HOW TO PRIORITIZE PUBLIC INVESTMENTS WITH A **SUSTAINABLE APPROACH**

MEF Climate Change PLATFORM

Ministries of Economy and Finance

IDB

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About the platform

The MEF Climate Change Platform is a unique regional collaboration network between governments that is transforming the way Latin American and Caribbean countries address climate challenges through fiscal policy, turning them into opportunities for economic development. Established in 2022 by mandate of the IDB Governors and led by the ministries of economy and finance, it brings together 26 borrowing countries around a shared vision of sustainable financing. Through collective intelligence, it generates specialized knowledge and promotes the implementation of practical climate fiscal policy solutions, strengthening the competitiveness and resilience of the region's economies. The Platform is funded by the German Government's International Climate Initiative.

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Acronyms

AHP	Analytical hierarchy process
CBA	Cost–benefit analysis
CC	Climate change
CI	Consistency index
CR	Consistency ratio
DRAT	Arenal Tempisque Irrigation District
IDB	Inter-American Development Bank
IMF	International Monetary Fund
IMU	Investment management unit
NPV	Net present value
OECD	Organisation for Economic Co-operation and Development
PRAT	Arenal Tempisque Irrigation Project
PVC	Present value of costs
PVCB	Present value of costs per beneficiary
RI	Random Index
SNIP	National Public Investment System (Sistemas Nacionales de Inversión Pública)

Introduction

The life cycle of public investment consists of several stages designed to ensure that projects are both technically feasible and socioeconomically profitable. The International Monetary Fund (IMF) identifies three key stages in public investment management: planning, resource allocation, and implementation. Within the resource allocation stage, one of the processes to be carried out is the *prioritization or selection of projects*. In contexts of fiscal constraints and limited resources, prioritization becomes an essential tool, as it provides a framework for ranking investments according to predefined criteria. This process is therefore a key decision point to ensure that only projects with the highest scores in the prioritization ranking are deemed eligible to receive the budget allocation (World Bank, 2022).

Currently, national public investment systems (sistemas nacionales de inversión pública, or SNIPs) face the challenge of implementing investments that contribute to nationally defined priority areas. The prioritization process supports this objective by establishing orders of preference that consider not only the socioeconomic returns of projects, but also indicators that reflect the country's social, environmental, and institutional priorities. In Latin America and the Caribbean (LAC), one of the main challenges is selecting and executing investments that can adapt to climate change (CC) and foster the necessary transformations to enable a transition to a carbon-neutral economy (Fazekas, Bataille, and Vogt-Schilb, 2022). This requires integrating both adaptation and mitigation objectives into project prioritization processes.

As stated by Eguino et al. (2024), adopting prioritization methodologies that incorporate resilience and decarbonization criteria[1] requires indicators and metrics to quantify each project's contribution to national decarbonization and resilience goals to be defined. In addition, it is important to apply multi-criteria decision-making models within prioritization processes and to build institutional capacities for managing these tools in an integrated manner. The effectiveness of the system will depend largely on its ability to recognize climate risks arising from environmental disasters and to measure the projects' contribution to decarbonization.

The adoption of prioritization systems that integrate sustainability and resilience considerations generate important benefits. These include promoting the most efficient use of public resources in resilient and low-carbon investments, improving the management of climate and transition risks, and aligning public investments with the objectives defined in the countries' medium- and long-term climate strategies (Eguino et al., 2024).

Within this context, the purpose of this document is to offer a practical guide to aid decision-making in the prioritization of projects, based on the application of sustainability criteria to a portfolio of socially profitable public investment initiatives.[2] This guide considers "environmental sustainability and resilience" in the prioritization framework. This criterion contains the following sub-criteria: emissions reduction; climate risk, resilience, adaptation and multi-hazard disaster risk management; and sustainable use and conservation of habitat and ecosystem.

[1] Decarbonization is the progressive process of reducing carbon emissions into the atmosphere.
[2] In other words, a portfolio of investment initiatives that have previously successfully passed the filter of socio-economic project assessment.

This document was developed based on a review of existing methodologies for prioritization of public investment projects with sustainability criteria developed by countries of the Organisation for Economic Co-operation and Development (OECD) and the region, carrying out a comparative analysis of these practices and their main findings. The aim is for this methodological guide, which incorporates sustainability and resilience criteria, to be applicable across LAC countries. It also emphasizes that prioritization of projects with a focus on sustainability and resilience should occur only after the projects have proven to be technically feasible, socioeconomically profitable, and approved as eligible for budget allocation (endorsement).

To determine whether a project is consistent with climate objectives, the guide suggests establishing indicators for each sub-criterion, subject to the availability of information to quantify them. In LAC, a persistent challenge for SNIPs is the lack of robust investment project databases with reliable information systems to support this analysis. In addition, the region must continue to advance in integrating climate action into all stages of the project cycle. This implies, for example, considering such aspects in the project appraisal evaluation of projects, so that they arrive at the prioritization stage better prepared and with sounder information on relevant sustainability and resilience indicators.

Finally, the guide highlights that, although climate change is an increasingly relevant aspect, it is not the only criterion that countries consider when prioritizing their investments. The weighting that each country assigns to the prioritization criteria must be tailored to its national context. To this end, the process of defining criteria, sub-criteria, and indicators must be aligned with public policy goals, national and sectoral plans, and other strategic documents of the country.

This document is organized in three main sections. The first section presents the framework for efficient investment management, in which the investment prioritization process is situated within the life cycle of public investment projects. The second section outlines the proposed methodology to carry out the project prioritization exercise, incorporating sustainability considerations. Finally, the third section provides a set of recommendations for countries to consider during the construction of investment prioritization processes.

1 Framework for Efficient Investment Management

Currently, SNIPs face, among other challenges, the need to select and implement investments that can avoid, mitigate or adapt to CC. Thus, the effectiveness of the system also depends largely on its ability to recognize climate risks generated by environmental disasters and its capacity to measure projects' contributions to decarbonization.

Therefore, in the context of climate action, prioritization procedures, systems, and tools should consider incorporating the mitigation and adaptation objectives established by the countries themselves. Among others, the adoption of prioritization systems that integrate climate action generates benefits such as: (i) optimization of the use of public resources in investments with social impact; (ii) prioritization of climate-resilient investments, (iii) improved management of climate and transition risks, and (iv) better alignment of public investments with the objectives defined in the countries' medium- and long-term climate strategies (Eguino et al., 2024).

From an operational standpoint, this means adopting formal investment prioritization tools that are applied to socioeconomically cost-effective projects and that can be aligned to instruments such as long-term climate strategies, national decarbonization and resilience strategies, sectoral energy transition plans, nationally determined contributions, or fiscal instruments such as medium-term expenditure frameworks (Eguino et al., 2024). In doing so, CC considerations can be integrated into capital expenditure management, optimizing resource allocation, improving efficiency in climate risk management, and maximizing the social impact of investments that are resilient (i.e., sustainable over time) and aligned with national decarbonization goals.

Essential Concepts

Considering the challenges faced by SNIPs, it is essential to establish some key concepts, as pointed out by Eguino et al. (2024). *Resilient infrastructure* refers to infrastructure that is planned, designed, built, and operated in a way that anticipates and adapts to changing climate conditions. Furthermore, this infrastructure must also be able to withstand, respond to, and recover quickly from disruptions caused by climate conditions. Thus, resilience is the result of investing in three main areas:

- Adaptation to climate risks, to reduce the climate exposure or vulnerability of an asset or infrastructure network.[3]
- Creating an enabling environment, through investments in climate information systems, raising awareness among decision-makers, capacity building, and adapting governance systems to climate change.
- Developing new resilient infrastructure.

Conversely, *low-carbon infrastructure* refers to infrastructure that generates fewer greenhouse gas emissions than traditional infrastructure. Some examples include the following:

- Rail systems that reduce reliance on high-emission vehicles
- Urban transportation projects such as subways and light rail, which reduce the use of automobiles

[3] For example, engineering works with additional redesign costs or the application of more stringent design standards.

- Renewable energy projects (solar, wind, and hydroelectric), which emit far less carbon than conventional energy sources

Integrating these concepts is fundamental for efficient management of the countries' capital expenditure. As stated by the IMF (2021), failure to consider CC in public infrastructure can result in several negative outcomes:

- The risk of failing to meet climate targets, potentially affecting the country's fiscal and economic stability
- Development of infrastructure that becomes unusable, stranded (*stranded assets*), or subject to accelerated depreciation because of damage or loss of functionality in infrastructure networks
- Reduced net private and socioeconomic benefits from infrastructure investment due to higher one-time repair costs and suspension of services
- The need to allocate supplementary and extraordinary resources, both for routine maintenance and for attending to emergencies that may arise during the useful life of the projects
- Loss of physical capital, accompanied by high replacement costs, especially in the case of infrastructure with high repair costs (such as that associated with transportation) and infrastructure with high social opportunity costs in terms of providing services to users, such as those associated with health and transportation

Naturally, all these effects force the reallocation of resources from other sectors toward infrastructure, reducing the efficiency of public resource management.

Objective of the Guide

Given this context, the purpose of this document is to offer a practical guide to inform decision making in the prioritization of projects based on the application of CC-related criteria[4] to a portfolio of socially profitable public investment initiatives.[5] At the core of this objective lies the concept of *sustainable infrastructure*, that is, infrastructure projects selected in a way that ensures economic, social, institutional, and environmental sustainability, including climate resilience and decarbonization.

[4] In terms of their contribution to climate change adaptation or mitigation objectives.
[5] In other words, a portfolio of investment initiatives that has previously successfully passed the filter of socioeconomic project assessment.

The Investment Life Cycle

Within the framework of efficient public investment management, it is essential to establish how the various tools are integrated with climate action throughout the different stages of the capital expenditure process. The SNIP is the institutional scheme that provides legal and regulatory support to the public investment management process and links processes (planning, resource allocation, and implementation). Initiatives must overcome various stages that challenge them from the technical point of view, to ensure their viability and socioeconomic profitability. Prioritization is a process that is part of the **resource allocation** stage (Figure 1). To this end, it is necessary to establish guidelines that reflect national investment priorities.

Figure 1. Tools for Integrating Climate Action into Public Investment Management

Source: Eguino et al. (2024).

Within this framework, it is crucial not to confuse or overlap the processes associated with the life cycle of projects, nor to lose sight of the fact that prioritization is inherently a technical-political process. Even when SNIPs can merge some of these processes, each must retain and fulfill its independent function to ensure efficient project management. In this sense, as the IMF (2022, p. 114) emphasizes, "[P]roject selection is by nature a separate process from project planning and appraisal, although many real-life public investment systems do not recognize this distinction…project selection involves choosing projects from a plan or from a set of evaluated (and approved) projects, taking due account of relevant economic, social, environmental, and political conditions…(selection) is not just a technical process; it involves fundamental political considerations."[6]

Evaluation

Appraisal takes place during the **planning** stage and follows a regulated sequence of steps that involve the elaboration of studies at the profile, pre-feasibility and feasibility levels, to establish the technical relevance and socio-economic profitability of the projects.[7] *Evaluation* is generally carried out by the sectoral ministries in line with the criteria and norms established by the SNIP through the investment management unit (IMU).[8]

Once the projects have been evaluated by the sectors, they are submitted to the system for an *independent review* conducted by the IMU. This process concludes with an opinion of eligibility, rejection or endorsement opinion, and includes an analysis of the prefeasibility and feasibility studies to ensure compliance with the methodological and regulatory guidelines established by the SNIP.[9] The review also seeks to counteract and minimize optimism bias (i.e., the tendency to overestimate demand and underestimate costs) that frequently arises during project evaluation carried out by the sectors or agencies promoting the initiatives.[10] This process, also referred to as project appraisal evaluation, serves to validate the proposed technical solution, verify compliance with regulatory requirements, and assess the project's socioeconomic profitability, among other aspects.

If the project satisfactorily meets the technical, regulatory, and socioeconomic profitability standards, it is *approved* and *granted* an endorsement to receive budgetary funding (or "quality seal"). This endorsement[11] is typically valid for one or two years, although it does not imply that the project must necessarily be included in the budget (Box 1).

[6] Project selection is a decision milestone, between the prioritization and budgeting sub-processes.

[7] The evaluation includes the project preparation process, in which the problem, diagnosis, population characteristics, supply analysis, demand and gap estimation, technical solutions, cost and benefit estimation, and socioeconomic profitability estimation, among other activities, must be reported. Under this scheme, the assessment also involves the estimation and use of a "specific shadow carbon price" for each SNIP and country.

[8] This unit has different names in each country. Some examples are: General Directorate of Public Investment (Paraguay and Dominican Republic), General Directorate of Multiannual Investment Programming (Peru), Division of Social Evaluation of Investments (Chile), among others.

[9] Depending on the SNIP structure, this unit may be in the Ministry of Planning (when SNIPs are co-managed between Planning and Finance) or the Ministry of Finance or Treasury (when SNIPs are centralized in this ministry).

[10] Optimism bias is the systematic tendency to underestimate costs and overestimate benefits, making the project appraisal arguments in favor of the project more convincing than they turn out to be. The typical result of the bias manifests itself in cost overruns, delays, and benefit shortfalls that undermine the viability of the project during implementation and operations (Flyvbjerg 2014; UK HM Treasury, 2022).

[11] If the project does not meet the standards required by the SNIP during the independent review process, it must be reformulated, postponed, or rejected outright.

Box 1. **Socioeconomic Evaluation Methods**

For investment appraisal, social cost–benefit analysis is recommended as the preferred tool for estimating the socioeconomic profitability of projects. However, in the case of projects in the social sector, it is common to apply a cost-effectiveness analysis or cost-efficiency analysis in place of cost-benefit analysis. It is also important to highlight that environmental impact assessments (regulatory in nature) and the estimation of environmental externalities (technical in nature) should form part of these analyses. However, they should not be confused with *project prioritization*, which occurs once the project has been evaluated, approved, and "endorsed" by the investment management unit as part of its *independent review* function, described above.

Based on Kim, Fallov, and Groom (2020)
Note: Sectors such as health, education, social housing or security, among others.

Prioritization

Once the project begins the **resource allocation** stage, it is essential to adopt methodologies and criteria to quantify its contribution to the resilience and decarbonization goals. As proposed by Eguino et al. (2024), it is recommended to: (i) establish criteria and indicators to quantify the contribution of projects to decarbonization and resilience goals, (ii) apply multi-criteria decision models in project prioritization processes, and (iii) generate institutional capacities to manage these tools in a comprehensive manner.

Project *prioritization* should be understood to be a technical-political process aimed at establishing orders of preference. From a theoretical standpoint, projects should be ranked according to socioeconomic profitability; however, and for different reasons,[12] prioritization should have a broader approach that also includes considerations of social, environmental, and institutional context, among others, to make the selection process more realistic. This guide focuses on this stage of the project life cycle, providing guidelines for the prioritization of a previously approved project portfolio,[13] while incorporating CC considerations.

Budgeting

Following *prioritization*, the process of *multi-year investment budgeting* begins. This stage involves *project selection* as a key decision point and the culmination of the investment quality analysis processes. Project selection is based on the findings and recommendations issued by the IMU *review function* and concludes with a formal decision on the project's eligibility and inclusion in the following year's budget. At this stage, the most relevant financing mechanism (e.g., traditional public financing, public–private partnership, or donor provision) is also determined.

[12] In general, these reasons refer to the difficulties in monetizing all the benefits and costs, as well as the need to include the preferences and strategic guidelines established by the *policymakers*.

[13] The fact that the project portfolio has been previously approved implies, de facto, that it has been independently evaluated and reviewed beforehand, thus ensuring the quality of the technical solutions, regulatory compliance, and positive socioeconomic return on investment.

In this regard, *multi-year investment budgeting* connects project prioritization with fiscal constraint, where political-technical criteria generally prevail to safeguard the financial sustainability of projects. This involves scrutiny of future costs and assurance of financing during the project life cycle. As a result, both the priority and eligibility of projects for final implementation are validated.

