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RISK ASSESSMENT AND MANAGEMENT IN RENEWABLE ENERGY PROJECTS IN KYRGYZSTAN/

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The Kyrgyz Republic occupies a distinctive position in the renewable energy transition: its electricity system is already approximately ninety per cent renewable, yet structurally fragile, owing to near-total dependence on glacier-fed hydropower. This article applies the principal international standards for risk management — ISO 31000:2018, ISO/IEC 31010:2019, the IFC Performance Standards, the World Bank Environmental and Social Framework, the Equator Principles (EP4, 2020) and the IRENA risk-mitigation taxonomy — to the Kyrgyz renewable energy portfolio, including the trilateral USD 4.2 billion Kambarata-1 hydropower project. The article identifies five categories of risk, plots them on an ISO 31010-compliant heat map, and proposes a mitigation portfolio combining contractual, financial and institutional instruments.

Keywords: ISO 31000; IFC Performance Standards; Equator Principles; Kyrgyzstan; hydropower; Kambarata-1; renewable energy risk.

1. Introduction

The Kyrgyz Republic has long been characterised as a country of exceptional hydropower endowment. Total hydropower potential is estimated at 142 billion kWh per annum, of which approximately ten per cent has been developed [18]. Hydropower accounted for around eighty-six per cent of electricity generation in 2023, with the Soviet-era Toktogul reservoir and cascade producing roughly ninety-seven per cent of national hydroelectricity [20]. On aggregate measures, the Kyrgyz electricity system is therefore among the most renewable in the world. Yet this apparent advantage conceals an acute vulnerability: the dominant generation technology is itself the principal transmission channel through which climate variability enters project economics.

Against the background of accelerating glacial retreat, rising electricity demand, and an ambitious project pipeline including the USD 4.2 billion trilateral Kambarata-1 hydropower plant [17], the assessment and management of risks in Kyrgyz renewable energy projects has become a first-order policy concern. This article examines how the principal international risk-management standards — ISO 31000:2018 [9], ISO/IEC 31010:2019 [10], the IFC Performance Standards [6], the World Bank Environmental and Social Framework [19], the Equator Principles (EP4, 2020) [2] and the IRENA risk-mitigation taxonomy [8] — can be operationalised in the specific institutional, hydrological and political-economic context of Kyrgyzstan. The article is organised in five sections following this introduction: the international standards framework, the Kyrgyz energy profile, risk assessment, risk management, and conclusions.

2. The International Standards Framework

ISO 31000:2018 provides the master framework for risk management. The standard defines risk as the effect of uncertainty on objectives and prescribes a structured process comprising the establishment of scope, context and criteria; risk identification; risk analysis; risk evaluation; risk treatment; and ongoing communication, monitoring and review [9]. Its companion ISO/IEC 31010:2019 catalogues thirty-one risk assessment techniques, including the likelihood-impact matrix used in Section 4 below [10].

The IFC Performance Standards address environmental and social dimensions of risk insufficiently treated in ISO 31000. Performance Standard 1 requires an Environmental and Social Management System and an Environmental and Social Impact Assessment (ESIA); Performance Standards 2 to 8 address labour, pollution prevention, community health and safety, land acquisition, biodiversity, indigenous peoples and cultural heritage [6]. The World Bank Environmental and Social Framework plays an analogous role for public-sector projects through ten Environmental and Social Standards, with ESS1 requiring explicit assessment of cumulative and transboundary impacts [19]. The Equator Principles, in their fourth iteration (EP4, 2020), translate the IFC standards into binding commitments for project finance transactions above USD 10 million, requiring risk-based project categorisation, independent review of environmental and social assessments, and climate change risk assessment aligned with the Task Force on Climate-related Financial Disclosures [2]. The IRENA risk-mitigation taxonomy completes the framework by cataloguing the contractual, financial and institutional instruments appropriate to each category of risk [8].

3. The Kyrgyz Energy Profile and Risk Context

Figure 1 sets out the Kyrgyz electricity generation mix and the structure of installed capacity at end-2025. Panel (a) confirms the overwhelming weight of hydropower in generation; panel (b) reveals the limited contribution of non-hydro renewables, although the commissioning of the first 100 MW solar plant in late 2025 and the addition of small hydropower totalling 115 to 120 MW during the year mark the beginning of a structural diversification [13; 14].

