the Diama and Manantali dams, the OMVS, with the assistance of a number of international organisations, established a programme to mitigate the impacts of those facilities on the environment (in French: *Programme*

d'Attenuation et de Suivi des Impacts sur l'Environnement, PASIF). PASIF included projects to optimise the management of the Manantali Reservoir regime, improve sanitation, monitor the environment with the engagement of the local population and non-governmental organisations, and a number of other projects. The materials obtained in the framework of the programme are collected at the Regional Information Centre in Saint-Louis. The Centre also stores technical and administrative documents related to the activities of the OMVS and houses the secretariat of the basin organisation.

Thirty years after the founding of the OMVS, the legal and institutional frameworks for cooperation were clarified and enshrined in the Charter of Waters of the Senegal River (in French: *Charte des eaux du fleuve Sénégal*), signed by Mali, Mauritania, and Senegal at the Conference of Heads of State and Government of the OMVS on 28 May 2002. Guinea, the fourth state of the basin, signed the document on 17 March 2006. The Charter consists of a Preamble and seven chapters: Chapter 1 "Definitions", Chapter 2 "Object and Scope of Application", Chapter 3 "Principles and Methods of Water Allocation among Users", Chapter 4 "Protection and Preservation of the Environment", Chapter 5 "Institutions Charged with Management of Water Resources and Environmental Management", Chapter 6 "Procedure for Examination and Approval of New Projects", and Chapter 7 "Final Provisions".

The purpose of the Charter, according to Article 2, is to determine:

- the principles and methods of allocating water resources in the Senegal River basin among various economic sectors, including agriculture, animal husbandry, inland fisheries and fish farming, forestry, hydropower generation, water supply to urban and rural households, health, manufacturing, navigation, wildlife and the environment, taking into account local traditions and customs;

- the procedure for examination and approval of projects that affect the quantity and quality of water;

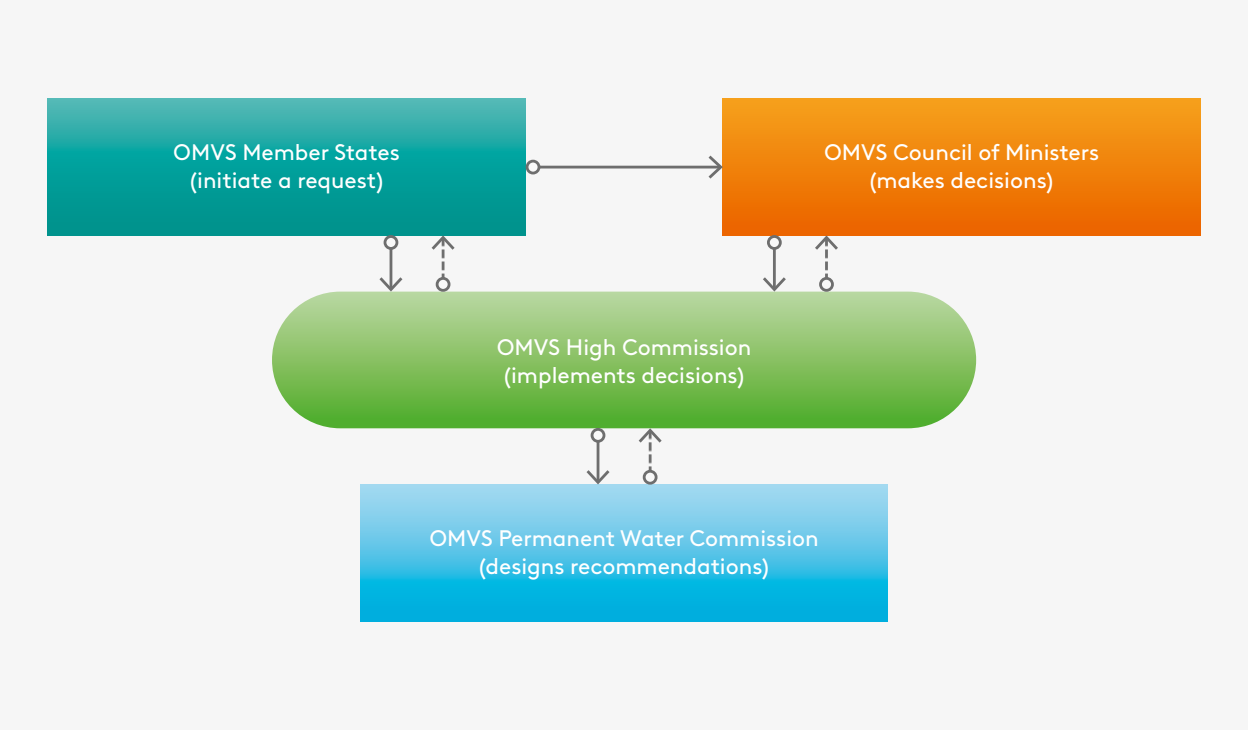
- the rules related to conservation and protection of the environment, especially wildlife, floodplain and wetland ecosystems;

- the forms of participation of water users in decision-making on water resources management in the Senegal River basin.

According to Article 3, the provisions of the Charter apply to the entire catchment area of the Senegal River, including its tributaries that affect the river's status. The document enshrines the basic principles of cooperation: equal rights to use water resources; jointly built waterworks are the common and indivisible property of the OMVS member states; the costs of their operation and maintenance, as well as other shared costs, are distributed among the member states in proportion to their benefits; the free navigation of the Senegal River.

Provisions related to the environment and sustainable development that were not part of the 1972 Treaties were first introduced in the Charter. The Charter establishes the principles and procedures for allocation of water among various water users; determines the course of action for examination and potential approval of requests from new water users; establishes the rules for environmental protection; and regulates the participation of water users in decision-making. It should be noted that there are no water quotas established for individual countries, water is allocated to water users and is allocated for use by the following main sectors: agriculture, fishery, animal husbandry, domestic water supply, hydropower generation, and navigation. In the event of water scarcity, when disposable resources are insufficient to cover the needs of all consumers, priority is given to water supply to households and farm animals, then comes irrigated agriculture,

↓ Figure 24. Decision-Making on Allocation of Water Resources in the Senegal River Basin



Source: Yasinsky et al., 2011

and power generation at the HPP, while river navigation comes last. It is also envisaged that part of the flow should be allocated for environmental needs.

In accordance with the Charter (Articles 19–23), recommendations for regulation of the river flow regime and its allocation are developed by the OMVS Permanent Water Commission and approved by the Council of Ministers.

The member states of the Senegal River Basin Organisation have made substantial progress in advancing cooperation to accelerate economic development, although not all of the established goals have been fully achieved. Unique experience has been accumulated in financing, building, and operating the Manantali Dam, which is jointly owned by all member states. Over time, more attention has been paid to environmental protection and sustainable development. When determining the regimes of water releases from the Manantali Reservoir, not only the interests of the hydropower generation sector are considered, but also the needs of households for water and the demand for water for agriculture, inland navigation, and the environment.

Cooperation among the Senegal River basin countries is unique, as the countries have delegated their rights to manage the use of the river's water and hydropower resources to an international basin organisation. The basin countries use the organisation as a vehicle for joint ownership of a number of waterworks, including a large HPP with an over-year storage reservoir, located on the territory of one of the upstream countries, and for determining their operating regime (Yasinsky et al., 2011).

The experience of international cooperation in the Senegal River basin is of great interest to the CA countries, as it demonstrates one of the potential approaches to joint development of the hydropower potential in an international watercourse basin, taking into account the interests of other water users.

4.3 Window of Opportunity for Reformatting Current Frameworks for Regulation of the Water and Energy Complex in Central Asia

The processes of regionalisation have noticeably accelerated in CA in connection with the renewed political agenda of Uzbekistan to strengthen trust among the CA countries. In 2017, a mechanism for holding consultative meetings of Heads of State, establishing a regional economic forum, and creating an association of heads of regions and business communities was initiated at the conference "Central Asia: Shared Past and a Common Future, Cooperation for Sustainable Development and Mutual Prosperity", which took place in the city of Samarkand (UNRCCA, 2017).

The process of removing political barriers that have long prevented the normalisation of interstate relations in the region is underway. For example, in 2017, after a 25-year break, flights between Dushanbe and Tashkent were resumed. A year later, Tajikistan and Uzbekistan abolished a visa regime, and they signed an agreement on strategic partnership the same year. After 30 years, Tajikistan and Uzbekistan resumed railway communication: on 21 June 2022, the first train arrived in Tashkent from Dushanbe (NIAT Khovar, 2022). On a bilateral basis, cooperation has intensified between Uzbekistan and Kazakhstan, Uzbekistan and Tajikistan in the area of hydropower generation and shared transboundary water resources (Gazeta.uz, 2021; 24.kg, 2022). This creates objective prerequisites for the CA countries to establish consortia for the construction of the Rogun HPP and the Kambarata HPP-1 and the implementation of other projects of regional importance. It should be noted that Russia and China have expressed their intent to take part in the projects, which improves the likelihood of cooperation between the countries to co-finance the development of the CA water and energy complex.

On 26 November 2021, President of the Republic of Kazakhstan K.K. Tokayev stressed the feasibility of creating an International Water and Energy Consortium. Improvement of the institutional and legal frameworks for cooperation among the CA countries in the water and energy sector has always remained on the agenda of negotiations between the Heads of State and Government in the region and is also a topic for consultations with international organisations (KazTAG, 2021).

Cooperation among the CA states within the EAEU has developed to a certain extent. Kazakhstan and Kyrgyzstan are full members, while Uzbekistan has had observer status in the EAEU since 11 December 2020. The high-level political dialogue has significantly altered the positions of the countries on economic cooperation and, despite some local border conflicts in 2020–2021, is aimed at further enhancement of the interaction.

Cooperation within the CA region can get additional stimuli for development through enhanced interaction among the countries within other regional alliances and initiatives, such as the EAEU and the concept of Greater Eurasia. The regional work does not rule out participation in other regional blocs, including the EAEU, the SCO, the CIS, the CSTO, the OEC, etc. Collaboration can rely on the concept of overlapping regionalism — i.e., interaction among regional integration projects, their complementarity and congruence. It means that one state can be simultaneously a member of several integration institutions (Mikhaylenko, Sukhrob, 2019).

Disagreements caused by objective national interests (the goals of achieving food and energy self-sufficiency) as well as differences in economic reforms and levels of development of the countries of the region, in the context of insufficiently effective interstate cooperation

arrangements, hinder the resolution of problems of joint management of water and energy resources and regional development.

The need for further integration in the water and energy sector of the CA states is determined by the following factors:

- growing demand of the CA economies for water and energy resources;
- the transboundary nature of the water use in the Syr Darya and Amu Darya river basins, increasing water scarcity, and degradation of water sources;
- lack of territorial and time uniformity in the formation and use of water and energy resources;
- interconnection of water and energy resources and imperfect interstate legal and economic frameworks for their development and regulation, lack of economic incentives for the states to improve the performance of facilities of interstate importance;
- high dependence of the economies on disposable water resources and their quality, risk of significant economic and social losses in the event of destabilisation of regulation, especially in low-water years;
- acceleration of the Aral Sea crisis and desertification of the territories;
- lack of financial resources for effective development of the hydropower potential of the Syr Darya and Amu Darya rivers by the upstream states, combined with prospects for expanded use of hydropower resources in the context of rising energy prices;
- negative consequences of global climate change and a need to develop measures for the economies to adjust to that;
- positive international experience of basin integration in addressing water, energy, and environmental problems.

The main objectives of integration and regional cooperation include ensuring a sustainable supply of drinking water for the population, as well as water and energy resources to sectors of the economy, based on effective functioning of the water and energy complex. It is essential to further improve the mechanism for water sharing, aligning it with the political, economic, financial, and environmental goals of each state.

