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# Energy and Water Baseline and Best Practice Guidelines for the Agro-processing Industry: An Executive Summary

## Brewery sector | Fruit and vegetable sector | Poultry sector | Sugar cane sector









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This publication provides an executive summary of the following guidelines and study, which were developed under the South African Industry Adaptation (SAIA) project during 2024:

- A series of guidelines for the brewery, fruit and vegetable, poultry, and sugar cane sectors;
- A 'Decarbonisation Roadmap for the Agro-processing Sector'; and
- A multi-sector study titled 'Strengthened Adaptation Capacity for a Green and Resilient Economy in South Africa: The Food-Water-Energy Nexus'.

These best practice guidelines, tailored to the specific needs and constraints of both small and large agro-processing establishments, will help industry stakeholders adopt sustainable practices and improve operational efficiency. A more detailed, Consolidated Synopsis of all the guidelines is available from www.saia-project.co.za.

The SAIA project is funded by the Government of Flanders and implemented by UNIDO, in collaboration with the National Cleaner Production Centre South Africa (NCPC-SA) and the Technology Innovation Agency (TIA). The overall objective of the project is to accelerate the transition to a decarbonised industry, a green and inclusive economy and a vibrant job market in South Africa. The project addresses the barriers to the adoption of technologies and creates an enabling environment for the private sector to capitalise on the opportunities to shift towards a green economy.

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## Sector significance

The agro-processing sector plays a significant role in the country's economy and food security. It involves transforming raw agricultural products into value-added goods, ranging from processed foods and beverages to other relevant sub-sectors including dairy, fruit processing (peels and pulp, apples, grapes, oranges, olives), breweries and wineries, sugarcane, and pecan. South Africa is a leading exporter in the brewery, fruit and vegetable, poultry, and sugar cane agro-processing sectors. These industries rely on the country's limited and diminishing water and energy resources.

South Africa's diverse climate and fertile land provide a conducive environment for agricultural production, resulting in a wide array of crops and raw materials suitable for agro-processing; however, in recent years, the sub-sector has faced notable challenges in specific areas relating to energy shortage and water scarcity.

The estimated surge in population places unprecedented sustainability pressures on food manufacturing systems, particularly in energy consumption and emissions production. Decarbonisation of these systems is essential not only for mitigating climate change but also for enhancing competitiveness and resilience in global markets, especially for countries like South Africa which rely heavily on coal for electricity.

### In numbers

| | |
|---|---|
| **500mm** | Average annual rainfall in South Africa, <60% of the world average |
| **63%** | Of total energy use is from industrial energy use |
| **2.7%** | Gross domestic product contribution in 2018 by the sector |
| **3.2%** | Employment contribution by the sector (2018) |
| **0.43 kWh** | Energy consumption per litre beer |
| **6.5 hL** | Water consumption per hectolitre beer |
| **510–842 g/l** | Carbon consumption breweries |
| **416 to 833 kWh** | Energy intensity per ton of fruit and vegetable product |
| **1.5 to 10** | Cubic meters of water per ton of fruit and vegetable product |
| **90%** | Of fruit and vegetable water consumption attributed to washing and rinsing |
| **56 218** | People directly employed by the poultry sector |
| **108 000** | People indirectly employed by the poultry sector |
| **2.742 million** | Tonnes poultry meat and eggs consumed in 2015 |
| **~26/5 l** | Litres of water required per bird in poultry processing |
| **85 000** | People directly employed by the sugar cane sector |
| **350 000** | People indirectly employed by the sugar cane sector |
| **300–500** | kWh per ton of cane processed in South African mills |

## Adaptation accentuated

For decades, climate change mitigation has been at the forefront, concentrating on ways to avoid and reduce greenhouse gas emissions to prevent more extreme temperatures.

Now, however, climate change adaptation is necessary and brings into sharp focus deliberate behaviour change and transforming the way systems work to afford our people, economies and the environment better protection against climate change impacts that are unavoidable.

