Sustainable Water Management in the Iron and Steel Industry: Trends, Practices, and ESG Insights

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Sustainable Water Management

Water is essential in the iron and steel industry, as it is crucial for cooling, descaling, dust suppression, and various chemical processes. As one of the largest users of freshwater due to its extensive operations, the industry is increasingly adopting sustainable water management practices. This shift is driven by growing environmental awareness and stricter regulatory practices.

A 2011 survey by World Steel found that integrated steel plants typically used 28.6 kL of water per tonne of steel, with 25.3 kL then discharged. Electric arc furnace plants had comparable figures, with an intake of 28.1 kL and a discharge of 26.5 kL per tonne. This results in a low net water consumption of approximately 3.3 to 1.6 kL per tonne, primarily due to evaporation.

From Ore to TMT – Water Flows Through Every Step

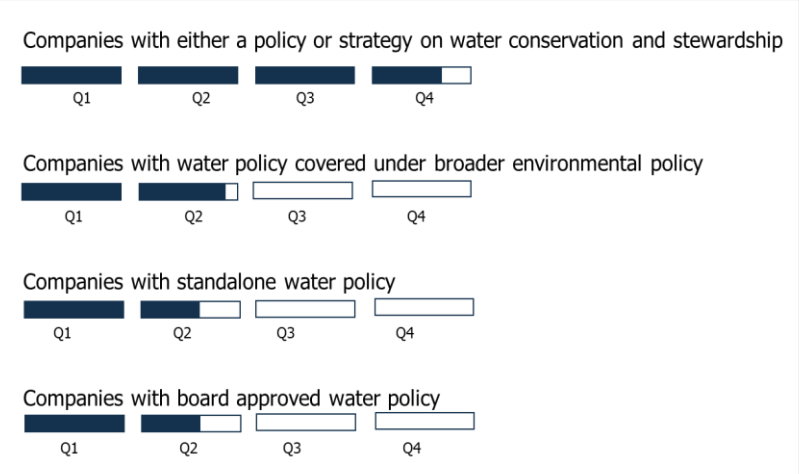
Once raw iron ore is mined, it undergoes pelletisation, where water is mainly used to mix iron ore fines with binders, forming pellets. This moisture is essential for particle adhesion and shaping during the balling process. After the pellets are formed, water also cools the hardened pellets after induration. Following pelletisation, the iron ore pellets are placed into a rotary kiln with coal. They are heated to high temperatures in a controlled environment, triggering a chemical reduction process that removes oxygen from the iron ore, converting it into sponge iron, also known as Direct Reduced Iron (DRI). Water's primary role here is to cool the kiln shell and discharge area, as well as to suppress dust during material handling.

Following DRI, the steelmaking process proceeds by melting sponge iron in an induction furnace. Scrap metal and fluxes are then added to refine the steel's composition. Once the target temperature and chemistry are reached, the molten steel is tapped into a ladle for alloying and deoxidation treatments. Subsequently, it is transferred to a continuous casting machine where it solidifies into billets. Throughout this process, various cooling and cleaning steps are crucial to ensure equipment efficiency and maintain product quality.

After billets are produced, they are reheated in a furnace and then processed through multiple rolling stands in a mill to decrease their cross-section and shape them into TMT (Thermo-Mechanically Treated) bars. The hot-rolled bars are then quickly cooled with water sprayed from a quenching box, creating a hardened surface while maintaining a hot and soft core.

From Strategy to Boardroom

Out of 11 companies assessed by CareEde-ESG, 10 have demonstrated commitment to water stewardship through either a formal policy or strategic disclosures. One company has outlined its approach solely through strategy, while five have embedded water-related provisions within broader environmental policies. This data reflects a generally positive trend in corporate water stewardship, with most companies recognising its importance.



However, only a minority, 4 out of 11, have formal, Board-level approved standalone policies, indicating that water governance is still evolving. The presence of water commitments within broader environmental policies suggests integration but may lack focused action. The absence of any framework in one company highlights a gap that could pose operational and reputational risks.

Limited Target Setting Undermines Water Stewardship Efforts

Out of the 11 companies evaluated, four have defined specific water reduction targets, indicating a proactive stance on water stewardship. However, this is considerably fewer than the seven companies that lack such targets, pointing to a worrying gap in measurable commitments. The lack of clear reduction goals in most companies suggests that water sustainability is still not given the priority it requires, particularly in resource-intensive industries such as steel and power.