2 Prioritizing Sustainability Projects

The fundamental principle underlying SNIPs is the efficient management of public investments, to maximize social welfare in the context of limited public resources, which requires decision making based on efficient criteria. In this regard, it is essential to have formal project prioritization processes to select the investment portfolio that will be incorporated into the budget and executed.

From a purely efficiency-oriented perspective,[14] project prioritization should be based on the socioeconomic profitability of the projects. However, in a more complex world, where projects must address multiple dimensions (such as contributions to equity, territorial development, or CC), profitability alone may be insufficient as a prioritization tool in contexts of limited resources. Given this reality, and because some of the dimensions cannot necessarily be monetized and included as part of the cost-effectiveness indicators, prioritization based on multi-criteria analysis (MCA) has gained ground to prioritize investments, especially when there are multiple criteria and aspects to be reconciled (Eguino et al., 2024).

The Concept of Sustainability

International experience reveals a broader view of the prioritization process linked to the concept of "sustainable infrastructure." As Bhattacharya et al. (2019) argue, infrastructure sustainability should account for the benefits and costs of an investment across the entire project life cycle, including both positive and negative externalities. Additionally, sustainability should be assessed comprehensively, encompassing dimensions such as economic, financial, social, environmental, and institutional impacts. According to this approach, sustainable infrastructure can be said to refer to:

> "[infrastructure] projects that are planned, designed, constructed, operated, and decommissioned in a manner that ensures economic and financial, social, environmental (including climate resilience), and institutional sustainability throughout the project life cycle" (Bhattacharya et al., 2019, p. 23).

[14] The transcendent aspect of this approach is that it rejects the correction of socioeconomic evaluation results by using distributive weights for correction. Harberger (1971) formalizes the principles of this approach through three fundamental postulates, which establish the criteria under which the socioeconomic evaluation of projects should be established. The postulates are based on the fundamentals of welfare economics and establish the basis for project evaluation in most countries with best practices in public investment management (Australia, Canada, Chile, Colombia, Ireland, Mexico, United Kingdom, among others); likewise, the efficiency approach is also used and suggested by multilateral lending agencies (Asian Development Bank, Inter-American Development Bank, International Monetary Fund, World Bank, and others). In practical terms, any country that evaluates public investment projects using cost–benefit analysis without corrections for distributional weights is appealing to the principles of the efficiency approach, even if it is not formalized in the system's regulations.

The definitions for each sustainability dimension are derived from the statement above as follows (Bhattacharya et al., 2019, pp. 24–26):

1. Economic and financial sustainability. Infrastructure can be considered economically sustainable when it delivers a positive net economic return once all benefits, costs, and externalities–both positive and negative– are considered across the project's life cycle. Sustainable infrastructure should also be conceived to foster inclusive and sustainable growth, enhance productivity, and ensure access to affordable, high-quality services. Risks should be allocated to those entities that are best able to manage or absorb their impact, while fiscal liabilities should be fully recognized and investment decisions aligned with debt and fiscal sustainability.

2. Environmental sustainability and resilience. Sustainable infrastructure protects and integrates the natural environment, promotes efficient use of resources, and applies nature-based solutions. It also minimizes pollution across the project life cycle, supports the transition to a low-carbon and resource-efficient economy, and is designed to withstand climate and natural disaster risks.

3. Social sustainability. Sustainable infrastructure is inclusive and gains support from communities that may be affected. It should benefit all stakeholders, especially vulnerable populations, by enhancing well-being and living standards across the project's life span. Projects must uphold strong labor, health, and safety norms, ensure fair and transparent distribution of benefits, and advance gender equality, diversity, and human rights. Forced resettlement should be avoided whenever possible; if displacement is unavoidable, it should be minimized and managed through fair, consultative processes that also respect culture and heritage.

4. Institutional sustainability. Sustainable infrastructure should align with global and national commitments, such as the Sustainable Development Goals and the Paris Agreement, and be supported by transparent, consistent governance throughout the project cycle. Strong institutions, clear rules for planning, procurement, and operation, and the development of local capacities are essential. Building technical and managerial skills, fostering innovation, and ensuring systems for data, monitoring, and evaluation help strengthen evidence-based decision-making and demonstrate impacts.

In this guide, the definitions serve as the basis for establishing the criteria proposed in the investment prioritization model. Likewise, the definition of sub-criteria and associated indicators will be based on international experience, within the same conceptual framework. Although **the countries may take this guide into account as an initial recommendation for the prioritization process, it is recommended that in the medium term, each country develop its own guide, validating or redefining the criteria and weightings through an internal discussion within the SNIP**. In this regard, the list of criteria and sub-criteria included here is not exhaustive and can be adjusted to each country by removing or adding dimensions to reflect national circumstances and the government's public policy preferences.

It is also important to consider that the criteria or strategic objectives defined in the model may lose relevance or pertinence over time. Therefore, it is advisable to allow for a degree of flexibility to reflect the dynamics of public policies, society's preferences, and national development objectives.

Multi-criteria Analysis

MCA is a methodology used for complex decision making involving multiple policy objectives, which allows the systematic comparison of projects based on qualitative and quantitative indicators. Its application in the infrastructure sector has proven to be particularly useful, as it contributes to the efficient allocation of scarce resources by incorporating technical rigor in the decision process (Arteaga et al., 2019). In addition, it facilitates the structuring of investment decisions by reconciling various aspects associated with investment proposals, which has increased its relevance in this area (Marcelo et al., 2016).

Multi-criteria decision approaches allow the integration of nonmonetary and qualitative factors in decision analysis, which is key in contexts where information or analytical resources are limited. In infrastructure development, these methods help balance different policy objectives and overcome time and capacity constraints. By incorporating diverse decision criteria and assigning preference weights, MCA helps manage uncertainties and data heterogeneity, while also promoting the participation of multiple stakeholders in the process, thereby fostering communication and transparency in decision making (Marcelo et al., 2016).

Countries such as Australia (Infrastructure Australia, 2021), Chile,[15] Costa Rica, the Dominican Republic, Ecuador, Honduras,[16] Peru, and the United Kingdom (UK Department of Food, Environment, and Rural Affairs, 2025), among others, have incorporated formal multi-criteria decision-making processes within the framework of their SNIPs (Box 2). On the other hand, OECD (2018) links MCA to applications related to sustainability, understood as a concept that articulates concern for future generations (intergenerational equity, long-term prospects for well-being, and natural capital as an asset of an economy).

[15] For more information, see the following link: **https://sni.gob.cl/storage/docs/Metodologia_PQMB_20221221.pdf.**

[16] Honduras is in the process of implementing a project prioritization guide that includes sustainability considerations, as reported during the XII Seminar of the SNIP Network. However, it was not official when this guide was prepared.

Box 2. Multi-criteria Analysis and Public Infrastructure Prioritization

Among the countries that have made formal efforts to apply MCA, the following experiences are noteworthy.[a]

In the **Republic of Korea** (Public and Private Infrastructure Investment Management Center, 2008), project selection is based on an MCA structured based on a three-dimensional polynomial, where the *socioeconomic profitability* of the project represents approximately 50 percent. The other two dimensions are the *strategic alignment and project-specific factors* (with a weighting of 25 to 35 percent depending on the sector and measuring consistency with policies, implementation risk factors and special project characteristics) and the contribution to *balanced regional development* (with a weighting of 15 to 25 percent depending on the sector and measuring the ripple effects and the impact of the project on regional economies). The MCA is applied in successive stages, addressing the dimensions of economic analysis, policy analysis, and analysis of balanced regional development.

A group of 8 to 10 professions score the projects and then formulate a collective recommendation. The individual scores are compared to arrive at an aggregate recommendation.[b]

Ecuador has a methodology based on an investment priority index, designed as an objective tool to weight investment projects to be considered within the Annual Investment Plan. The indicator is composed of three variables: (i) employment generation, weighted at 1/4; (ii) territorial equity, weighted at 1/4; and (iii) systemic productivity, weighted at 1/2 (National Secretariat of Planning and Development of Ecuador, n.d.).

- To estimate the impact on employment generation, each investment project is classified according to the economic sector (industry) to which it belongs. Then, the employment generated is estimated based on the technical employment/gross production ratio. This ratio measures the number of workers needed for US$1 million of gross production of the industry. Employment data are obtained from the National Survey of Employment, Unemployment and Underemployment,c and gross production data are obtained from the supply-utilization table at current values, published in the Annual National Accounts by the Central Bank of Ecuador.

- *The regional or territorial equity* component positively values those projects located in areas of greater poverty due to unsatisfied basic needs. In addition, the regions that will be affected by the project in its operational phase are considered. The values of these variables are obtained from the poverty index of the region where the project will be implemented. If the project covers two or more regions, the highest value of the index is taken.

- Systemic productivity considers three variables: (i) capital increase (1/3), (ii) geographic systemic impact of the project (1/3), and (iii) self-sufficiency (1/3), which in turn consists of the input-output interrelationship, import substitution, and the strategic sector.

Box 2. Multi-criteria Analysis and Public Infrastructure Prioritization (*continuation*)

The **Dominican Republic** also adopted a formal project prioritization methodology, structured around an MCA tool and developed based on the *AHP*.[d] The prioritization model comprises three criteria, with into seven sub-criteria. Each sub-criterion carries equal weight using a scale ranging from 1 to 7 (Dominican Republic Ministry of Economy and Planning, 2023).

- The project attributes criterion is composed of the sub-criteria: (i) degree of progress of the project and (ii) proportion of external financing of the project.
- The territorial aspects criterion is composed of the following sub-criteria: (i) population density; (ii) "very low" socioeconomic level of the beneficiaries, and (iii) provinces less benefited by the investment.
- The political and planning aspects criterion is composed of the following sub-criteria: (i) contribution to the development results of the National Multi-year Public Sector Plan and (ii) demands prioritized by the territory.

The stages for the application of the instrument consist of (i) assignment of scores, (ii) project ranking, (iii) definition of investment goals, (iv) prioritization of projects to cover the investment goal, (v) definition of prioritized demands by institution (sum), and (vi) assignment of budget ceilings by institution. The case of the Republic of Korea is the most sophisticated and rigorous in terms of identification, estimation, and application of weightings. In the Dominican Republic and Ecuador, the application of the MCA is relatively easy and intuitive (due to its simplicity and practicality). However, the latter two countries do not include different relative weights for the strategic criteria, nor do they explicitly include CC considerations in the prioritization tools. Other countries, such as Costa Rica and Peru, do incorporate CC criteria and are developed later herein.

Sources: National Secretariat of Planning and Development of Ecuador. n.d. Inversion Publica: Guia de Productos. Quito: National Secretariat of Planning and Development; Ministry of Economy and Planning of the Dominican Republic. 2023. Model of Prioritization of the National Multiannual Public Investment Plan. Presentation by Mr. Martin Francos at the Seminar of the Network of National Public Investment Systems of Latin America and the Caribbean. Santo Domingo: Ministry of Economy and Planning.

Notes: [a]*Related experiences are developed in Equino et al*. (2008). [b]If all evaluators agree and their opinions are combined to arrive at a comprehensive opinion above 0.5, the project is approved. If the opinion is not unanimous, 84 percent confidence interval is used. If the sample mean is above 0.55, the project is considered feasible; if the mean score is below 0.45, then project is considered unfeasible; between 0.45 and 0.55, the project is understood to fall in a “gray zone” (caution is recommended in the decision. [c]To consult the Survey, see the following link: https://www.ecuadorencifras.gob.ec/empleo-desempleo-y-subempleo/; [d]The AHP is developed later in more detail and as part of the prioritized proposal.

Advantages and Disadvantages of Using Multi-criteria Analysis

MCA allows investment projects to be evaluated considering multiple dimensions within a single analytical framework and integrating both quantitative and qualitative factors. Its additive capability allows for the aggregation of weighted criteria values, providing a structured, objective, and transparent methodology for prioritizing alternatives. In addition, MCA is characterized by flexibility to address complex scenarios, incorporate multiple decision makers, and encourage stakeholder participation. MCA also contributes to the transparency and reliability of public investment decisions by making explicit the objectives, criteria and weightings used.

However, its application implies significant costs in terms of information and analysis, as it demands precise measurement of different impacts. Unlike cost–benefit analysis, MCA allows the inclusion of non-monetary criteria in a formalized manner, although this same feature can make the results sensitive to the choice and weighting of criteria, which calls for rigorous implementation to avoid biases or distortions. In the same sense, MCA implies a highly technical and disciplined process that, if not strictly adhered to, can lead to errors. For example, standardization processes and weighting methods involve a certain degree of technicality in the process, so if the concepts are not well defined, erroneous and confusing conclusions may be reached. Despite these limitations, MCA remains a key tool for efficient investment management, especially when multiple policy objectives need to be integrated into decision making.

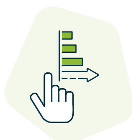
Design of the Prioritization Tool

The following are the conceptual and operational guidelines for the practical application of the AHP methodology in the prioritization of investment projects:

Step 1. Define the problem to be solved and identify the set of decision makers and experts with strategic and technical representativeness with whom it is expected to collaborate to build and feed the process.[17]

Step 2. Establish an overall objective that clearly reflects the purpose and scope of the problem being addressed.

Step 3. Identify and define the relevant criteria and sub-criteria for decision making, which disaggregate and describe the global objective, based on a hierarchy that allows for the structuring of the above. Complementarily, define the related indicators.



[17] Eventually, citizen participation and representation in the process may be relevant.

Step 4. Determine the importance of each criterion and sub-criterion by estimating the weights and synthesize the information for decision making.

Step 5. Definir las escalas de medida para cada criterio y subcriterio.

Step 6. Verify the consistency of the judgments made through mathematical properties that support the method.

Step 7. Prioritize the projects by estimating the scores and synthesizing the results; to do this, the list of projects to be prioritized must be defined beforehand.

Step 1. Define the Problem and Identify Decision Makers and Experts

The first step involves a conceptual exercise to define the problem that will underpin the preliminary prioritization model, drawing on the available background information on the reality to be addressed. The model should be built on the definition of the objectives pursued by the prioritization exercise; however, it should always be guided by a predefined set of dimensions that will (i) make the process of selecting initiatives transparent and formalized, (ii) reduce the political discretionality inherent in the democratic process, and (iii) promote greater confidence in public institutions.

The model should be developed in collaboration with a group of subject-matter experts directly linked to the problem or thematic area of the intervention. This group of experts should have sound technical knowledge and experience and be recognized as providing representative, impartial, and non-self-interested opinions.

It is also important that the deliberation process with experts be participatory, enabling the incorporation of different perspectives (Box 3). This discussion is mostly carried out through meetings, interviews, workshops, surveys, or through the Delphi method.18 The way in which the opinions and judgments of the experts are recorded will depend on the resources, the objective, and the type of study.

[18] For more information on the Delphi method, see the following link: https://www.researchgate.net/publication/ 304674496_El_metodo_Delphi-.

Box 3. Designation of Experts

To define the prioritization model, it is important to have a team of experts available from the outset of the process. The composition and size of this team will depend on the complexity of the problem, as well as the possibilities of financing. In particular, the following aspects should be considered when selecting the team:

- The experts should fully understand the challenges of the project prioritization exercise, as well as the concepts underlying efficient capital expenditure management; that is, they should have a specific understanding of the nature, functions, roles and responsibility of the SNIP.
- The group of experts should have professionals with solid knowledge and experience in the planning, preparation, evaluation, prioritization, budgeting and implementation of public investment projects.
- The professional backgrounds of the experts may vary, as well as their ideological affinities; however, in any case, it is essential that they always meet the above requirements.

Finally, it is important to point out that, during the prioritization exercise, it may be necessary to conduct interviews, meetings and workshops with the experts, so that the results obtained are the fruit of a methodological consensus.

Source: Authors' elaboration based on United Nations, ILPES, and ECLAC (2008).