***Climate change adaptation is defined as the "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities".***

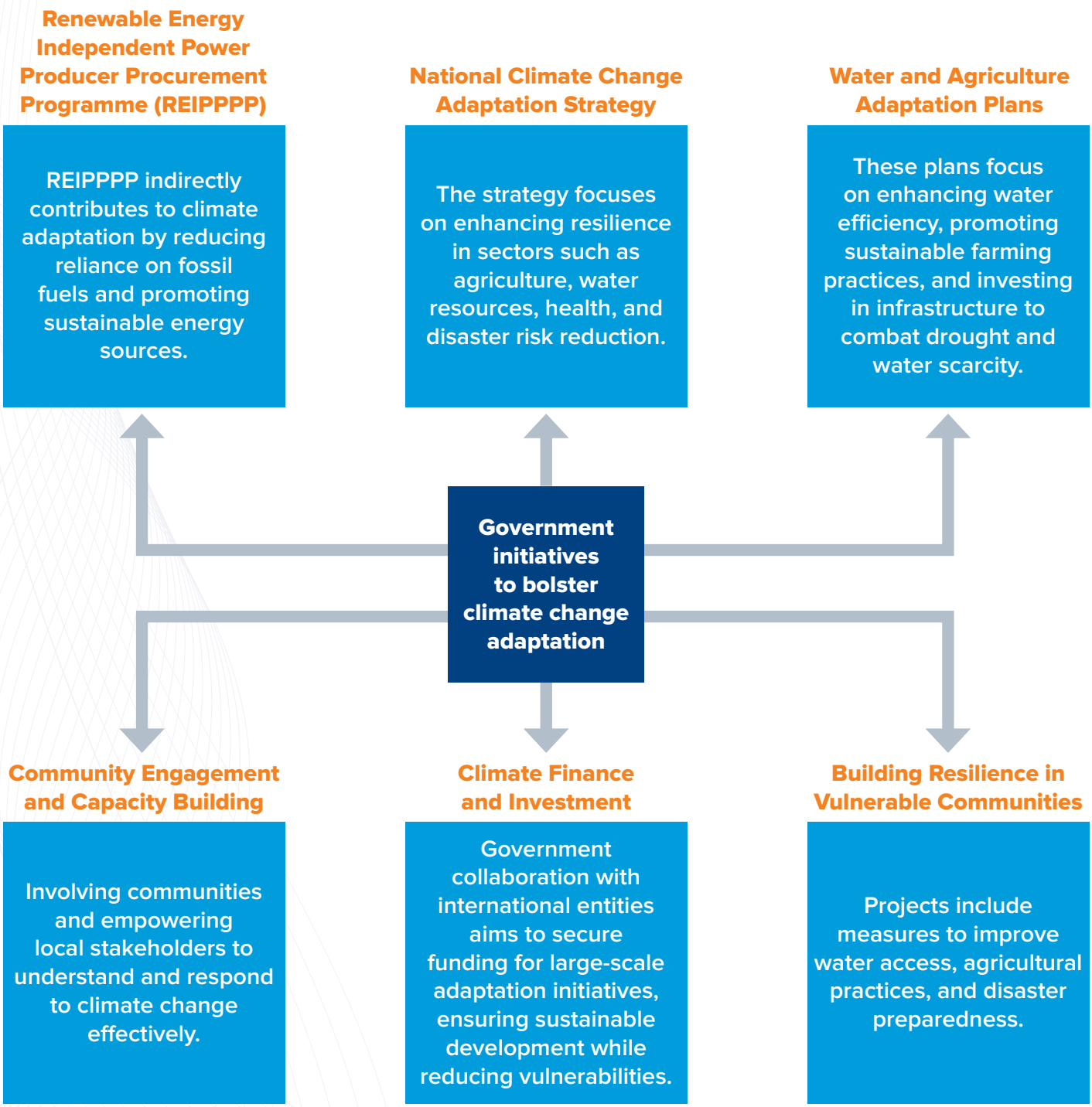
It is estimated that without adaptation, climate change will drive approximately 132 million people into extreme poverty in the next decade. Climate change is expected to have the largest impact on rainfall, temperature, and water availability in South Africa. The western regions of South Africa are projected to have 30% reduced water availability by 2050.