Given the increasing scarcity of water and energy resources and strengthening regional cooperation in CA, there is a window of opportunity now for reformatting the architecture of relationships in the water and energy complex. Analysis of the evolution of various regulatory arrangements identifies several important principles for developing effective new solutions for regulation. Those principles include:

- Sovereign equality, territorial integrity, and mutual benefits of equitable use of water and energy resources in the region on the basis of international water law and international principles of integrated resources management for all member states.
- Ensuring an optimal mix of the irrigation and the energy regimes of operation of reservoir cascades, taking into account annual and long-term cycles of flow fluctuations and balances of water and energy resources. At the same time, the irrigation regime of operation of the CA water and energy complex is preferable from the point of view of economic feasibility (according to historical experience

and the findings of most studies). The critical aspects include optimisation of water use technologies (irrigation) in the states of the lower reaches of the Aral Sea basin (Kazakhstan, Turkmenistan, Uzbekistan) and addressing the issue of joint maintenance of waterworks in the upper reaches of the rivers (Kyrgyzstan and Tajikistan).

- A mechanism for meeting the energy needs of the states in the upper reaches of the Aral Sea basin (Kyrgyzstan and Tajikistan), among other things on the basis of contractual and market principles (development of the regional market, in particular an appropriate institutional environment and connective cross-border infrastructure) and coordinated investment policies aimed at creating an optimal regional mix of generating capacities and ensuring reliable access to energy (electricity, fuel and energy resources) through joint construction, upgrading, and operation of the necessary power generation infrastructure.

- Strengthening the existing and creating new interstate governing and executive bodies with appropriate status to perform their functions of coordinated and transparent regulation of the water and the energy regimes of the rivers on the basis of the basin principle; development and use of water and energy resources; regulation of regimes of interstate electricity cross-flows and energy supplies associated with the implementation of the agreed water and energy regime of the rivers in the CA region.

- An effective mechanism to create investment incentives and mobilise investment: security of property rights; investment protection; and, possibly, equitable distribution of incomes and costs related to joint operation of facilities (cf. the experience of the Senegal basin) to implement projects (including joint ones) to renovate existing and build new hydropower and water management facilities of interstate importance in order to develop and effectively use the water and energy potential of the region, taking into account environmental protection requirements.

- Creating conditions for industrial, technological, and scientific cooperation in the water and energy sectors, enhancement of their export potential and introduction of advanced technologies.

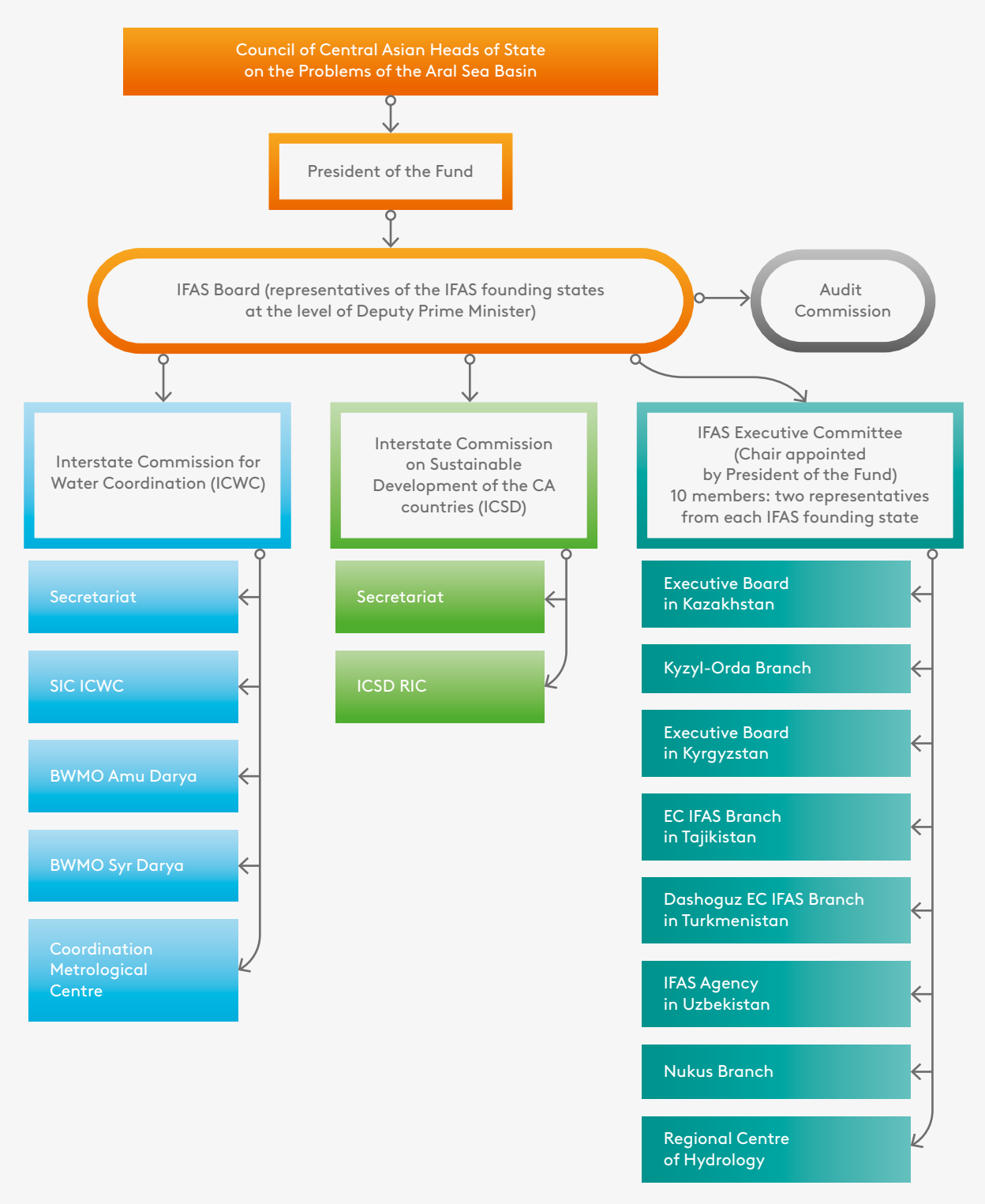
4.4 The International Fund for Saving the Aral Sea and Its Priorities in Addressing Water, Energy, and Environmental Problems and Enhancing Regional Cooperation

The main solution for upgrading the current regulatory framework for the CA water and energy complex is to reformat and enhance the activities of existing regional organisations. This applies primarily to IFAS, which has become the subject of criticism, in particular by Kyrgyzstan. With any regulatory decision, existing institutions will serve as a basis, but should meet modern challenges.

IFAS is the only regional organisation in which one of the Heads of State of Central Asia is elected President of the Fund. In December 2008, IFAS was granted observer status in the UN General Assembly.

We would like to point out that, in accordance with the Regulations on IFAS of 9 April 1999, the main objective of the Fund is to finance and lend to joint practical actions and long-term programmes and projects for saving the Aral Sea, ecological rehabilitation of the Aral Sea region and the Aral Sea basin in general, taking into account the interests of all states

↓ Figure 25. Current Organigram of IFAS



Source: IFAS

of the region. The Fund's objectives also include: creating and supporting the operation of an interstate environmental monitoring system, a data bank and other information systems on the state of the natural environment in the Aral Sea basin; mobilisation of funds for joint activities to protect the air basin, water and land resources, flora and fauna; financing joint research and technical projects and designs for the management of transboundary inland waters.

The institutional framework of IFAS includes — at the highest level — the Council of Central Asian Heads of State on Problems of the Aral Sea Basin, which deals with strategic areas

of activity of the Fund. Other main units of the Fund are the Board, whose members are appointed from among the Deputy Prime Ministers of the member countries, and the Executive Committee, a permanent body of the Fund.

The institutional framework of the Fund includes the ICWC, which, in accordance with its Regulations, is a regional body charged with ensuring joint solution of issues of management, sustainable use, and protection of water resources of interstate sources in the Aral Sea basin and implementing joint programmes. The executive bodies of the ICWC are: the Secretariat; BWMO Amu Darya; BWMO Syr Darya; the Water Management Research and Information Centre (RIC) with its national branches; the Coordination Metrological Centre (CMC) with its national organisations; the Training Centre (TC) with its branches; the Interstate Commission on Sustainable Development (ICSD), the units of which are also part of IFAS.

An analysis of IFAS activities in 1993–2021 shows that the work of the Fund and its institutions has to be improved to achieve its objectives, taking into account geopolitical developments and changes in regions adjacent to CA. At present, the interaction among the Fund's bodies themselves is weak that has a negative impact on regional cooperation. The reason is that the areas of activity and the competencies of the institutions are not sufficiently delineated and defined in legal terms. It can also be noted that their functions overlap and they duplicate one another's work.

Since the Regulations on these institutions are not considered and approved by the IFAS supreme bodies, they are not interlinked and are not aligned in important aspects with the overall strategy and policy of the Fund. The lack of interaction in planning the activities of regional organisations and dividing the responsibilities for the implementation of regional programmes and work plans, especially the Aral Sea Basin Programme (ASBP), among them should be seen as a serious flaw in the activities of the IFAS bodies. The ASBP is the main long-term programme of actions in the region. Instructions on its preparation and implementation are issued by the Heads of State of the CA countries. The EC IFAS is responsible for its implementation and control. However, there is no effective control over the implementation of the ASBP and its stages. In total, four ASBPs have been adopted since 1994, and the first three of them failed to achieve their goals. The new ASBP-4 for 2020–2030 was adopted on 29 June 2021, again with no delivery mechanism and responsibilities of national authorities for its implementation defined.

Moreover, each of the IFAS regional organisations has its own work programme, which is not linked either to the ASBP or to the programmes of other organisations and is not coordinated by the EC IFAS. The regional organisations do not submit their plans and programmes of work for review and approval by the IFAS governing bodies.

The practice of relocating the EC IFAS when a new President of the Fund is elected has an extremely negative impact on its activities. Since the President is elected every three years, the EC IFAS has to relocate with the same frequency. As a result, the EC IFAS is unable to quickly organise its work at a new location, recruit new employees in a timely manner, and, in fact, the real period of its operation does not exceed half of the time that it is based in a country. At present, President of the Republic of Tajikistan E.Sh. Rahmon is President of IFAS, and the EC IFAS is based in Dushanbe.

The international practice is that executive bodies are usually not expected to relocate on a rotational basis; they are based permanently in one of the countries that are parties to a given agreement. An example would be the Secretariat of the Mekong River Commission, based in Vientiane (Laos). The staff of the Secretariat comprises about 150 people. The Secretariat moved from one country to another twice, with almost disastrous consequences for the organisation, as this weakened its ability to carry out administrative and technical functions related to implementing the projects covered by the Commission's programme. That resulted in a sharp decrease in donor assistance. Therefore,

the member countries of the Commission (Cambodia, Laos, Thailand, and Vietnam) decided to discontinue the practice of the Secretariat's relocation on a rotational basis and to establish it permanently in one country.

In accordance with the decision taken at the meeting of the Heads of State of Central Asia on 27 February 1997 in Almaty, each of the IFAS member countries has undertaken to pay, starting in 1998, an annual membership fee in US dollars at the exchange rate to the national currencies. The amount of the contribution was determined based on budget revenues: for Kazakhstan, Turkmenistan, and Uzbekistan — 0.3%, and for Kyrgyzstan and Tajikistan — 0.1%. The decision has never been fully implemented. First, each country allocates less than its expected contribution to the IFAS budget. Second, each country usually dedicates part of the IFAS membership fee to fund its national IFAS branch in its national currency for domestic projects. The countries do not make regular contributions in convertible currency to the IFAS general budget, which is intended to finance the EC IFAS and the implementation of regional projects. The EC IFAS is funded by the country of its location. As a result, the EC IFAS does not have funds for the implementation of regional projects, which, therefore, are almost entirely financed by international organisations and donors, making the implementation of the ASBP and other projects dependent on external support. This means that they fundamentally cannot be implemented.