Practical Application

Within the framework of this guide, and with the purpose of orienting the concepts toward their practical implementation, the following prioritization problem is proposed for a hypothetical country and SNIP:

> Deficit of a formal process for the prioritization of public investments, with inclusion of climate change considerations, to allocate a budget to a portfolio of projects previously approved by the SNIP.

Based on the above, the objective of the prioritization model should focus on responding to the problem posed.

Step 2. Establish the Overall Prioritization Objective

The SNIP technical teams, typically involving the ministries of planning, finance, and/or economy, usually define the overall objective. It must then be validated with the participation of experts, through public dialogue with key stakeholders. This procedure ensures that relevant technical aspects are taken into consideration and can then be approved through a participatory exercise (e.g., workshops). It is recommended that the initial design of the model be based on a review of international experience and published technical documents, complemented by a review of the regulatory and institutional framework that establishes the country's strategies, including CC commitments (Box 4).

Box 4. Peru's National Sustainable Infrastructure Plan

Examples of public policies that incorporate climate change considerations into investment prioritization include Peru's National Sustainable Infrastructure Plan for Competitiveness 2022–2025, which synthesizes the long-term vision for the country's different infrastructure sectors for the next 20 years. These sectoral visions are aligned with the Sustainable Development Goals, the preservation of the natural environment, the management of environmental impacts, resilient infrastructure and low GHG emissions, and the focus on the territory, among other aspects. For example, the water and sanitation sector establishes the following vision:

"The country has provided sustainable and universal quality sanitation services, considering criteria of equity, affordability, security of supply, adaptation and mitigation to climate change, disaster risk management and circular economy. In addition, the sector makes intensive use of research, development, and innovation and fosters the capacities of its actors, which allows for the development of efficient and sustainable solutions." Peruvian Ministry of Finance (2022).

The Plan also establishes that all sectors must incorporate quantitative variables to promote the efficient use of resources, reduce pollution in the life cycle of infrastructure and ensure its climate resilience. Likewise, all sectors must consider the alignment of projects with national and sectoral strategic planning in their prioritization methodologies, which is a fundamental attribute of sustainable infrastructure.

Source: Authors' elaboration.

It is important to emphasize the need to establish, at the outset of the process, a well-defined overall objective. In turn, second-level objectives (i.e., strategic criteria and sub-criteria) should be subject to scrutiny in subsequent discussions with experts and stakeholders. Likewise, the overall objective must be aligned with the country's strategic objectives (expressed in national development plans or strategies), as well as with national commitments on decarbonization[19] and CC.

[19] For example, a long-term decarbonization strategy should define the path that the different sectors of the economy should follow to achieve net zero emissions by 2050; for example, modifying the energy matrix by promoting the use of cleaner sources (solar, wind and hydropower).

Practical Application

Within the framework of the guide and as an example, the following overall objective is proposed for the prioritization exercise:

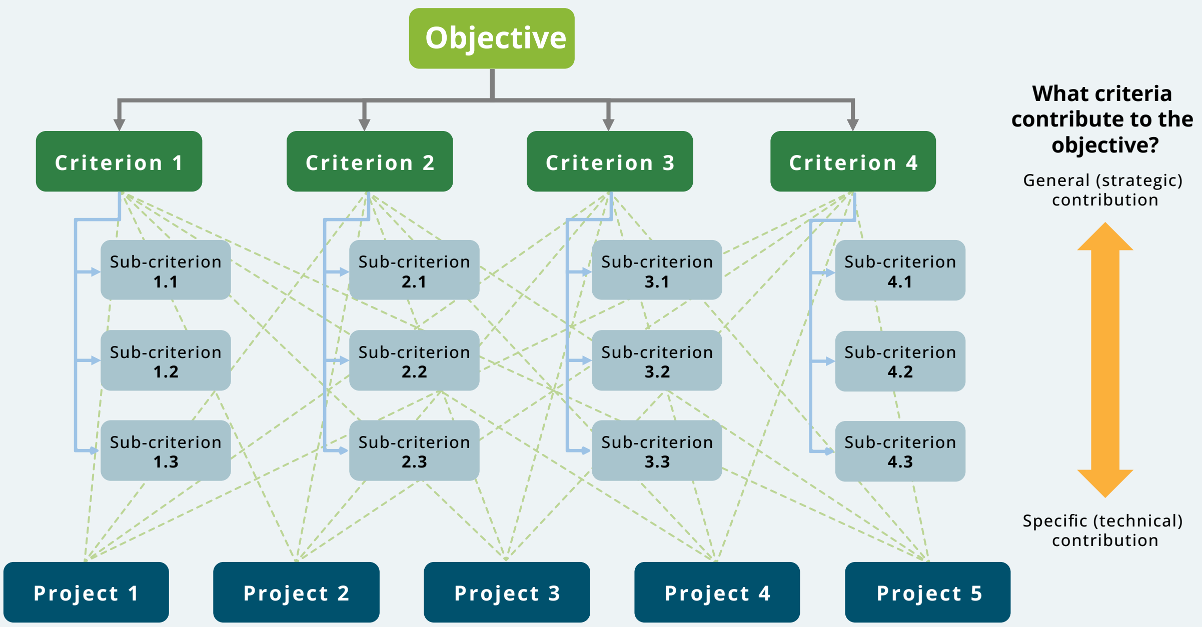
> Prioritize the project portfolio according to its effectiveness, to improve the quality of life of the country's inhabitants through the reduction of social gaps and the development of sustainable public infrastructure aligned with the decarbonization objectives established in both the long-term climate strategy and the nationally determined contributions strategy for 2040.

Accordingly, the prioritization model should focus on responding to the stated objective.

Step 3. Identification and Definition of Criteria, Sub-criteria, and Relevant Indicators

Based on the definition of the overall objective, a hierarchical map should be developed to establish the impact criteria that contribute to its achievement. These criteria should be disaggregated into sub-criteria, which, in turn, should be linked to quantitative or qualitative indicators. Figure 2 shows a typical general structure of an AHP applied to project prioritization. It starts with an objective whose satisfaction can be achieved by different project alternatives (*P1, P2, P3, ... , Py*), which are compared by means of a set of criteria (*C1, C2, C3, ... , Cx*). Each criterion may or may not be subdivided into up to *n* sub-criteria (*Ci.1, Ci.2,... , Ci.n*).

Figure 2. General Hierarchical Map of the Problem



Source: Authors' elaboration, based on Arteaga, et al. (2019) and United Nations, ILPES (Latin American and Caribbean Institute for Economic and Social Planning) and ECLAC (2008).

Definition of criteria and sub-criteria. Drawing on the most representative international and regional experiences (such as those of Costa Rica and Peru,[20] ILPES [2024] and the United Nations, ILPES, and ECLAC [2008]), the following guidelines are aplicable in defining the strategic criteria:[21]

- They should represent a key reference point, guiding infrastructure decision making based on the areas that have been defined as priorities (e.g., CC). They are expected to be developed from the review of related policy and program objectives.
- They should be linked to policy goals, such as national adaptation plans, nationally determined contribution, and national and sectoral development plans.
- They should be clearly defined to avoid different interpretations by model users.
- They should be divided into sub-criteria that, in turn, are also aligned with the areas linked to the overall objective.[22]
- They must be specific with respect to the problem addressed and maintain their permanence over time. The latter allows initiatives from different periods to be evaluated and compared for subsequent analysis.

In addition, the process should incorporate a validation exercise of the strategic criteria (and their related sub-criteria) with key stakeholders (Box 5). It may also be advisable to include a *significance* criterion to prioritize relevant investments, as decided by the political authority. For example, nationally significant investments that provide new or replacement infrastructure and are of substantially higher quality, sustainability, and capacity; investments with the potential to boost economic growth or promote private investment; or investments that contribute significantly to the government's strategic objectives. This could be the case for a prioritization process with numerous projects and scarce resources for the management exercise.

Box 5. Correlation Between Alternative Criteria and Sub-criteria

One aspect that may require attention in model design concerns the correlation between sub-criteria. In general, in multicriteria analysis applications, selection criteria and sub-criteria are adopted directly and specific tests to determine their correlation are not usually performed. However, it may be relevant to consider the independence between criteria and sub-criteria to avoid the overrepresentation of certain dimensions (especially if this is a formal objective of the model). Also, it may be particularly important to limit the number of criteria to around seven to obtain a model that is sensitive to variations in the weights assigned. Thus, performing correlation tests may be useful to identify an independent set of criteria, allowing their number to be reduced to a manageable level without losing representativeness with respect to the selection problem.

Source: Yurdakul and Tansel (2009).

[20] These cases are presented in detail throughout the document.

[21] If the country does not have a defined decarbonization pathway or nationally determined contribution, one option is to use a taxonomy of investments in the SNIP that filters out investments that are consistent with decarbonization and those that are not. The use of taxonomies instead of a decarbonization pathway is not an optimal solution but would be applicable should the country decide not to implement a formal prioritization process.

[22] For example, in this context, criteria linked to environmental sustainability and resilience, economic and financial sustainability, or social sustainability, among others, can be discussed.

On the other hand, defining and validating the strategic criteria (as well as their respective sub-criteria) are the responsibility of the group of experts, who, as noted above, must have a deep understanding of the problem and the global objective of prioritization. Likewise, the participation of these or other experts may be necessary to define indicators, rules of measurement, and cardinal scales. In this regard, it is important to note that the criteria are a tool for measuring the contribution of initiatives to the fulfillment of national objectives. Therefore, a clear causal relationship between the defined criteria and the established objectives must be verified.

Costa Rica and Peru, among other countries, have adopted the above definitions. They have the most complete experiences in the region regarding prioritization of public investments, based on tools that explicitly include the dimension of environmental sustainability. Box 6 details the case of Peru.

Box 6. Definition of Strategic Criteria and Sub-criteria: The Case of Peru

In the case of Peru, the strategic criteria and sub-criteria were articulated in terms of sustainability. Accordingly, the country's National Sustainable Infrastructure Plan for Competitiveness 2022–2025 establishes a reference model for the prioritization of public projects that includes some key definitions with respect to the dimensions linked to sustainability:

1. **Costs during the life cycle of the project.** These include direct and indirect effects and translate into a risk-adjusted rate of return that is appropriate for the project's investors.

2. **Social sustainability.** This implies that the infrastructure is inclusive, considering potentially affected communities and stakeholders, so that it contributes to improving livelihoods and social welfare throughout the project's life cycle.

3. **Environmental sustainability and resilience.** It implies an infrastructure that (i) preserves, restores, and integrates with the natural environment, including biodiversity and ecosystems; (ii) supports the sustainable and efficient use of natural resources such as energy, water, and materials; (iii) limits the impacts of pollution throughout the life cycle of the project; and (iv) contributes to a low-carbon economy, resilient to CC and efficient with its resources. A resilient infrastructure is one that can withstand and recover from CC, adapting to CC and other shocks and stresses and ensuring the continuity of its essential functions.

4. **Institutional sustainability.** It seeks strong capacity and clearly defined procedures for project planning, bidding, and operation. Organizations or institutions play an important role in the execution of any project; it is important to recognize that they require support services to enable the long-term objectives to be met.

Source: Authors' elaboration, based on Peru's National Sustainable Infrastructure Plan for Competitiveness 2022–2025.

Definition of indicators. The definition of indicators is a key step, as they implement the criteria and sub-criteria. The participation of experts at this stage is essential. They may be part of the same group that participated in the development of the model, or they may be meet specifically to define indicators that require specific technical knowledge. For example, the participation of expert advisors on a particular subject may be necessary, even though they may not necessarily have been the most suitable for the definition of criteria and sub-criteria. In any case, it is essential to ensure that each indicator is associated with a sub-criterion of the model (Box 7).

Box 7. Prioritization of Projects that Include Climate Change Considerations in Costa Rica

Costa Rica has made progress on sustainable development and climate action. In 2022, it developed a methodology for prioritizing projects with the potential to contribute to the achievement of the 2050 decarbonization goals. Designed and implemented within the framework of the SNIP, this methodology seeks to improve the prioritization of public investment projects by incorporating criteria related to decarbonization, sustainability, and risk management. This methodology proposed to sequentially apply a set of prioritization criteria to identify a portfolio of projects with high potential to contribute to decarbonization, sustainability, and risk management in the face of extreme climate events. Table R7.1 provides the criteria, sub-criteria, and indicators for each dimension.

Table R7.1. Matrix of Indicators for Project Prioritization

Strategic Criterion	Sub-criterion	Indicator
Environmental and resilience (40%)	Carbon emissions reduction/ prevention	1. Environmental impact mitigation 2. Carbon emissions reduction (CO_2)
	Climate risk, resilience and disaster risk management	3. Multi-hazard risk integration 4. Risk & resilience management
	Energy and water efficiency	5. Energy efficiency 6. Water use efficiency 7. Impact on aquifers and water bodies
Social (20%)	Service access and affordability	8. Territorial equity 9. Poverty reduction 10. Social inclusion
	Gender integration	11. Equal opportunity 12. Female integration and employment
Institutional (10%)	Anti-corruption protocols and procedures	13. Institutional responsibilities & public spending 14. Alignment with global and national strategies
Economic and Financial (30%)	Positive economic and social return	15. Sustainable socio-economic return
	Indirect contribution to economic growth	16. Contribution to the 3D economy 17. Job creation

Source: Ministry of National Planning and Economic Policy of Costa Rica. 2023. Prioritization Guide for Public Investment Projects with Sustainability and Decarbonization Criteria. San José: MIDEPLAN.

The application of the prioritization methodology makes it possible to develop a portfolio of sustainable projects that can contribute to the country's decarbonization agenda, with the potential to be financed by investors interested in environmental, social, and governance issues.

Practical Application

The definition of criteria presented here follows the proposal of Bhattacharya et al. (2019), which also informed the definition of criteria and sub-criteria in the experiences of Peru and Costa Rica. Within this framework, a *sustainable infrastructure project* is understood as one that preserves, restores, and integrates the natural environment, including biodiversity and ecosystems, and is anchored to adequate land use planning. Sustainable infrastructure encourages the sustainable and efficient use of natural resources (such as energy, water and different construction materials) and promotes nature-based solutions. It also seeks to limit all types of pollution throughout the life cycle of the project, as well as contribute to a low-carbon, resilient, and resource-efficient economy. Sustainable infrastructure projects are positioned and designed to ensure resilience to climate risks and natural disasters.

Tables 1 to 4 show indicators proposed for each of the sub-criteria developed. These indicators were designed in a referential manner, according to the hypothetical global objective proposed as an example for this exercise. Each one includes a field of observations that presents concepts and examples linked to the sub-criteria and indicators. This matrix was prepared with the support of experts in each corresponding area. As mentioned above, it is not necessary that the experts who estimate the weightings be the same as those who establish the indicators; what is essential is that they be people with knowledgeable authority in each of the areas developed.

Table 1. Proposed Matrix for Economic and Financial Sustainability Criterion

Sub-criterion	Indicator	Observations
Net socioeconomic profitability	Net present value (NPV) of the project compared to the average of projects in the sector implemented in the last five years. Or alternatively: NPV per project beneficiary compared to the average of sector projects implemented in the last five years.	The measure of socioeconomic profitability is a standard element in any public investment project prioritization model. In this case, the indicator and its associated scale aim to measure the project's contribution in terms of efficiency gains relative to the sector average. For projects in the productive infrastructure sector, which are evaluated using the cost–benefit analysis (e.g., transportation, energy, irrigation), the corresponding indicator is the NPV of the project. For projects in the social infrastructure sector, which are evaluated using the cost-effectiveness analysis (e.g., health, education, social housing), the corresponding indicator is the present value of costs of the project.
Job creation	Direct job creation, greater than 12 months term.	Job creation is usually a public policy objective and therefore a desired social and secondary impact of public investment projects. In all cases, it should be kept in mind that job creation is a desired impact, but it should not be the main justification for the development of public investments; on the contrary, these should be justified on the grounds of socioeconomic profitability (where employment is a project cost, adjusted by its corresponding social price). Likewise, job creation should not be transitory or very short term, so it is required, in this case, to have a minimum term of 12 months. Thus, job creation could correspond to any of the phases of the project, although it is customary that the first direct job creation takes place during the project implementation stage.
Fiscal sustainability	Availability of non-public and non-reimbursable financing.	Maintaining fiscal balance is a crucial public policy objective, particularly from the standpoint of the Ministries of Finance, Treasury or Economy. Therefore, it may be desirable for projects to secure some form of non-reimbursable financing, thereby helping to reduce, or at least avoid significantly increasing, the burden on public expenditures. Examples of this indicator include grants and contributions from nongovernmental organizations, multilateral lending banks, international agencies, and foreign governments, among others, for the implementation of infrastructure. It also includes public-private partnerships with payments by users. In short, it refers to any contribution to the financing of the project that does not involve the use of public resources and does not have to be reimbursed in the future.

