

Article

## Rogun Dam—Path to Energy Independence or Security Threat?

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**Abstract:** The revitalization of the Rogun hydropower station project and launch of an Initial Public Offering has led the water-energy disputes between Tajikistan and Uzbekistan to a new stage. While two riparian states advocate their positions from their own perspective, it gives the impression of being a “prisoners’ dilemma” case from a regional cooperation point. This paper aims to review the decision of project revitalization from the unconventional security perspective, focusing mainly on its impact on Tajikistan. The scope will be limited to economic, energy, social and political security. The paper attempts to reveal the existing unconventional security threats and suggest possible solutions for the arising problems.

**Keywords:** water-energy trade-off; unconventional security; opportunity costs; Tajikistan; Uzbekistan; Central Asia

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### 1. Introduction

How to adequately meet growing energy needs is a vital question for every nation. The Central Asian (CA) republics, endowed with abundant natural resources and Soviet inherited energy systems, have their own path of energy policy, non-diverseness being the common characteristic for all. Two consequent years of energy crisis during the harsh winters of 2008 and 2009 led the Government of Tajikistan (GoT) to revitalize the frozen Rogun Hydropower Station (HPS) project. The GoT claims

that Rogun HPS will strengthen energy security and accelerate the development of industry and economic progress in Central Asia [1].

Energy security is undoubtedly one of the main building blocks of economic development and social and political stability. However, the methods of achieving energy security should also take into account the overall security principles in order not to destabilize the economic, social and political systems while attempting to strengthen one of the pillars of that overall security.

GoT's decision to re-launch the construction of the tremendous Rogun HPS fueled the intricacy between the upstream Tajikistan and downstream Uzbekistan, leading the annually re-occurring water-energy disputes to a new stage. At a glance, the positions these states take seem to be the best options from their individual perspectives, while being a "prisoners' dilemma" case from the regional cooperation perspective [2]. The prisoners' dilemma concept, also applied to water-related conflicts, is known for suggesting optimal "win-win" solution through cooperation and on the contrary, resulting a continuous "lose-lose" cycle through prioritizing individual objectives over the system's objectives [3].

The current paper aims to study the impact of revitalization of the Rogun HPS project on national and regional unconventional (Factors that lead to degradation by stifling the economic growth, quaking the socio-political stability and harming the environment.) security from the Tajik people's perspective. By this, the paper targets to shed light on the neglected side of the problem—being the effect of a unilateral decision on the internal and regional security. Additionally, the study searches for possible solutions for the water-energy dispute. Direct environmental impacts of the project such as impact on water quantity and quality, impact on agricultural productivity, soil degradation and Aral Sea disaster, sufficiently covered by Hartman [4], Tookey [5], Rakel [6], Laldjebayev [7] and others will not be considered within the scope of this paper.

The next section reviews the unconventional security literature and its applicability to the Rogun HPS project case. The third section briefs the Soviet period water-energy nexus and reasons for its actual failure as well as reasons for revival of the need for a large dam such as Rogun. The impact of large dams, the case of Rogun, its history during the soviet and post-soviet periods and discussion of its current technical condition, take place in the fourth section. The fifth section tackles the economic and socio-political security aspects of the project revitalization decision. The later sections discuss the possible alternative options and derive conclusions.

## **2. Unconventional Aspects of Security in Central Asia**

Conventional security theory encompasses the ways of identifying and responding effectively and properly to any external or internal threat or aggression with the means of military force. It used to serve as a basis for any national security doctrine before the end of the Cold War. Today, threats may be not only military as traditionally described, but may include a variety of other forms. The unconventional security threats such as environmental, economic, social and political threat, gained more importance after the end of the Cold War period, expanding the scope of security-based studies.

Definition of unconventional security threats varies from case to case [8]. The definition by Ullman [9], describes unconventional threats to security as "anything degrading the quality of life of a nation or limiting the nation's policy options". This definition is criticized by some for being broad, so that it may include too many variables, which in turn can make it ineffective for policy analysis [4].

The criticism of Ullman's [9] unconventional security theory is appropriate to a certain extent; therefore it is important for the analysis to choose the relevant variables and their measurable indicators to perform a feasible analysis. For the application of this theory, it is necessary to check the causal relationship between the project revitalization and ongoing trends in the energy, economic and socio-political spheres.

Another unconventional security approach by Levy [10] defines the situations in which some of the nation's values are drastically degraded by external action as a threat to security. Sometimes, the scale and magnitude of a threat is highly underestimated or concealed from the public due to certain political or economic reasons. Therefore, it might not always be clear whether the existing threat is internal or external until the drastically degrading event occurs. For example, one could not see any security concern or strong opposition against the construction and operation of the Chernobyl Nuclear Power Plant (NPP) in Ukraine before the well-known accident that took place in 1986. Although the accident occurred during the soviet ruling period, the conflict between Belarus and Ukraine due to the accident arose only five years later when the Soviet Union collapsed. The dispute between Tajikistan and Uzbekistan thus also corresponds to the aforementioned theory by Levy [10].

Hence, an attempt to make a reasonable conclusion will be made by exploring the energy policy, and the economic and socio-political trends in Tajikistan. The possible impact of the project revitalization on the energy sector and the economic and socio-political spheres can be revealed via the following indicators respectively:

- (a) by looking at a status quo of the energy sector policy and analyzing the possible future options as well as their opportunity costs;
- (b) by observing the dynamics of macroeconomic indicators and short and medium term economic stability analysis as well as looking at the successfulness of high priority state programs such as healthcare, education and social security;
- (c) by analyzing the socio-political atmosphere through the national and international media and concerns of the people, government, political opposition and downstream neighbors.