The key IFAS organisation is the ICWC. However, this interdepartmental body, consisting of the heads of the water management agencies of the CA countries, does not have sufficient powers to ensure that ministries and agencies of the member countries implement its decisions on regulation of the flow regime in the Amu Darya and Syr Darya basins. The ICWC does not have mechanisms for resolving disagreements in cases where countries do not comply with their obligations related to the use of water and energy resources. The ICWC does not represent the interests of the key energy sector or those of the environmental protection bodies, hydrometeorological services, and local administrations. The mandates of its executive bodies — BWMO Amu Darya and BWMO Syr Darya — extend only to the middle and lower reaches of the Amu Darya River and the middle reaches of the Syr Darya River, respectively. In this regard, it is difficult for the ICWC to take any action to introduce IWRM within the transboundary river basins in the region.

It is important to emphasize that the resolution of water use problems in the transboundary river basins largely depends on national actions to manage water resources. Low efficiency at the national and basin levels is one of the main reasons for the lack of harmonised approaches to sharing transboundary waters and insufficient interaction in this area among the countries of the region.

The water shortage faced by the CA countries is largely attributable to the poor organisation of water use in agriculture and manufacturing, the poor state of water management facilities, and the insufficient funding for their maintenance and development. The transition to water conservation has not yet received proper organisational, technological, and methodological support. Moreover, the countries of the region do not have specific laws on water conservation, which should define policy principles and mechanisms for efficient water use. The provisions on water conservation available in the water legislation are declarative in nature and are not supported by an implementation mechanism. No proper legal environment has been created to engage water users in control over efficient water use and water quality protection.

IFAS should address the system-wide problems faced by the water management complex of the CA states, including:

- the poor state of the household drinking water supply;
- the poor condition of irrigation infrastructure, large losses of water in irrigation systems;

- imperfect legislative, legal, regulatory, methodological, organisational, economic, technical, technological, and information support;

- low efficiency of the agricultural water and irrigation complex management;

- a shortage of qualified research and production personnel in the water management complex.

In the new, changed circumstances, it is advisable to consider the role of IFAS as a political platform for economic integration of the CA countries on the basis of their common interests. Over its 30 years of activity, IFAS has created a sufficient legal framework and basic institutions for managing transboundary resources: the ICWC, BWMO Syr Darya, and BWMO Amu Darya. It seems necessary to ensure interaction among these bodies under the auspices of IFAS, engaging the Coordination Council of the CDC Energy in the efforts. There are political opportunities for that: IFAS is headed by one of the CA Heads of State, and the Council of Central Asian Heads of State on the Problems of the Aral Sea Basin is functioning.

Engagement of the countries of the region in water and energy integration efforts should be seen as a vital condition for development of their national economies. The process of water and energy integration — specifically through unification of their energy systems and compliance with the design rules for the operation of regulation reservoirs — will be an important step in addressing crises in the fuel and energy sectors of the region, primarily in hydropower generation and optimising the operation of reservoirs.

In a joint statement issued following the meeting of the Council of Heads of State on the Problems of the Aral Sea Basin, held on 28 April 2009 in Almaty, the parties expressed "readiness to further improve the institutional and legal frameworks for IFAS". In pursuance of that decision, the EC IFAS, relying on the support provided by the UNECE and German Agency for International Cooperation (GTZ), engaged international experts and specialists from the region to prepare a Discussion Paper, "Strengthening the Institutional and Legal Frameworks of the IFAS: Review and Proposals" (31 January 2010). In February 2010, the paper was presented to the Governments of the CA countries (GTZ, 2010).

The paper presents various approaches to improving the institutional framework of IFAS and its bodies, highlighting the advisability of consistent and phased enhancement of existing mechanism of regional cooperation. It is proposed to address the following issues:

- clarification and delineation of responsibilities of the IFAS central bodies and the regional commissions — the ICWC and the ICSD;

- clarification of mandates and competencies for each regional body and regional commission;

- enhancement of the coordinating role of the IFAS central bodies — the Board and the Executive Committee — and establishment of procedures for reporting and interaction between them and the regional commissions;

- cooperation between the ICWC and the ICSD;

- improved distribution of locations of regional bodies and their units among member countries;

- introduction of the international rotation of Heads of regional bodies and their units;

- implementation of IWRM by engaging the energy and environment sectors in regional cooperation;
- internationalisation of the staff (professional employees) of the secretariats of regional bodies, research and training centres, and other regional and basin institutions;
- streamlining coordination and collaboration among ministries and agencies involved in cooperation in the framework of IFAS in each member state;
- streamlining the funding for maintenance and operational activities of the entire IFAS system from national sources;
- improved coordination with international organisations and donors;
- improved transparency in the allocation and use of assistance provided by the international community.

Improvements of the legal regulation of water, energy, and environmental relations under the auspices of IFAS should be implemented at the regional, basin, national, and bilateral levels of cooperation among the CA states and meet IWRM requirements.

While supporting the main provisions of the document in general, we should note the relevance of creating a national IFAS committee in each country to improve the interaction among all ministries, agencies, and other organisations engaged in IFAS activities. The National Committees should include representatives of the Ministries of Foreign Affairs, Justice, Social and Economic Development, Water Management and Environmental Agencies, Ministries of Energy and Emergency Situations, and other organisations. National branches of the EC IFAS should assume the functions of Secretariats to the National Committees. The frequency of their meetings should be at least the same as that of IFAS Board meetings. The National Committees should be headed by the Deputy Prime Minister representing the country on the IFAS Board. The main objectives of the National Committees include:

- developing an agreed national position on engagement in IFAS activities;
- coordinating the participation of national ministries and agencies in IFAS work;
- making arrangements for the implementation of decisions of IFAS governing bodies at the national level.

Addressing these problems is an important area of the strategic programmes and development plans of the CA countries and should be seen as a national contribution to strengthening cooperation in the transboundary river basins. Therefore, further improvement of basin management of water resources at the national and basin levels is of particular importance.

Strengthening regional basin organisations in the most appropriate form, especially international commissions, management departments, and other transboundary basin associations, facilitates the dialogue, cooperation, information exchange, joint projects and actions to share benefits, predict the future, and prevent potential conflicts among stakeholders. Basin organisations should coordinate comprehensive water resources management activities involving relevant sectors and agencies at the national and regional levels. They should have sufficient powers to solve the problems of sustainable use and protection of water resources (Yasinsky et al., 2013).

One of the main areas of IFAS activities should be holding regular high-level meetings of the Council of Central Asian Heads of State on the problems of the Aral Sea basin, environment, and water resources of the region in order to:

- further improve the activities of IFAS and its institutions;
- coordinate the implementation of multilateral agreements or other arrangements related to the use of water resources and environmental protection in a transboundary context.

The EC IFAS should be more active in implementing its Secretariat functions of convening and preparing high-level meetings.

Recognising the SDGs approved by the UN for 2016–2030, which are laid out in the 2030 Agenda for Sustainable Development (UN Summit, New York, 2015), as well as the objectives of the International Decade for Action on Water for Sustainable Development (2018–2028), IFAS should take an active part in holding these events, harmonised with the ASBP-4 and aimed at:

- integrated management of transboundary water resources;
- development of techniques for efficient and sustainable use of water and land resources in economic sectors;
- promotion of the transition to efficient water-saving techniques in irrigated agriculture;
- ensuring access of the population to quality drinking water;
- improvement of the activities of BWMO Syr Darya and BWMO Amu Darya.

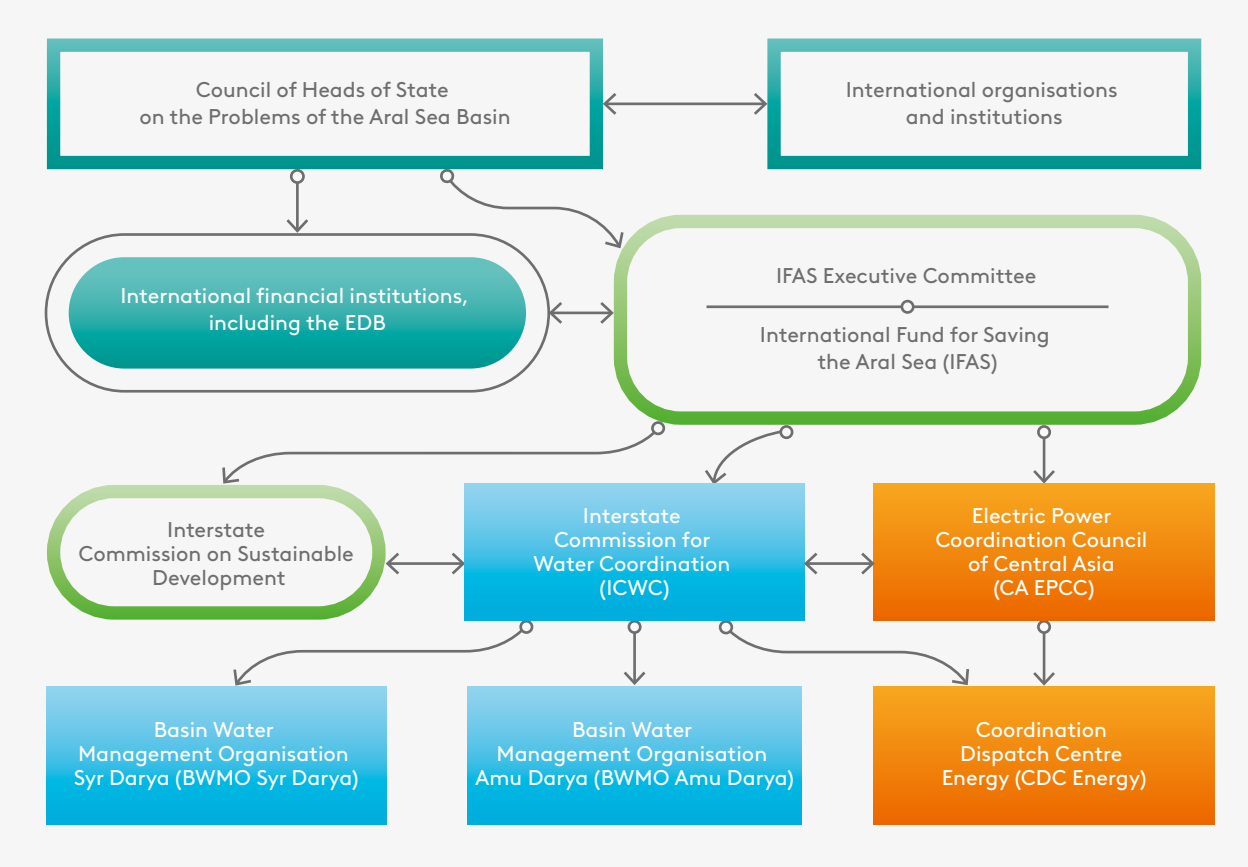
Interstate water relations in CA require further improvement of the legislative framework to eliminate the current shortcomings in the activities of the regional institutions managing transboundary water resources.

Additional arrangements are needed to supplement and extend the Agreement of 18 February 1992 with new legal provisions. This applies to generally accepted principles and conceptual frameworks for water management, such as reasonable and equitable use of transboundary waters; the principle of preventive measures; "the polluter pays" principle; the ecosystem approach; the basin management principle; etc. The procedures for notification and consultation when planning activities likely to cause transboundary impact should also be regulated. Moreover, the Agreement does not include provisions on access to information on the state of water resources and on the role of the public in decision-making regarding their use. The institutional framework for cooperation and procedures for resolving potential disagreements are poorly defined. It is necessary to include provisions on the organisation of monitoring, the functioning of a warning system for natural disasters and emergency situations, the protection of aquatic ecosystems and biological resources, etc.

