



ACADES
Asociación Chilena de
Desalación y Reúso A.G.

PLUSmining

Report

Economic and Regulatory Keys to the Cost of Desalinated Water in Chile



EXECUTIVE SUMMARY

Context

Seawater desalination has become a strategic pillar of water supply in mining and is beginning to expand to other productive sectors. According to projections from the Chilean Copper Commission (Cochilco), by 2034, 66% of the water used in copper mining will come from the sea, equivalent to a flow of more than 14 m³/s.

The current debate has moved beyond technical feasibility to focus on the economic sustainability and competitiveness of the cost per cubic meter (\$/m³). However, this cost depends not only on technology—which is already mature and standardized—but on a complex system of geographic, energy, and regulatory variables that determine the long-term viability of projects.

Key Findings

- **Dominant Cost Structure:** Between 80% and 90% of the total cost of water is explained by the combination of initial investment (CAPEX) and energy costs. In systems that integrate desalination and pumping toward high mountain elevations, energy can represent more than half of operating expenditure, tripling the cost of water compared to the coastal price due to altitude and distance.
- **Financial Sensitivity:** The discount rate is the variable with the greatest silent impact. An increase of merely one percentage point in this rate can jeopardize the viability of a project. In Chile—rated A2 by Moody's in 2026—risk perception is tied to regulatory uncertainty and litigation over strategic projects, which drives up the cost of financing.
- **Permitting and Timelines:** Development timelines in Chile range from 8 to 12 years due to bureaucratic sectoral permits and environmental assessments. This capital immobilized over a decade acts as a direct cost-escalating factor, raising the levelized cost of water without adding technical value to the process.
- **Operational Efficiency and Energy:** The cost of electricity is the primary operational determinant, accounting for 20–30% of total cost. The competitiveness of desalination is tied to the national electricity system's capacity to offer stable base prices and reduce transmission or congestion charges.

- **Optimization Potential:** Scenario analysis indicates that strategic management of these variables (competitive energy, limited timelines, and legal certainty) could reduce unit costs by between 10% and 30% under the same physical conditions.

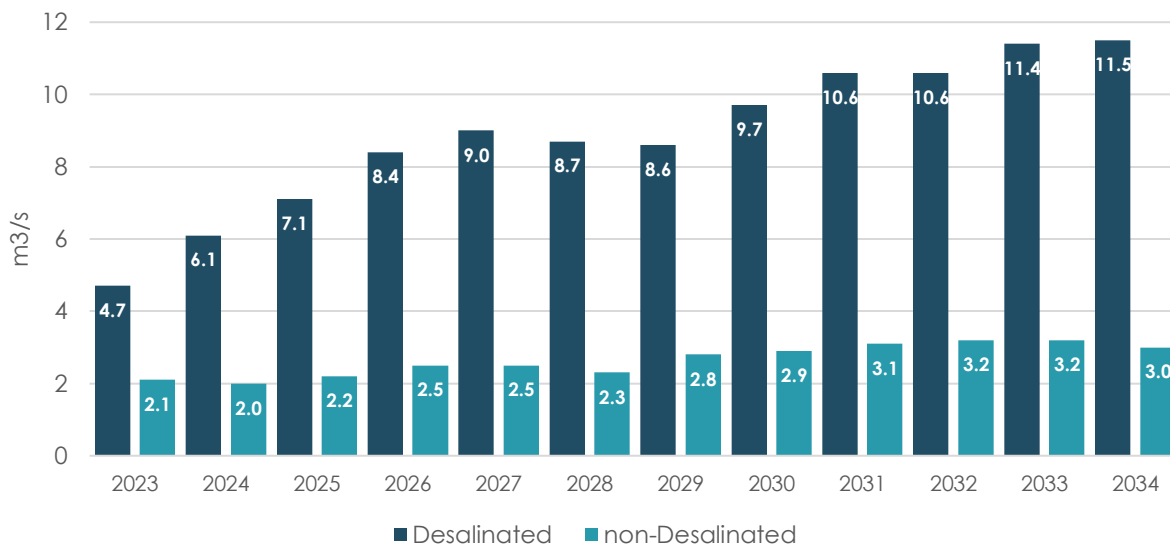
CONCLUSION

The cost of desalinated water in Chile does not depend primarily on technology—which has already reached high levels of maturity—but on a set of economic, energy, and institutional variables that determine its competitiveness. Reducing regulatory uncertainty, timely development of electrical infrastructure, optimization of permitting timelines, and promotion of multipurpose models emerge as key factors to contain costs and strengthen desalination as a structural solution. In this scenario, coordination between public policy, territorial planning, and private investment will be decisive in consolidating desalination as an enabler of sustainable growth in mining and other productive sectors in Chile.