Based on these three impact analysis, the current study attempts to assess the possible security risks rising from the decision of revitalizing the Rogun HPS project. Furthermore, the study will examine the impact of project revitalization on the strategic regional cooperation, including the perspective of electricity exports to Afghanistan and Pakistan, which encompass crucial factors such as security and economic development.

### **3. The Water Energy Nexus**

With the breakdown of the Soviet Union era in 1991, the five CA countries Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan have also gradually phased-out the water-energy nexus between the upstream Kyrgyzstan and Tajikistan and the downstream Kazakhstan, Turkmenistan, and Uzbekistan, of the two major rivers, the Syr-Darya and the Amu-Darya. According to this nexus, resource-rich downstream countries (Table 1) provided energy to resource-poor upstream countries in exchange for water.

**Table 1.** Natural Gas Production, Consumption and Export in the Downstream CA Countries, 2007 (in billion cubic meters (*bcm*)).

	World Ranks *	Production	Consumption	Export
Kazakhstan	15	12.9	10.6	2.3
Turkmenistan	4	72.3	18.0	54.3
Uzbekistan	18	65.3	50.6	14.7

\* World rankings according to the proven natural gas reserves. Source: [11].

The “mutually beneficial mechanism” [7] of water-energy exchange has not proven to be capable of surviving in the free market environment, which leads to an annually rebounding water-energy trade-off challenges and particularly natural gas price disputes between supplier Uzbekistan and upstream Kyrgyzstan and Tajikistan.

The export price of natural gas in Turkmenistan and Uzbekistan is based on the annual agreements with Russian GazProm. Moreover, natural gas export has a significant share in the balance of payments of both CA countries. At the same time, it is the main source of electricity generation, industrial production, space heating and household energy demand for the downstream economies. Thus, Uzbekistan wants to apply the export price agreed with GazProm in the trade with upstream Kyrgyzstan and Tajikistan.

GazProm as major “wholesale” customer receives the lowest possible market price, and Uzbekistan tries to apply this lowest possible market price in the trade with upstream neighbors in exchange for water. Consequently, price related negotiations arise annually. After a round of dialogue, both sides agree on a price, lower than the previously agreed wholesale price. As a result, Uzbekistan sells 25–30% (*i.e.*, 29% in 2007) of its exported natural gas within CA at an annual average discount of 10–15% as a compensation for the received water (Table 2). In line with agreeing for a price lower than the GazProm price, Uzbekistan annually faces a difficulty of receiving a payment for the supplied gas.

**Table 2.** Breakdown of Natural Gas Exports by Destinations, 2007 (in *bcm*).

	Kazakhstan	Turkmenistan	Uzbekistan
Total	2.3	54.3	14.7
Within CA			4.2
to Russia	2.3	48.1	10.5
to Iran		6.2	

Source: [11].

Indeed, the creation of the Nurek (With its 300m height, the Nurek dam in Tajikistan is the highest operating dam in the world, located lower on the same cascade with the projected Rogun dam.) dam with a reservoir volume of 10.5 km<sup>3</sup> increased the seismic activity in the reservoir area with a factor of four [13]. The Rogun dam, being constructed on the higher location of the same cascade, with a reservoir of 13.5 km<sup>3</sup> has a potential of increasing the seismic activity even more, as well as potential of inducing higher scale earthquakes. The possible damage from the collapse of a dam with a larger

reservoir due to a self-induced earthquake is incalculably high, particularly for the downstream Uzbekistan and Turkmenistan [14].

Finally, there is a concern that the Rogun dam cannot guarantee the satisfaction of the existing peak energy demand in the near future, due to its huge scale and hence very long time period required for construction. On top of that, the winter peak demand corresponds to the coldest period of the year; therefore, more obstructions may arise with exploiting the projected Rogun HPS. For example, the Nurek dam in Tajikistan was not able to meet the peak electricity demand in 2009, was excessively overloaded by utilizing significantly more water and was overheated. Consequently it was switched off due to technical reasons [15], further aggravating the energy shortage problem. As climatic anomalies become more frequent in CA [16], Uzbekistan's concern that the water mode will change significantly due to the Rogun dam will only grow.

Water use in CA is clearly a transboundary issue: decisions in one of the countries impact water use in the other. Disputes over water allocation between the riparian countries are therefore annually re-occurring since the independence, despite the acceptance of a Framework Agreement for the Syr-Darya River between Kyrgyzstan and downstream states in 1998 that recognized the water-energy nexus and which was also recognized one year later by the Tajik government. With the recent disputes about the Rogun dam, it seems that CA countries are entering a new phase of dispute as (i) serious investment in communication about the Rogun dam was made by the GoT, the World Bank was involved for their expertise and for searching possible investors [17]; and (ii) by being more active through media action to obtain support of international organizations for an enormous Rogun HPS project [18].

#### **4. Large Dams and the Case of Rogun**

In terms of each kilowatt of installed capacity, large dams are known to be relatively economically feasible and less environmentally hazardous in comparison to other types of large energy generation facilities such as coal and oil thermal power plants [19]. Tajikistan and Kyrgyzstan have an enormous technically feasible hydropower potential. A large part of this potential has already been exploited during the former Soviet Union's control. Few large scale projects were inherited by the newly independent states. Economic feasibility of realization and further utilization of these resources and the real cost of previously envisaged projects were not thoroughly re-assessed after the collapse of the Soviet Union.