It seems that the system of legal regulation of water relations in the region should have several levels:

- regional — engaging all states of the Aral Sea basin and regulating the basic principles of cooperation, common obligations, and common institutional frameworks;
- basin — engaging the states of the multinational transboundary watercourse basin and regulating specific rules, procedures, and organisational frameworks;

↓ Figure 26. IFAS Institutional Framework with Participation of International Financial Institutions



Source: EDB

- national — engaging the ministries and agencies involved in IFAS activities;
- bilateral — regulating, as needed, specific issues of cooperation on certain watercourses of interest to two states.

Taking into account the nexus factor of various economic activities and their environmental impact, as well as the extreme sensitivity of the river ecosystems of the Aral Sea basin to economic activity and climate change, the solution of problems of interstate water use depends on strengthening the cooperation among the CA countries. Therefore, IFAS is invited to:

- ensure enhanced cooperation with the EAEU, the EU, UNDP, UNEP, UNESCO, UNECE, ESCAP, UNICEF, SPECA, OECD, and other international organisations, institutions, and programmes;
- establish an early warning system (or a warning system for emergency situations resulting from accidents on transboundary rivers or transboundary territories) when accidental pollution creates threats to the water use, the population, and economic activities in the border areas;
- support consultations on proposed activities that are likely to have a significant adverse transboundary impact and, to this end, provide timely notifications of planned activities in a transboundary river basin;
- improve the training and retraining of specialists in design, informatisation, monitoring, and assessment of water resources in the region.

The implementation of national and regional water management programmes and projects requires sustained investment, but the countries of the region do not have sufficient

financial and physical resources to address such problems in the water sector and water resources management.

Water management and hydropower projects are among the world's most capital-intensive. Regional programmes and projects, including the ASBPs as well as national programmes, have not been properly implemented due to lack of sufficient funding and access to international sources of financing. Numerous attempts to create an effective arrangement for regional water use have been made, not only for the benefit of interstate allocation of water resources, but also to solve problems of financial support for the functioning of water management facilities.

In this regard, IFIs, including the EDB, could act as financial agents to raise funds for programmes and projects that will enhance the water sector of the CA countries, and to participate in the financing of national and transboundary water and energy infrastructure projects. The EDB could take part in coordinated research of the SIC ICWC and CDC Energy in Tashkent, using, for example, its technical assistance instruments. Such cooperation could later be transformed into an International Research Centre of the Water and Energy Complex of Central Asia. Thus, the Bank would be able to directly participate in the design of a joint vision and strategic planning for the CA water and energy complex. The interrelated issues of ensuring water, energy, food, and environmental security in the Aral Sea basin going forward can be resolved only on the basis of common and coordinated policies.

4.5 The International Water and Energy Consortium of Central Asia

Reformatting the system of regulation of the CA water and energy complex — in the development of the solution proposed above — can be based on a new dedicated institution — the International Water and Energy Consortium of Central Asia. This institution could assume the key function of seeking and securing financing for the implementation of national and transboundary infrastructure projects in the CA water and energy sectors and can be created under the auspices of IFAS.

According to definition a **consortium** (from Latin *consortium* — participation, society) is a temporary association (agreement) of independent enterprises created to implement projects, including for investment, research and development, nature conservation, etc. (Barikhin, 2010). A consortium is created on a voluntary basis as an agreement between different countries, firms, organisations, banks, or private individuals, who maintain their financial and economic independence. Each member of a consortium contributes its share of investment or performs its part of the work to jointly achieve the goals and targets set within the framework of large-scale projects, tenders, financial investments, loans, and credits. A consortium may cease to exist once the joint project is completed. If it operates for a long time, a consortium can be transformed into a more complex integrated macro arrangement.

The specific features of a consortium include:

- registration of the establishment of a consortium by agreement;
- options of creating a consortium either as a legal entity or not;
- lack of an institutional framework, other than a small staff (for example, Consortium Board of Directors);

- fully maintained economic and legal independence of enterprises, companies, etc. that are part of the consortium, except for activities related to achieving the goals of the consortium;

- joining efforts to implement a specific project, usually in the core activities of consortium members;

- implementation of science- and capital-intensive projects, including international ones;

- ability of enterprises, organisations, and companies to simultaneously join several consortia to participate in several projects;

- coordination of activities based on a long-term development strategy and common investment policy.

A consortium is a form of integration of economic entities that benefits from almost all the advantages available to companies with a legal liability. In particular, it is able to effectively mobilise investment for major hydropower, irrigation, and other projects (Guerrero, 2021). A distinctive feature of this form of integration is its internationalisation, especially in the areas of finance and construction. Modern consortia tend to have international representation. Governments and private enterprises often cooperate within the framework of a consortium, taking part, for example, in developing standards for production, consumer safety, etc., acting as the customer and the beneficiary of those and other services.

Improvement of the institutional and legal frameworks for cooperation among the CA countries in the water and energy sector has always been on the agenda of negotiations among Heads of State and Government in the region and is also a topic for consultations with international organisations. For instance, on 26 November 2021, President of the Republic of Kazakhstan K.K. Tokayev stressed the feasibility of creating an International Water and Energy Consortium.

The proposed approach is based on the economic interests of the parties in joint implementation of new water and energy projects and the operation of existing facilities, as well as enhancement of regional and national water and energy infrastructure. The Water and Energy Consortium should also rely on the redesigned existing framework: IFAS, the ICWC, BWMO Amu Darya, BWMO Syr Darya, CDC Energy, etc.

The International Water and Energy Consortium of Central Asia may take the shape of a legal entity established by an international treaty, which should define the legal status, starting conditions, conditions of establishment, size of the authorised capital, and location of the Consortium, as well as other terms and conditions for its creation. Each member state determines the founders of the Consortium in the international treaty. The contributions to the authorised fund of the Consortium are determined by its charter as agreed by the parties depending on the project(s) being implemented (Dukhovny et al., 2005).

The Consortium is managed by a Council (supervisory body) of authorised representatives of the member states formed on the basis of the principle of equal representation of the parties. When decisions are adopted, all sides have an equal number of votes. Decisions are made with the full consent of the parties.

Interstate cooperation in the format of a Water and Energy Consortium should be based on the following main provisions:

- common interests of the member states in cooperation on the basis of sovereign equality, territorial integrity, and mutual benefits of equitable use of water and energy

resources, and expanding cooperation in this area with other countries concerned and international organisations;

- the right to use agreed water withdrawal quotas within the territorial boundaries in accordance with provisions of national legislation;
- reasonable restriction of any activities violating environmental legislation;
- no harm to neighbouring states in the development and use of water and energy resources;
- implementation of the principle of equitable use of water resources and mutual benefits;
- implementation of the principle of the optimal mix of the irrigation and the energy regimes of the water resources regulation, taking into account the satisfaction of energy needs by market mechanisms;
- stakeholder sharing of the costs of economic, environmental, and other activities of interstate importance;
- peaceful settlement of interstate disputes concerning water and energy problems on the basis of agreed procedures.

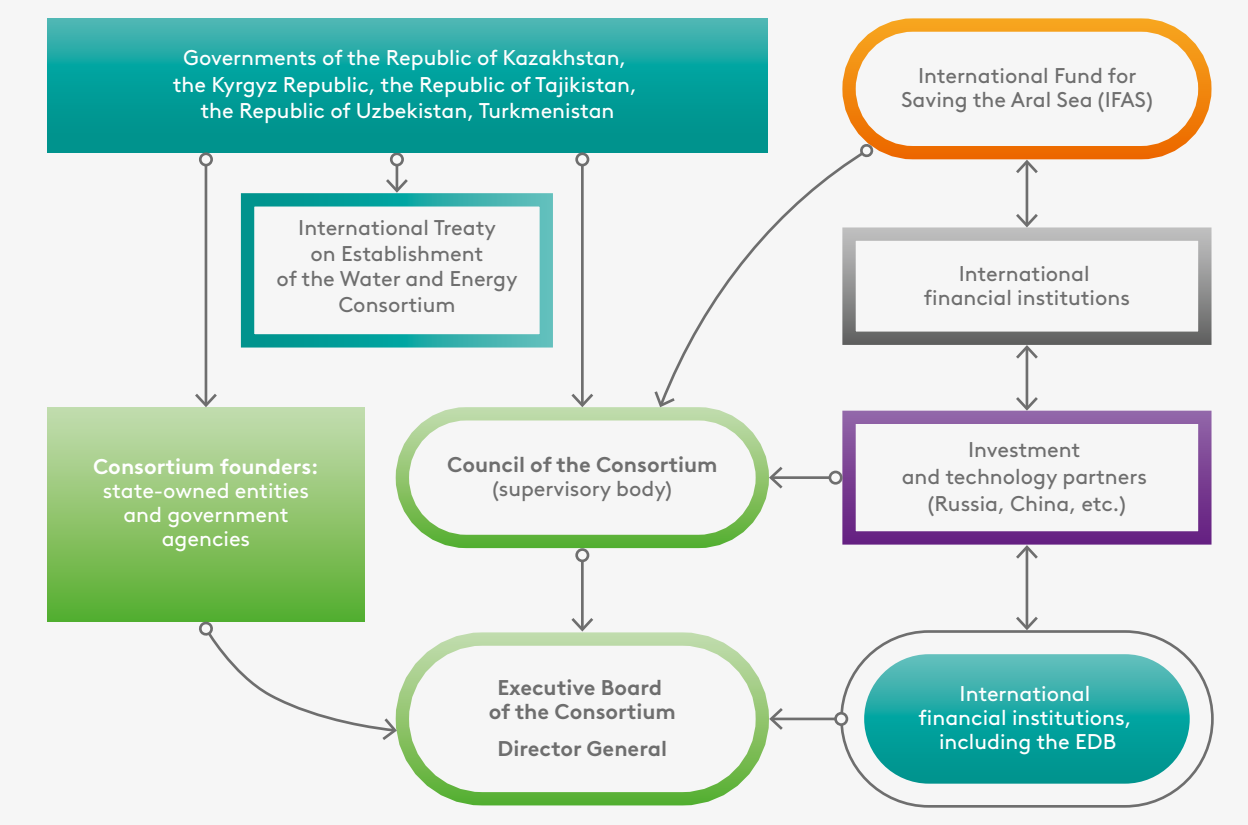
The main goals of the Water and Energy Consortium should be a joint implementation of major investment projects in the water sector, aimed at optimising the use of water resources (including through the upgrading of the irrigation infrastructure and introduction of modern irrigation techniques), and in the electric power industry in order to form a reliable regional mix of generating capacities (including through the diversification of energy sources, helping ensure the energy security of all participants) and ensure appropriate transboundary energy cross-flows in CA;

The Consortium Council and its executive body (Board) should include representatives of the founding countries and heads of the national institutions whose mandates cover the management of water and energy resources.

The financial operator of the Consortium could be an IFI — for example the EDB — whose activities will be determined by a special agreement with the Consortium. The modalities of the financial operator's engagement in the CA water and energy complex activities may include:

- provision of long-term loans, including project-related ones (and under government guarantees), to finance the construction of power generation and water management facilities;
- investment through the issue of bonds (green bonds in the power industry and their derivative «water bonds« in the water sector to finance the construction and upgrading of water pipelines and sewers), as well as acquisition of shares in facilities under construction;
- creation of joint ventures for the construction and operation of facilities with resources potentially mobilised from IFIs, international donors, and private investors;
- organisation of syndicated financing to pool financial resources from international donors and potentially mobilise additional external and domestic financial resources of the private sector;

↓ Figure 27. Proposed Institutional Framework for the International Water and Energy Consortium of Central Asia. Option of an International Organisation's Creation



Note: the diagram shows the functional interaction of IFAS with the Consortium (not reflecting the hierarchy). IFAS remains subordinate to the Council of Heads of State.
Source: EDB

- trade finance aimed at ensuring timely mutual settlements of the Consortium members for the supply of electricity, fuel and energy resources, payments for water management services, purchases of necessary power generation equipment, etc. The Consortium can streamline the system of payments and cash flows among the CA states and thereby ensure sustainable functioning of the CA water and energy complex;

- provision of financial, technical, and advisory assistance in the preparation of feasibility studies for construction of facilities and enhancement of research potential in the area of management of water and energy resources in CA.