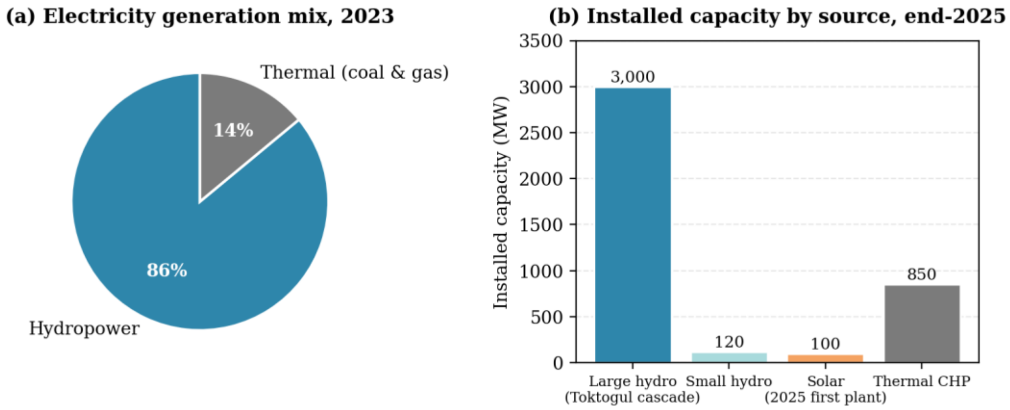

Figure 1. Kyrgyz electricity generation mix (2023) and installed capacity by source (end-2025). Sources: [20]; [13]; author estimates.

The structural vulnerability of this profile is illustrated in Figure 2, which plots the September water level of the Toktogul reservoir between 2017 and 2025. The reservoir operates between a maximum of 19.5 km³ and an operational minimum of 5.5 km³, below which the dependent hydroelectric cascade cannot operate. The September level has declined monotonically from its 2017 peak, reaching 10.8 km³ in 2025 — the lowest September reading in over a decade [11]. The climatological backdrop is unambiguous: Kyrgyzstan has lost approximately sixteen per cent of its glaciers over the past seventy years, with projected additional losses of up to fifty per cent by 2050 [7]. Domestic hydropower generation fell by sixteen per cent between 2018 and 2022, and in the first half of 2025 the country imported more than twenty per cent of its electricity consumption [16].

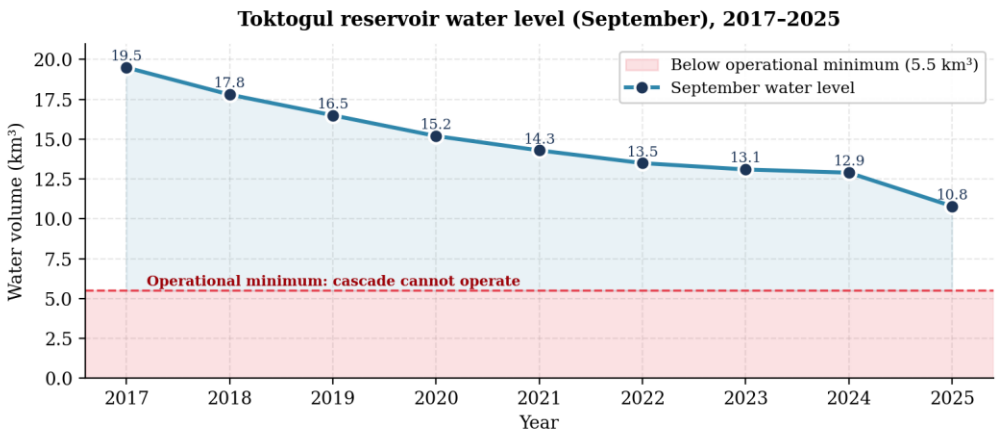

Figure 2. Toktogul reservoir water level, September 2017–2025 (km³). The reservoir operates between 19.5 km³ (full) and 5.5 km³ (operational minimum). Source: [11].

The regulatory environment is itself volatile. A draft Law on Renewable Energy Sources circulated in mid-2025 proposed a one per cent revenue levy and a thirty-per-cent accumulation capacity requirement on renewable energy operators [17]; in January 2026 the Jogorku Kenesh approved amendments introducing foreign-currency tariff indexation for investment projects and a competitive auction mechanism [14]. The two episodes, taken together, illustrate the regulatory uncertainty within which investment decisions must be made.

4. Risk Assessment per ISO 31000 / ISO 31010

Application of the ISO 31000 risk-identification step to the Kyrgyz renewable energy portfolio yields five categories of risk. R1 is hydrological and glaciological risk — the endogenous climate exposure of the dominant hydropower technology described in Section 3. R2 is regulatory and tariff risk, illustrated by the 2025–2026 legislative cycle. R3 is currency and off-taker risk, arising from the depreciation history of the Kyrgyz som and from the limited creditworthiness of the state-owned utility. R4 is transboundary and geopolitical risk, most acute for the Kambarata-1 project, whose Cumulative Impact Assessment has been criticised for the absence of a designed and agreed flow regime governing the Toktogul–Kambarata-1 cascade [15; 1]. R5 is technical and grid-integration risk, derived from aged transmission infrastructure with losses above twenty per cent and from limited grid capacity to absorb variable renewables [3].