Source: Authors' elaboration based on consultation with experts, international experience, and literature review.

Table 2. Proposed Matrix for the Social Sustainability Criterion

Subcriterion	Indicator	Comments
Scope	Population directly benefited.	The scope of the project refers to the number of beneficiaries. Usually, projects with the largest number of beneficiaries will be preferred.
Poverty (measured in income)	Percentage of beneficiaries living in poverty in the commune/region where the project is implemented.	Poverty reduction, along with job creation, is generally recognized as a public policy objective and, therefore, as a desirable social and secondary impact of public investment projects. As in the case of job creation, it should be kept in mind that the project's contribution to poverty alleviation is a desired impact but should not be the justification for the development of public investments. In this case, in general, preference will be given to projects that are in areas with the highest poverty in a region or country.
Priority areas and vulnerable groups	The project benefits priority areas and/or groups.	As in the case of poverty reduction, preference will generally be given to projects located in areas that the country has defined as a priority or, similarly, projects that benefit a group of society that has been defined as a priority. For example, projects located in environmentally degraded territories, localities of tourist interest, areas of heritage interest, areas of armed conflict, strategic areas from the point of view of national security (borders), strategic areas from the productive point of view (mining corridors), isolated territories, among others. Likewise, examples of priority groups may be native and indigenous groups, population with a lack of basic services, population with gaps in social services, population with deficiencies not related to poverty, discriminated minority groups, vulnerable groups (women, youth, or older adults depending on the reality of the country), among others.

Source: Authors' elaboration based on consultation with experts, international experience, and literature review.

Table 3. Proposed Matrix for the Environmental Sustainability and Resilience Criterion

Subcriterion	Indicator	Comments
Emission reduction (mitigation)	Consistency with the decarbonization pathway.	Decarbonization is, or should be, a core public policy objective; therefore, it is desirable for public investment projects to contribute to this objective or to be consistent with related policies. In contexts where a country has not yet defined a national or sectoral decarbonization trajectory until 2050, project alignment with an investment taxonomy, that filters between investments consistent with decarbonization and those that are not, could be used as a proxy. Of course, the use of taxonomies instead of a decarbonization pathway is not an optimal solution, although it also reduces the risk of generating stranded assets. Ultimately, it would be possible to identify the sectors with the greatest contribution to the mitigation of GHG emissions.
Climate risk, resilience, adaptation and multi-hazard disaster risk management	Multi-hazard disaster risk identification and management.	The resilience of public infrastructure has proven to be crucial in reducing the economic and social losses associated with climate events, as well as in reducing the fiscal costs of reconstruction and restoration of public services. It is therefore natural that aspects such as project management for disaster risk reduction are positively valued. For example, disaster risk-related measures such as land use planning, the establishment of early warning and information systems, actions to improve economic, social, and environmental resilience, as well as preparedness measures for efficient and effective response during recovery, rehabilitation, and reconstruction are considered relevant.
Sustainable use, conservation of habitat and ecosystems	Ecosystem conservation actions and ecosystem services are considered as follows.	Ecosystem services refer to a set of benefits that ecosystems provide to society, thereby contributing to overall quality of life. These services and benefits include: (i) provision of products such as food, wood, water or energy; (ii) regulation of ecosystem processes, such as flood and pest control, water and air purification, among others; (iii) cultural: non-material, such as recreation, spiritual values or aesthetic contemplation, and (iv) support: service that allows the existence of the previous ones, such as primary production and nutrient cycling, among others. For example, the project minimizes environmental disturbances by preserving areas with high ecological value, biodiversity, and ecosystem functions (pollination, conservation of natural habitats, water cycle, soil erosion control) (Eguino et al., 2024).

Source: Authors' elaboration based on consultation with experts, international experience, and literature review.

Table 4. Proposed Matrix for the Institutional Sustainability Criterion

Sub-criterion	Indicator	Observations
Strategic alignment	Alignment with strategic planning instruments.	Strategic alignment enables policymakers to make decisions at the sectoral level and to ensure that project concepts meet minimum standards of consistency with the government's strategic objectives. Therefore, it is important to establish the extent to which the project is aligned with strategic planning instruments, such as the national or regional development plan or strategy, or productive development, competitiveness, and territorial equity policies, among others.
Capabilities	Contribution to the development of institutional capacities in the public sector and civil society.	Institutional capacity building, both in the public and private (civil society) spheres, is desirable in public investment projects. Projects that promote capacity building are those that (*i*) include a training program, (*ii*) develop new technologies (such as the acquisition or development of new software that improves public sector efficiency), (*iii*) increase efficiency by reducing unit costs of production of goods and services (increased public sector productivity), and (*iv*) provide new organizational development that increases public sector productivity (redesign of managerial and supervisory functions).
Governance	Contributions to improved governance.	The contribution of public investment projects to improved governance is also desirable. For example, an investment initiative can contribute to strengthening governance because it (i) describes pre-investment arrangements (such as an assessment of the human and financial resource capacities of the Executing Unit), (ii) includes a social impact assessment (with a qualitative description of the stakeholders who are positively and negatively affected by the project), (iii) includes arrangements for monitoring and evaluation of performance indicators (such as early warning systems for deviations in timing or costs), (iv) includes procurement processes established by the National Anti-Corruption Agency (such as competitive and sustainable procurement), and (v) includes processes linked to climate governance in the context of the SNIP (including coordination and linkage mechanisms between institutions, development of specific methodologies, inclusive participation of civil society, and open government, among others).

Source: Authors' elaboration based on consultation with experts, international experience, and literature review.

Step 4. Determination of the Importance of the Criteria and Sub-criteria (weightings)

There are different alternatives for determining the weightings of the criteria. However, this guide adopts the AHP method as the preferred option, since it provides a better solution to some of the difficulties observed in other methods, such as the simple standardization method.

Pairwise comparison seeks to answer the question, To what extent is one element (*or activity) preferable to the element with which it is being compared?* As established by the United Nations, ILPES, and ECLAC (2008), human beings can make pairwise comparisons to express the preference of one criterion over another. The synthesis of all these judgments defines the scale of preference intensities (priority) among the total of the compared elements. In this regard, it is possible to integrate logical thinking with knowledge, experience, and intuition, among others. Thus, pairwise comparison allows for the establishment of an order of preference among decision alternatives, resulting in a hierarchical ranking of priorities of decision alternatives, based on the overall preferences expressed by the decision maker (Arteaga *et al*., 2019).

In practical terms, the pairwise comparison is performed by assigning relative intensity values between each of the criteria and using the fundamental scale of absolute numbers developed by Saaty (2004), which includes values from 1 to 9, as shown in Table 5. Then, *the comparison matrix by pairs of criteria* is obtained from the values assigned to each comparison.

Table 5. Fundamental Scale of Absolute Numbers

Intensity of importance	Definition of relative importance	Explanation
1	Equal	Two activities that also contribute to the objective
2	Slight	Intermediate value
3	Moderate	Experience and judgments slightly biased in favor of one over the other
4	Moderately greater	Intermediate value
5	Stronger	Experience and judgments strongly biased in favor of one over the other
6	Stronger plus	Intermediate value
7	Much stronger or demonstrated	One activity is strongly favored over the other; its superiority is demonstrable in practice.
8	Very very strong	Intermediate value
9	Extreme	Evidence favoring one activity over the other is at the highest possible level of affirmation.

Source: Arteaga et al. (2019).

It is important to prioritize by consensus when more than one expert is involved. When this is not possible, individual judgments can be integrated through the geometric mean[23] as follows (United Nations, ILPES, and ECLAC, 2008):

$$A_{ij} = \sqrt[n]{\prod_{1}^{n} a_{ij}^{n}} \quad (1)$$

where:

A_{ij} is the result of the integration of the judgments for the pair of criteria **i, j;**

a_{ij}^{n} is the judgment of the person involved for the pair of criteria;

$n = 1,\dots,$ ***n*** is the number of persons involved who express their judgments on the criteria.

[23] In statistics, the geometric mean of an arbitrary quantity of numbers is the n-th root of the product of all the numbers; it is recommended for analyzing geometric progression data, or for averaging ratios, compound interest and index numbers. For example, it is used when comparing items whose yields have units of measure in different numerical ranges. The geometric mean can then give a meaningful value for comparing two companies that have a score between 0 to 5 for environmental sustainability, and a score between 0 to 100 for financial viability. If the arithmetic mean were used instead of the geometric mean, financial viability would have greater weight because its numerical range is larger. That is, a small percentage change in the financial rating (e.g., moving from 80 to 90) would have a greater impact on the arithmetic mean than a large percentage change in environmental sustainability (e.g., moving from 2 to 5). The use of the geometric mean allows normalizing values of different rank, meaning that a given percentage change in any of the properties has the same effect on the geometric mean. Thus, a 20 percent change in environmental sustainability (from 4.0 to 4.8) has the same effect on the geometric mean as a 20 percent change in financial viability (from 60 to 72).

For example, the geometric mean of 2 and 18 is the square root of the product of the two, as follows:

$$AI_{2,18} = \sqrt[2]{2 * 18} = \sqrt[2]{\quad} = 6$$

In another example, the geometric mean of 1, 3, and 9 would be the cube root of the product of the three numbers, as follows:

$$AI_{1,3,9} = \sqrt[3]{1 * 3 * 9} = \sqrt[3]{27} = 3$$

For the practical application of the above steps, the development of workshops is highly recommended. These can have different configurations and objectives, all of them aimed at achieving the final prioritization tool.

Summary of comparison results. Once the pairwise comparisons have been made, the results are summarized in the criteria comparison matrix, as presented in Table 6.

Table 6. Criteria or Sub-criteria Comparison Matrix C According to their Relative Contribution to the Achievement of the Objective.

	C1	C2	C3
C1	$A_{1,1}$	$A_{1,2}$	$A_{1,3}$
C2	$A_{2,1}$	$A_{2,2}$	$A_{2,3}$
C3	$A_{3,1}$	$A_{3,2}$	$A_{3,3}$

Source: Arteaga, et al. (2019).

To derive the criteria weights, the above matrix must be normalized. The normalized matrix (Table 7) is obtained by dividing each element by the sum of the elements of the membership column, using the following equation:

$$C'_{ij} = \frac{C_{ij}}{\sum_{i=1}^{n} C_{ij}} \quad (2)$$

where:

C_{ij} is the element (**i, j**) of the comparison matrix and

C'_{ij} is the result of the comparison exercise of criterion **i**, with respect to criterion **j** and normalization of **Cij**.

Table 7. **Normalized Matrix C' of Comparison of Criteria or Sub-criteria According to their Relative Contribution to the Achievement of the Objective.**

	C1	C2	C3	Eigenvector
C1	$C'_{1,1}$	$C'_{1,2}$	$C'_{1,3}$	W_1
C2	$C'_{2,1}$	$C'_{2,2}$	$C'_{2,3}$	W_2
C3	$C'_{3,1}$	$C'_{3,2}$	$C'_{3,2}$	W_3

Source: Arteaga, et al. (2019).

The eigenvector W represents the relative weights of the criteria and sub-criteria, and is obtained by averaging the elements of the corresponding row of the normalized matrix C', as follows:

$$W_i = \frac{\sum_{i=1}^{n} C'_{ij}}{n} \quad (3)$$

where:

W_i is the relative weighting of criterion **i**;

C'_{ij} is the result of the comparison exercise of criterion **i**, with respect to criterion **j** and normalization of **Cij;**

n is the total number of criteria.

This modeling can be solved by means of a spreadsheet, although the AHP can also be applied by means of specialized *software* such as Expert Choice, MPC2.0©, and ArcGIS, among others.

The measurement rule (or weights) is one of the most important results of the pairwise comparison process within the decision model, as it represents the final synthesis of the measurement indicators. This rule is derived from the global weightings of the criteria and sub-criteria of the decision model. Thus, it makes it possible to establish the weight of each indicator with respect to the objective and, therefore, the extent to which it influences the comparative evaluation between alternatives (project prioritization) (Box 8).

Box 8. Estimation of Weights for Project Prioritization: The Case of Peru

Peru's National Sustainable Infrastructure Plan for Competitiveness 2022–2025 establishes the reference framework for the prioritization of public projects. Based on a multi-criteria analysis exercise, it has established different weightings for the strategic criteria (Table R8.1).

Table R8.1. Investment Prioritization Model in Peru

Strategic criterion	Peru weighting
Economic and financial	36.4%
Social	32.4%
Environmental (and resilience)	21.1%
Institutional	10.2%

Source: Authors' elaboration, based on Peru's National Sustainable Infrastructure Plan for Competitiveness 2022–2025.

Practical Application

The definition of the weightings starts with the pairwise comparison of the four previous criteria according to the experts' preference (Figure 3 and Table 8).

Figure 3. Example of Weightings According to Relative Preferences and Intensity

Value		9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	
1	Economic evaluation and fiscal affordability		Social
2	Economic evaluation and fiscal affordability		Environmental and resilience
1/5	Economic evaluation and fiscal affordability		Institutional
2	Social		Environmental and resilience
1/4	Social		Institutional
1/3	Environmental and resilience		Institutional

Source: Authors' elaboration based on consultation with experts.

Table 8. Matrix P for Comparison of Criteria According to their Relative Contribution to the Achievement of the Objective

	Economic and financial sustainability	Social sustainability	Environmental sustainability and resilience	Institutional sustainability
Economic and financial sustainability	1.00	1.00	0.50	5.00
Social sustainability	1.00	1.00	0.50	4.00
Environmental sustainability and resilience	2.00	2.00	1.00	3.00
Institutional sustainability	0.20	0.25	0.33	1.00

Source: Authors' elaboration, based on consultations with experts at the XII Seminar of the SNIP Network, Honduras, 2024.

Based on the above, the normalized matrix is constructed, and the eigenvector is estimated (Table 9).

Table 9. Normalized Matrix P for Comparison of Criteria According to their Relative Contribution to the Achievement of the Objective and Eigenvector

	Economic and financial sustainability	Social sustainability	Environmental sustainability and resilience	Institutional sustainability	Eigenvector	
Economic and financial sustainability	0.23810	0.23529	0.21429	0.38462	0.2681	**26.8%**
Social sustainability	0.23810	0.23529	0.21429	0.30769	0.2488	**24.9%**
Environmental sustainability and	0.47619	0.47059	0.42857	0.23077	0.4015	**40.2%**
Institutional sustainability	0.04762	0.05882	0.14286	0.07692	0.0816	**8.2%**

Source: Authors' elaboration, based on consultation with experts at the XII Seminar of the SNIP Network, Honduras, 2024.

Although not developed in this guide, the same process should be applied to determine the weightings for each of the sub-criteria. Table 10 provides an example and, in the following section, Tables 11 to 14 present the results of a sub-criteria weighting exercise[24]. For reference, Annex 1 presents the methodology for estimating weightings.

[24] This exercise was performed with the assistance of a prioritization model developed in Excel.