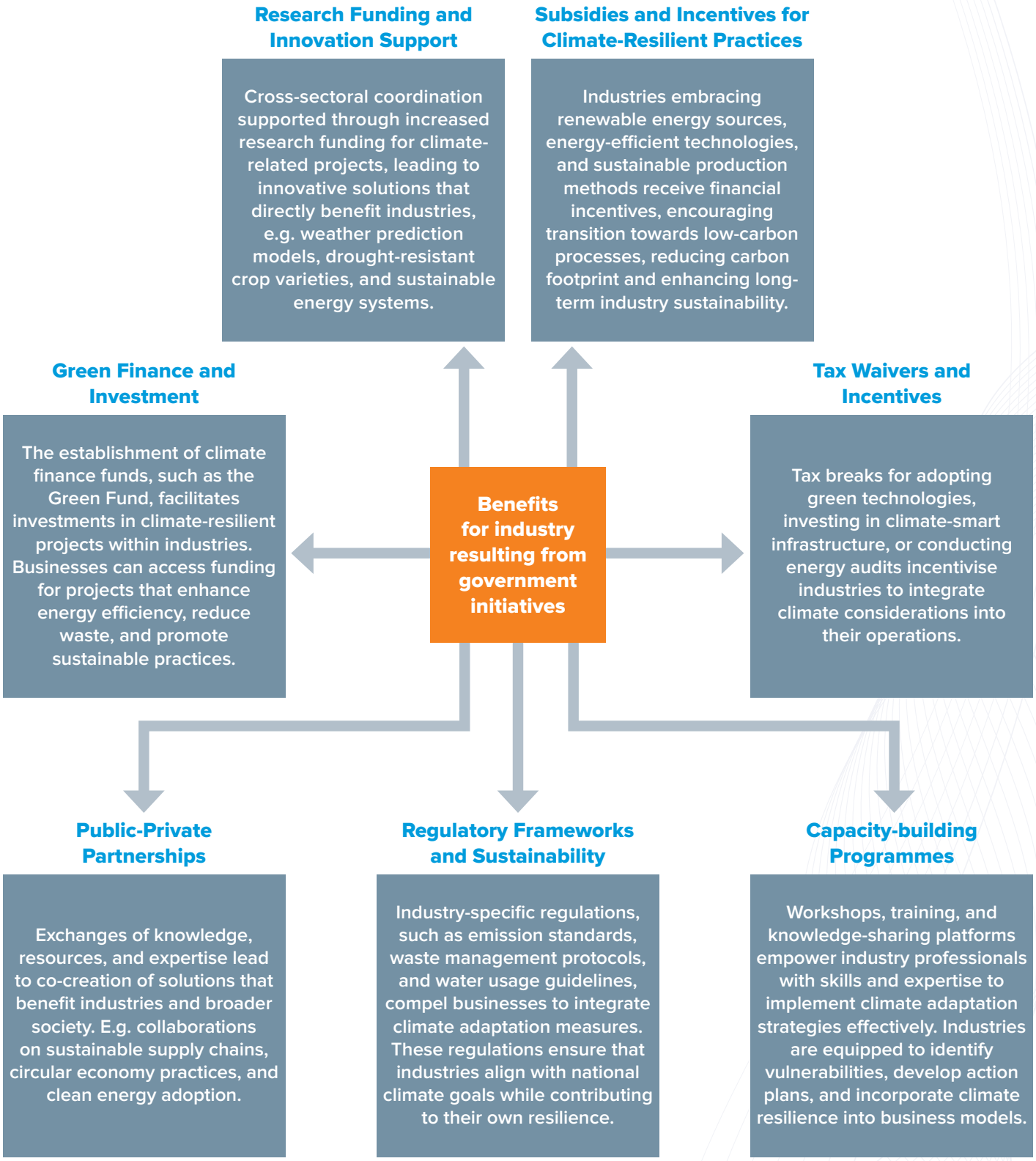
Understanding and addressing the intricate relationships between food, water, and energy is pivotal to achieving a resilient and sustainable economy. The nexus between these sectors is intricate, necessitating a comprehensive approach to mitigate vulnerabilities and exploit synergies.