The cooperation arrangement assumes two levels of financing of the water and energy infrastructure. The first level includes regional regulators (facilities of UDC Energy, BWMO Syr Darya, and BWMO Amu Darya), which should be financed partially by the states themselves and partly through fees for the activities they regulate. At the second level, public investment in the electric power industry can be supplemented by investment funded by IFIs and private capital.

Therefore, the agenda of the water and energy complex associated with planning and regulating the transboundary water use should be addressed jointly by the ICWC, CA EPCC, regional basin organisations, and CDC Energy, in cooperation with the national water and energy authorities of the CA countries.

Taking into account the international experience of creating consortia and the specifics of their mandates, it seems appropriate for the CA countries to establish, at the first stage, a water and energy consortium to focus primarily on financing projects related to the construction and rehabilitation of hydropower, irrigation, hydro-protective, and other facilities of regional importance and, as a rule, of high cost.

It is common international practice to establish consortia servicing large hydropower and irrigation projects. For example, a consortium of development finance institutions and commercial lenders has completed the refinancing of more than USD 400 million in loans to Bujagali Energy Limited (BEL), owner of the 250MW Bujagali hydropower project in Uganda. The financing organisations include the IFC, a member of the World Bank Group; the African Development Bank; the Netherlands Development Finance Company (FMO); France's Proparco; Germany's DEG; the UK's CDC; and two commercial banks — ABSA and Nedbank. The refinancing package extended the maturity of most of the loans originally provided in 2007. Bujagali, an HPP on the Victoria Nile River, is one of the largest power plants in Uganda, contributing 45% of the country's annual electricity generation. Alongside the original financing for BEL, the African Development Bank financed a transmission line project to link the HPP to the national electric grid (Water Power & Dam Construction, 2018).

However, the creation of a water and energy consortium to encompass the water and energy complex of an entire region is a difficult task and is unparalleled anywhere in the world. First of all, regulating the operation of international consortia is not covered by the national legislation of the CA states. Another obstacle to the creation of a consortium is that the CA water and energy complex consists of national hydropower and irrigation facilities, with the exclusive and sovereign right to own and manage them reserved by the relevant CA states.

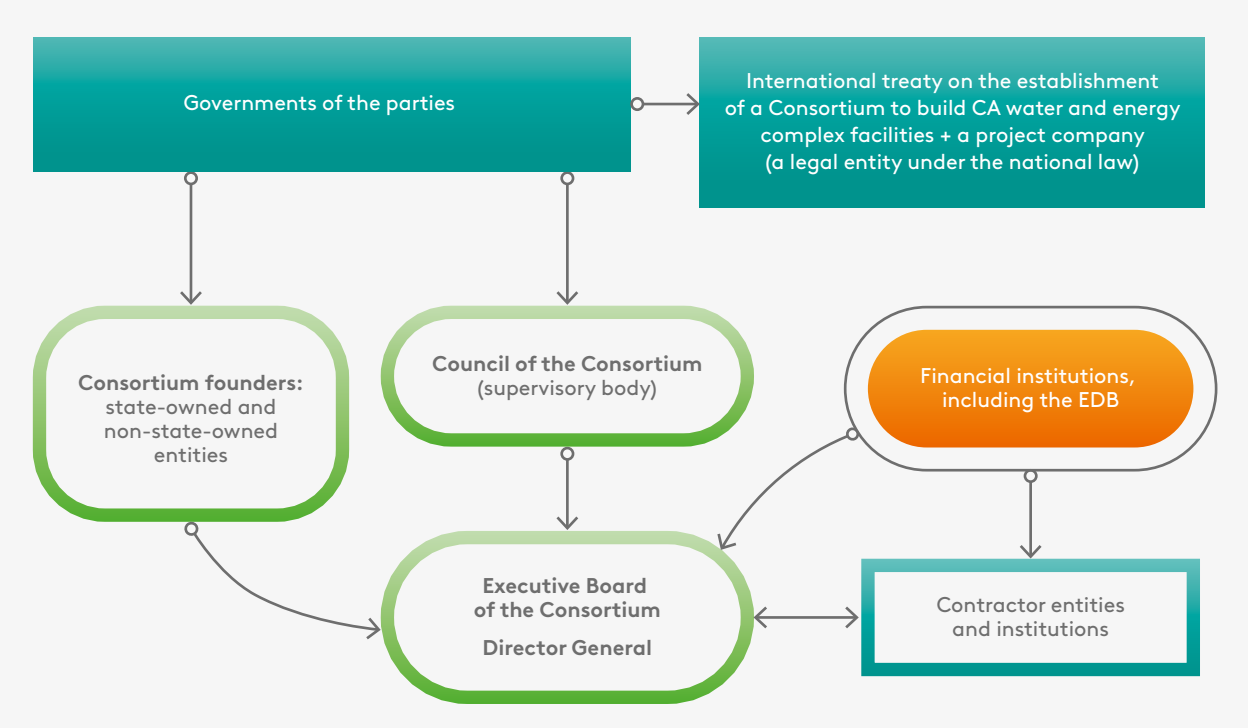
Therefore, it should be noted that a consortium can also be established by its members in a simplified, project-based form, separately for each major facility of the CA water and energy complex (for example, an HPP) using the BOT (build — operate — transfer) or BOOT (build — own — operate — transfer) model and based on the principles of project financing (Yeskomb, 2019). The main features of those models include the following:

- Project investment and implementation are planned and financed directly or indirectly by a consortium — often a private consortium, usually operating through a project company;
- Private sector participation is possible;
- Financing is based only on the risks of the project itself and its cash flow;
- The consortium is responsible for project management and support over a specified period of time, based on a concession granted by the host Government;
- The investment is recouped by selling the products of the facility constructed; returns are usually guaranteed based either on agreed tariff formulas or on long-term off-take agreements;
- At the end of the concession period, the facility is transferred to the host Government, which becomes responsible for its operation.

The BOT model is widely used for a whole cluster of methods for private financing of public infrastructure projects, including:

- BOO (build — operate — own): the facility is owned by the consortium;
- BOOM (build — operate — own — maintain): the maintenance function and responsibility are added;
- BOTT (build — operate — transfer — training);
- ROT (rehabilitate — operate — transfer): an existing facility is rehabilitated, operated, and then transferred; and ROL (rehabilitate — operate — leasing): an existing facility is

↓ Figure 28. Institutional Framework for Consortium Based on the BOT Model



Source: EDB.

rehabilitated, operated, and leased out by the consortium for the period of cooperation for operation and maintenance.

To prepare for the operation of a consortium under those arrangements, there should be a number of agreements executed by the parties, including the Government(s). The key ones (for example, for the construction of an HPP) are:

- a design-and-build contract with a contractor;
- an agreement for electricity purchase;
- an operation-and-maintenance contract with facility operators;
- a land sales contract with the Government or regional/district authorities;
- a loan agreement with banking institutions;
- an agreement on implementation of activities; and an insurance contract and other legal acts covering all the issues of the consortium for the entire period of its operation.

It is important for lenders to address the issues of state support before they commit to providing project financing. At the same time, a concession agreement between the parties, which provides the regulatory framework and guarantees, should include clauses that give the sponsoring consortium the right to build and enjoy relevant benefits from exercising its rights. Project financing under the above arrangements usually consists of 75% debt and 25% equity. The sources of financing of an HPP project would include export credits if the electricity is exported, medium-term loans syndicated by a group of commercial banks from different countries, or debt obligations and shares issued on capital markets. Export credits are usually long-term and guaranteed by the Government of the state that supplies goods and services for the HPP project. Loans would be primarily used to service the debt, in order to ensure that the project is able to withstand relevant risks.

The long implementation period for HPP projects means, on the one hand, that the projects would have a full range of risks and, on the other hand, that the project company would need time to recoup investment and achieve acceptable returns. It also takes time and planning to share risks and create a financial framework to manage them.

There would be significant benefits and advantages generated if any of the above types of international water and energy consortium were used — either in the form of an international organisation operating on a permanent basis, or in one of the forms of a project consortium created for a specific large investment project.

4.6 Benefits and Advantages of Cooperation and Investment Policy Coordination

Improving the efficiency of regulation of the CA water and energy complex through its modernisation and enhancement of existing frameworks would first of all facilitate an optimal regime for the use of water and energy resources in the Aral Sea basin, while respecting the interests of the upper and lower reaches of the Amu Darya and Syr Darya river basins. Coordinated investment policies would play an important role in that. From the perspective of the CA region as a whole, the implementation of such policies would help:

- to optimise the composition of required investments, avoid overinvestment — for example, in the power generation sector to build additional generating capacities — and to redistribute the savings to other important areas within the CA water and energy complex;
- to address the problem of water shortage and achieve significant positive effects on sectors related to the CA water and energy complex, for example, agriculture, thereby improving food security in the region, etc.;
- to reduce the region's compliance and environmental recovery costs;
- to reduce the carbon footprint by 5 million tons of CO_2 by building new, advanced HPPs, which, according to EDB estimates, would cover up to 16% of electricity demand by 2035;
- to enhance the investment attractiveness of building new HPPs through green economy tools — green certificates; and ultimately to reduce the total costs of building infrastructure facilities and maintaining affordable electricity and water tariffs, taking into account all the potential beneficial effects on power generation, water resources, agriculture, food security, and the environment.

For example, stronger coordination of investment policies among the CA countries in the energy sector will facilitate resumption of full—scale parallel operation of the CAPS and the power system of Tajikistan and Turkmenistan. Intensified cooperation and greater electricity flows among the countries would promote expansion of regulatory and reserve capacities in the electric power system, reduce the need for new capacities, enhance the reliability of the CAPS (an arrangement for implementing bilateral agreements under the Intergovernmental Agreement on Parallel Operation of Power Systems), and lay the groundwork for launching a regional electricity market.

Owing to synchronised construction of generating capacities and joint planning for development of the CAPS electric grid complex, the need for new capacities would also decrease. Regional cooperation would open up opportunities for all countries in the region to select the composition of capacities and investment projects based on minimising the total cost of electricity for CAPS customers. As a result, instead of USD 44 billion in investment currently planned in national policy documents to build an additional 34.7

GW of generating capacities (net of replacement of decommissioned facilities), only USD 33 billion may be needed in the period until 2035 (saving USD 11 billion). According to EDB estimates, to meet the growing demand for electricity, the CA region would be able to do with 75 GW in 2035, taking into account the stand-by capacity, instead of the planned total capacity of 84 GW.

The savings could be used to develop the electric grid infrastructure and the land reclamation complex. This would generate additional effects for agriculture and improve water availability for the population and, thus, the quality of life. The savings would also affect tariffs. With coordination and cooperation, the average consumer tariff would increase by about 35%, against 50% under the scenario of individual government programmes. Maintaining and developing the joint operation of the power systems within the region and establishing a common electricity market would be instrumental in ensuring optimal utilisation of generating capacities, expanding the share of renewable energy, and maintaining an adequate level of reliability of power supplies to consumers.

Another example of mutually beneficial cooperation is the joint construction of regionally important HPPs in Kyrgyzstan and Tajikistan (Kambarata-1 HPP, Rogun HPP) in cooperation with stakeholder countries (Kazakhstan, Uzbekistan, Turkmenistan). It will help address the most pressing issues of regulating the flow of major rivers. If the Kambarata-1 HPP project is implemented, in addition to greater electricity generation, we can expect the Toktogul Reservoir, which operates as a compensating reservoir, to switch to the energy-and-irrigation regime. As a result, according to EDB estimates, water availability in the Syr Darya river basin will increase, and the water shortage will decrease by about 1.2 km^3. That transition would also promote lower agricultural losses in the Syr Darya river basin, declining by a factor of 1.7. In case of water shortage, the losses of the value of agricultural products would amount to about USD 0.36 billion per year under the energy-and-irrigation regime, while under the current (energy) regime, they would amount to USD 0.61 billion.