Table 10. Eigenvectors of the Sustainability Sub-criteria

Economic and financial sustainability		Social sustainability		Environmental sustainability and resilience		Institutional sustainability	
Sub-criterion	Vector	Sub-criterion	Vector	Sub-criterion	Vector	Sub-criterion	Vector
Net socioeconomic profitability	34.6%	Reach	12.0%	Emission reduction (mitigation)	7,0%	Strategic alignment	64.6%
Job creation	11.0%	Poverty (measured by	60.8%	Climate risk. resilience. adaptation and multi-hazard disaster risk management	58,0%	Capacities	6.4%
Fiscal sustainability	54.4%	Priority areas and vulnerable groups	27.2%	Sustainable use. habitat conservation and ecosystems	35,0%	Governance	29.0%

Source: Authors' elaboration based on consultation with experts at the XII Seminar of the SNIP Network, Honduras, 2024.

Step 5. Definition of Scales for Indicators

Once the weightings for each criterion, sub-criterion, and indicator have been defined, it is necessary to construct a **qualitative or quantitative scale** to represent the different qualitative assessments numerically, thereby enabling the evaluation of each alternative based on these elements. The definition of scales implies establishing the different values that each indicator linked to the sub-criteria can assume. Initially, scores may be assigned qualitatively (e.g., with values of low, medium, and high), although a related score must then be assigned. Also, in some cases the scale may have dichotomous values (yes/no) and in others, the scale may be associated with broader values (e.g., high, medium, low; or very good, good, fair, poor, and very poor). The level of the scales and their associated values will depend, on the one hand, on each indicator and the opinion of the experts invited to establish them and, on the other, on the characteristics of each SNIP and country.

Once the scales have been defined, their range must be standardized to ensure that the quantitative and qualitative scales have similar ranges. This process is known as **scale standardization**, and its purpose is to bring all the individual scales to a common scale (for example, between -1 and 1, between 0 and 1, or between 0 and 100). This standardization process makes it possible to make the dimensions evaluated comparable, since if the scales are different, it is not possible to arrive at an appropriate weighted index.

Scale standardization must be carried out by applying the following formula:

$$Z_{ji} = \frac{x_{ji} - \bar{x}_j}{S_j} \quad (4)$$

where:

x_{ji} is the i-th data of the j-th scale;

$\bar{x}_j$ is the arithmetic mean (average) of the i-th data of the j-th scale;

S_j is the standard deviation of the i-th data of the j-th scale;

Practical Application

Following the example developed in the guide, each sustainability criterion is linked to different sub-criteria, which, in turn, are linked to different indicators. Likewise, each indicator is linked to different scales. The following tables show the summary of criteria, sub-criteria, indicators, and scales. In addition, each scale is associated with a value. The sub-criteria, indicators, scales, and values should be constructed with the participation of the experts convened to carry out the construction of the prioritization model.

Table 11. Proposed Sub-criteria, Indicators, and Scales for the Socioeconomic and Fiscal Evaluation Sustainability Criterion

Criterion	Sub-criterion	Indicator	Scale	Value
Economic and financial sustainability	Net socioeconomic profitability	NPV of the project compared to the average of projects in the sector implemented in the last 5 years. Or, alternatively: NPV per beneficiary (NPVBV) of the project compared to the average of sector projects implemented in the last 5 years	NPV less than average **or** NPVBV greater than average	1
			NPV or NPVBV equal to the average	2
			NPV greater than average **or** NPVBV less than average	3
	Job creation	Direct job creation, greater than 12-month term	Less than 500 (very low);	1
			Between 501 and 1,000 (low);	2
			Between 1,001 and 2,000	3
			(medium);	4
			Between 2,001 and 3,000 (high)	5
	Fiscal sustainability	Availability of non-public and nonreimbursable financing	Greater than 3,000 (very high)	1
			Yes (less than 50% of CAPEX)	2
			Yes (more than 50% of CAPEX)	3

Source: Authors' elaboration, based on consultation with experts.

Table 12. Proposed Sub-criteria, Indicators, and Scales for the Social Sustainability Criterion

Criterion	Sub-criterion	Indicator	Scale	Value
Social sustainability	Scope	Population directly benefited	Less than 500 (very low)	1
			Between 500 and 1,000 (low)	2
			Between 1,001 and 5,000 (medium)	3
			Between 5,001 and 20,000 (high)	4
			Greater than 20,001 (very high)	5
	Poverty (income)	Percentage of poor beneficiaries in the commune/region where the	Less than 10%;	1
			Between 10.01 and 20%; 2	2
			Between 20.01 and 30%; 3	3
	Priority areas and vulnerable groups	Priority areas and vulnerable groups	The project is not located in priority areas and does not benefit a priority group.	1
			The project is in priority zones **OR** benefits a priority group	2
			The project is in priority areas **AND** benefits a priority group	3

Source: Authors' elaboration, based on consultation with experts.

Table 13. Proposed Sub-criteria, Indicators, and Scales for the Environmental Sustainability and Resilience Criterion

Criterion	Sub-criterion	Indicator	Scale	Value
Environmental sustainability and resilience	Sustainable use, habitat and ecosystem conservation	The project considers actions to conserve ecosystems and ecosystem services	The project does NOT consider	0
			The project **DOES** consider	1
	Emission reduction (mitigation)	Consistency with decarbonization pathway	The project is **NOT** linked to the decarbonization pathway.	0
			Project **IS** linked to decarbonization pathway	1
	Climate risk, resilience, adaptation and multi-hazard disaster risk management	Multi-hazard disaster risks identified and managed	Project does **NOT** identify multi-hazard disaster risk and/or improve adaptive capacity.	1
			Project **DOES** identify multi-hazard disaster risk and/or improve adaptive capacity	2
			Project **WITH** multi-hazard disaster risk management plan	3

Source: Authors' elaboration, based on consultation with experts.

Table 14. Proposed Sub-criteria, Indicators, and Scales of the Institutional Sustainability Criterion

Criterion	Sub-criterion	Indicator	Scale	Value
Institutional sustainability	Capacities	Contribution to the development of institutional capacities in the public sector and civil society	No contribution	1
			Contributes to some of the capacities	2
			Contributes to 2 of the capacities	3
			Contributes to all capabilities	4
	Governance	Contributions to better governance	No contribution	1
			1 contribution	2
			Makes 2 contributions	3
			Gives 3 contributions	4
			Contribute 4 contributions	5
	Strategic alignment	Alignment with strategic planning instruments	The project is **NOT** aligned with strategic planning instruments.	0
			Project **DOES** align with strategic planning instruments	1

Source: Authors' elaboration, based on consultation with experts.

Naturally, the definition of some indicators may introduce bias in favor of certain types of projects. For example, coverage indicators, which are very common in prioritization models, could lead to a preference for larger projects. However, this bias is mitigated within a multidimensional framework that considers not only project scope, but also factors such as profitability, complexity, environmental risk, institutional contributions, and fiscal sustainability, which generate trends in the opposite direction and compensate for the former. For example, a larger project could have greater exposure to disaster risk or face greater difficulties in committing resources to ensure its fiscal sustainability. Thus, the multidimensionality of the analysis helps mitigate potential biases that may result from the definition of some indicators.

Using the same example, Table 15 shows the detail of criteria, sub-criteria, and indicators, with the values of the standardized scales. In this case, since a standardized scale[25] was adopted for values between 0 and 100, the standardization formula previously presented (*Z_ji*) should be corrected as follows:

$$\text{Normalization } 0\text{-}100 = 0 + (Zi-min(Zi))/(max(zi)-min(zi))*100$$

This adjustment is not essential and was only made for the purpose of using an intuitively simpler standardized scale, with minimum and maximum values of 0 and 100, respectively. Therefore, by using standardization without adjustment, the project prioritization exercise should lead to identical results.

Table 15. Proposed Criteria, Sub-criteria, Indicators, and Standardized Scales

Criterion	Sub-criterion	Indicator	Scale	Value of standardized scales
Economic and financial sustainability	Net socioeconomic profitability	NPV of the project compared to the average of projects in the sector executed in the last 5 years. Or alternatively: ACV per beneficiary (ACBV) of the project compared to the average of sector projects implemented in the last five years.	NPV less than average **or** ACBV greater than average	0
			NPV **or** GAACPBV equal to	50
			NPV greater than average **or** BACPV below average	100
	Job creation	Direct job creation, greater than 12-month term	Less than 500 (very low)	0
			Between 501 and 1,000 (low)	25
			Between 1,001 and 2,000	50
			(medium)	75
			Between 2,001 and 3,000 (high)	100
	Fiscal sustainability	Availability of non-public and nonreimbursable financing.	No	0
			Yes (less than 50% of CAPEX)	50
			Yes (more than 50% of CAPEX)	100
Social sustainability	Outreach	Population directly benefited	Less than 500 (very low)	0
			Between 500 and 1,000 (low)	25
			Between 1,001 and 5,000	50
			(medium)	75
			Between 5,001 and 20,000 (high)	100
	Poverty (income)	Percentage of poor beneficiaries in the commune/region where the project is implemented	Greater than 20,001 (very high)	0
			Less than 10%.	50
			Between 10.01and 20%	100
	Priority areas and vulnerable groups	The project benefits priority areas and/or priority groups.	Project is not located in priority areas and does not benefit a priority group	0
			Project is in priority areas **OR** benefits a priority group	50
			Project is in priority areas **AND** benefits a priority group	100

[25] This standardization process is also often referred to as normalization.

Table 15. Proposed Criteria, Sub-criteria, Indicators, and Standardized Scales *(continuation)*

Environmental sustainability and resilience	Sustainable use, habitat, and ecosystem conservation	The project considers conservation actions for ecosystems and ecosystem services.	The project does **NOT** consider actions	0
			Project **DOES** consider actions	100
	Emission reduction (mitigation)	Consistency with decarbonization pathway	The project is **NOT** linked to the decarbonization pathway.	0
			Project **IS** linked to the decarbonization pathway	100
	Climate risk, resilience, adaptation, and multi-hazard disaster risk management	Multi-hazard disaster risks are identified and managed.	Project **does NOT** identify multi-hazard disaster risk and/or improve adaptive capacity.	0
			Project **DOES** identify multi-hazard disaster risk and/or improve adaptive capacity	50
			Project **WITH** multi-hazard disaster risk management plan	100
Institutional sustainability	Capacities	Contribution to the development of institutional capacities in the public sector and civil	No contribution	0
			Contributes to some of the capacities	33
			Contributes to 2 of the	67
			capacities	100
	Governance	Contributions to better governance	Contributes to all capabilities	0
			No contribution	25
			1 contribution	50
			2 contributions	75
			Contribute 3 contributions	100
	Strategic alignment	Alignment with strategic planning Instruments	The project is **NOT** aligned with strategic planning instruments.	0
			Project **DOES** align with strategic planning instruments	100

Source: Authors' elaboration, based on expert consultation.
CAPEX: capital investments.

Step 6. Model Consistency Verification

As established by one of the AHP principles, to minimize errors in the assignment of scores and judgments, and to verify that the exercise complies with the consistency property, **consistency tests** must be performed on each of the comparison matrices developed. This test is performed by means of the consistency ratio (CR) and the AHP establishes that the result of the weighting will be consistent when it is less than 10 percent. The CR is estimated by applying the following formula:

$$RC = \frac{IC}{IA} \quad (5)$$

where:

RC is the consistency ratio (measure of the consistency test);

IC is the consistency index;

IA is the random index.

The consistency index (CI) is a measure of the consistency deviation of the pairwise comparisons matrix and is estimated as follows:

$$IC = \frac{\lambda_{max} - n}{n - 1} \quad (5)$$

Where:

λ_{max} is the weighted average of the sum of the values assigned in the non-normalized matrix of comparisons and the eigenvector.

n is the number of criteria;

The *random index* (RI) is the consistency index of a random reciprocal matrix, with forced reciprocals, of the same scale range from 1 to 9; it is obtained from a matrix established by Saaty (ILPES, 2024) where a "reference matrix-RI size" ratio of: 2-0.00; 3-0.58; 4-0.90; 5-1.12; 6-1.24; 7-1.32; 8-1.45, and 10-1.49 is observed.

For the case of the criteria, the reference AI will be 0.90 (corresponding to 4 criteria); and for the case of the sub-criteria, the reference RI will be 0.58 (corresponding to 3 criteria). In the example developed in this guide, each criterion is linked to three sub-criteria; however, this is not a general rule, so each dimension could have sub-criteria.

Inconsistency of preferences. As a result of the preference voting, it may happen that the *consistency ratio* for some of the criteria and sub-criteria matrices is higher than 10 percent. In that case, the preference exercise should be repeated and the judgments in the matrix(es) showing inconsistency should be re-entered; thus, the weights will be re-estimated. The repetition of the preference exercise should be carried out until the CR is less than 10 percent (United Nations, ILPES, and ECLAC, 2008).

Likewise, it is possible that the inconsistency has its origin in the noncompliance with the principles of *(i) transitivity* (if A is preferred to B and B is preferred to C, then A should be preferred to C) and/or *(ii) proportionality* (if A is preferred to B with a certain intensity and B is preferred to C with a certain intensity, then A should be preferred to C, with an intensity relatively proportional to the sum of the previous ones). Therefore, attention should be paid to both aspects when repeating the preference manifestation exercise.

Practical Application

Following the example developed in the guide, the calculation of the consistency ratio is presented below. Table 16 presents the information necessary for the estimation of. $\lambda_{max.}$

Table 16. P-matrix for Comparison of Criteria and Eigenvector

	Economic and financial sustainability	Social sustainability	Environmental sustainability and resilience	Institutional sustainability	Eigenvector
Economic and financial sustainability	1.00	1.00	0.50	5.00	**0.2681**
Social sustainability	1.00	1.00	0.50	4.00	**0.2488**
Environmental sustainability and resilience	2.00	2.00	1.00	3.00	**0.4015**
Institutional sustainability	0.20	0.25	0.33	1.00	**0.0816**
Total	**4.20**	**4.25**	**2.33**	**13.00**	

Source: Authors' elaboration based on consultations with experts at the XII Seminar of the SNIP Network, Honduras, 2024.

Thus, $\lambda_{max.}$ is calculated as follows:

$$\lambda_{max} = \sum_i^n Pref_i * VP_i$$

Where:

i are the criteria (or sub-criteria);

$Pref_i$ is the sum of the preferences (votes) for each criterion (or sub-criteria) in the non-normalized matrix;

n is the number of criteria;

For this example:

λ_{max} = 4.20*0.2681 + 4.25*0.2488 + 2.33*0.4015 + 13*0.0816 = **4.181**

with n = 4, the CI is calculated as follows:

$$IC = \frac{4{,}191 - 4}{4-1} = 0.060$$

Given a RI of 0.90, the consistency ratio will be:

$$RC = \frac{0{,}064}{0{,}90} = 6.7\%$$

In this case, the CR is below 10 percent (with a CR of 2.6 percent for environmental sustainability and resilience to 6.5 percent for the institutional sustainability criterion), indicating that consistency is met in the estimation of the weights. This same exercise is repeated for the weight estimates of each criterion (with a CR of 4.0 percent for economic and financial sustainability, and a CR of 6.0 percent for social sustainability).

Step 7. Project Prioritization

Once the consistency of the model has been checked, the prioritization tool can be used to rank a previously defined set of projects. The prioritization tool should be the result of an institutional agreement process, involving the participation of the expert teams. In this way, it will have the necessary technical validation to enable its relatively immediate application. It is also recommended that the prioritization model be updated and modified with the participation of all parties.

Identification of projects to be prioritized. The first step in this stage is identifying the set of projects to be prioritized. This set of investment initiatives should already have satisfactorily completed the *independent review* process and been *deemed* eligible for financing. Applying *prioritization* process should produce a ranking of projects that will be recommended at the *budgeting* stage.