However, large HPS are also criticized for generating environmental, social and political disadvantages such as flooding of unique ecosystems, moving large number of communities from their adopted livelihoods and problems related to transboundary resource management [20]. Decisions concerning the transboundary resource management in CA are highly conflict driven in the background of arid agricultural production backbone national economies. The water-energy nexus, inherited projects and energy networks built during the Soviet period under "one state" ideology makes the situation even more complex in the context of missing free market economy principles.

Apart from environmental, social and political "costs", large dam projects have also been proven to be economically burdensome for the governments, historically. For instance, the "Three Gorges" HPS project in China took about 100 years from the birth of the idea to the launch of the HPS [21] despite

China's enormous financial potential, which is far greater than those that can be mobilized in Tajikistan. The Aswan High Dam HPS project in Egypt is also well known for its huge impact on agriculture and environment and fishery of its downstream regions [22]. Large dam projects, thus, should only be realized with the agreement of riparian neighbors and with their respective voluntary economic contributions. The possible negative impacts of large dam projects in CA can be minimized only in this case. Otherwise, the project may produce an undesirable negative impact on economic, social and political stability.

The Nurek dam, with a height of 300 m, currently the highest operating dam in the world, is part of a cascade system of eight dams [23]. The idea of taming the Vakhsh River on the top of the above-mentioned cascade by the ninth dam with projected height of 335 m was born during the Soviet Union era in the late 1950s and fitted the overarching Soviet ideology of "technically, everything is possible". Hence, the first blueprint was designed by the mid-1960s and the construction started in 1976. But due to a lack of funding and the continuing controversies triggered by protests of Russian scientists and experts over the project, while pointing at the ecological and social damage when completing this endeavor, the progress was slow and the project was postponed several times. Controversies arose about the security risks among the soviet experts during the realization of the Nurek HPS project. Due to lack of sufficient knowledge and experience, soviet experts could not guarantee the security of the project and so the expertise of the US engineers and scholars was conducted. However, experts concluded that the risks remained. Therefore, the decision was made to include the region into the project of continuous monitoring of the seismic activity, which is still being carried out [24]. Thus, the ongoing dispute on security risk was one of the main reasons for freezing the Rogun HPS project. On top of these elements, severe floods in 1993 destroyed the partly constructed dam [25], when civil war reigned in Tajikistan, making the existing part of the construction completely unusable [26].

As the Soviet inherited water-energy nexus was not functioning anymore, both resource-poor upstream states have changed the course of energy policy towards energy self-sufficiency. Coming out of almost a decade-long civil war, Tajikistan, with a devastated economy, was in short supply of energy. Russian aluminum giant RusAl was interested in the Rogun HPS project as an electricity supplier for the current TalCo—Tajikistan Aluminum Company located close to the border with Uzbekistan.

The GoT signed an agreement with the RusAl regarding the construction of the Rogun HPS in 2004. According to this agreement, RusAl planned to invest US\$ 2 billion in the project. But divergence in partners' views arose immediately, which led to the conduction of a number of studies in the high seismic-prone area by Lahmeyer International—German engineering and consulting company. Based on the expert conclusions of Lahmeyer International RusAl foresaw the project dam at 225 m in height and with two turbines generating a total capacity of 1200 MW [25], consequently, 110 meters lower and three times less than presently envisaged generation capacity and much smaller reservoir.

According to the Soviet period project, the total generation capacity of a 335 m high Rogun dam, the world's highest projected dam is 3600 MW, which is equivalent to the capacity of three average nuclear power plants. Actual total costs of the construction, according to GoT's project, is estimated as between US\$ 2.5 to US\$ 3 billion and the inauguration of the first two generators is scheduled for 2013 [1], although this does not comply with the estimates of Lahmeyer International, according to

which, the first stage requires ca 8.5 years [26]. Considering that it takes 12–15 years to fill the reservoir with a volume of 13.5 km<sup>3</sup> (up to 17 km<sup>3</sup> according to different sources) which will allow in turn exploiting the HPS in full capacity, the projected period would rather be about 20 years. Agreements have been reached over the payback period of the investments, which are set at 20–22 years after the full completion and full operation of the project. Moreover, Lahmeyer International reported that the remains of the initial construction are outdated and concluded that project realization should start from scratch, meaning with a full replacement of all technical parts, except for the hydraulic steel structures that should be re-installed on a new foundation [26].

In the context of an ambitious decision making under a financial shortage, the GoT's ignorance of the expertise by Lahmeyer International is worrisome. Moreover, the World Bank's decision to run a technical and economic feasibility study has further fueled the activities being carried-out on the construction site [27]. The GoT pointed out the importance of the Rogun HPS in overcoming the energy crisis as an explanation for its rushing behavior.

## 5. The Energy Security Problem

The modest energy sector of Tajikistan manufactured a total primary energy amount of 1582 ktoe (kilotons of oil equivalent) in 2007 [28], which is mainly based on hydropower. About 70 percent of the total electricity is generated in the Nurek HPS [29]. The aluminum industry consumes 40% of the total electrical power in the country, while share of residential and commercial sectors together constitute to 10% [28]. The country imports 95% of its domestic gas demands from neighboring Uzbekistan. Whereas the industrial sector dominates in consumption of natural gas, the share used by households is low, 10–15%, since only a limited number of households are connected to the centralized natural gas supply infrastructure [30].