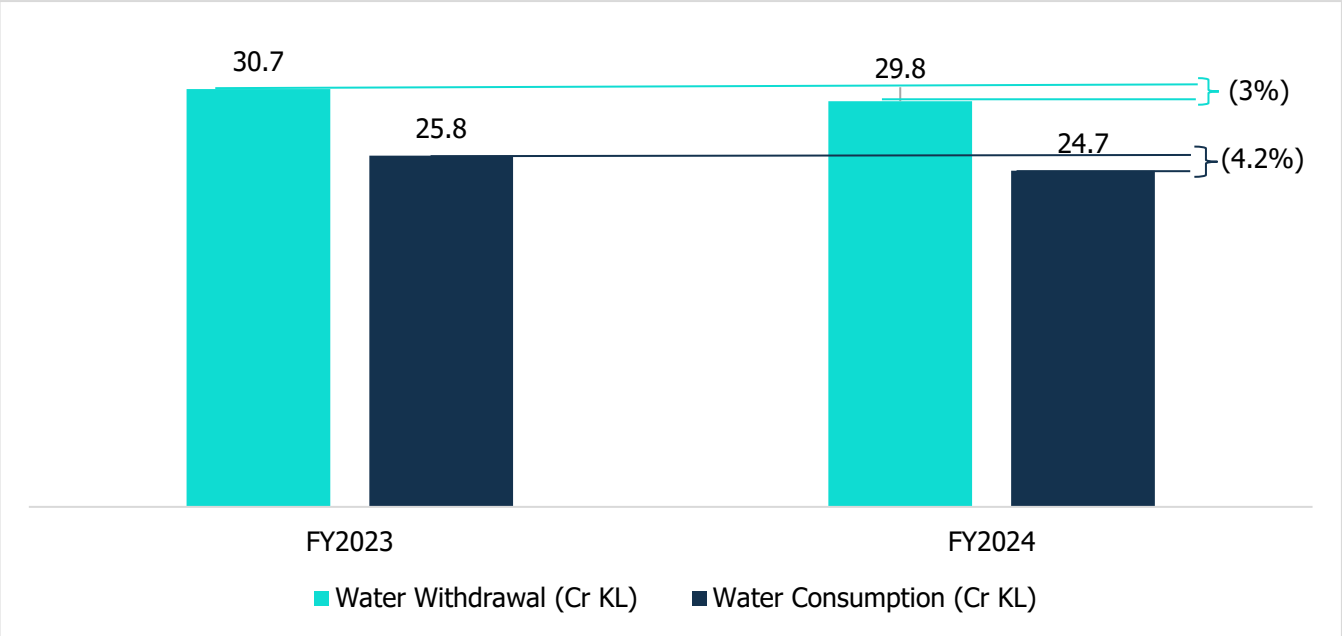
Initiatives Driving Efficient Water Use and Recycling in The Steel Sector

To reduce the water use in steel production, companies in the sector have implemented various technological and operational measures to boost water efficiency. Although the basic water needs per tonne of steel seem unchanged, actual reductions are achieved through smarter resource management. Important approaches include adopting closed-loop recycling and improving concentration cycles in cooling towers. Many facilities now use treated sewage water or harvested rainwater instead of freshwater for tasks like slag quenching, dust suppression, and gardening. Technologies such as real-time monitoring, automated leak detection, and dry cooling systems also significantly reduce water withdrawals. Overall, these initiatives contribute to reducing water consumption per tonne of steel, demonstrating that even resource-intensive industries can achieve efficiency improvements through innovation and system optimisation.

Improved Efficiency Reflected in Declining Water Withdrawal and Consumption

Water withdrawal refers to the total volume of water taken from natural or municipal sources for industrial use. At the same time, consumption indicates the portion that is not returned to the source after use. In FY24, based on disclosures from 1,000 listed companies, India withdrew approximately 1,440 Cr KL of water, down from 1,550 Cr KL in FY23. Of this, 420 Cr KL were consumed, compared to 500 Cr KL consumed out of the total withdrawal in FY23, indicating improved water use efficiency.