Optionally, it may be appropriate to establish minimum thresholds (e.g., in terms of cost or project size) as an entry criterion for the inclusion of projects in the prioritization portfolio. This is because the initiatives selected are expected to represent a list of significant infrastructure priorities (medium and large projects). This also avoids allocating resources to an extensive exercise of prioritizing projects with little contribution to the country's development or environmental sustainability goals. Naturally, the establishment of thresholds is not mandatory, and their application is subject to the decision of decision makers.

Synthesis of results. Once the projects have been prioritized based on the model and the methodology related to them, the initiatives should be ranked according to their score.

If the decision maker is satisfied with the results, the process is concluded. However, sometimes an additional step, linked to sensitivity analysis, may be required (Box 9).

Box 9. Sensitivity Analysis

Sensitivity analysis makes it possible to define how the order of the options examined would be affected by different scoring and/or weighting assumptions. For example, it makes it easier to assess the impact of changes in the prioritization results when faced with changes in the relative weightings of the criteria and sub-criteria and to determine the conditions under which the prioritization of projects is maintained or altered.

Thus, this complementary analysis contributes to the robustness of the recommendations by providing the opportunity to test any specific areas of disagreement previously raised and the degree to which it has a practical effect on the results. It also makes it possible to establish which criteria and sub-criteria

Box 9. Sensitivity Analysis *(continuation)*

most sensitively influence the results. For example, if the ranking of the highest-ranked options remain the same under different scenarios, it can be concluded that the results are stable and that one option consistently dominates the others. This provides confidence in the decision to be made. Otherwise, it may be necessary for stakeholders to have further discussions to decide which of the options will be prioritized.

The challenge of sensitivity analysis is that, because of its complexity, it often requires the use of specialized *software*. However, it is generally a complementary aspect of the AHP application, so it could be omitted without loss of generality.

Source: DESNZ (UK Department of Energy Security and Net Zero) (2024).
Note: An example of specialized software is Expert Choice, which has five ways to represent the result of sensitivity analysis.

Practical Application

To provide a practical example, the methodology developed will be used to implement the prioritization of two projects, one called Irrigation and the other called Mining. Annex 2 presents the baseline information for the projects. Note that this exercise is merely illustrative and does not imply the formal definition of weights or priorities. Table 17 provides the results of the project evaluation.

Table 17. Results of the Prioritization Process

Criterion	Sub-criterion	Irrigation project		Mining project	
		Criterion score	Sub-criteria score	Criterion score	Sub-criteria score
Economic and financial sustainability	Net socioeconomic profitability	10.25	0.00	26.81	9.27
	Job creation		2.96		2.96
	Fiscal sustainability		7.29		14.58
Social sustainability	Scope	22.65	0.75	9.01	2.84
	Poverty (income)		15.13		0.00
	Priority areas and vulnerable groups		6.77		6.77
Environmental sustainability and resilience	Sustainable use, habitat conservation, and ecosystems	28.51	14.02	11.65	0.00
	Emission reductions (mitigation)		2.82		0.00
	Climate risk, resilience, adaptation, and multi-hazard disaster risk management		11.65		11.65
Institutional sustainability	Capacities	6.04	0.17	6.80	0.35
	Governance		0.59		1.18
	Strategic alignment		5.27		5.27
Aggregate project score		67.43		54.26	

Source: Authors' elaboration based on consultation with experts at the XII Seminar of the SNIP Network, Honduras, 2024.

The results presented are based on the assumptions defined for each of the projects (Annex 2), the weightings assigned to each criterion and sub-criterion, and the corresponding scales. The cases were elaborated as examples only, to illustrate the application of the AHP. If the projects mentioned belong to a larger portfolio, and this prioritization exercise has been applied to 15 projects, Table 18 provides the aggregate results of the ranking.

Table 18. Results of the Ranking of Projects by their Scores

Order	Project name	Score
1	Drinking Water Project	87.41
2	Urban Bikeways Project	78.96
3	Transportation Project	76.74
4	Irrigation Project	67.43
5	Millennium Schools Project	66.53
6	Binational Bridge Project	60.42
7	Regional Airport Project	56.84
8	Mining Project	54.26
9	Waste Project	48.07
10	Urban Train Project	43.16
11	Desalination Project	41.38
12	Gas Transportation Project	39.88
13	Bicentennial Port Project	36.12
14	Justice Center Project	25.07
15	Computer System Project	21.21

Source: Authors' elaboraton based on consultation with experts at the XII Seminar of the SNIP Network, Honduras, 2024.

The presented ranking constitutes the basis for the technical recommendation that formalizes the prioritization of the portfolio of investment initiatives, to be presented to the political authority (decision makers).

Sensitivity analysis of the results. As a complement to the information presented, and as a theoretical exercise, a sensitivity analysis is carried out below. First, the results are tested under the assumption that the weights for the criteria and sub-criteria are constant and equal, that is, that the eigenvector is identical (Table 19).

Table 19. Sensitivity Analysis: Weighting of Eigenvectors, Criteria, and Sub-criteria

Criterion	Eigenvector	Sub-criterion	Own vector
Sustainability of socio-economic and fiscal evaluation	25%	Profitability	33.33%
		Employment	33.33%
		Fiscal sustainability	33.33%
Social sustainability	25%	Scope	33.33%
		Poverty (Income)	33.33%
		Priority Areas and Vulnerable Groups	33.33%
Environmental sustainability and resilience	25%	Emission reduction (mitigation)	33.33%
		Climate risk, resilience and multi-hazard disaster risk management	33.33%
		Sustainable use, habitat and ecosystem conservation	33.33%
Institutional sustainability	25%	Capabilities	33.33%
		Governance	33.33%
		Strategic alignment	33.33%

Source: Authors' elaboration, based on consultations with experts at the XII Seminar of the SNIP Network, Honduras, 2024.

Table 20. Sensitivity Analysis: Summary of Project Prioritization

Name	Initial model score	Order	Sensitized model score	Order
Transportation project	76.74	1	62.50	2
Irrigation project	67.43	2	65.28	1
Mining project	54.26	3	61.81	3
Waste project	48.07	4	48.61	4
Desalination project	41.38	5	43.75	5

Source: Authors' elaboration, based on consultation with experts at the XII Seminar of the SNIP Network, Honduras, 2024.

For simplicity, the sensitivity analysis has been applied only to a sample of projects (Table 20). However, in practice it should be applied to the entire portfolio of investment initiatives. As these results show, with the sensitized model the order of the projects is modified, especially in the upper part of the table, while the order in the lower part remains unchanged. However, this result should not be generalized, as the outcome of the sensitized model will depend on the nature of each project as well as the evaluators' interpretation of the information available for each project.

Guidance for Facilitators of the Prioritization Process

Below are some guidelines for the practical application of the prioritization model, especially with respect to defining the weightings.

- All participants in the exercise should have a thorough understanding of the prioritization problem and objective.

- All aspects of the discussion should be noted, particularly the difficulties and challenges encountered during the voting of participants' preferences. This record will allow the creation of a knowledge base that could be useful in case it is necessary to repeat the exercise.

- Before voting on the weights begins, the conceptual prioritization model (proto-model) should be presented, including an explanation of the steps and information required.

- Voting should begin with the pairwise comparison. First, participants should vote their relative preference among criteria and then assign an intensity of that preference on a scale of 1 to 9. Although each model may establish its own rules, to simplify the exercise, preferences should be resolved by simple majority, and the intensity result should be derived from the geometric average of the votes. In both instances of voting (preferences and intensity) all members involved should participate, even if they initially had different preferences or different priorities among the criteria.

- To present the intensities, it may be useful to start by mentioning some of the values of the scale, to facilitate the intuitive understanding of the levels by the participants (e.g., extremely is 9, strongly is 5, moderately is 3, and the point of indifference is 1). It is also important to keep a record of the votes, to facilitate eventual repeat voting processes in cases of inconsistency.
- Once the voting has been completed, the consistency analysis must be performed. As indicated, if the result is inconsistent, a new vote should be taken, considering the following potential causes of inconsistency: (i) noncompliance with the principle of transitivity or (ii) noncompliance with the principle of proportionality.

Final Recommendations

Climate change can have a significant impact on the sustainability of public infrastructure. On the one hand, climate hazards induced by CC have the potential to cause direct damage to physical assets and infrastructure, as well as to disrupt related services. On the other hand, infrastructure that is not climate resilient will require additional routine and emergency maintenance over its lifetime, which could lead governments to reallocate resources from productive capital to adaptation capital (IMF, 2021; World Bank, 2019). Therefore, investing in the retrofitting of traditional technologies to adapt to CC may prove more costly than ensuring climate-resilient infrastructure from the outset.

This guide sets out a methodology for project prioritization, incorporating the CC dimension as one of the priority criteria. While some sections of the document include conceptual and theoretical details, together with international examples to illustrate the practical applicability of the tool in public investment management, this prioritization exercise can be simplified in a guide adapted to each SNIP, focusing exclusively on the application of the steps (defined in this document as **Practical Applications**). Simplified guides could also reduce the number of indicators to decrease the workload involved in project analysis.

Furthermore, prioritization of investments including CC considerations in the context of SNIPs is still a work in progress, and there is no consensus on how to approach it. According to the review of international experience, current mechanisms for including CC vary from their incorporation into methodologies to the development of specific guidelines, through merely enunciative efforts that are usually associated with national investment plans.

On the other hand, the inclusion of CC at different stages of the project life cycle is not exclusive; therefore, parallel efforts should be made to address CC both in socioeconomic assessment methodologies (through the measurement of economic externalities), as well as in the project selection process and prior to the budgeting of initiatives (using specific prioritization methodologies).

Among the prioritization practices highlighted, MCA is a widely disseminated and accepted method for investment prioritization. It is flexible and can be adapted to different environments and complexities and makes it possible to structure investment programs in a way that is compatible with climate policies and international commitments. As stated by OECD (2018), only MCA is as comprehensive as CBA and may even be more so when objectives beyond efficiency and distributional impact are considered.

However, its rigorous application can be complex and not without practical difficulties. As Marcelo et al. (2016) point out, MCA lacks the utilitarian basis of welfare economics that accompanies CBA, in which project selection is based on maximizing social welfare. Thus, there is also the threat of subjective manipulation of weights and criteria to favor certain projects over others.

Beyond the weaknesses noted above, Marcelo et al. (2016) themselves offer answers to them. First, while MCA is not based on utilitarian welfare economics, it aligns with policy analysis theory, democratic accountability, and deliberative governance, in which policy selection is based on the stated objectives of a political entity and its citizens, considering criteria such as effectiveness, efficiency, feasibility, appropriateness, equity, responsiveness and relevance. Second, the manipulation of results to privilege the selection of certain projects is not exclusive to multi-criteria evaluation; in fact, the threat of methodological corruption is present in all evaluation and selection approaches. Third, the rules guiding implementation can help deal with the latter issue; in particular, the decision criteria, the weighting of criteria and sensitivity analysis should be defined and made transparent prior to selection. Also, the data used and the resulting analysis should be made publicly available and open to third-party review.

An additional aspect that may condition the application of MCA is related to the availability of information to respond to the indicators established in the model. Although this should be considered when defining them, sometimes it is not clear how projects are linked to public and official sources of information. For this reason, the strengthening of national systems for recording information is still a challenge for SNIPs, especially regarding the investment project bank, which is essential for facilitating analysis. It is necessary to improve interoperability with other public management systems to make efforts to quantify and assess climate impacts more useful. In addition, indicators should ideally be linked to official sources of information, avoiding, as far as possible, an additional search and processing of information that would make prioritization more onerous and less efficient.

Another challenge in the development of prioritization exercises concerns the identification of the experts who participate in the different stages of the exercise. As already mentioned, the experts will not necessarily be the same across all decision processes; each criterion or dimension could have specific specialists who understand both the nature of the problem and the specific requirements of the analysis. On the other hand, since most of the countries in the region have formally constituted SNIPs, the professionals linked to the system already comprise a first universe for selection, to which should be added professionals from academia or think tanks, who usually support the development of the methodological tools of the systems. Multilateral lending agencies, such as the IDB, also tend to support these initiatives through their own teams and outsourced teams. In any case, this guide aims to be a contribution to demonstrate that prioritization can be carried out, at least in the initial stages of analysis, without the need for sophisticated models, even when in-house capabilities may be complex.

In relation to the formal implementation of the prioritization exercise, it is important to take some considerations into account. First, project formulators should be informed in advance of any changes. Although the guide is addressed to decision makers (in a collegiate exercise between the SNIP and the ministry of finance and at the highest level of decision making for the allocation of resources), project formulators must necessarily understand the relevant concepts and "rules of the game" of prioritization, since in addition to accepting the decisions, they must provide the corresponding information for the evaluation of the initiatives.

Secondly, the implementation of the prioritization process must consider the workload of the project formulation and evaluation teams. This will avoid establishing new work obligations that make the process of project preparation, evaluation, approval, and selection less efficient.

Third, it is essential to have standardized definitions, nomenclature, and terminology to avoid subjective interpretations of criteria, sub-criteria, indicators, and scales by analysts. Only to the extent that interpretations are collegial and ideally unambiguous will the prioritization process be efficient.

Fourth, implementation should begin with a pilot application to a sample of projects, which will serve as a calibration exercise. Once it has been shown to operate without inconsistencies or practical difficulties, the model should be applied to the full portfolio of investments. The calibration stage may also reveal the need for adjustments or redefinition of certain criteria or scales, if this is adequately justified from a technical point of view.

Finally, ideally the team of analysts selected to carry out the project prioritization should be the same to maintain consistent criteria in the assignment of scores (to which, of course, the existence of definitions, nomenclature and standardized terminology also contributes). However, if this is not possible, it is recommended that a team of accredited professionals be formed, who can be exchanged and grouped together in different prioritization exercises, establishing their recommendations based on a collegiate judgment of specialists, as is the case of the Republic of Korea's public investment management system.

In any case, and beyond the limitations that SNIPs may face in terms of project selection, it is essential to make rapid progress in exploring the use of MCA for prioritizing investments with the inclusion of CC considerations, as one of the possible priority criteria and in a complementary manner to the traditional CBA. It is hoped that this tool will be a first step in that direction, promoting a more holistic view of budget allocations, with the understanding that technical and political aspects must be balanced in this decision.

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Annexes

Annex 1. Methodology for Estimating Weights

Multi-criteria analysis is a decision support process that requires the application of comparative methods to ensure that decisions are fully consistent with a given adopted rationality framework. Two critical issues emerge from the literature review in the application of MCA. The first has to do with the selection of criteria for prioritization of alternatives and the second with the weighting of these criteria. The simplest way of weighting is to assign all criteria the same weight or importance (as in the case of the Dominican Republic). An alternative method is to use a panel of experts to decide the weights based on their experience and knowledge. The third, more precise and sophisticated method is weighting criteria based on the AHP, developed by Saaty (2004) (Box A1.1).

Box A1.1. Multi-criteria Analysis Methods

There are different methods belonging to the MCA family that use linear additive models to calculate the overall benefit. They differ in that each emphasizes different techniques, which also affects their rigor. The methods are:

- Simple multi attribute weighting technique using swings. This method emphasizes component value functions and swing weighting but only addresses a flat list of objectives or criteria, not a hierarchy. In its SMARTER variant, it uses an algorithm to derive ratings from ranks.
- Measuring attractiveness by a categorical based evaluation technique.
- This method uses a discrete pairwise comparison algorithm for initial scoring, followed by stakeholder refinement. It supports component value functions and swing weighting.
- Most economically advantageous tender. This method describes scoring and weighting approaches for bid evaluation. It is not an MCA method per se but could be used to create a rigorous bid evaluation scheme that complies with the most economically advantageous tender.
- Analytical hierarchy process. This method emphasizes a hierarchy of objectives or criteria and defines an open source discrete pairwise comparison matrix algorithm.

Thomas L. Saaty developed the latter method. It consists of decomposing complex structures into components and arranging them in a hierarchical structure. From this structure, numerical values are obtained for the preference judgments, which are then synthesized to determine which variable has the highest priority. The

Box A1.1. Multi-criteria Analysis Methods *(continuation)*

method is based on a simple but solid theoretical foundation, which proposes ordering analytical thinking according to three principles: (*i*) construction of hierarchies, (*ii*) establishment of priorities, and (*iii*) logical consistency.