Harsh winters recur annually. The winter of 2008 was unexpectedly harsh for the entire CA and during the peak of the winter 2008, energy became in short supply. Among the five CA states, fossil-poor Tajikistan suffered from this weather anomaly the most. As two consequent years of energy crisis shook the social stability in the country, the GoT found the revitalization of Rogun dam project as an adequate solution for the existing energy problem. Therefore, it announced an Initial Public Offering (IPO) in late 2009.

Obviously, due to the financial limitations of the people, voluntary participation in the IPO campaign stopped a few months after the launch of IPO. Since the required amount is dozens of times higher than the already collected amount, voluntary IPO was turned into a forced campaign of collecting the savings of the common citizens. The forced IPO campaign has shaken the wellbeing of the ordinary people in a short period [31]. As the population has already figured out that the GoT is not taking adequate actions towards meeting the peak winter energy demand between now and the finalization of the dam project, discontent among the people against the government started to grow. Moreover, recurring climatic anomalies during the winter worsened the overall picture. Hence, the population with low income, those who were not capable of preparing to face harsh winters, suffered the most.

Regardless of the fact that the GoT attempted to idealize the Rogun HPS project throughout the media, people have quickly realized that it will not ease the situation in the near future. Interviews with

dozens of people in Tajikistan revealed that discontent against GoT, due to the project revitalization, is gradually rising [32]. This survey also revealed that the number of people who really believe in the future of the physically outdated Rogun dam are very few.

Despite the expertise conclusion and recommendations from Lahmeyer International of starting the construction from scratch, the GoT is planning to take over the construction process of the project from the damaged ruins. On top of this, the GoT has ordered two hydropower generators, of 400 MW each, instead of the projected 600 MW turbines. The GoT is rushing with the realization of the dam project under the euphoria of energy independence and in conditions of financial shortcomings. Being built on an unsustainable base that was damaged two decades ago, and with smaller production capacities than originally projected, the Rogun HPS project will lose its investment attraction in the eyes of the external investors. All this may threaten the internal stability, environment and regional security.

## 6. Impact on Economic Development

The data on most of the indicators which would allow us to provide better quantitative analysis and draw more detailed conclusions are not available for this short period. Nevertheless, most up-to-date available indicators will be observed in this section. Table 3 demonstrates the current trends in the economy of Tajikistan based on the data from the World Factbook, Index Mundi and the World Bank Database. The economy of Tajikistan mostly consisted of foreign trade and aid before 2000 and gradually gained stable economic growth from 2000 to 2008.

**Table 3.** Macroeconomic trends in Tajikistan, 2000–2010.

	2000	2005	2006	2007	2008	2009	2010
GDP (bln US\$)	0.86	2.31	2.81	3.71	5.13	4.98	5.25 *
GDP growth (annual %)	8.30	6.70	7.00	7.80	7.90	3.40	5.50 *
Total External Debt						1.66 *	1.97 *
Imports of goods and services (% of GDP)	100.91	52.84	57.55	68.82	72.38	56.34	
Exports of goods and services (% of GDP)	98.76	26.03	23.35	20.66	16.85	13.41	
Inflation, GDP deflator (annual %)	22.67	9.43	20.34	27.86	27.70	13.27	
Real interest rate (%)	2.38	12.64	3.35	-3.90	-3.13	8.51	
Trade (% of GDP)		78.87	80.89	89.48	89.24	69.75	
1 US\$ Exchange rate (Tajik Somoni)			3.30 *	3.44 *	3.46 *	4.14 *	4.38 *
State Budget (US\$)						1.20 *	1.50 *
Unemployment (%)		40.00 <sup>Δ</sup>	12.00 <sup>Δ</sup>	12.00 <sup>Δ</sup>	2.40 <sup>Δ</sup>	2.30 <sup>Δ</sup>	2.20 <sup>Δ</sup>

\* Obtained from the World Factbook online database; <sup>Δ</sup> Obtained from the Index Mundi; Source: the World Bank Online Database, the World Factbook and Index Mundi.

Being poor in fossil fuels and having a relatively small industrial sector, the country is highly dependent on labor force export to Russia. Studying the financial crisis, trade, finance and Small and Medium Enterprises (SMEs) in CA, Pasadilla [33] found out that Tajikistan is the most immigration remittance dependent country and, thus, most vulnerable to global economic crisis. Average annual immigration fluctuated between 0.6 and 1.2 million over the last five years. In 2008, around 50% of the country's GDP consisted of remittances, received mainly from Kazakhstan and Russia. An International Monetary Fund (IMF) study predicted a 30% decline in the remittances in 2010, which

may be a major external shock for the economy of Tajikistan during 2011, as well as for the Tajik banking sector, where 30% of the profit correspondences to remittances [33].

On top of everything, severe forest fires destroyed the large fields of wheat and other agricultural products in the summer of 2010, forcing the Government of Russia to impose a wheat export ban. Climatic cataclysm in Pakistan in 2010 has also contributed to the food price increase in Asia. Thus, food prices in Tajikistan rose drastically, on average between 30–80%, during the winter of 2010–2011 [34]. The lack of energy and high food prices during the winter have mostly affected the poor layers of society, fueling the social tension.

The voluntary-forced IPO has also significantly affected the business sector. SMEs had no willingness to contribute to the project, but were forced to participate [35]. The SME sector has the highest share in GDP after the remittances from the citizens in migration. In line with the ordinary citizens, the highest opportunity cost of the project, currently, is its burden on the newly emerging small and medium sized businesses.