In turn, the design of new investment project financing arrangements using various forms of consortia with international financial organisations will be a way to implement the regional investment policy in the CA energy and water sectors, offering the advantages of combining syndicated financing and joint financing with private capital for major public infrastructure projects. Potential new forms for financing major projects in the CA water and energy complex would contribute to pooling the resources of several participants, accumulating a large amount of cash, and sharing the credit risk among all parties to the deal. A syndicated loan is usually a flexible financial instrument with widely variable parameters. Compared to other debt financing instruments, such a loan would generally have many advantages and very few disadvantages for both the borrowing company and the managing bank.

An important advantage of joint implementation of major infrastructure projects, including with the participation of private investors, is that it gives a real opportunity to optimise the design, construction, modernisation, and operation costs of a facility (a set of facilities, an infrastructure network, etc.) and a potential opportunity to reduce total project costs, including costs to the government. If the designer and the developer have a financial interest in an infrastructure project throughout the entire period of its implementation, they are motivated to more carefully take into account and develop the design features of the facilities, optimising the proposed technical solutions and their economic support, to reduce the integral long-term facility operation costs.

The financial advantages of options for joint financing are particularly prominent when several HPP projects are implemented in parallel. This approach is quite common and economically feasible when developing the hydropotential of a river basin through the construction of a cascade of HPPs on one river or when implementing a cluster approach, aimed at building several HPPs within one river system. A consortium saves money through economies of scale and synergies of costs and time at all development and construction stages.

4.7 A Common Energy Market of Central Asia

The adoption of a new arrangement for joint regulation of the CA water and energy complex can lay the foundation for enhancing economic, trade, and investment cooperation in the region. By providing a legal framework for cooperation at the regional level and incentives for combined efforts, the new approaches to the regulation of the CA water and energy complex may substantially simplify and accelerate the formation of the EAEU Integrated Energy Market (IEM) in the CA region, which includes two EAEU member states — Kazakhstan and Kyrgyzstan.

By 1 January 2025, it is planned to launch common markets for electricity, gas, oil, and petroleum products in the EAEU member states. The EAEU energy markets are designed to ensure and improve the availability of energy resources at market prices in the Union member states. The legal framework for common energy markets is based on the Treaty on Establishment of the EAEU, concept documents, programmes, and action plans for the formation of common markets. The creation of the electric power market is enshrined in Article 81, the gas market in Article 83, and the oil and petroleum product market in Article 84 of the Treaty on Establishment of the EAEU (EEC, 2014). Third countries will be able to participate in the common energy markets. Two of the five CA countries are already members of the EAEU, and the others will also have an opportunity to freely participate in the common energy markets in the near future.

At present, the EAEU does not have supranational rules for electricity trade; thus, the cross-border electricity trade is carried out under long-term bilateral agreements. The EAEU IEM will be based on international practice. The target model of the EAEU IEM will be the Central American electricity market SIEPAC. The EAEU IEM will be created as a supranational market, taking into account and preserving the specifics of national markets. The launch of the EAEU IEM is expected to generate the following effects (EEC, 2018):

- improved economic efficiency and more reliable functioning of the electric power complexes of the EAEU countries;
- effective use of the potential of the fuel and energy complexes;
- enhanced electricity export potential;
- improved energy security;
- reduced share of electricity costs in the cost of final products, etc.

To make the EAEU IEM fully operational, it will be necessary to create the relevant energy service infrastructure for the transmission of electricity between the Union member countries.

To this end, the Russian Federation is already initiating a number of investment projects for the comprehensive development of EAEU electric power infrastructure. Notably there has been an initiative to build an advanced power transmission line connecting the unified electricity system of Siberia and the power system of Kyrgyzstan through the territory of the Republic of Kazakhstan (CIS Internet Portal, 2022). If implemented, the project would lift the transit capacity constraints along the North-South route within the unified energy system of Kazakhstan, improve power exchange between the unified electricity system of the Russian Federation and the CAPS to eliminate local power shortages, ensure more efficient seasonal regulation of HPPs within the CAPS, as well as enhance the reliability of electricity supply to CAPS consumers, including in southern areas of Kazakhstan.

Major players in the Russian electric power market are engaged in regional integration activities. For instance, since January 2022, the System Operator of the Unified Energy System of the Russian Federation (UES SO) has participated in the work of the CA EPCC as an observer. The UES SO contributes to drafting documents on the development of the electric power industry, initiates proposals on the intensification of cooperation, provides information and methodological support to the CAPS component systems, and shares its experience in managing the electric power regime of the UES of the Russian Federation and ensuring its parallel operation with the CA power systems. In May 2022, a delegation of the UES SO participated in the 37th meeting of the CA EPCC held in Kyrgyzstan. At that event, it was decided to convene a separate meeting of the CA EPCC Coordination Commission and review in detail the additional proposals of the UES SO for cooperation with CDC Energy and the CA EPCC members (UES SO, 2022).

In order to deepen mutually beneficial cooperation in the joint operation of electric power systems, Russia is considering the option of the UES SO participating in the CA EPCC as a full member. It is proposed to consider the accession of Russia to the Agreement between the Government of the Republic of Kazakhstan, the Government of the Kyrgyz Republic, the Government of the Republic of Tajikistan, and the Government of the Republic of Uzbekistan on Parallel Operation of Power Systems of the Central Asian States, dated 17 June 1999.

If it obtains the status of a full member, Russia will be able to participate in the work of the CA EPCC in promising areas of power system development and interstate power connections. That status entails participation in the approval of regulations and technical documents concerning the parallel operation of the CAPS, including when it interacts with other power systems, as well as in making decisions on the future goals and targets of CDC Energy — including the modernisation and development of automatic dispatcher control systems, operator- and process-enabled control systems, research and feasibility studies on projects of common interest to improve the emergency and routine management of power systems.

At the same time, with the support of USAID, a similar Central Asia Regional Electricity Market (CAREM) project (USAID, 2021) is being implemented in the CA countries. The project involves the formation of a regional electricity market (REM) by 2025. The expected effect of the REM is to meet the electricity needs of each country at low prices. Globally, abundant examples of competing electric power markets are available, in particular in Germany (EEX and LPX) and the United Kingdom (UKPX, APX, PowerEx, and IPE) (INOGATE, 2016). The CAREM project complements CASA-1000 — a high-voltage electricity transmission system connecting four countries in Central and South Asia.

An effective balance of the interests of external players and the regional interests of CA can become a step towards the formation of a productive and integrated regional energy system.

Amid the growing needs of the CA countries for energy resources, the launch of EAEU integrated markets for gas, oil, and petroleum products is gaining relevance. Priority of domestic needs of the member states for gas, oil, and petroleum products is one of the principles of the EAEU common markets. The participation of the Republic of Tajikistan and the Republic of Uzbekistan in the common Union markets of gas, oil, and petroleum products will ensure equal access to energy products, contributing to a sound energy mix. Such a decision will balance the energy profiles of the countries and reduce the high dependence of the Kyrgyz Republic and the Republic of Tajikistan on hydropower.

The current Eurasian institutional framework enables pragmatic use of regional opportunities. The EAEU IEM can become an effective platform for consolidating efforts to eliminate energy imbalances in CA. The accession of Uzbekistan and Turkmenistan to the EDB and Tajikistan to the EAEU will significantly expand the capabilities of the EAEU IEM.

Conclusion

The central theme of this report is its recommendations for creating a regional mechanism for regulation of the water and energy complex in the Aral Sea basin. The goal is ambitious, albeit achievable, subject to adequate definition of the principles and approaches aimed at meeting the irrigation and energy needs of every CA state — Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan. Only confidence in the prospects of finding a regional solution to the top priority national issues in the areas of water, food, and energy security, taking into account climatic and environmental challenges, can spark the interest of the CA states and encourage them to show the political will required for regional cooperation on the management of the intricately connected water and energy resources of the region.

To do this, the CA states will have to show the political will to engage in mutually beneficial cooperation, expand their economic cooperation, and strengthen intraregional integration. Joint efforts to address regional problems, while taking into account national interests, should focus on adapting to climate change and effective management of transboundary water and energy resources. This is vital for achieving the water, food, and energy security of the countries in the region.

Building on that, the present report draws the following conclusions:

The countries of the Aral Sea basin are among the most exposed in the world to high risks and threats as a result of global and local climate change. A significant change in the hydrographic regime of surface waters is expected due to accelerated melting of glaciers and reduced snow cover, intensifying desertification, degradation and salinisation of land, loss of biodiversity, and increased deforestation. The mix of the negative effects of climate change will result in stronger competition for water among the countries in the region and will have a long-term and significant impact on political, food, energy, sanitary and epidemiological, and environmental security in the region.

A distinctive feature of the CA countries, primarily in the Aral Sea basin, is that their social and economic development is accompanied by complete depletion of water resources — i.e., the volume of resources used exceeds the volume of disposable resources — and that trend will determine the nature of interstate relations among the countries of the region. The use of water resources is growing rapidly in the region, driven by demographic factors and the development of manufacturing and agriculture, mainly irrigation. Water management policy in the region is secondary to the interests of agriculture and water supply for irrigated lands: 86% of the water used in the region goes to irrigation.

Despite the exhaustion of water resources, each country envisages a further increase in water consumption for irrigation and hydropower generation in its national strategies and programmes. Under these conditions, it is essential to implement coordinated regional water and energy policies aimed at ensuring balanced use of water resources and improving the environmental situation. Going forward, it will be possible to meet the water needs of the countries of the region only through sustainable and efficient use of disposable water resources, adoption of comprehensive measures for adaptation to climate change, and enhancement of regional cooperation in sharing and protection of transboundary river basins.

New approaches to water and energy resources management and irrigation are vital to address the environmental, social, and economic problems that have built up in the CA region. In the transboundary context, this should entail practical measures to get various

sectors of the economies adjusted to water constraints and climate change. First of all, this applies to such large industries (water users and water consumers) as agriculture and hydropower generation. In agriculture, it seems important to expand the practice of cultivating more drought-resistant varieties of crops and to upgrade engineering irrigation systems, equipping them with devices for automated distribution of irrigation water and monitoring of the ameliorative status of irrigated lands. In hydropower generation, it is necessary to optimise the operating regime of HPPs and reservoirs, aligning it with irrigation needs. Low-water technologies and recycling water supply systems should be introduced in manufacturing. In the utilities sector, the technical condition of water supply and sewage systems should be improved, reducing their water losses, and new technologies for wastewater treatment should be developed.

Challenges and risks to the water and energy security of the CA states are largely related to the insufficiently effective management of water and energy resources at the national and interstate levels, the weak institutional and legal framework, and the duplication of mandates of government bodies.

Joint work to address water, energy, environmental, and resource challenges in the transboundary river basins, implementation of multilateral investment projects, development of the scientific and technological base, and training of staff should become elements of sustainable development and expansion of concerted integration efforts. The coordination of regimes and rules of the operation of HPPs and reservoirs, main canals, and major pumping stations, as well as plans for the construction of facilities for various water uses and protection of water resources in the transboundary river basins calls for cooperation on the basis of IWRM. This draws upon links between water and energy resources management bodies and sectors of the economy that are water users and water consumers — the land–water–energy nexus.

In recent years, there has been an improvement in the geopolitical conditions for regional cooperation owing to the expansion of bilateral agreements and joint investments. The processes of regionalisation have noticeably accelerated in CA in connection with the renewed political agenda of Uzbekistan to strengthen trust among the CA countries. Against the background of strengthening regional cooperation and increasing scarcity of water and energy resources, there is a window of opportunity for reformatting the architecture of relationships in the CA water and energy complex.

An integrated system of water management in the countries of the region is still in its infancy, and its evolving legal framework should be harmonised with many branches of law: environmental protection, economics and finance, construction, education, science, international relations, and national security. The water policy of the CA countries can be based only on disposable water resources and their efficient use, which strengthens the role of regional institutions of water and energy regulation and coordination of their interaction.

