POLICY BRIEF

November 2025
The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

EXPLORING A NEW WATER ECONOMY FOR SUSTAINABLE DEVELOPMENT POST MINING IN SOUTH AFRICA'S COAL MINING ZONES

A Water Research Commission (WRC) funded study investigated how much water will become available as coal mines and power stations in Mpumalanga close, and how this water can be treated and reused to support sustainable economic activities post mining. The study further focused on identifying the main water sources associated with the coal mining sector and assessed their potential contribution to agriculture and emerging industries in the province. This analysis provided the foundation for evaluating technical options and estimating the economic benefits of water reuse in Mpumalanga post-coal mining.

Background

Coal has been central to South Africa's economy for more than a century, driving power generation, economic growth and employment. Mpumalanga Province (Figure 1), which produces about 80 percent of the country's coal and hosts most of Eskom's power stations, has long been the centre of this activity. However, this dependence has resulted in environmental degradation, reduced water quality, and social challenges.

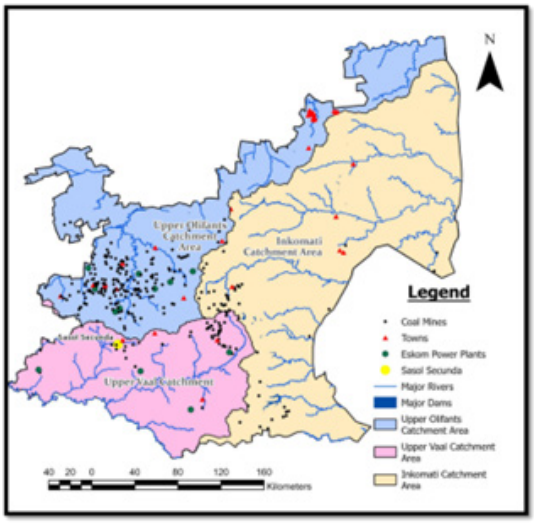

Figure 1: Study area and its land use activities

Continuous mining and industrial discharges have impacted water quality, while communities in coal mining areas continue to experience limited economic benefits.

The environmental impacts of coal mining and power generation include, ***inter alia***, degraded water and air quality, contaminated wetlands, and reduced soil fertility in nearby agricultural lands.

As global demand for coal decreases due to the need to reduce carbon-based energy consumption and increased renewable energy production, the coal mining regions in South Africa face growing socio-economic risks that must be addressed through inclusive and forward-looking developmental strategies. However, the transition away from coal provides an opportunity to reconfigure the economy of Mpumalanga around more sustainable and diverse economic activities.

In this regard, South Africa's Just Energy Transition seeks to achieve a balance between economic growth, environmental rehabilitation, and social equity. In this context, water emerges as a critical enabler of new economic activities post mining.

The inevitable closure of mines and power stations in coal mining and energy-generating regions may release significant quantities of water that can be treated and reused to support other economic activities, such as agriculture, manufacturing, and renewable energy. If properly managed, the water can drive new economic development through stimulation of new enterprises, thereby positively impacting the post-mining legacy.

The purpose of the study was to assess how water released through mine and power station closures can be reused to support sustainable development in South Africa's coal mining regions. The study explored how a new water

economy could be developed by redirecting available water to productive uses to strengthen local economies, create employment and restore ecosystems.

Particular attention was given to post-mining opportunities such as agriculture and energy, with special focus on irrigation and green hydrogen production. These opportunities are both considered significant in contributing to post-mining economic sustainability and long-term industrial transformation.

Methodology

The study investigated how much water will become available as coal mines and power stations in Mpumalanga are closed, and how this water can be treated and reused to support sustainable economic activities. It focused on identifying the main water sources associated with the coal sector and assessing their potential contribution to agriculture and emerging industries in the province. This analysis provided the foundation for evaluating technical options and estimating the economic value of water reuse.

A technical assessment was carried out to quantify and characterise the types of water likely to become available. Data were obtained from Eskom and the Department of Water and Sanitation. Three primary water sources were identified for evaluation: raw water currently used in power generation and coal mining, mining-influenced water from active and abandoned mining sites, and treated effluent from municipal wastewater treatment plants. Each of these sources was assessed for its potential to be recovered, treated, and reused for productive purposes.

Each water category was examined to determine its composition, main contaminants, and level of treatment required before reuse. The study reviewed a range of treatment technologies, including lime and limestone neutralisation, biological sulphate removal, and reverse osmosis.

These technologies were evaluated in terms of their efficiency, operating cost, maintenance needs, and suitability for specific applications, such as irrigation or industrial processes. The comparison enabled the identification of cost-effective and technically reliable solutions for large-scale water recovery and reuse in Mpumalanga. The analysis also explored the potential to integrate multiple treatment methods to meet varying water quality requirements across sectors.

An economic evaluation complemented the technical analysis to determine the feasibility and benefits of water reuse under different development scenarios. The evaluation examined how the treatment and redirection of recovered water could stimulate agricultural expansion, industrial diversification, and employment creation. The modelling approach incorporated sectoral multipliers to estimate both direct and indirect benefits, providing a quantitative link between technical options and regional economic outcomes.