Moreover, the IPO has affected all spheres of life in Tajikistan, including the healthcare sector. An outbreak of the polio virus was observed in Tajikistan in early 2010 and the Minister of Health of Tajikistan requested support from the World Health Organization (WHO), which launched a polio rehabilitation program in the country [36]. A new outbreak of tuberculosis in Tajikistan again in early 2011 has become another hot topic on the online media [37], which claims that the numbers of infected people are three times more than the officially reported statistics. These are some publicly verifiable evidences of Tajikistan's route to failure.

According to the project proposal by the GoT, the total cost of the Rogum HPS project is estimated to be more than 50% of the country's GDP [38]. However, the figure could be at least two times higher if started from scratch, as concluded by Lahmeyer International. Despite a high annual GDP growth rate of an average 8.3% between 2000 and 2008, Tajikistan remains a relatively poor country with 53.5% of the population living below the national poverty level and around 17% living under extreme poverty. Therefore, the country relies highly on international aid. A large-scale project, such as Rogun, will increase the country's budget deficit and external debt, increase the tax burden and stifle economic growth.

Moreover, revitalization of the project will obviously increase the imports of the country, further raising the share of imports in the balance of payments, which already has a significant negative balance. This will result in an increased demand for hard currency, and hence, will raise the inflation rate. Increased inflation, in turn, will impact on the business sector, decrease the national output and increase the bankruptcy rate. The government will have to raise the tax burden with an aim of tightening the budget deficit, putting further pressure on the real sector. A worsened business environment and an increased bankruptcy rate will raise the unemployment rate. Both unemployment and a need for a hard currency will lead to increased migration and brain-drain. Crucial state programs, such as education and healthcare, will suffer from the increased budget deficit. All these factors will shake the macroeconomic stability and deepen the poverty of the people. Decreased welfare and unemployment lead to social destabilization, such as an increased crime rate and a spread of terrorism. The increased discontent and social instability creates favorable condition for the penetration of terrorists into the country.

## 7. Impact on the Social and Political Stability

A Policy brief by EU CA Monitoring entitled “Tajikistan: Revolutionary Situation or a Resilient State?” states that, the GoT continues to place considerable and often impossible demands upon the population, including the announcement that each family would have to contribute around \$700 for the construction of Rogun dam. The citizens had to pay for provision of any official information by state bodies, and the drafting of state sector employees. [35].

It is worth remembering that, a few years ago, the GoT initiated another IPO for construction of Sangtuda-1 HPS and collected the money of common citizens. However, the Sangtuda-1 HPS was built with 75% Russian financing during 2004–2009. While the whereabouts of the Sangtuda-1 shares are unclear, Tajik energy company Barki Tojiki faced difficulties with payments to Russian investors and they were regularly threatened by the switching-off of the turbines [39]. While Sangtuda-2 HPS is also being built with Iranian financial involvement, Tajikistan is forcing its people to contribute to the Rogun dam project, despite its evident harm to wide variety of spheres of life, welfare of the ordinary people being the most important one.

Tajikistan, with more than half of the population under the poverty line, is prone to social destabilization. Social destabilization will definitely lead to a political destabilization and a loss of the rule of law. Being poor in fossil fuels and a low industrialized economy, there might not be a second come-back from a civil war. The GoT, therefore, should concentrate on alternative solutions that rapidly solve the energy crisis, strengthen the social and political stability and do not harm economic growth.

## 8. Discussion

The GoT has attempted to revitalize the Rogun HPS project several times during the last ten years. A first potential partner was RusAl in 2005, who planned to use the generated electricity for aluminum processing in TalCo. The next interested partner in 2008 was the Government of Ukraine [26], who later also lost the interest in the project and, in 2009, Tajikistan decided to start the project with its own potential. Simultaneously, some western politicians see the Rogun dam as cheap and accessible energy source for socio-economic development in Afghanistan; hence attempt to promote its realization. Table 4 summarizes the available parameters of the above-mentioned partnership plans on the Rogun HPS project.

**Table 4.** Some parameters of Rogun HPS project under different partnership projects.

Parameters	GoT * (2009)	Ukraine (2008)			RusAL (2005)	
		Stage 1	Stage 2	Stage 3	Stage 1	Stage 2
Height of the dam (m)	335	175	235	285	235	285
Completion period (years)	6	3.5				
Required funds (bln US\$)	1.3				2	
Reservoir storage (km <sup>3</sup> )	13.5					
Installed capacity (MW)	3600	1800		2400	1200	3600
Turbines (units × MW)	6 × 600				2 × 600	4 × 600
Annual Generation (TWh)	13.1				5.6	13.1

Note: empty cells indicate the lack of data; Sources: [40] \* [26].

RusAl initially invested US\$ 50 million for the feasibility study, according to the conclusions of which, the partnership fell apart. The GoT did not recognize the recommendations of the engineering firm, Lahmeyer International. Partnership with Ukraine did not move ahead from the documentations level. Finally, the GoT, by collecting over US\$ 200 million from its population through the IPO campaign, commenced on-site activities. At the same time, the GoT had ordered two generators from a Ukrainian producer. According to different sources, the final cost estimates range between US\$ 3 to 6 billion [41] and the current estimates of the GoT highly underestimate the project, which will cause more complications in the future.

However, seeing the Rogun dam project only as a cheap energy source for Afghanistan and Pakistan (AfPak Region) will lead the CA into collapse, starting from social destabilization in Tajikistan to regional economic quake in agriculture based CA. Almost two years of unilateral activities towards realization of the Rogun dam project has led the country into an excessive food price increase and economic downturn. Moreover, exploiting the Nurek dam under “energy mode” has affected the agricultural production in the downstream by decreasing the productivity and consequently aggravating the food price increase. The increases in food prices have in turn primarily affected the population of Tajikistan and revealed that the CA region is not ready for switching from mixed “irrigation-energy” mode to complete “energy mode” of river runoff.