The resolution of water use problems in the transboundary river basins largely depends on water management efforts of individual states. Low effectiveness of solutions at the national and basin levels is one of the key elements leading to failure to harmonise approaches to the use of shared transboundary waters and to ensure sufficient interaction among the countries of the region. National water programmes usually do not have sufficient funding, physical, research, and design support and do not correspond to the approved general schemes for integrated use and protection of water resources. The goals and targets enshrined in the programmes are not achieved.

As part of a potential mechanism for regulating the CA water and energy complex, it is necessary to update approaches to enhancing the activities of existing regional organisations. This applies primarily to IFAS and its bodies, the ICWC and the ICSD, as well as to CDC Energy. In the changed environment, it is vital to enhance the role of IFAS as a political platform

for integration of the CA countries. The IFAS format seems instrumental in addressing water, energy, environmental, and resource challenges in the transboundary river basins through joint efforts, implementing multilateral investment projects, developing the scientific and technological base, and training of staff. There are prerequisites established for that.

A more comprehensive way to reformat the system of regulation of the CA water and energy complex is to expand the above solution by creating a new dedicated institution, the International Water and Energy Consortium of Central Asia. The Consortium could assume the key function of seeking and securing financing for national and transboundary infrastructure projects in the CA water and energy sectors. The proposed approach is based on the economic interest of the parties in joint implementation of new water and energy projects, operation of existing facilities, and enhancement of the regional and national water and energy infrastructure. At the same time, the Water and Energy Consortium should rely on the redesigned existing framework: IFAS, the ICWC, BWMO Amu Darya, BWMO Syr Darya, CDC Energy, and others.

However, it should be noted that the creation of a water and energy consortium in CA to encompass the water and energy complex of the entire region is a difficult task and is unparalleled anywhere in the world. Therefore, stakeholders could use simplified forms of cooperation to build the major infrastructure facilities of the CA water and energy complex (for example, HPPs). This entails, for example, the creation of a project consortium using the BOT (build — operate — transfer) or BOOT (build — own — operate — transfer) model and based on the principles of project financing.

The development of a new mechanism for joint regulation of the CA water and energy complex can serve as a basis for enhancing economic, trade, and investment cooperation in the region. By providing a legal framework for cooperation at the regional level and incentives for combined efforts, the new approaches to the regulation of the CA water and energy complex may substantially simplify and accelerate the formation of the EAEU IEM in the CA region, which includes two EAEU member states, Kazakhstan and Kyrgyzstan.

Annexes

Annex 1.

Chronological Sequence of Adoption of Key Documents Determining Water Allocation in the Aral Sea Basin during the USSR Period

Syr Darya River Basin

- On 7 February 1973, the SEC of the State Planning Committee of the USSR reviewed the first SIUPWR of the Syr Darya River basin as of 1970.
- In 1976–1978, an updated SIUPWR was prepared for the Syr Darya River basin on the basis of the aforementioned resolution and the assignment of the Ministry of Water Resources of the USSR dated 30 January 1976.
- On 12 April 1982, the Expert Subcommission of the SEC of the State Planning Committee of the USSR signed an appraisal report on the updated SIUPWR for the Syr Darya River basin.
- On 5 May 1982, on the basis of that appraisal report, the SEC of the State Planning Committee of the USSR adopted Resolution No. 11 On Examination of the Updated Scheme of Integrated Use and Protection of Water Resources of the Syr Darya River. By that resolution, the SEC of the State Planning Committee of the USSR largely endorsed the appraisal report of the Expert Subcommission on the updated SIUPWR for the Syr Darya River basin, taking into account comments and suggestions, and recommended it for use to the Ministry of Water Resources of the USSR.
- The Ministry of Water Resources of the USSR issued Order No. 300 dated 27 August 1987 to create, from 1 September 1987, under the auspices of the Automated Dispatching Complex for regulating the use of water resources of the Syr Darya River (ADC Syr Darya), the Syr Darya Basin Department of inter-republican distribution of water resources and operation of water intake facilities and hydroengineering systems (Uprvodkhoz Syr Darya), based in Tashkent and subordinate to the Ministry of Water Resources of the USSR.

Amu Darya River Basin

- In 1950–1954, Sredazgiprovodkhlopok Institute prepared the first version of the General Scheme of Use of Water and Land Resources of the Amu Darya River Basin.
- In 1967–1971, the CA branch of the Hydroproject Institute prepared the General Scheme of Integrated Use of the Amu Darya Water Resources. Its first version was reviewed and endorsed by the SEC of the State Planning Committee of the USSR (Resolution No. 3 dated 19 February 1969).
- On 23 February 1972, the second edition of the General Scheme of Integrated Use of the Amu Darya Water Resources was endorsed by the Scientific and Technical Council (STC) of the Ministry of Water Resources of the USSR (Minutes No. 130).
- In 1973, Sredazgiprovodkhlopok Institute prepared the Scheme of Integrated Use of Water Resources of the Aral Sea Basin.
- In 1984, Sredazgiprovodkhlopok Institute completed an update of the Scheme of Integrated Use and Protection of Water Resources of the Amu Darya River.
- On 10 September 1987, the STC of the Ministry of Water Resources of the USSR approved the updated scheme (Minutes No. 556), which became the generally recognised basic document on the current interstate distribution of water resources in the Amu Darya basin.

- By Order No. 301 dated 27 August 1987, on 1 September 1987, the Ministry of Water Resources of the USSR created the Amu Darya Basin Department of inter-republican distribution of water resources and operation of water intake facilities and hydroengineering systems (Uprvodkhoz Amu Darya), based in Urgench and subordinate to the Ministry of Water Resources of the USSR.

Small Rivers of Central Asia

- On 10 April 1980, the Record of the Decision on Inter-Republican Distribution of Flow of Small Rivers of the Fergana Valley was adopted as approved by the Ministry of Water Resources of the USSR.
- On 27 April 1981, the Ministry of Water Resources of the USSR issued the Regulations on Division of the Talas River Basin Flow between the Kazakh SSR and the Kyrgyz SSR, prepared based on inter-republican flow division No. 1/1–36-427 (428).
- On 27 April 1981, the Ministry of Water Resources of the USSR issued the Regulations on Division of the Chu River Basin Flow between the Kazakh SSR and the Kyrgyz SSR, prepared based on inter-republican flow division No. 1/1–36-427 (428).

Solution to the Aral Sea Problem

- On 19 September 1988, the Central Committee of the CPSU and the Council of Ministers of the USSR adopted Resolution No. 1110 On Measures to Radically Improve Environmental and Sanitary Situation in the Aral Sea Region, Increase Efficiency of Use and Enhance Protection of Water and Land Resources in its Basin.
- On 27 November 1989, the Supreme Soviet of the USSR adopted Decision No. 829–1 On Urgent Measures for Environmental Rehabilitation of the Country, recognising the Aral Sea region as an environmental disaster area.
- On 14 February 1990, the Council of Ministers of the USSR adopted Resolution No. 189 On Ensuring Implementation of Resolution of the Supreme Soviet of the USSR «On Urgent Measures for Environmental Rehabilitation of the Country«.
- On 23 June 1990, the meeting of the leaders of the Central Asian republics held in Almaty adopted an Appeal to the Peoples of Central Asia and a Joint Statement, in which the countries of the region again noted that «the environmental catastrophe of the Aral Sea region is an acute problem of the region. In order to unite efforts aimed at restoring an environmental balance in the Aral Sea basin, we agreed to create an inter-republican commission and establish a Fund for Assistance to the Population of the Aral Sea Region«.
- On 24 November 1990, the Union-Republican Consortium «Aral« was established by Resolution No. 1185 of the Council of Ministers of the USSR. The founders were: the Governments of the Kazakh, Kyrgyz, Tajik, Uzbek, Turkmen, and Karakalpak Republics; the state concern Vodstroy (former Ministry of Water Resources of the USSR); Khorezm, Kzyl-Orda, and Tashauz regional executive committees.
- On 19 May 1991, the Cabinet of Ministers of the USSR adopted Resolution No. 261 On Measures to Implement Resolution of the Supreme Soviet of the USSR «On Progress in Implementation of the Resolution of the Supreme Soviet 'On Urgent Measures for Environmental Rehabilitation of the Country' Dealing with Problems of the Aral Sea«.

Annex 2.

Chronological Sequence of Main Events in the CA Water and Energy Complex after 1992

Aral Sea Basin

- On 19 November 1991, the Agreement on Parallel Operation of Power Systems of the Republic of Kazakhstan, the Kyrgyz Republic, the Republic of Tajikistan, Turkmenistan, and the Republic of Uzbekistan was signed in Ashgabat, and the Unified Dispatch Office of the Central Asia Power Systems (CA UDO) was founded, financed by the parties to the Agreement on a cost-sharing basis.
- On 18 February 1992, the Agreement among the Republic of Kazakhstan, the Republic of Kyrgyzstan, the Republic of Tajikistan, Turkmenistan, and the Republic of Uzbekistan on Cooperation in the Field of Joint Management of the Use and Conservation of Water Resources in Interstate Sources was signed in Almaty. The Agreement served as a basis for the creation of new bodies for interstate regulation of water resources: the Interstate Commission for Water Coordination (ICWC) and its executive bodies: BWMO Syr Darya and BWMO Amu Darya.
- On 6 April 1992, the ICWC approved the Charters of BWMO Syr Darya and BWMO Amu Darya.
- Kazakhstan's appeal to the Heads of State of Russia and the CA countries, putting forward a proposal (letter No. 23–17/I-238 of 5 October 1992) on the need to jointly address the problem of the Aral Sea and the Aral Sea region.
- On 4 January 1993, the Statement on the Establishment of the International Fund for Saving the Aral Sea was released at the Meeting of the Heads of State of the CA Countries in Tashkent.
- On 26 March 1993, the Agreement on Joint Actions to Address the Problem of the Aral Sea and the Aral Sea Region, Improving the Environment, and Ensuring Social and Economic Development of the Aral Sea Region, the composition the Interstate Council of the Central Asia States on the Aral Sea Basin Problems (ICAB), and Regulations on the International Fund for Saving the Aral Sea (IFAS) were approved in Kyzyl-Orda, and an appeal to the UN was adopted.
- On 11 January 1994, a meeting of the Heads of State of the CA countries in Nukus approved the Aral Sea Basin Programme (ASBP-1) and the Regulations on the Interstate Council on Aral Sea Basin Problems (ICAB).
- In 1994, the CA UDO changed its name to the Unified Dispatch Centre — UDC Energy.
- In 1995–1998, the practice developed of concluding interstate protocols and agreements among Kazakhstan, Kyrgyzstan, and Uzbekistan, establishing the scope of compensatory fuel and energy supplies and the volume of water released for irrigation from the Toktogul Reservoir.
- The new arrangement served as the basis for the development and signing on 17 March 1998 of a new multilateral Agreement among Kazakhstan, Kyrgyzstan, and Uzbekistan (later also Tajikistan) on the Use of Water and Energy Resources of the Syr Darya River Basin.
- In June 2003, Turkmenistan withdrew from the CAPS parallel operation, which severely impaired the operating conditions in the western part of the system and reduced the reliability of power supply to end consumers.
- In 2003–2005, the multilateral exchange arrangement was discontinued.
- In October 2004, the CAPS member countries entered into the Agreement on Coordination of Relations in the Central Asian Electric Power Industry and established the Electric Power Coordination Council of Central Asia (CA EPCC) as an advisory body.
- In 2005, the practice of concluding annual agreements and protocols on arranging energy cross-flows, coal and gas supplies in exchange for water, was resumed.
- In September 2006, the CA EPCC established a coordination dispatch centre, CDC Energy.

- In October 2009, Uzbekistan unilaterally disconnected the interstate PTL between Uzbekistan and Tajikistan, whereupon the latter's power system ceased to operate in the parallel mode.
- On 18 May 2016, Kyrgyzstan made a decision to «freeze« its participation in the International Fund for Saving the Aral Sea and its bodies.