AHP is one of the most widely used multi-criteria methodologies, since it works with discrete variables, with measurement of preferences by aggregation of criteria and operates deterministically (i.e., it does not consider uncertainty). Additionally, there are *software* tools that implement MCA using various combinations of the above methods.

Source: United Nations, ILPES, and ECLAC (2008); UK Government Analysis Function (2024).

The AHP is a widely applied tool for public investment decision support. It makes a distribution of decisions according to a priority or hierarchy that helps to visualize which alternatives have the greatest impact on the desired objective, based on a series of pairwise comparisons of alternative options. In addition, the AHP is used for its rigorous mathematical synthesis, as well as for the guarantee of consistency in the formalization of an intuitive understanding of complex problems, through the construction of a three-level hierarchical model (objective, criteria and alternatives) (Arteaga et al., 2019). The principles underlying the AHP method are developed in the following sections.

Principle of Hierarchy Construction of the Analytical Hierarchy Process

Hierarchies lead a system toward a desired objective. The construction of hierarchies follows the guidelines outlined above: definition of problem and objective, identification of criteria and sub-criteria, and definition of indicators.

The definition of hierarchies must follow an axiom of homogeneity, which requires that criteria within the same level be comparable using a limited scale. Thus, homogeneity means that the elements to be compared must be of the same order of magnitude. Therefore, when constructing the hierarchical model, all the sub-criteria derived from the same criterion must be relatively similar in importance; if this condition is not met, then it will be necessary to add intermediate levels of sub-criteria to separate the different orders of magnitude.

Prioritization Principle of the Analytical Hierarchy Process

The estimation of weights or weightings between criteria with their respective scales is a systematic process, based on pairwise comparisons of hierarchy elements and the use of the mathematical properties of the matrices associated with these comparisons. It is important to note that the mathematical support for each of these steps is fundamental, since it provides stability and ensures the validity of the results obtained.

It should also be noted that paired comparisons allow dimensions to be addressed:

- **1. Importance:** appropriate when comparing criteria with each other; for example, whether alternative A is more important than alternative B.
- **2. Preference:** appropriate when comparing alternatives; for example, if alternative A is preferable to alternative B.
- **3. More likely:** used when comparing the likelihood of outcomes, either between criteria or alternatives; for example, whether alternative A is more likely to be realized than alternative B or whether outcome A is more likely than outcome B.

Principle of Logical Consistency of the Analytical Hierarchy Process

As stated by the United Nations, ILPES, and ECLAC (2008), human beings have the capacity to establish relationships between objects and ideas in a consistent manner, that is, in such a way that they are adequately related to each other and their relationships show congruence. In this sense, consistency implies considering the following:

- **1. Transitivity:** the order relations between elements must be respected; that is, if A is greater than C and C is greater than B, then A should be greater than B.[1]
- **2. Reciprocity:** given two options, A and B, the decision maker must be able to compare them under some criteria, on a reciprocal scale, that is; the intensity of the preference of A over B must be the inverse of the intensity of the preference of B over A.
- **3. Proportionality:** the proportions between the orders of magnitude of these preferences must also be fulfilled (with an allowed range of error). For example, if A is 3 times greater than B and B is 2 times greater than C, then A should be 6 times greater than C for the judgment to be 100 percent consistent.[2]

Comparison scales are implicit in human judgement and do not always align with exact numerical values. Therefore, the human mind is not, in general, prepared to make 100 percent consistent judgments. However, it is expected that, even when the proportionality principle is violated, this does not imply transgressions to the principle of transitivity.

Score of the Analytical Hierarchy Process

The formula for the final score of an investment project or policy using the simplest form of the MCA is as follows:

$$Score_i = \sum_j p_j * s_{ij} \quad (1)$$

Where:

i	is the i-th option or alternative;
j	is the jth selection criterion;
p	is the weight of the selection
s	is the score.

[1] If A is preferred to B and B is preferred to C, then A should be preferred to C.
[2] If A is preferred to B with a certain intensity, and B is preferred to C with a certain intensity, then A should be preferred to C, with an intensity relatively proportional to the sum of the above.

Thus, a single indicator is obtained that makes it possible to rank priorities, applied in this context to a portfolio of public investment projects (Box A1.2).

Box A1.2. Simple Standardization Method

The simple standardization method is an alternative to the AHP and uses a matrix of criteria comparisons based on a Z statistical tool. Through this matrix, it is asked whether criterion "i" is more important than criterion "j". If this is the case, a value of 1 is assigned to the cell corresponding to the row containing criterion "i" and the column containing criterion "j"; otherwise, a value of 0 is assigned. The rows must be added up, and the percentage they represent with respect to the total must be calculated. In this way, the weighting for each criterion in the evaluation is obtained.

Likewise, the method can compare the different indicators of the projects or project alternatives in each of their criteria, through the standardization of their values. Standardization (Z) is a technique that allows the homogenization of measurement scales for comparability.

This method is valued for its simplicity in calculating weights through basic arithmetic. However, it has some limitations: it lacks ways to check the consistency of the judgments entered in the comparison matrix (i.e., to ensure that they represent informed and consistent opinions), and it does not allow differentiation between the degrees of importance of the criteria (how much more important one criterion is relative to another). Because of these weaknesses, AHP, which provides solutions to these limitations, has been preferred.

Source: United Nations, ILPES, and ECLAC (2008).

Annex 2. Background Information on Irrigation and Mining Projects

The projects described below are illustrative and hypothetical. Thus, some of the data they contain have been created and do not correspond to the reality of the place, region, or country.

Irrigation Project, Costa Rica. Infrastructure in Small Irrigated Areas

General Background

The *water* input in the agriculture sector allows increasing production and productivity. This generates new production alternatives that allow entry into new markets, in addition to the market generated by tourism development.

The implementation of this project is intended to contribute to the steady development of agricultural activities in the West Canal, benefiting the production and productivity of fish and agricultural activities that are greatly affected during the critical periods of the dry season.

The area of the West Canal domain is about 21,000 ha distributed among 777 landowners. Within the area there are five fish farming projects with a total of 400 ha of water bodies; 7,500 ha of sugar cane; 1,800 ha of melons during the dry season; 11,900 ha of rice during both periods, and other smaller-scale crops such as watermelon.

According to some runoff studies in the Bebedero basin conducted by the engineer William Murillo in 1987, the Tenorio River has an average annual flow of 9.9 m3/s, with an annual minimum of 4.9 m3/s at the end of the dry season. If we consider the great need for water availability for the current demands of the Arenal Tempisque Irrigation District, plus the growth in demand due to the increase in the number and size of fish farming developments and the expansion of the South canal, this project is of utmost importance as a contribution to the strengthening of production in the Di.

Political and Administrative Background

By Executive Decree n.° 15.321-MAG, the Arenal Irrigation District was created for the purposes of Law n.° 6.877, of July 29, 1983, for the National Groundwater, Irrigation and Drainage Service (SENARA) to adequately develop its programs. The area of the district partially covers the cantons of Abangares, Cañas, Bagaces, Liberia, and Carrillo in the province of Guanacaste and is part of the Arenal Tempisque Irrigation Project (PRAT). The project master plan contemplated the development of 60,000 potentially irrigable hectares.

In the early 1980s, the first stage of PRAT was developed, with an irrigation area of 6,000 ha, in the canton of Cañas. It currently has about 28,500 ha under irrigation and in operation. In recent years, there have been efforts to continue with the development of the next stages of PRAT. Construction will soon begin on the expansion of the South canal and the distribution network of the Lajas and Abangares subdistricts, with an irrigable area of 9,000 ha. Studies have also been carried out to increase water resources on the right bank of the Tempisque and in the coastal area of Guanacaste. In 2010, the feasibility study for the construction of the Piedras River reservoir project, which was contracted by the Central American Bank for Economic Integration in 2009, was completed.

With the experience gained in the implementation of the first stages of the irrigation project, the use of water to generate electricity has been given priority. Likewise, for the operation of the irrigation canals' hydraulic system, it is necessary to adjust to the generation regime of the Costa Rican Electricity Institute (ICE), to withstand significant variations in the flow of the main water source (Miguel Pablo Dengo Dam), sometimes for short periods during the day and other times for longer periods (days and even weeks). This situation becomes worse during the rainy season, when Arenal's electricity generation is reduced and replaced by other plants in the country that operate at the water's edge, so that the minimum flow is not available to meet irrigation demands. Thus, according to the development projections, it becomes necessary to maximize the use of water and the search for new sources.

The DRAT is a vital source for the agricultural and fish farming sector in the Chorotega region, as it represents an indispensable input for the development of production on a national and international scale and its feasibility to enter and/or expand into new markets. The project is expected to generate 3,200 direct jobs and more than 15,000 jobs during operation.

Study Area and Population

The 21,000 ha of irrigated land belong to 777 landowners, most of whom are small farmers from the IDA settlements (La Soga, San Martín, Bagatzí, Tamarindo, San Ramón, Playitas, Falconiana, Canje). There are also medium and large producers, including CATSA, El Pelón de la Bajura, and Azucarera El Viejo. This region is the focus of President Rodriguez's political management, because it is among the poorest in the country[3] and is the focus of the National Policy of Prioritized Territories. The project could also directly and indirectly benefit the sugarcane, rice, and melon producers, through a training program for farmers on irrigation. The PRAT, well consolidated in the region, can be an important source of direct and indirect employment, as well as produce food that benefits the entire region and a good part of the country.

Characteristics of the Study Area (Current Situation)

The water supply in the DRAT has the following characteristics:

- During some periods of the rainy season, there is no minimum flow to meet the demands of the DRAT, due to the lack of continuity of supply from the turbined waters of the hydroelectric complex operated by ICE.
- The Tenorio River has an average annual flow of 9.8 m3/s, and the annual minimum is 4.9 m3/s at the end of the dry period.
- In the short term, the Lajas and Abangares subdistricts will demand approximately 15.0 m3/s additional flow, which according to ICE projections would complicate the operation of the DRAT for its supply.
- SENARA, the institution responsible for managing the DRAT, does not have the necessary equipment and infrastructure to impound water during periods of excess supply from ICE.
- Agricultural production in influence of the DRAT is highly dependent on water as an input to compete in national and international markets.
- The growth in fish farming areas and the conditions of this activity in the area require the availability of a greater and more sustained flow of water.
- The execution of irrigation works on the Tenorio River would provide an alternative source, which would substantially alleviate the current and future water needs for irrigation in the DRAT, on which the most important productive sectors in the region depend.

Location. The project is in the province of Guanacaste, specifically in the cantons of Cañas and Bagaces. The Lambert coordinates of the quadrant where the diversion works are located are: 279.157 North and 409.853 East at the dam site, and 275.346 North and 408.259 East at the junction with the West canal.

The area of the West canal domain covers about 21,000 ha distributed among 777 landowners. These include small producers from the IDA settlements (La Soga, San Martín, Bagatzí, Tamarindo, San Ramón, Playitas, Falconiana, Canje), and medium and large producers such as CATSA, El Pelón de la Bajura, and Azucarera El Viejo.

[3] Poverty is around 29 percent of households, which consist of an average of 5.5 people.

Site selection. Site selection must consider the elevation with respect to the west channel, as well as the geology and shape of the river section, to obtain the best possible characteristics for the construction of the project. The flooded area is expected to affect five hectares of native forest, which will require a relocation program for native species. The west channel, at the point of discharge of the project waters, has a bank elevation of 52.80 meters above sea level (m.a.s.l), while the dam site to be selected is located 4.5 km away horizontally and has a bottom elevation of 53.35 m.a.s.l.

Technical Analysis

In general, the project consists of two major infrastructure components:

- The first is the diversion dam, a reinforced concrete structure 45.0 meters long and 5.0 m high, to be built on the Tenorio riverbed. This structure consists of a spillway, a stilling basin, a cleaning and desanding structure, and the intake work.
- The second component is the conduction channel, which connects the diversion dam with the west channel. This channel is 4.5 km long and has a maximum conveyance capacity of 7.0 m3/s. This channel must also be accompanied by two concrete bridges and a discharge outlet when it reaches the west canal.

It is also expected to incorporate a 40 megawatt run-of-river power plant to generate electricity in the central channel. The objective is that the energy generated will replace a series of thermal power plants that are in the final period of technical obsolescence and currently emit 200 tons of nitrous oxide (N(2)O). Thus, the project is part of the country's Decarbonization Program for 2050.

The dam to be built on the Tenorio River is a diversion dam, and its main function is to raise the water level of the river to approximately 5 m and introduce it into the intake works. It is a gravity dam (i.e., it is stable under its own weight), built mainly of concrete. This type of structure does not generate a reservoir; the objective is to flood as little area as possible.

The structure must have a high-capacity spillway, since it is located on the riverbed itself. Thus, during the rainy season, all the water that runs off the river can pass over it and continue its flow downstream, without causing damage to the structure or its surroundings.

Feasibility and Sustainability Analysis

The project is part of the National Development and Public Investment Plan (PNDIP). Its challenge is to promote the integrated and sustainable management of water resources, within a renewed legal and institutional framework that avoids disarticulation, overlaps, and gaps in competencies, replacing them with an effective sectoral steering role that includes all public entities in the sector. Its objective is to contribute to strengthen the country’s commitment to sustainable development.

The PNDIP encompasses four fundamental sectoral policies:

- National Water Policy. The sustainable water use pillar states that the water resource must be developed, allocated, and managed equitably among all user sectors, conserving the desired quantity, quality, continuity, and security of water, in a sustainable manner.

- National Integrated Water Resource Management Plan. This plan is based on the premise that water is necessary for human development and has social, environmental, and economic value.

- National Food Plan. The priority sector concerning this project focuses on productive development, with new irrigated production areas to increase competitiveness in the production of basic grains.

- Institutional Strategic Plan. SENARA's raison d'être "is to contribute to the improvement of the quality of life of the inhabitants, through the protection and integrated management of water resources, and the development of hydro-productive systems, in harmony with the environment, with the active participation of society" (SENARA, n.d.)

Environmental Disaster Risk Analysis

According to the geographical location, natural disasters are a threat that can have great impact, but with a very low probability of occurrence of damage. The main natural hazards include earthquakes and hurricanes, with their respective indirect effects.

Hurricanes could cause strong flooding in the Tenorio River and damage to the dam and the canal. A high-intensity earthquake could slightly affect the dam infrastructure and, to a greater extent, the canal.

In accordance with the procedure established by the National Environmental Technical Secretariat, and subject to the matrix of the United Nations International Standard Industrial Classification of All Economic Activities, Third Revision, irrigation projects are classified and identified with the number 140, which implies that a type D1 environmental impact assessment must be performed.

Profitability Analysis

A national consulting team conducted the feasibility study, with support and financing from the IDB.

Initial investment. Regarding the investment required for execution, a total amount of US$29,996,930 is required, which includes the cost of the works, land, and supervision. This amount will be financed through the public–private partnership mechanism, where foreign investment banks are expected to participate with a conditional loan for approximately 60 percent of the total cost.

Operating and administration costs. To calculate the costs, total current expenditures for the operation and administration of the PRAT must be considered. They amount to US$1,878,887 per year (operation: US$1,293,437, administration: US$ 585,450).

Profitability. The project has an NPV of US$9,126,821, estimated at a social discount rate of 8 percent. The project evaluation period is 15 years, and the residual value corresponds to 50 percent of the initial investment cost. This profitability is just below the average profitability of the sector over the last five years; however, it is recommended that it be prioritized due to the enormous social impacts derived from the project.