ECONOMIC AND REGULATORY KEYS TO THE COST OF DESALINATED WATER IN CHILE

Seawater desalination has become a structural component of the water supply model for Chilean mining and, increasingly, for other productive sectors. According to official and sectoral projections, by 2034 approximately 66%¹ of the water used in copper mining is expected to come from marine sources, primarily desalinated water, consolidating a transition that can no longer be understood as marginal or cyclical, but rather as strategic. In quantitative terms, this is equivalent to more than 14 m³/s of seawater, of which approximately 80% would correspond to desalinated water, reflecting the physical and economic magnitude of the ongoing shift.

Figure 1. Seawater Demand Projection.



Source: Proyección de la demanda de agua en la minería del cobre en Chile 2024-2034, Cochilco, 2025.

In this context, public and technical debate tends to focus on the unit cost of desalinated water, understood as a long-term levelized cost that integrates not only operating expenses but also the recovery of the initial investment and the cost of capital associated with the project. This indicator allows for evaluating the industry's competitiveness. However, this approach tends to oversimplify a phenomenon that is, by nature, multivariable and responds to market temporalities. Focusing exclusively on this indicator conceals the factors that explain

¹ "Proyección de la demanda de agua en la minería del cobre en Chile 2024-2034", Cochilco, 2025.

the dispersion of costs across projects, the sensitivity to different regulatory, financial, and energy scenarios, and above all, the effective decision levers available to both public policy and infrastructure developers.

A responsible analysis of desalination development in Chile requires shifting the focus from the final unit cost per cubic meter to the behavior of the variables that determine it. Understanding how these variables interact, what factors amplify or attenuate their impact, and which can be managed over time is key to evaluating the economic sustainability of desalination and its role as an enabler of mining growth and associated multipurpose solutions.

The recent development of Chile's desalination industry shows that the unit cost of producing and pumping desalinated water responds to a relatively clear but highly sensitive structure based on a limited set of variables. Analysis of operating facilities and projects at various stages of development allows for identifying the main components of the unit cost, where investment and energy-related items together account for approximately 80% to 90% of the total cost of water, rather than being driven by technological constraints per se.

Indeed, in projects that combine desalination and pumping—the predominant configuration in Chilean mining—the relative weight of CAPEX and energy costs accounts for most of the total unit cost. In such systems, the energy associated with pumping can represent more than half of total operating costs. This structure becomes even more demanding in projects where water must be transported to operations located at high altitudes, in a geographic context characterized by steep gradients, long distances, and continuous pumping requirements. In these cases, the elevation of the consumption point becomes a determining technical-economic factor, potentially multiplying the unit cost of water by two or even three times compared to the coastal production cost, depending on the final elevation and distance traveled.

This reality reinforces a central conclusion: the unit cost of desalinated water in Chile is not determined solely by desalination technology, which has reached high levels of maturity and standardization, but by financial, energy, regulatory, and territorial conditions. Desalination itself is only one part of the system; the competitiveness of water depends on how that system fits within the institutional and productive environment of the country.

From a financial perspective, the discount rate emerges as one of the most influential variables and, at the same time, one of the least visible in public debate. In capital-intensive projects with long useful lives, small variations in the discount rate can generate significant changes in the *levelized cost of water*. In practical terms, an increase of one percentage point in the discount rate can raise the unit cost of water to the point of jeopardizing the viability of the investment, even when the physical characteristics of the project remain unchanged.

In Chile, the rates used by private investors reflect risk perceptions associated with regulatory uncertainty, litigation over strategic projects, and a lack of clarity in certain sectoral permits. To the extent that these risks are reduced through clear rules, predictable processes, and stable contractual frameworks, the financial cost of water can decrease on a structural basis.

Table 1. Country Risk Rating and Comparison Among OECD Member Countries².

OECD Ranking	Country	Moody's Rating
1	Australia	Aaa
1	Canada	Aaa
1	Denmark	Aaa
1	Germany	Aaa
1	Luxembourg	Aaa
1	Netherlands	Aaa
1	New Zealand	Aaa
1	Norway	Aaa
1	Sweden	Aaa
1	Switzerland	Aaa
1	United States	Aaa
12	Austria	Aa1
12	Finland	Aa1
14	France	Aa2
14	Korea	Aa2
16	Belgium	Aa3
16	Czech Republic	Aa3
16	Ireland	Aa3
16	United Kingdom	Aa3
20	Estonia	A1
20	Israel	A1
20	Japan	A1
23	Chile	A2
23	Iceland	A2
23	Lithuania	A2
23	Poland	A2
23	Slovak Republic	A2
28	Latvia	A3
28	Slovenia	A3
30	Spain	Baa1
31	Colombia	Baa2
31	Hungary	Baa2