Petrov and Normatov [42] have stated that the water resources in the region were primarily used for agricultural needs during the Soviet ruling and the runoff control was based on this rule. Applying the cooperative game theory concept, Teasley and McKinney [43] have also revealed that cooperative use of water resources in the Syr Darya Basin is the only optimal solution for the existing water-energy debate. The mixed mode of water runoff has revived after the independence of the CA countries, analysis of which demonstrated them to be the best available solution both from economic and regional cooperation perspective. Considering the fact that Tajikistan will not gain high export potential after the completion of the first phase, the AfPak region should not rely on the electricity generated on the HPS of CA rivers in the close future. Moreover, use of rivers under full energy mode both in Kyrgyzstan and Tajikistan have already demonstrated that neither geographical and climatic conditions, nor the structure of economy is prepared for exploiting the rivers under this mode.

With its enormously promising potential, the Rogun dam may well be a perfect solution for CA and the AfPak region’s growing energy needs in the long-run. Therefore there is no need to look for new shareholders at this point. If approved by the World Bank initiated study, Central Asian states, Uzbekistan being the most interested party, will support the project [7]. Besides that, the World Bank is also planning to assist with finding investors. But for Tajikistan alone, the project is (a) not an energy solution within the short and medium term as it is soundly claimed; (b) economically extremely burdensome; and (c) socio-politically highly destructive.

Hence, the Rogun HPS project currently poses the following major possible impacts on Tajikistan: First of all, it is politically conflict driven since Uzbekistan is concerned about irrigational water, environmental sustainability and regional security. The revitalization of the project has worsened the already ill-sorted relations between these states. Besides that, some parties in Tajikistan, who are interested in the state’s failure, are attempting to further worsen the situation through intrigues and provocations, further singling out the GoT. Agreement of the riparian neighbors is extremely important for any investor to invest such large amount of funds. Consequently, the current “at any price” trend

will very likely lead the project towards a failure because (i) the riparian neighbors and international community may have the impression that the recommendation of the ongoing World Bank initiated study may again be met by ignorance; and (ii) recent changes in the projections due to financial shortcomings will decrease the economic value and technical potential of the project, thus losing its investment attractiveness in the eyes of potential investors.

Secondly, the barely achieved economic stability is already shaken and economic downturn, due to the project revitalization, seems to be inevitable. While major sectors of the economy stagnate, being underdeveloped, the GoT is sticking to an unaffordable project realization at any price. SMEs, the national backbone of the economy, received an enormous impact, due to the mismanagement and inadequate measures to support the project, which is leading to an economic downturn.

Moreover, as climatic anomalies are becoming recurrent, the larger share of the population, especially the poor layers of society, is suffering from a winter energy crisis. Being forced to contribute to an over-ambitious project, people have lost their capability of collecting for their basic needs, such as firewood or coal, for the winter period. And due to the global food price increase, the numbers of starving people are increasing daily.

Finally, political stability is shaken due to the growing discontent because of the high corruption rate and ambiguity in the management of Rogun funds, collected through the IPO. The leader of the opposition party Mukhiddin Kabiri sees the IPO as further bait to divert the people's attention from the current problems, as well as another opportunity for money laundering [44].

Tajik's people are tired of an almost decade-long war and, although they are relatively more tolerant, the recent downturn in their wellbeing, due to the IPO campaign, and starvation, due to the food price increase, may have a negative impact on them. The supporters of forbidden militant groups and movements may increase, reviving more ties with the GoT.

Recent terrorist events in the Rasht valley of Tajikistan have demonstrated that terrorist confrontation against the state has a significant potential. It has also revealed the capability and collectiveness of Islamic militarism and has questioned the preparedness of the army and the stability of the state. The failure to respond, both on-time and adequately, to recent terroristic attacks, as happened in the case of the Rasht event, may attract the militant groups in Afghanistan, who could relocate to Tajikistan. Insecurity, decreased welfare and starvation might empower the terrorist organizations in the country. Instability, especially with the involvement of terrorism in one of the CA states, will definitely affect the stability of the other states and, therefore, regional cooperation in this matter is an important aspect.

All riparian states have to act in coordination towards effective utilization of the water resources and they must take into account Afghanistan's future demand and right for water [45]. Turkmenistan and Uzbekistan have to develop important reforms towards water use and management efficiency. Oclott [46] criticized the privatization of land and small-sized farms in Uzbekistan for decreasing efficiency of water usage. The GoU launched a land consolidation campaign and re-establishing large sized farms [47] that envisages ensuring water efficiency. A pilot project to implement integrated water resources management elements at the main canal levels and below, entitled "The Integrated Water Resources Management in Ferghana Valley" has also promoted and implemented participatory irrigation management. The preliminary results of the project were published [48] and can be disseminated over the country to promote increased water use efficiency. Uzbekistan has significant

potential for techno-economically exploitable small and medium scale hydropower, which should also be considered within the energy sector reform policy [49].

However, efficient water use in Uzbekistan will not decrease its water demand to a level which would allow the Amu-Darya River to be used under an “energy” regime. The change in water regime jeopardizes the economic development in the downstream countries, where the share of the agricultural sector is high. Stability of the irrigational water regime is thus a question of life or death for the downstream populations, while the GoT aims meeting its winter energy shortage by constructing and exploiting the Rogun dam.