***This convergence promises to revolutionise adaptation strategies within the agro-processing value chain, amplifying its sustainability and resilience in previously underserved areas. By harnessing the potential of the food-water-energy nexus and prioritising adaptation, South African industry can chart a course toward a more sustainable, climate-resilient economy while fostering opportunities for a greener workforce.***


## Leveraging technology

Technology emerges as a potent catalyst for strengthening industry resilience. The integration of innovative solutions, such as smart manufacturing processes, predictive analytics, and renewable energy adoption, can enhance operational efficiency while mitigating climate-related risks. Government plays an important role in ensuring easy access and adoption of such technologies for industry's benefit.




Research Funding and Innovation Support
Cross-sectoral coordination supported through increased research funding for climate-related projects, leading to innovative solutions that directly benefit industries, e.g. weather prediction models, drought-resistant crop varieties, and sustainable energy systems.
Subsidies and Incentives for Climate-Resilient Practices
Industries embracing renewable energy sources, energy-efficient technologies, and sustainable production methods receive financial incentives, encouraging transition towards low-carbon processes, reducing carbon footprint and enhancing long-term industry sustainability.
Green Finance and Investment
The establishment of climate finance funds, such as the Green Fund, facilitates investments in climate-resilient projects within industries. Businesses can access funding for projects that enhance energy efficiency, reduce waste, and promote sustainable practices.
Benefits for industry resulting from government initiatives
Tax Waivers and Incentives
Tax breaks for adopting green technologies, investing in climate-smart infrastructure, or conducting energy audits incentivise industries to integrate climate considerations into their operations.
Public-Private Partnerships
Exchanges of knowledge, resources, and expertise lead to co-creation of solutions that benefit industries and broader society. E.g. collaborations on sustainable supply chains, circular economy practices, and clean energy adoption.
Regulatory Frameworks and Sustainability
Industry-specific regulations, such as emission standards, waste management protocols, and water usage guidelines, compel businesses to integrate climate adaptation measures. These regulations ensure that industries align with national climate goals while contributing to their own resilience.
Capacity-building Programmes
Workshops, training, and knowledge-sharing platforms empower industry professionals with skills and expertise to implement climate adaptation strategies effectively. Industries are equipped to identify vulnerabilities, develop action plans, and incorporate climate resilience into business models.

## One ecosystem working together

This journey through South Africa's pursuit of a green and resilient economy is emblematic of a global shift towards sustainable practices. It is a journey best served by embracing adaptability, innovation, and collaboration.

Industry participation in the opportunities and platforms provided by government and its agencies contributes to this healthy ecosystem.

***Through collaborative innovation, technology adoption, and a commitment to inclusivity, South Africa's agro-processing industry is poised to lead the charge in climate adaptation, sustainable practices, and economic prosperity. Technology-enabled solutions can empower industries to not only survive but thrive in the face of climate challenges, embodying a vision of a greener, more resilient future for all, driving economic growth, job creation and environmental stewardship.***

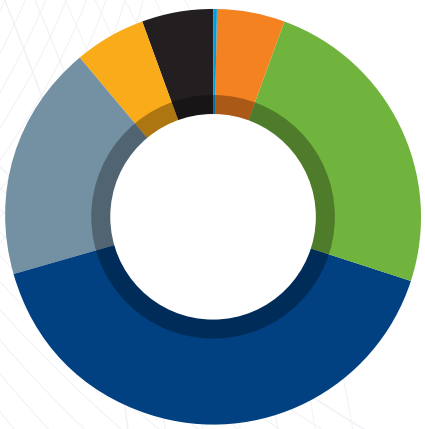
## Making progress

As part of the manufacturing sector, agro-processing is resource-intensive, particularly concerning energy and water consumption. Key recommendations from the SAIA-commissioned guidelines to improve energy and water management within the brewery, fruit and vegetable, poultry, and sugar cane sectors of the agro-processing industry include:

- An implementation algorithm based on measure, analyse, intervene, and validate. This practice aligns with ISO 50001 for certification but offers benefits even for those not seeking certification.
- Implementing energy management systems (EnMS) to monitor, control, and optimise energy use.
- Upgrading to high-efficiency equipment and integrating renewable energy sources, such as solar and biomass.
- Adopting water recycling and reuse practices to minimise freshwater consumption.
- Implementing advanced water treatment systems to ensure sustainable water use.
- Automated metering for ease of use and scalability. Regular analysis, reflection, and measurement improve the likelihood of plant improvements. Repeatable and shareable prior and post datasets provide valuable insights.