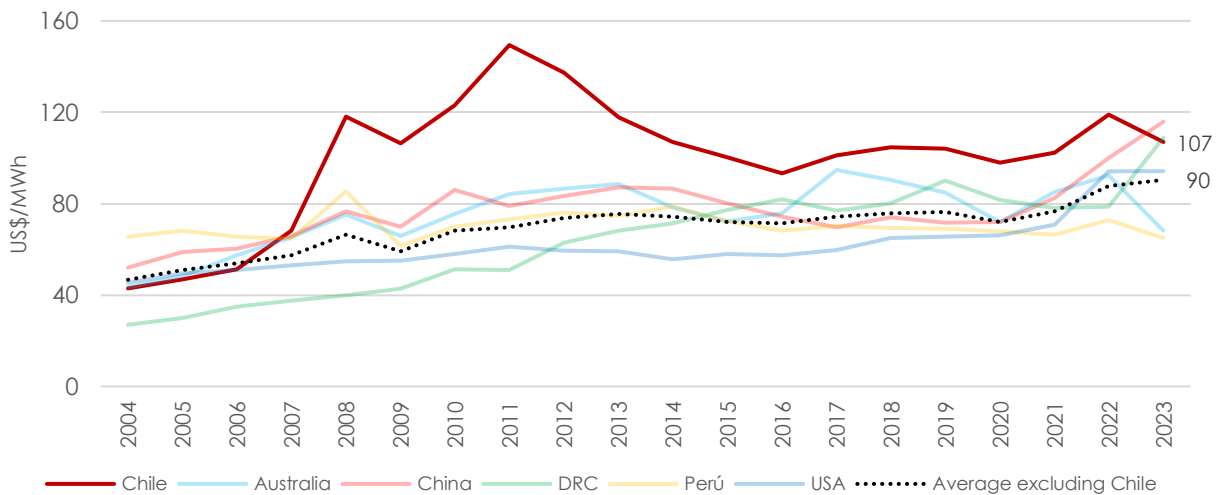
² The OECD (Organisation for Economic Co-operation and Development) is an international body comprising 38 member countries that promotes standards and policies to strengthen economic growth and financial stability.

31	Mexico	Baa2
31	Portugal	Baa2
35	Italy	Baa3
36	Greece	Ba1
37	Costa Rica	B1
37	Turkey	B1

Source: Sovereign Ratings Methodology, Moody's Investors Service, 2026.

On the operational side, the cost of electricity constitutes the primary operational determinant in desalination and pumping systems. The high energy requirements of pumping, particularly in high-altitude mining operations, expose projects to the price and charge structure of the Chilean electricity system. Beyond the base energy price, the effective cost incorporates transmission tolls, regulatory charges, and contractual risks that directly affect the final cost of water. In aggregate terms, the energy costs associated with desalination and pumping can represent between 20% and 30% of the unit cost of water, and their impact is highly sensitive to the price of electricity.

Figure 2. Electricity Cost for Copper-Producing Countries.



Source: Cifras Actualizadas de la Minería, Consejo Minero based on Wood Mackenzie, 2022.

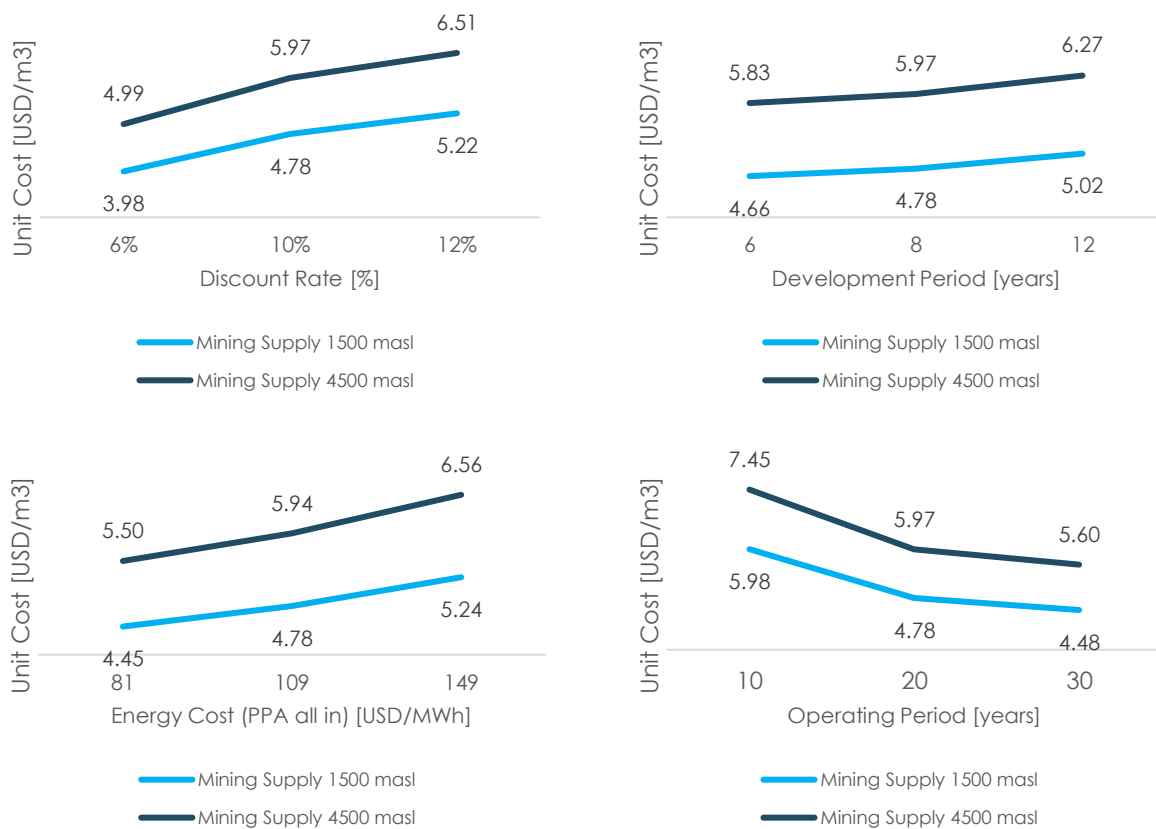
In this regard, the competitiveness of desalination is closely linked to the timely development of electrical infrastructure, the reduction of congestion, and the coherence between the regulatory design of the electricity system and the needs of long-term infrastructure projects.