Other CA basins

Kazakhstan signed a number of bilateral agreements on water sharing (Dukhovny et al., 2020), including:

- with China on all 24 transboundary rivers, including six rivers in the Irtysh basin, seven rivers in the Ili basin, three rivers in the Emel basin, etc.;
- with Russia on the transboundary rivers Ural, Irtysh, Ishim, Tobol, Big and Small Uzen, a branch of the Kigach River; and with Kyrgyzstan on the Chu and the Talas.

Annex 3.

State Water Management Bodies in Central Asian Countries

Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
Interdepartmental coordination				
Interdepartmental Council on Water Management (Article 131)	National Water Council	National Water Council	—	—
Transboundary water issues				
Ministry of Foreign Affairs	Ministry of Foreign Affairs, Foreign Trade, and Investments	Ministry of Foreign Affairs	Ministry of Foreign Affairs	Ministry of Foreign Affairs
Border Service of the National Security Committee	Border Service of the State National Security Committee of the Kyrgyz Republic	Border Service of the State National Security Committee of the Republic of Tajikistan	State Border Service of Turkmenistan	Border Service of the National Security Committee of the Republic of Uzbekistan
Water resources and water management infrastructure within the countries and at the transboundary level (basin management)				
Committee on Water Resources of the Ministry of Ecology, Geology, and Natural Resources	State Agency for Water Resources of the Ministry of Agriculture, Water Resources, and Regional Development	Ministry of Energy and Water Resources of the Republic of Tajikistan	State Committee for Water Resources of Turkmenistan	Ministry of Water Resources of Uzbekistan
Basin inspectorates for regulation of water use and protection. Basin councils	Basin water departments (5). Basin councils	Regional and inter-district water management departments. Agency for Land Reclamation and Irrigation under the Government of the Republic of Tajikistan. Basin water councils	Regional and district (velayat) water management associations	District basin departments of irrigation systems (59)
Power generation and energy infrastructure within the countries and at the regional level				
Ministry of Energy of the Republic of Kazakhstan	Ministry of Energy and Industry of the Kyrgyz Republic	Ministry of Energy and Water Resources of the Republic of Tajikistan	Ministry of Energy of Turkmenistan	Ministry of Energy of the Republic of Uzbekistan

Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
Agriculture and food (irrigation and irrigated agriculture)				
Ministry of Agriculture of the Republic of Kazakhstan	Ministry of Agriculture, Water Resources, and Regional Development of the Kyrgyz Republic	Ministry of Agriculture of the Republic of Tajikistan Agency for Land Reclamation and Irrigation under the Government of the Republic of Tajikistan	Ministry of Agriculture and Environmental Protection of Turkmenistan	Ministry of Agriculture of the Republic of Uzbekistan
Sanitary and hygienic safety of water				
Committee of Sanitary and Epidemiological Surveillance of the Ministry of Health of the Republic of Kazakhstan	Department for Disease Prevention and Sanitary and Epidemiological Surveillance of the Ministry of Health of the Kyrgyz Republic	Ministry of Health and Social Protection	Sanitary and Epidemiological Service of the Ministry of Health and Medical Industry of Turkmenistan	Service of Sanitary and Epidemiological Wellbeing and Public Health of the Ministry of Health of the Republic of Uzbekistan
Environment and environmental protection				
Ministry of Ecology, Geology, and Natural Resources of the Republic of Kazakhstan	Ministry of Natural Resources, Ecology, and Technical Supervision of the Kyrgyz Republic	Committee for Environmental Protection under the Government of the Republic of Tajikistan	Environmental Protection Service of the Ministry of Agriculture and Environmental Protection of Turkmenistan	State Committee for Ecology and Environmental Protection of the Republic of Uzbekistan
Hydrometeorological services				
Republican State Enterprise Kazhydromet of the Ministry of Ecology, Geology, and Natural Resources of the Republic of Kazakhstan	Agency on Hydrometeorology (Kyrgyzhydromet). Ministry of Natural Resources, Ecology, and Technical Supervision of the Kyrgyz Republic	Agency on Hydrometeorology of the Republic of Tajikistan (Tajikhydromet). Committee for Environmental Protection under the Government of the Republic of Tajikistan	Hydrometeorology Service of the Ministry of Agriculture and Environmental Protection of Turkmenistan	Centre of Hydrometeorological Service of the Republic of Uzbekistan (Uzhydromet)
Prevention of emergency situations and emergency response				
Ministry of Emergency Situations of the Republic of Kazakhstan	Ministry of Emergency Situations of the Kyrgyz Republic	Committee for Emergency Situations and Civil Defence under the Government of the Republic of Tajikistan	State Emergency Management Commission (SEMC) under the Cabinet of Ministers of Turkmenistan	Ministry of Emergency Situations of the Republic of Uzbekistan

Kazakhstan	Kyrgyzstan	Tajikistan	Turkmenistan	Uzbekistan
Issues of local water management				
Regional and district akimats and their executive bodies	Regional and district state administrations	Regional and district khukumats (executive authorities)		Regional and district khokimiyats and their executive bodies
Safety of waterworks				
Committee on Water Resources of the Ministry of Ecology, Geology, and Natural Resources of the Republic of Kazakhstan	State Inspectorate for Environmental and Technical Safety	Service of State Supervision in the Sphere of Security of the Ministry of Energy and Water Resources of the Republic of Tajikistan		State Inspectorate for Safety Control of Water Facilities under the Cabinet of Ministers of the Republic of Uzbekistan
Mudflow control				
Main Directorate Kazselezashchita of the Ministry of Emergency Situations of the Republic of Kazakhstan	Ministry of Emergency Situations of the Kyrgyz Republic	Committee for Emergency Situations and Civil Defence under the Government of the Republic of Tajikistan		Ministry of Emergency Situations of the Republic of Uzbekistan
Groundwater				
Geology Committee of the Ministry of Ecology, Geology, and Natural Resources of the Republic of Kazakhstan	State Agency for Geology and Mineral Resources of the Ministry of Natural Resources, Ecology, and Technical Supervision of the Kyrgyz Republic	Main Geology Department under the Government of the Republic of Tajikistan	Turkmengeology State Concern	State Committee of the Republic of Uzbekistan for Geology and Mineral Resources

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Abbreviations

ABMS — automated basin management system
ADB — Asian Development Bank
ADC — automated dispatching complex
ASBP — Aral Sea Basin Programme
BWMD — basin water management department
BWMO — basin water management organisation
CA — Central Asia
CAC — Central Asian Cooperation Organisation
CAEC — Central Asian Economic Community
CA EPCC — Electric Power Coordination Council of Central Asia
CAPS — Central Asia Power System
CAREC — Central Asia Regional Economic Cooperation
CASA-1000 — Central Asia — South Asia Power Project
CASAREM — Central Asia/South Asia Regional Electricity Market
CAU — Central Asian Union
CA UDO — Unified Dispatch Office of Central Asia
CAWEP — Central Asia Water and Energy Programme
CDC — coordination dispatch centre
CES — Common Economic Space
CHP — combined heat and power plant
CIS — Commonwealth of Independent States
CMC — Coordination Metrological Centre
CSD — Commission on Sustainable Development
CSTO — Collective Security Treaty Organisation
EAEU, the Union — Eurasian Economic Union
EBRD — European Bank for Reconstruction and Development
EC — executive committee
EDB, the Bank — Eurasian Development Bank
EEC — Eurasian Economic Commission
EECCA — Eastern Europe, Caucasus, and Central Asia
EIB — European Investment Bank
ESCAP — Economic and Social Commission for Asia and the Pacific
EU — European Union
EurAsEC — Eurasian Economic Community
EUWI+ — European Union Water Initiative Plus for Eastern Partnership Countries
GDP — gross domestic product
GW — gigawatt
ha — hectare
HLG — high-level group
HPP — hydro power plant
IC — Interstate Council
ICAB — Interstate Council of the Central Asia States on the Aral Sea Basin Problems
ICSD — Interstate Commission on Sustainable Development
ICWC — Interstate Commission for Water Coordination
IEM — integrated energy market
IFAS — International Fund for Saving the Aral Sea
IFI — international financial institution
IMF — International Monetary Fund
IWRM — integrated water resources management
km — kilometre
km³ — cubic kilometre
KR — Kyrgyz Republic
kW — kilowatt
kWh — kilowatt-hour
m — meter
m³ — cubic meter
NPP — nuclear power plant
OEC — Organisation for Economic Cooperation
OECD — Organisation for Economic Cooperation and Development
OMVS — Senegal River Basin Development Organisation (in French: Organisation pour la mise en valeur du fleuve Sénégal)
PTL — power transmission line
RF — Russian Federation
RK — Republic of Kazakhstan
RT — Republic of Tajikistan
RU — Republic of Uzbekistan
SCO — Shanghai Cooperation Organisation
SDG — Sustainable Development Goal
SEC — State Expert Commission
SIC ICWC — Scientific-Information Center of the Interstate Commission for Water Coordination of Central Asia
SIUPWR — Scheme of Integrated Use and Protection of Water Resources
SPECA — Special Programme for the Economies of Central Asia (UN)
STC — Scientific and Technical Council
TC — training centre
TM — Turkmenistan
TPP — thermal power plant
UDC — unified dispatch centre
UES — unified energy system
UN — United Nations Organisation
UNDP — United Nations Development Programme

UNECE — United Nations Economic Commission for Europe
UNEP — United Nations Environment Programme
UNICEF — United Nations Children's Fund
USA — United States of America
USAID — United States Agency for International Development
USD — US dollar
USSR — Union of Soviet Socialist Republics
% y/y — year-on-year growth rate

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(RU)

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Macroeconomic Outlook
(RU/EN)

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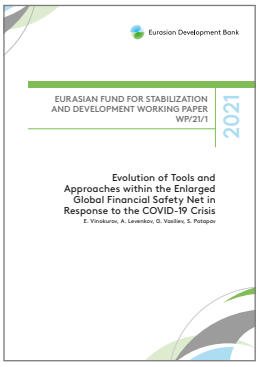

Working Paper WP/21/1
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Evolution of Tools and Approaches within the Enlarged Global Financial Safety Net in Response to the COVID-19 Crisis

This working paper provides the analysis how the GFSN responded to pandemic on global level and on regional level (in the EFSD countries).

Working Paper WP/21/2
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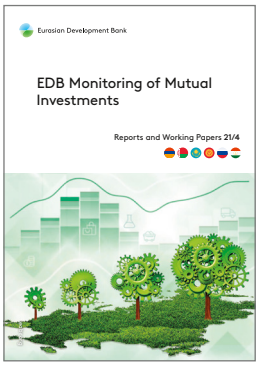
This study aims to contribute to understanding the potential risks and impacts of both explicit and implicit contingent liability shocks on government fiscal and debt positions in the EFSD recipient countries.



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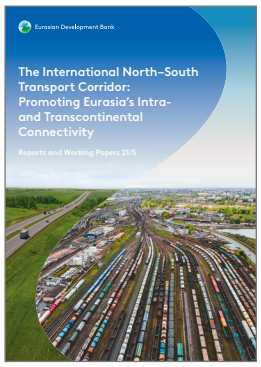
Mutual investments in Eurasia, calculated using a new methodology, reach US $46 billion. FDI has been growing steadily since 2016.



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EDB Integration Business Barometer

About 73% of companies feel positive about the EAEU and say it makes doing business easier.

Report 22/2
(RU/EN)

International North–South Transport Corridor: Investments and Soft Infrastructure

The study assesses the investment potential of the INSTC, identifies barriers to its development and provides recommendations on how to eliminate them.

Report 22/3
(RU/EN)

The Economy of Central Asia: A Fresh Perspective

The report provides a renewed perspective on Central Asia as a large, dynamic and promising economic region and analyses its current structural changes and major growth areas.

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