One possible solution to the case may be operating the Rogun and Nurek dams in combination with a coordinated scheme that would allow keeping the irrigational water mode. In other words, releasing certain amounts of water from the Nurek dam and collecting more water from the Rogun dam, during the irrigational period, would allow Rogun HPS to generate electricity from the collected water during the winter and then storing this water in the Nurek reservoir. Organizing this scheme could minimize the winter release of water and therefore be a solution for guaranteeing the irrigational water regime while enabling generation of electricity to meet the peak winter electricity demand [50].

The GoT should recognize the fact that the Rogun Dam is not a solution for a recurring energy crisis in the short term. On the contrary, it is a lead towards hardly achieved macroeconomic and social stability. Thus it is crucially important for the GoT to focus on alternative solutions. Firstly, it has to seek a rapid solution, for the annually re-occurring energy crisis, that strengthens the macroeconomic stability, fuels economic growth and overcomes the existing energy problems.

Tajikistan faces viable appropriate paths for overcoming its energy crises by taking rapid actions on meeting the growing demand through improved efficiency and awareness, and preparing back-up sources such as petrol, coal or firewood in households and high priority facilities. Focusing on an urgent diversification of supplies, with sustainable and rapid energy solutions, is another important direction. There are technically feasible, economically viable, and, more importantly, harmless and sustainable solutions for the existing energy problem.

With annual sunny days ranging from 280 to 330, Tajikistan possesses very favorable conditions for solar power generation. The total intensity of solar radiation varies within a year from 280 to 925 MJ/m<sup>2</sup> in the lowlands and from 360 to 1120 MJ/m<sup>2</sup> in the mountainous regions [51]. An expert interview carried out by the authors in Uzbekistan revealed that the current price of installing each Watt of solar panels cost US\$ 2.70. In other words, installation of a solar panel with 100 W capacity costs US\$ 270. Maximal daily household electricity consumption corresponds to 2–2.5 kWh/day in Central Asian households. Considering that a solar panel can produce electricity at full capacity for eight hours a day, solar panel with 100 W capacity can produce 800 Wh of electricity daily. Based on the above-mentioned fact, three solar panels with a capacity of 300 W for the price of US\$ 840 would be sufficient for meeting the 2.4 kWh daily electricity demand of an average household. For comparison, an average household with five members are required to pay US\$ 3500 for the successful completion of the first stage of the Rogun dam [35], while US\$ 840 is sufficient for meeting their electricity demand in a quick and safe way.

Resource use efficiency is a major concern in all CA transition economies. Energy efficiency measures directly reduce consumer costs and provide considerable benefits, and most of the efficiency measures have relatively short payback periods. Achieving energy efficiency, in turn, allows for

meeting the energy demand with small changes in the supply side. Resource use efficiency for residential Tajikistan, who suffers from the energy crisis the most, may be divided into two parts (i) efficiency in space heating; and (ii) efficiency in lighting.

Regarding efficiency in space heating, relatively small investments in thermal insulation, such as changing the doors and windows and covering the floors and ceilings with thermostatic materials result in significant energy efficiency due to avoided heat loss. The effect of thermal insulation is exponentially high in CA due to its severe winters. For example, a study of thermal insulation efficiency by Stettler [52] in Switzerland revealed that a saving of greater than 50% can be made through investments in improved thermal insulation in the residential buildings. In Tajikistan, with similar climatic conditions and however, lower level of insulation efficiency, this number could be even higher.

Changing spiral-based lamps with luminescent bulbs also leads to energy efficiency by a factor of five. Statistics indicate that ca. 15% of the residentially consumed energy is used for lighting purposes and ca. 60% is used for space heating in the Western countries [53]. While the figure for space heating is relatively similar, energy spent for illumination in transition economies is significantly higher with regard to Western economies. This can be explained by inefficiency, due to use of spiral based lamps, which are to a large extent replaced with high efficiency luminescent lamps in the West. Tajikistan has been a pioneer in CA in terms of replacing old spiral based lamps with GoT's intervention and must serve as an example, in this case, to neighboring states. The Chinese-Tajik joint-venture in Chkalovsk city, with an annual production capacity of 2 million bulbs [54], will serve to decrease the price of the efficient lamps to an accessible level and thus facilitate the process of transition to efficient illumination solutions.

At the same time, using the underground water for space heating with small capacity high efficiency pumps is a solution in areas experiencing high groundwater tables, as well as in mountainous regions where geothermal sources is available. Underground water aquifers with temperatures of 20–90 °C [50] is a new cheap heating system based on a low capacity electric pump would decrease the consumption of gas or other fossil and related expenditures to a high extent. Installing an underground water well that can supply dozens of households with hot underground water costs up to 200 US\$, and based on the number of households, electric pump costs no more than US\$ 20 per person, making the overall per capita installments to US\$ 50, which is 14 times less than their desired per capita contribution to the Rogun dam project.

Moreover, the energy supplied as gas and electricity and used for heating and cooking in the rural areas of Tajikistan is a major responsibility and provided by the state. Since these energy sources are generally in undersupply and suffer from malfunctioning, users are reluctant to pay. Instead, households search for substitutes such as kerosene, charcoal, cotton stalks, manure and fuel-wood. The latter are illegally gained from tree plantings and the expansion of agricultural land and illegal logging has contributed further to the on-going land degradation. Both the environment and the population would thus benefit from afforestation projects that would also allow the sequestration of large amounts of the greenhouse gas Carbon Dioxide and thus contribute to the mitigation of global warming [55].