Exhibit 1: Water Withdrawal and Consumption

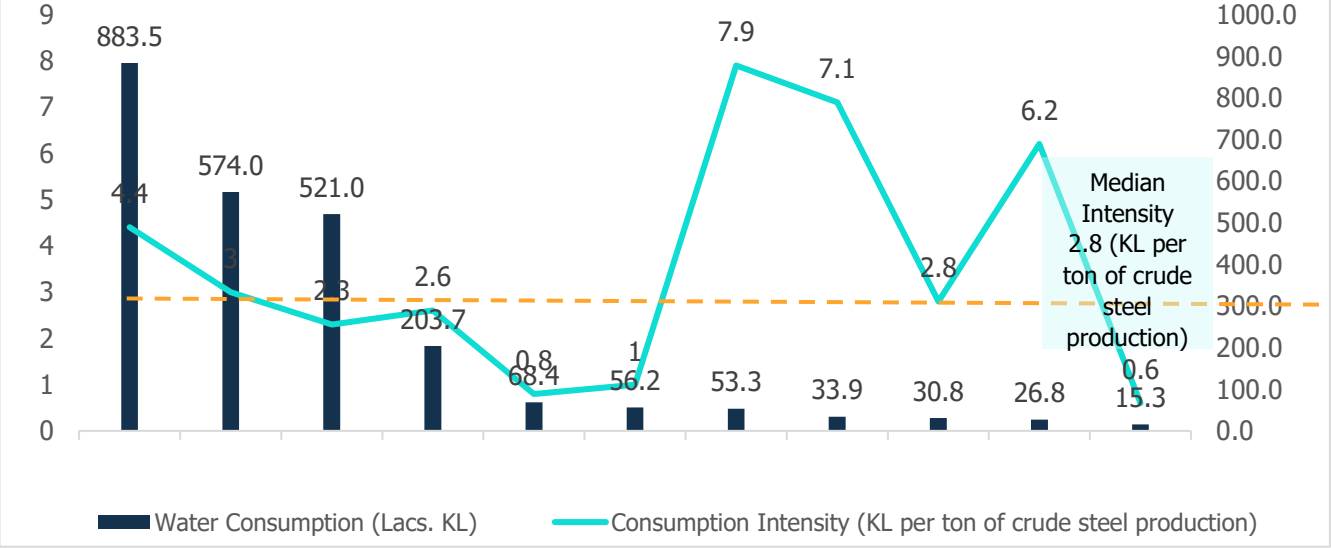


As seen in Exhibit 1, in FY24, total water withdrawal of the 11 companies stood at 29.8 Cr Kilo Litres (KL), a 3.0% decrease from FY23. Similarly, water consumption reduced by 4.2%, from 25.8 Cr KL to 24.7 Cr KL. This decline is a positive sign of improved water efficiency, driven by investments in recycling systems and the adoption of Zero Liquid Discharge (ZLD) technologies.

Water Intensity in Steelmaking: A Key Indicator of Resource Efficiency

Water use intensity is a crucial metric that measures the water consumed per ton of crude steel produced. It serves to evaluate operational efficiency and enable comparisons across companies or time periods. Monitoring this ratio, rather than just total water consumption, provides more detailed insights into how effectively companies separate production growth from resource use, which is fundamental to sustainable industrial practices.

Exhibit 2: Water Consumption and Intensity



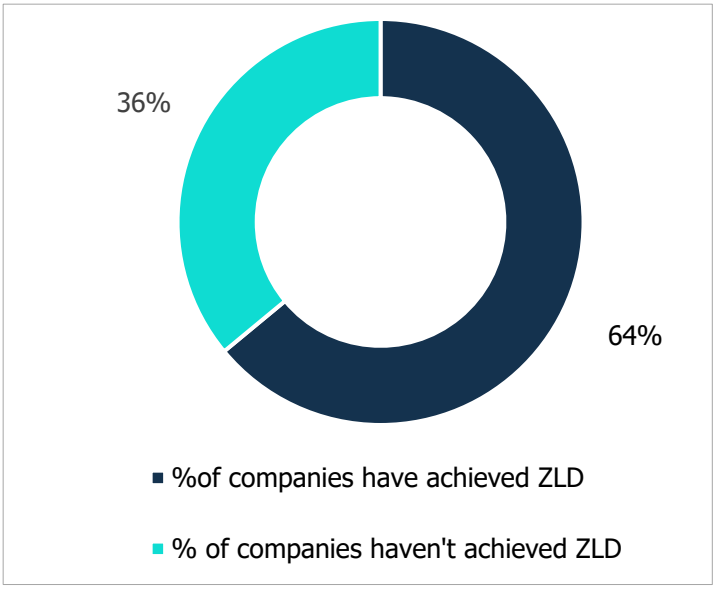
Among the 11 companies, the median water consumption intensity has decreased by 6.7% from FY23 to FY24. This improvement reflects better water efficiency through lower freshwater use, increased recycling, and stricter process controls. The decline in intensity despite increased production suggests a positive separation of growth from resource consumption.