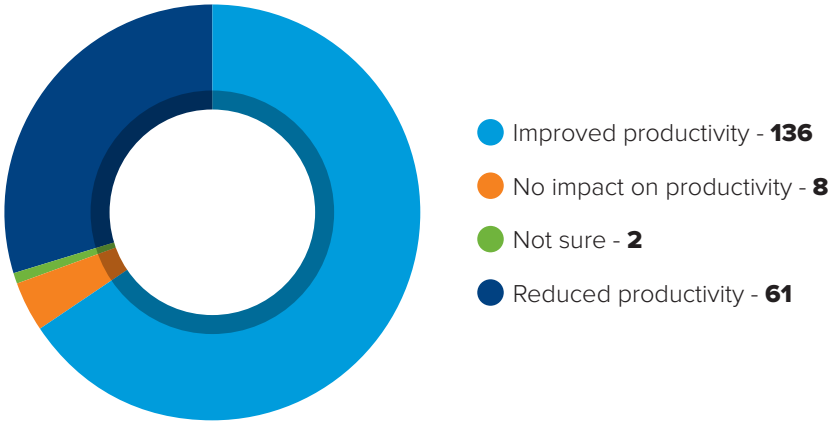
As part of study commissioned by TIA under the project, industry stakeholders provided valuable observations that underscored the sector's dynamics, challenges and the potential for transformation. The 207 responses from heads of departments (108), chief executive officers (24), chief technology officers (37), managers (13), and directors (25) offered insights into how collaboration, technology adoption, and adaptation strategies are perceived and practised within the agro-processing value chain. A few results follow:

### Technological solutions implemented by industry

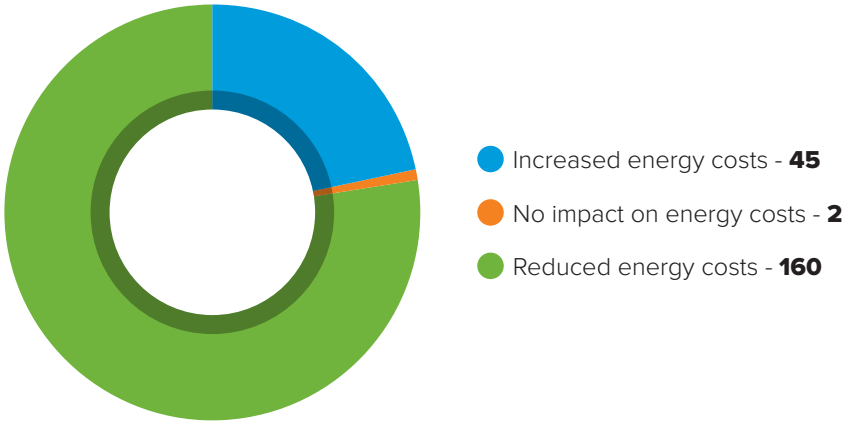


- Water monitoring and management sensors - **2**
- Robotics and drone technology - **21**
- Renewable energy technology - **97**
- Precision agriculture technology - **162**
- IoT sensors for water and energy management - **73**
- Biotechnology - **22**
- Artificial intelligence / machine learning - **22**

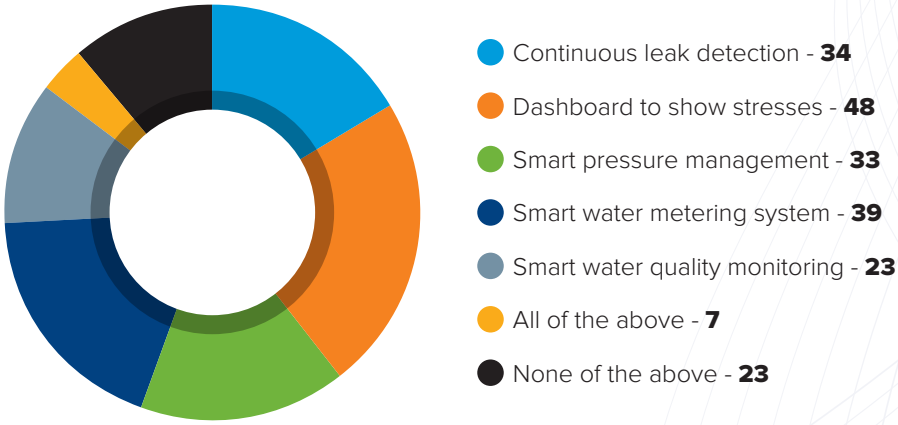
## What industry is saying about the impact of ICT technology in agro production