Figure 3 plots these risks on the standard likelihood-impact heat map prescribed by ISO/IEC 31010:2019 [10].

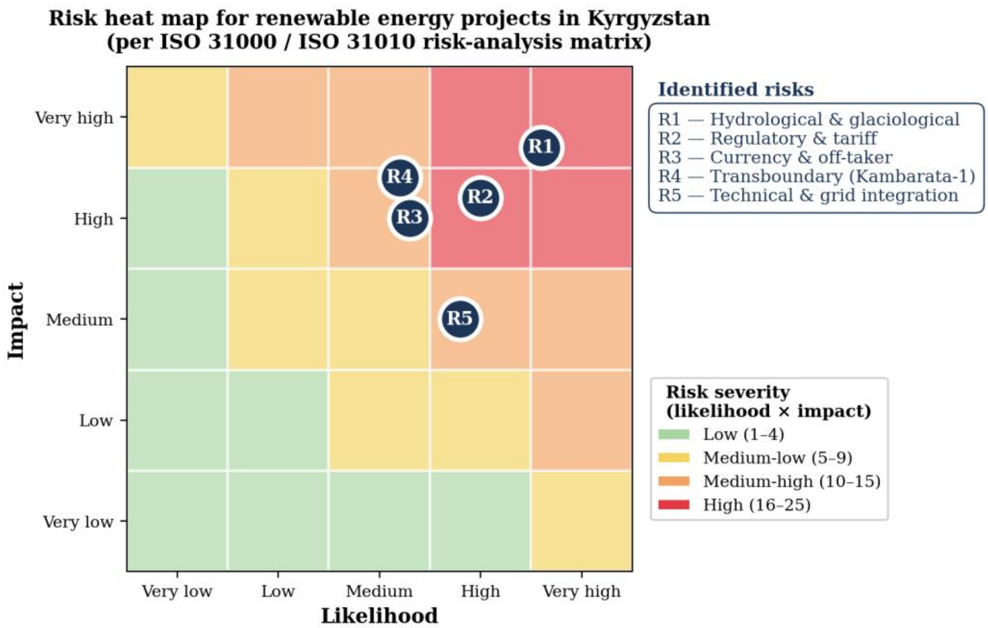

Figure 3. Risk heat map for renewable energy projects in Kyrgyzstan, plotted on the ISO 31000 / ISO 31010 likelihood–impact matrix (5×5 scale). Source: author, based on ISO/IEC 31010:2019 methodology [10].

Risks R1 and R2 fall in the high-severity zone (likelihood × impact ≥ 16); R3 and R4 fall in the medium-high zone; R5 in the medium-high zone with lower impact. The concentration of identified risks in the upper-right quadrant of the matrix is itself a diagnostic finding: it indicates that the dominant risks confronting Kyrgyz renewable energy projects are neither rare-event tail risks nor low-impact operational risks but rather structural risks whose materialisation is moderately to highly likely and whose consequences are material for project economics.

5. Risk Management and Mitigation

The treatment of the risks identified above requires a portfolio of instruments rather than reliance on any single mechanism. Hydrological risk (R1) is structural and cannot be diversified away within the dominant hydropower technology; mitigation requires portfolio-level diversification toward solar and wind, supported by grid-scale battery storage and by basin-scale water-management agreements with downstream states. The October 2025 amendments raising the renewable energy facility capacity threshold from 30 MW to 50 MW [12], and the recent commissioning of the first 100 MW solar plant, are consistent with this strategy.

Regulatory and tariff risk (R2) is mitigated by the 2026 amendments permitting foreign-currency tariff indexation for investment projects and public-private partnerships, by the introduction of competitive auctions, and, prospectively, by the inclusion of stabilisation clauses in primary legislation [14]. Currency and off-taker risk (R3) is addressed by local-currency financing facilities from the International Finance Corporation and the Asian Development Bank, by MIGA political risk insurance, and by sovereign guarantees applied selectively in conjunction with multilateral risk-sharing instruments [8].

Transboundary risk (R4), most acute for Kambarata-1, requires institutional rather than purely contractual mitigation. Under ESS1 of the World Bank Environmental and Social Framework [19] and PS6 of the IFC Performance Standards [6], financial close should be conditional on the prior conclusion of a binding transboundary environmental flow regime governing the Toktogul–Kambarata-1 cascade. Under EP4, the project would be classified as Category A, requiring independent review of the ESIA, TCFD-aligned climate risk assessment, and continued compliance through the financing life-cycle [2]. Technical risk (R5) is mitigated through compliance with the relevant IEC technical standards (IEC 61400 for wind turbines [4]; IEC 61724 for photovoltaic systems [5]), supported by grid modernisation co-financed with multilateral institutions.