Another critical, though less visible, variable is the project development timeline. In Chile, the timelines associated with engineering, environmental assessment, and obtaining sectoral permits can extend from 8 to 12 years. These extended timelines imply capital immobilized for long periods, increase exposure to regulatory changes, and raise risk perception, with direct

effects on the cost of financing. In unfavorable scenarios, cumulative delays can become one of the main cost-escalating factors for desalinated water. Reducing these timelines does not mean relaxing environmental standards, but rather improving institutional coordination, process predictability, and the technical quality of evaluations.

The useful life considered for desalination plants and pumping systems also plays a relevant role in determining the unit cost of desalinated water. Projects conceived with limited contractual horizons tend to have higher *unit costs* on average than those designed to operate over longer periods. This dimension becomes especially important in multipurpose or multi-client schemes, where infrastructure built to endure dilutes CAPEX and extends the income-generating period, reducing the unit cost of water for the various users. For these models to be viable, clear governance frameworks, defined access rules, and contractual conditions (legal guarantees) are required that provide certainty to both initial investors and future users throughout the full duration of the contract.

Figure 3. Scenario Analysis for Seawater Supply to Mining Companies Located at 1,500 and 4,500 masl.³



Source: Desalination Supply Scenarios & Key Variables, ACADES, 2026.

³ Both cases were modeled on the basis of a desalination plant with a capacity of 1,000 l/s. The mining case with delivery to 1,500 masl considers a 150 km aqueduct, three pumping stations, and a 60 km electrical transmission line. The case with delivery to 4,500 masl considers a 200 km aqueduct, five

Scenario analysis reveals that, in recent years, differences in the unit cost of desalinated water do not respond significantly to disruptive technological changes, but rather to different combinations of institutional and strategic variables. Scenarios characterized by competitive energy, limited development timelines, lower risk perception, and extended useful lives make it possible to contain *unit costs* even in projects with high geographic complexity. In aggregate terms, the absence of coordinated improvements in these variables implies that projects may be paying between 10% and 30% more in unit costs compared to strategically managed scenarios, even when the physical conditions of the project remain unchanged. In contrast, scenarios where delays, high energy costs, and regulatory uncertainty converge generate significant increases in the unit cost of water, affecting not only the competitiveness of single-use projects, but also the viability of multipurpose solutions of territorial scope.

This analysis reveals that the cost of desalinated water is highly sensitive to variables that are, to a large extent, manageable. Public policy has a direct influence through regulation, legal certainty, and permitting timelines. Energy consolidates as the primary competitiveness driver for desalination in Chile. Furthermore, early coordination among mining projects, water infrastructure, the electricity system, and territorial planning emerges as one of the main opportunities to achieve structural cost reductions in the medium and long term.

Desalination has ceased to be a last-resort alternative and has become a pillar of Chilean productive development. Optimizing its contribution to mining and other sectors such as agriculture (and shared solutions) requires a deep understanding of the variables that determine its cost and coordinated action on those that define its future behavior. In that space —where economics, regulation, energy, and planning converge— lies the competitiveness of the desalination industry and, to a large extent, the sustainability of the country's mining and industrial growth.

pumping stations, and a 100 km electrical transmission line. The charts illustrate the sensitivity analysis of the Unit Cost with respect to the variable shown on the X-axis, holding the other model variables constant.