Mining Project, Chile: Infrastructure for Copper Mining and Others

General Background

The Playa Blanca mining site is a mining deposit located in the I Region of Tarapacá, Chile, at 4,500 meters above sea level, 165 km as the crow flies from the city of Iquique, and 240 km to the southeast of this city by public roads or routes. The personnel associated with the work at Playa Blanca Phase I come from different parts of the country, mainly Arica, Iquique, La Serena, and Santiago. For this reason, the project generates a positive effect by reactivating the regional economy, which has been designated as one of the Prioritized Border Zones within the framework of the special development plans for extreme zones.

According to geological, metallurgical, and economic profitability information, construction of the mining facilities for Playa Blanca Phase I took place between 1992 and 1994. The Playa Blanca Phase I operation commenced in late 1994 targeting supergene ore through open pit mining. It also included a material handling and acidification plant through agglomeration drum, dynamic leaching heaps, conventional solvent extraction (SX) and electrowinning (EW) plants, to obtain high purity copper cathodes as a commercial product. The copper cathodes are transported by truck from the Playa Blanca Phase I facilities to the port of shipment to the destination countries.

The Playa Blanca I operation to extract supergene ore was completed at the end of 2019. It should be noted that during the period 2006–2019 a total of 75 MT of soluble copper grade 0.819 percent were extracted and sent to leaching heaps, and an additional 114 MT soluble copper grade 0.238 ROM (run of mine) were sent to leach dumps.

Recent studies have found that there is a significant number of reserves of hypogene-type minerals, located at depths greater than the current exploitation. These are of low solubility and require an adaptation of mining and metallurgical processing methods.

Political-administrative Background

One of the main economic activities developed in Chile is the mining of various metallic and non-metallic minerals. Among these, in first place is copper and, in second place, iron, and in both cases the main market is exports to other countries.

The owner of the project is Compañía Minera Playa Blanca SA, a publicly owned company. This company has different shareholders who make up the company's board of directors and are responsible for making decisions regarding the future of the operation.

The need to carry out joint and sustainable work among the different actors in the mining sector is a fundamental aspect today. Environmental measures tend to become more and more restrictive, just as globalization has allowed communities to have a better command of information, which has helped them to become stronger and to assert their importance when evaluating a project; for example, frequently to deny the so-called Social License to Operate.[4] Therefore, considering guidelines on the basis of joint action makes it possible to promote productive development linked to the preservation of the environment and the social growth of the sector.

With respect to the communal authorities, there is optimism regarding the approval and implementation of the project. It is expected to boost communal development through a massive source of employability and all that this implies for the economic growth of the area, which is the main point of interest of the authorities in the execution of the project. This is especially relevant considering that the poverty rate has increased in the last three years from 6.1 percent to the current 8.9 percent.

The project also contemplates the construction of a shipping terminal, located in the town of Totoralillo, which is intended to allow the export of the concentrates obtained without relying on third parties. This port is located close (30 km north of the site) to the Humboldt Penguin National Reserve, which is home to about 80 percent of the world's population of endangered Humboldt penguin species.

Study Area

The initial open pit mine at Playa Blanca (the Playa Blanca Phase 1 or PB1 operation) began operations in 1994, mining supergene copper mineralization. To date, operations at the mine have utilized a heap leach, dump leach, and SX/EW extraction process. The supergene ore is currently depleted, and mining operations have ceased; however, the SX/EW plant continued to produce cathode during 2019 and 2020 from the existing supergene leach pads.

Factors that may affect mineral resource estimates include the following:

- Changes in local interpretations of mineralization geometry and continuity of mineralized zones
- Density and dominance assignments
- Changes in geotechnical, mining and metallurgical recovery assumptions

Mineralization consists of supergene (chalcocite and, to a lesser extent, copper oxides such as atacamite, cuprite and, locally, brochantite) and hypogene (chalcopyrite, bornite, molybdenite) mineralization.

Supergene zone a. Secondary mineralization appears to be preferentially concentrated near more permeable structures and rocks. The thickness of the leach layer varies between 7 and 200 m, while the thickness of the secondary copper zone varies between 10 and 200 m. Continuous supergene copper mineralization has been traced over a 2.5 x 1.5 km area. The lower portions of the secondary enrichment zone transition to primary copper mineralization, resulting in a low-grade mixed ore type. This zone was mined during PB1 and is now almost entirely depleted.

[4] The Social License to Operate is the permission granted by communities to large-scale projects carried out in their territory. It has its origin in the "Mining and the Community" Conference of May 1997, sponsored by the World Bank, in Quito, Ecuador.

Hypogene zone. In the hypogene environment, mineralization occurs primarily as disseminated, vein-like, brecciated cement mineralization following an approximately 2 x 5 km east-northeast trending area that is hosted within Paleozoic quartz-monzonite to granodiorite, feldspar porphyry intrusions and breccias. Drill holes have intercepted mineralization at over 1,000 m vertical depth in the hypogene zone. The hypogene mineralization was exposed during the mining of the supergene ore and stockpiled when encountered and is currently available from these stockpiles.

Due to the opportunity provided by the remaining untapped resources at the Playa Blanca mine site, using a solution tree and identifying different possible actions, the following alternatives are proposed for the project.

- **Alternative 1.** *Overhaul* the main equipment. Use additives, such as chlorine, to increase the recovery of mixed minerals or minerals with lower solubility ratio. If additional water is required, it will be trucked to the plant site. The plant process will be optimized by incorporating recirculation lines from the riprap dumps to the SX-EW plants.

- **Alternative 2.** Change mining method to a more selective one, such as Sub Level Stoping (subway). The extracted minerals will be processed in a new bioleaching line and transferred to the SX-EW plant. The water required for the process will be pumped from the sea; and for industrial requirements, water will be trucked in.

- **Alternative 3.** Change mining method to a more selective one, such as Sub Level Stoping (subway). The extracted minerals will be processed in a new bioleaching line and transferred to SX-EW silver. A desalination plant will be built, and the water will be pumped to the site.

- **Alternative 4.** Develop a new flotation line to beneficiate the mixed and sulfide ores present in the hypogene body to maximize their recovery, decrease processing costs and, by default, lower the cut-off grade, allowing more resources to be transformed to reserves. The mining method will be open pit, to maximize the amount of fine extracted. It also considers the dismantling of the leaching plant to expose the minerals present there and the construction of a desalination plant to drive water to the site.

The identified actions that are part of the optimized baseline situation, allow the continuity of the processing of the existing leaching heaps, to obtain copper cathodes with SX/EW plants currently in operation. This requires acid solution irrigation of the leach heaps as well as the existing low-grade dumps.

For both heaps and dumps, physical facilities are available and operational; the SX/EW plants do not require modifications, and the service facilities require minor investments. In addition, minor investment is required in the areas of acid solution recirculation ponds, personnel redeployment, and general management measures.

Likewise, the actions identified that are part of the optimized baseline situation correspond to the following:

- Expansion and modification of accesses for the leaching dumps and riprap dumps
- Minor water management works
- Redeployment and reassignment of personnel

Technical Analysis

The project will consist of obtaining iron and copper concentrates from the extraction of material from two pits (North and South pits). The total daily, monthly and annual average production of copper concentrate will be, respectively, 33,300, 1,000,000, and 12,000,000 tons; the total daily, monthly, and annual average production of copper concentrate will be, respectively, 420, 12,500, and 150,000 tons.

The activity that will mark the start of project execution will be the construction of access roads to the mine, prior to the start of construction of the temporary camp in that sector.

- The waste material generated by the exploitation of the South and North pits will be disposed of in a single ballast deposit common to both.

- The extracted ore will be transported in trucks to a processing plant where it will be first crushed (primary and secondary crushing) to reduce its size to a suitable particle size to be transported by a closed conveyor belt to a *stockpile*. From there, it will be subjected to a two-stage grinding process (high pressure grinding rolls, and wet grinding) where the material will continue to be reduced in particle size until an optimum particle size is obtained. For the optimum handling of the extracted material, a new Canadian robotic technology is planned to be incorporated, whose *software* development will be made available free of charge to small and medium mining companies.

- The tailings generated in the iron and copper concentrate plants will be thickened to obtain final tailings with an approximate concentration of between 50 and 55 percent solids. This will be pumped by positive displacement pumps through a tailings pipeline to a thickener system located in the same sector where a thickened tailings deposit will be built for final disposal.

- The iron concentrate pulp transported to the Totoralillo sector will undergo a thickening and filtering process to obtain a magnetic iron concentrate (*pellet feed*) with 8 to 9 percent humidity; after filtering, the iron concentrate will be sent by conveyor belts to a stockpile sector from where it will be taken to a marine shipping terminal built in the Totoralillo Norte cove. Once there, it will be loaded onto bulk carriers that will transport it to its destination. For the transport of the pulp, a training program on handling oversized equipment is planned for female drivers, as part of the company's gender support program.

Feasibility and Sustainability Analysis

The project is part of the National Mining Development Program, which considers increasing road infrastructure nationwide to support the country's healthy and sustainable development. This plan is based on two fundamental goals for the sector:

- National Mining Policy. This policy is designed to improve the sector's productivity, ensuring that the country remains a world leader in copper production.

- Institutional Strategic Plan. The project expects to contribute to the improvement of the quality of life of the inhabitants through the development of productive systems in harmony with the environment, with the active participation of society.

In addition, as part of the feasibility analysis, a *stakeholder* analysis was carried out, from which the management plan was designed based on three types of actions (table A2.1):

- **Management and intervention:** aimed at stakeholders who will require communication efforts, to inform them about the project and gather their opinions through lobbying actions and/or the contracting of studies or expert advice.
- **Management:** for those stakeholders in whom resources will be invested to keep them informed and gather their opinions.
- **Monitoring:** for stakeholders who will only require sporadic follow-up during project processing and construction.

Table A2.1. Feasibility Analysis

Stakeholder	Plan
Environmental authority	Manage and intervene
Community mayor	Manage and intervene
Local community	Manage and intervene
Indigenous communities	Manage and intervene
National parliament	Manage
Port concessionaire	Monitoring
Equipment suppliers	Monitoring
Construction companies	Monitoring

The *stakeholder* management plan must consider a proposed investment plan for the annual contribution of US$ 1,300,000, so that the community perceives the benefits of this investment. This management plan relates to the National Sustainable Mining Policy, which will be developed as a contribution from the project.

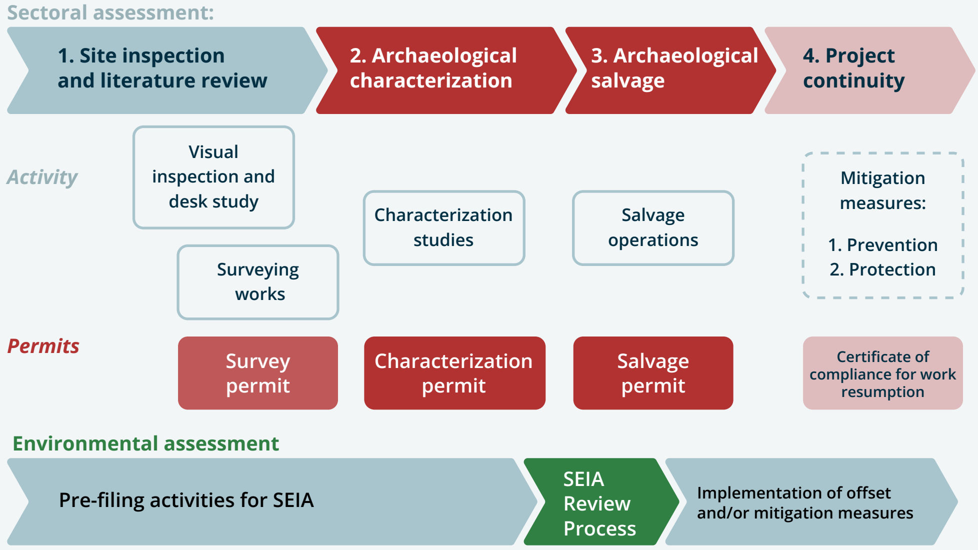
Environmental Disaster Risk Analysis

In mid-September 2022 the mining company submitted an environmental impact study to the respective legal entity in charge of evaluating it (Environmental Impact Assessment Service). The study consisted of 14 chapters, including technical details of the project, its baseline and potential environmental risks, together with the mitigation measures proposed by the company.

The study established that altiplanic rains could cause heavy flooding in the project area and produce eventual damage to the leaching piles. On the other hand, a high-intensity earthquake could seriously affect the network of tunnels that connect the extractive processes.

The following chart summarizes the hazard risk assessment process within the framework of Mining Law n.° 17,288 and Environmental Laws n.° 19,300 and n.° 20,417. The corresponding detail of the stages is presented in the feasibility study.

Figure A2.1. Project Feasibility Study



Source: Environmental Impact Assessment Service.

The environmental impact assessment ruled out the effects of the project on the Humboldt Penguin National Reserve protected area and other priority sites for biodiversity conservation such as the Punta Choros Marine Reserve, which have been declared exclusion areas for the project. Thus, the works and activities contemplated by the project will not be developed in the Pingüino de Humboldt National Reserve, so there will be no impact on resources or areas located in the Atacama Region.

Profitability Analysis

A national consulting team developed the feasibility study, with support and financing from the IDB.

Costs. The operating cost estimate includes all operating activities required for the mining and processing of hypogene ore through the concentrator facilities, as well as its production of copper and molybdenum concentrates, including all services required to support these operations.

The battery limits of the estimate range from in-situ ore to concentrate dispatch via concentrate transport pipelines to loading on a ship (in the case of copper concentrate) or in maxisacks (in the case of molybdenum concentrate).

The life of the operation is 28 years, at an initial plant throughput rate of 140,000 tons/day, which will reach a rate of 143,000 tons/day starting in 2029. The steady state costs are based on a maximum annual ore treatment rate of 52,195,000 tons/year at an average of 143,000 tons/day with costs in ramp-up and ramp-down years determined using the key fixed cost factors and variable components of these costs.

The main works contemplated in the development of the project and their associated capital expenditures (CAPEX) include the following:

- Mine infrastructure and equipment: US$195 million
- Concentrator plant: US$1.416 billion
- Desalting plant and pumping line: US$848 million
- Tailings dam: US$285 million
- Port structures: US$470 million
- Access to project areas: US$49 million
- Engineering, procurement and construction management: US$633 million
- Contingencies: US$411,000
- Owner's costs: US$407 million

The estimated maximum labor force hired for the construction, operation and closure phases will be, respectively, 9,800 people (8,600 Dominga sector and 1,200 Totoralillo sector), 1,450 people (1,250 Dominga sector and 200 Totoralillo sector) and 980 people (860 Dominga sector and 120 Totoralillo sector). The expected staffing requirements for the Lineal sector are distributed between the two sectors. These jobs will be created for at least the 36 months of project implementation.

Profitability. The project is expected to be financed through a loan from Banco Internacional Industrial, for 60 percent of the CAPEX. The bankability indicators are above the minimum values required by the market; therefore, the project should have no problems in obtaining financing (Table A2.2). The financing considers a five-year German model loan, to be disbursed in 2026, with repayments starting in 2032. The nominal interest rate is 9.36 percent.

Table A2.2. Bankability Indicators

Año	2032	2033	2034	2035	2036
ADSCR	1,79	2,74	4,38	4,91	3,63
LLCR	3,65	4,26	5,23	5,78	6,81

Nota: ADSCR minimum requirement > 1.45; LLCR minimum requirement > 1.15.
ADSCR: Average Debt Service Coverage Ratio; LLCR: Life of Loan Coverage Ratio.

Based on this information, the project's annual cash flows are high enough to pay the principal and interest for each period.

The project records an NPV of US$106,806,345, estimated using a social discount rate of 8 percent; the corresponding internal rate of return is 33.82 percent. This profitability corresponds to 182 percent of the average profitability of the sector over the last five years. The positive NPV, which is similar in magnitude to the investment, coupled with a high internal rate of return, make this project a very attractive investment option.

Finally, it should be noted that the mining industry has no major control over product sales prices. Therefore, copper and molybdenum prices will also be an *input* to be established based on long-term market projections.

IDB