ZLD Adoption Strengthens Circular Water Management in the Steel Sector

ZLD (zero Liquid Discharge) is a water management strategy that ensures no industrial wastewater is discharged into the environment. Instead, all wastewater is treated, recovered, and reused on-site. In the iron and steel industry, this typically involves using filtration, evaporation, and crystallisation systems to recycle process water and recover valuable resource solids.

As seen in Exhibit 3, among the 11 companies analysed, 64% have achieved ZLD, highlighting a significant transition towards water recycling and conservation. This adoption not only reduces freshwater demand but also helps companies meet environmental compliance norms and minimise pollution load.

Exhibit 3: Zero Liquid Discharge (ZLD)



The push for ZLD is particularly important in water-stressed regions, where closed-loop systems reduce reliance on external water sources and discharge to local water bodies.

Difference Between ZLD and Water Positivity

Aspect	Zero Liquid Discharge (ZLD)	Water Positivity
Definition	• No liquid waste is discharged; all water is recycled.	• A company replenishes more water than it consumes.
Focus	• Internal water reuse and pollution prevention.	• External water restoration and community impact.
Goal	• Achieve closed-loop water systems.	• Achieve a net positive water balance.
Measurement	• Based on discharge volume.	• Based on water replenishment vs. consumption.

While ZLD focuses on internal water management, water positivity extends the responsibility to the broader ecosystem, aiming to restore water sources and support community water needs.

High Dependence on Water-Stressed Areas Elevates ESG Risk Exposure

Water-stressed areas are regions where the water demand exceeds the available supply, often due to a combination of limited freshwater sources and high competing usage from agriculture, industry, and domestic needs. Steel plants operating in such areas face higher environmental and social responsibility for water efficiency.

Out of 11 companies analysed, six have withdrawn water from water-stressed areas, while five have not. Notably, three companies sourced their entire water withdrawal from such areas. Overall, 53% of the total water withdrawn by all companies came from water-stressed regions.

This performance reflects increasing awareness of local water risks and improved implementation of water budgeting, recycling, and rainwater harvesting in high-risk regions. Companies operating in these areas are aligning with ESG expectations, which emphasise water risk mitigation.