Key Findings

The study found that approximately 434 million m^3/a of water will potentially become available across Mpumalanga as coal mines and power stations are closed. This total amount of water includes about 117 million m^3/a of raw water currently used by Eskom for cooling and power generation, 224 million m^3/a of mining-influenced water from active and abandoned mines, and around 93 million m^3/a of treated municipal effluent from 76 wastewater treatment works.

The Eskom water is of relatively high quality and can be reused with limited treatment, while the mining-influenced water requires chemical and physical treatment to remove acidity, sulphates, and metals. The municipal effluent, as recorded in the 2022 Department of Water and Sanitation Green Drop Report, can also be further treated for irrigation or industrial applications. Together, these flows represent a valuable resource that can be repurposed to support new economic sectors and improve social, economic and environmental conditions in the province.

An assessment of treatment technologies confirmed that existing methods are capable of transforming the available water into a usable resource. Lime and limestone neutralisation were identified as the most cost-effective approaches for large volumes, providing reliable removal of acidity and suspended solids. Biological sulphate removal was found to be a suitable alternative in areas where sulphate concentrations are high and organic substrates are available, although it requires more complex operational control. Reverse osmosis, while the most expensive option, remains essential for high-purity applications such as green hydrogen production and certain industrial processes that demand deionised water.

The economic modelling estimated that the reuse of treated water could generate major benefits for Mpumalanga's economy. Redirecting approximately 224 million m^3/a of treated water for irrigation would create more than 16 000 jobs and produce direct value addition of about

R3 billion, with a total economic output exceeding R26 billion once multiplier effects are considered. This would support agricultural expansion, enhance food production, and revitalise local economies affected by mine closure.

While both irrigation and green hydrogen production present viable pathways for water reuse, irrigation emerges as the most immediately feasible and cost-effective option. The economic returns are substantial, treatment costs are lower, and the infrastructure requirements are relatively modest.

Green hydrogen production remains a promising long-term opportunity but will depend on factors beyond water availability, including the development of renewable energy, electrolyser technology, adequate storage, transport and distribution infrastructure.

Key Findings Implications

The study confirms that it is both technically and economically feasible to establish a new water economy in Mpumalanga. The water released from mine closure and power station decommissioning can be treated and reused to support agriculture, industrial development, and environmental rehabilitation. This transition represents an opportunity to redefine the province's development path by transforming a legacy of environmental degradation into a platform for sustainable growth. With careful management, targeted investment, and well-designed governance structures, the shift from a coal-based economy to a new water-driven economy can promote inclusive growth, strengthen climate resilience, and improve long-term water security across the region.

Although the cost of treatment and infrastructure development is considerable, the overall benefits are greater than the required investment. Water reuse can generate significant economic value through job creation, increased agricultural output, and new industrial opportunities. Expanding irrigation using treated mine and raw water can strengthen food production and rural development.

Industrial reuse, including hydrogen production and manufacturing processes, can enhance innovation, attract private investment, and open new export markets. The economic modelling confirms that the social and financial gains of water reuse far exceed the costs, demonstrating that the creation of a new water-based economy post mining is both viable and beneficial for Mpumalanga.

However, the realisation of this vision depends on effective governance, institutional coordination, and transparent management of water resources. Coordination between national departments, municipalities, and provincial authorities is essential to link mine closure, water reallocation, and land rehabilitation within a unified policy framework. Simplified licensing and allocation procedures will allow new users, including smallholder farmers and emerging industries, to access treated water.

Partnerships between the public and private sectors will be critical for financing treatment plants, distribution systems, and quality monitoring infrastructure. Integrating environmental safeguards and continuous performance assessment will ensure that water reuse supports both economic and ecological objectives.

For the transition to a green hydrogen economy, it is important to understand the differences between production pathways and their implications for water, energy, and cost. Green hydrogen produced using renewable electricity from electrolysis of treated water may provide a sustainable option when compared with grey hydrogen produced from fossil fuels. Although production costs are affected by electricity prices, electrolyser efficiency, and treatment requirements, technological progress and a decline in renewable energy costs are expected to improve competitiveness.

Overall, Mpumalanga's growing renewable energy capacity and the potential access to water that may be released from both mining and power generation post mine and power station closures, including treated mining-influenced and municipal wastewater, offer an opportunity to establish a viable and environmentally responsible green hydrogen industry.

Conclusions

In conclusion, developing a new water economy in Mpumalanga is technically achievable, economically viable, and socially beneficial. The reuse of water from coal-based activities can support ecosystem restoration, local economic growth, and the goals of South Africa's Just Energy Transition. Agricultural reuse offers the most immediate benefits, while hydrogen development provides a long-term opportunity for industrial expansion. With effective planning, investment, and governance, Mpumalanga can transform its post-coal water legacy into a foundation for sustainable regional development.

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