The share of small HPS in the energy sector used to be significantly high during the Soviet Union epoch in Tajikistan. The number of small HPS declined from 69, in 1978, to 5 in 1990. UNDP and various multilateral organizations have already provided pilot projects and feasibility studies in the

field [56]. According to Safarov [57] the GoT intended to construct 50 small HPS during 2009 but the euphoria about the Rogun seem to have postponed this process. Small HPS are relatively affordable, secure and are a relatively rapid solution for the energy crises as well as a suitable and affordable alternative for large HPS facilities with huge reservoirs in a seismological active region. However, depending on the location, they might not be utilizable during the winters, when the flow of water decreases and even freezes, due to the cold. Therefore, a combination of other alternatives, such as biomass, solar, and geothermal could be a full energy solution for the residential sector.

Although the financial feasibility of renewable solar and wind energy sources has not been studied sufficiently, so far, it is clear that they are quicker and more sustainable solutions for the existing energy crisis. The GoT can facilitate solar and wind as a quick-sustainable solution for the residential sector by directing the savings of the people, as well as further supporting the promotion of renewable sources, by announcing tax-breaks, giving further crediting and involving international donors. Moreover, utilization of renewable sources gives an opportunity of attracting Clean Development Mechanism (CDM) projects to the country in a large scale.

The state and its population would therefore benefit from an increased awareness, so as to increase energy efficiency and also to provide from diversified sources of energy. It is crucially important, and a prior concern for the GoT, to invest in research, development and application of alternative sources, diversifying the energy sources and promoting energy efficiency. In contrast, alternative solutions to the Rogun HPS project include the opportunity of involving Cleaner Development Mechanism projects, which, in line with decreasing the energy dependence and diversifying the energy sources, decrease the project costs and facilitate the task of overcoming the energy related problems quickly. Diversification of energy sources, and hence economic activities, create new jobs, facilitate economic growth and lead to a sustainable development.

Considering the Rogun dam as a cheap and quick energy solution for meeting the newly emerging electricity demand in Afghanistan will lead the region into an imminent economic and political crisis. Economic development in Afghanistan is vitally important for the overall regional development in CA and the AfPak region, however this development must not jeopardize the stability by immediately changing the runoff of the rivers from the historical “agricultural irrigation” mode to “energy” mode. CA states will remain highly dependent on agricultural production and change of water runoff to full energy mode will reflect on the livelihood of dozens of millions of people in the form of increased food prices, decreased income and social and environmental degradation.

## 9. Conclusions

Depending on the findings of the ongoing study by the World Bank, the Rogun dam may be an adequate solution for CA’s growing energy needs in the long run. At this point, however, the revitalization decision is leading the country into a security threat, which has already started to be reflected in everyday life in Tajikistan.

Two years after the 2008–2009 catastrophic energy crises, no action was taken to solve the existing energy problem. GoT has collected a significant amount of savings of the people for an ambitious dam project, offering an energy solution while diminishing their capability of individually coping with the

problem. Although quick and more feasible solutions exist, energy security, both in short and medium term, remains absent.

Disputes with Uzbekistan concerning the water mode change, increased seismic activity and possible environmental and humanitarian damage are leading the bilateral relations to a point of no return. The GoT's unilateral decision making, in the context of disregard of the interest and serious concerns of its neighbors, is leading the country to an imminent socio-political collapse. Signing contract and agreements on electricity export with Afghanistan and Pakistan while the lacking capacity of meeting the peak winter demand is not fulfilled, is extremely worrisome. Even more worrisome is the fact that the cheaper, quicker and more sustainable solutions mentioned in this paper, which do not jeopardize regional security, development and cooperation, are being neglected.

Increased poverty and famine and energy shortage are the major issues at this point, when the country is heading to a winter with even fewer food products available for accumulation. Hence, all of these problems need to be resolved rapidly and without putting an excessive burden on either the population or SMEs, which together are the engine of economic development in Tajikistan. The GoT has to focus on the major sectors where underdevelopment is fuelling the current threats to national and regional security. Further degradation of the energy, economic and socio-politic security may at any moment lead to the failure of the state.

Furthermore, this short period of exploiting the Central Asian Rivers partly under the "energy" mode has already demonstrated that water in Central Asia is more a source of food and income for far larger number of people, than a source of energy. Further extensive exploitation of these rivers for energy generation purposes and neglecting the irrigation water needs of the downstream population could lead the region into a famine. Hence, energy problems should be resolved with alternative methods, including the revitalization of water-energy nexus between the riparian countries. Considering the Rogun dam as a source of cheap electricity for Afghanistan and Pakistan will bring the Central Asian region into a socio-political collapse and expansion of Afghanistan's problems to the Central Asian region whilst attempting to bring development to Afghanistan.

Moreover, whereas the ecological impact of the construction of the Rogun dam can only be guessed, with the pursuit of the dam's construction it is certain that this inflicts with the water management in the CA countries and hence bears a significant danger through further conflicts. The revitalization of a long-term project which previously had been abandoned and even destroyed by natural disasters does not hold a promising solution for Tajikistan at this point. The decade-long water-energy dispute can only be resolved in dialogue and mutual understanding and in attributing respect to each other but certainly not by isolated actions of individual states, irrespective of the motivations for doing so. It is, therefore, up to the Governments of all five CA countries to demonstrate to the international community that they have unraveled themselves from the Soviet Union legacies and are ready to become members of an international community that solves problems rather than creating them. Hence, the international Community, as well as the populations of the five CA countries, will benefit from finally committing to a binding agreement. This is no time for another round of conflicts.

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