Exhibit 4: Water stressed areas

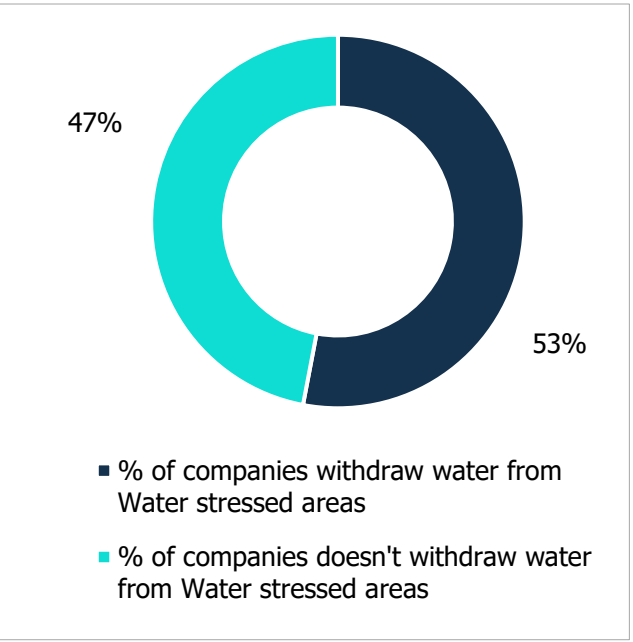
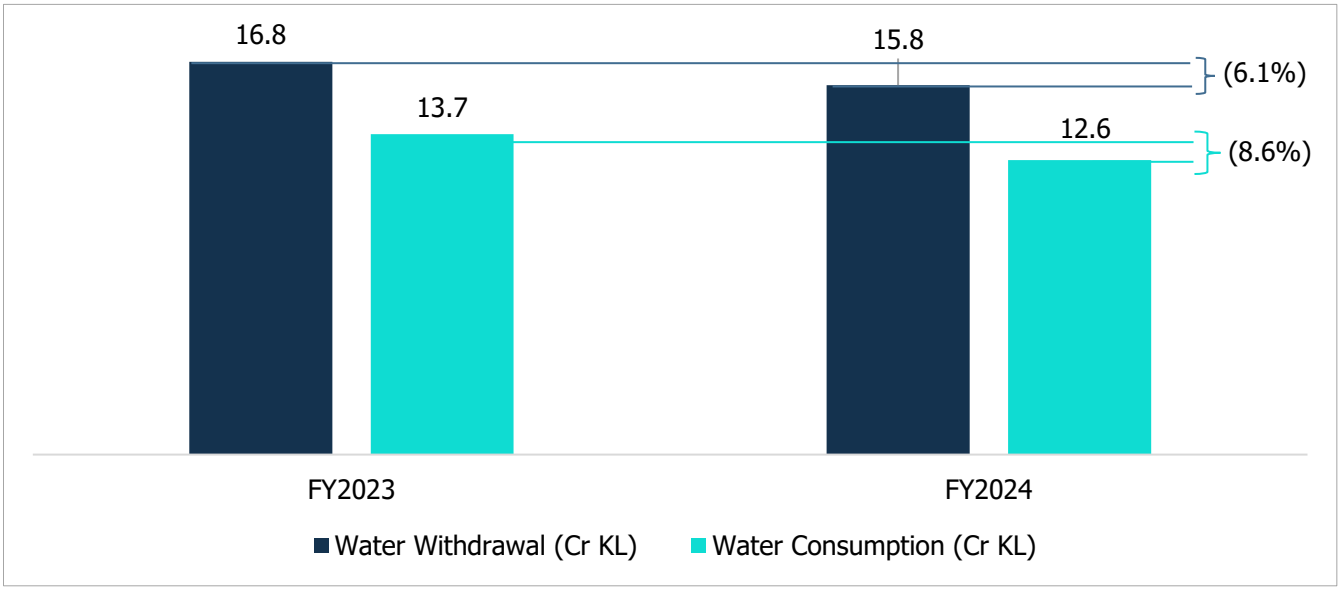


Exhibit 5: Water Withdrawal and Consumption in Water-Stressed Areas



Lack of ISO 46001 Drives Water Management Gaps

ISO 46001 is a globally recognised standard for implementing a Water Efficiency Management System (WEMS), aimed at optimising water usage and promoting sustainability in industrial operations. Achieving this certification requires a structured approach, which includes a gap analysis, a review of water use, setting performance targets, and continuous monitoring. Despite its relevance to water-intensive sectors such as iron and steel, none of the 11 companies assessed has attained ISO 46001 certification. This highlights a significant opportunity for the industry to enhance water stewardship and align with global sustainability benchmarks.

CareEdge-ESG's View

CareEdge-ESG emphasises that industries, especially those heavily dependent on water, need to adopt sustainable water management practices to foster meaningful change and lessen environmental impact. This is seen as a crucial step toward responsible industrial growth that balances economic progress with the conservation of vital natural resources. Water-intensive industries often play a major role in depleting freshwater sources, especially in water-stressed regions. By adhering to global water stewardship standards, these industries can attract environmentally conscious stakeholders, improve operational resilience, and enhance long-term cost efficiency.

Companies no longer need to depend on excessive water use to stay competitive. Instead, they should shift away from extractive methods and implement circular water strategies. Investing in technologies such as Zero Liquid Discharge (ZLD) and water recycling systems allows companies to reuse water within their processes, minimise waste, and lower their environmental footprint. This not only boosts their ESG profile but also appeals to environmentally aware consumers and investors. Sustainable water practices, such as reuse, recycling, and efficient withdrawal, can generate long-term value, protect ecosystems, and strengthen a company's reputation in an increasingly resource-conscious market.

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