6. Conclusions

The renewable energy portfolio of the Kyrgyz Republic is at an inflection point. The 2026 legislative amendments [14], the commissioning of the first utility-scale solar plant and the advance preparation of Kambarata-1 under World Bank technical assistance [20] together represent a substantive move toward alignment with international risk-management practice, while the unresolved transboundary flow regime and the structural decline of the Toktogul reservoir indicate that significant work remains. Four recommendations follow. The Kyrgyz government should enact comprehensive primary legislation incorporating ISO 31000 principles, including stabilisation clauses. Multilateral lenders should make financial close on Kambarata-1 conditional on a binding transboundary flow regime. Private sponsors should adopt EP4 as the minimum standard, with TCFD-aligned climate risk assessment treated as a determinant of bankability. Finally, the Kyrgyz technical regulator should be strengthened to verify compliance with IEC 61400 and IEC 61724. The structural fragility of the Kyrgyz hydropower base renders the consistent integration of internationally recognised standards into domestic practice not optional but essential.

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ОЦЕНКА И УПРАВЛЕНИЕ РИСКАМИ В ПРОЕКТАХ ВОЗОБНОВЛЯЕМОЙ ЭНЕРГЕТИКИ В КЫРГЫЗСТАНЕ

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Кыргызская Республика занимает особое место в переходе к возобновляемой энергетике: её электроэнергетическая система уже примерно на девяносто процентов основана на возобновляемых источниках энергии, однако остаётся структурно уязвимой из-за почти полной зависимости от гидроэнергетики, питаемой ледниковыми водами. В данной статье применяются основные международные стандарты управления рисками — ISO 31000:2018, ISO/IEC 31010:2019, Стандарты деятельности IFC, Экологическая и социальная рамочная программа Всемирного банка, Принципы Экватора (EP4, 2020), а также классификация инструментов снижения рисков IRENA — к портфелю проектов возобновляемой энергетики Кыргызстана, включая трёхсторонний гидроэнергетический проект «Камбар-Ата-1» стоимостью 4,2 млрд долларов США. В статье выделяются пять *категорий рисков, которые отображаются на тепловой карте в соответствии с ISO 31010, а также предлагается комплекс мер по снижению рисков, сочетающий договорные, финансовые и институциональные инструменты.*

Ключевые слова: ISO 31000; Стандарты деятельности IFC; Принципы Экватора; Кыргызстан; гидроэнергетика; Камбар-Ата-1; риски возобновляемой энергетики.

ҚЫРҒЫЗСТАНДАҒЫ ЖАҢАРТЫЛАТЫН ЭНЕРГЕТИКА ЖОБАЛАРЫНДАҒЫ ТӘУЕКЕЛДЕРДІ БАҒАЛАУ ЖӘНЕ БАСҚАРУ

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Қырғыз Республикасы жаңартылатын энергетикаға көшу үдерісінде ерекше орын алады: елдің электр энергетикалық жүйесі шамамен тоқсан пайызға жаңартылатын энергия көздеріне негізделгенімен, мұздық суларымен қоректенетін гидроэнергетикаға тәуелділігіне байланысты құрылымдық тұрғыдан осал болып қала береді. Бұл мақалада тәуекелдерді басқарудың негізгі халықаралық стандарттары — ISO 31000:2018, ISO/IEC 31010:2019, IFC қызмет стандарттары, Дүниежүзілік банктің экологиялық және әлеуметтік негіздемелік бағдарламасы, Экватор принциптері (EP4, 2020), сондай-ақ IRENA ұйымының тәуекелдерді төмендету құралдарының жіктемесі — Қырғызстандағы жаңартылатын энергетика жобаларының портфеліне, соның ішінде құны 4,2 миллиард АҚШ долларын құрайтын үшжақты «Қамбар-Ата-1» гидроэнергетикалық жобасына қолданылды. Мақалада ISO 31010 стандартына сәйкес жылу картасында көрсетілетін тәуекелдердің бес санаты айқындалып, шарттық, қаржылық және институционалдық құралдарды үйлестіретін тәуекелдерді төмендету шараларының кешені ұсынылады.

Кілт сөздер: ISO 31000; IFC қызмет стандарттары; Экватор принциптері; Қырғызстан; гидроэнергетика; Қамбар-Ата-1; жаңартылатын энергетика тәуекелдері.