## Impact of renewable energy solutions deployed by the agro-processing industry

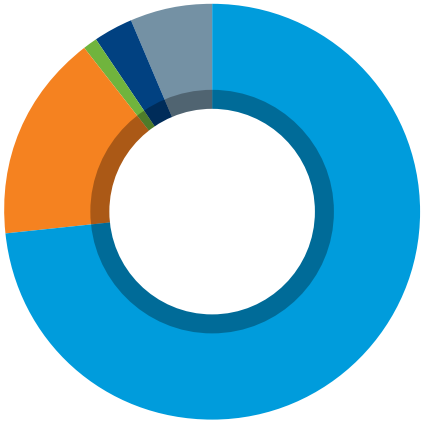



## Specific water management solutions implemented



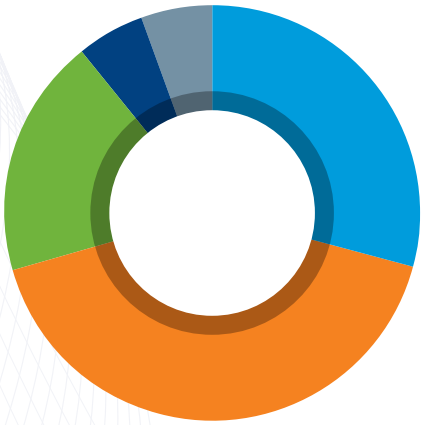
Responses from academic researchers totalled 204 (58% researchers, 29% professors, 6% lecturers, 3% postdoctoral researchers, 2% PhD students, 2% other) and provided a baseline for research, innovation, and technology adoption strategies.

## Identified area that impacts the agro-processing value chain the most



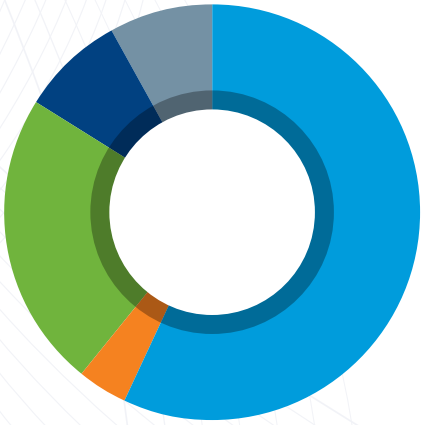
- Economic impact - **73,53%**
- Environmental impact - **16,18%**
- None, not sure - **0,98%**
- Social impact - **2,94%**
- All of the above - **6,37%**

## Specific areas within the agro value chain that require technological advancements



- Crop harvesting and post-harvest handling - **60**
- Food processing and preservation - **84**
- Supply chain management and traceability - **38**
- Waste management and sustainability practices - **11**
- All of the above - **11**

## Emerging technology with the greatest potential to address the value chain's technology gaps



- AI and machine learning - **57%**
- Blockchain and distributed ledger technology - **4%**
- IoT and sensors - **23%**
- Robotics and automation - **8%**
- All of the above - **8%**

# Foundational best practices

The following represents an overview of the best practices and their supporting priorities relevant to all four target sectors. More information is available in the Consolidated Synopsis at www.saia-project.co.za.

## Implementing an EnMS

- Executive commitment and leadership
- Establish clear goals and objectives
- Energy policy development
- Conduct energy audits and assessments
- Develop an energy management team
- Implement energy monitoring and targeting
- Employee engagement and training
- Regular reporting and communication
- Continuous improvement and feedback loop
- Incentives and recognition

## Audit guideline

- Assessment: Gather data and log information
- Develop a site-specific baseline: Regression analysis
- Energy balance: Determine the energy breakdown
- Water balance: Same methodology as for energy balance
- Determine the significant resource users (SRUs): Energy and water SRUs
- Select recommendations
- Implementation and validation

## Baseline formulation for energy and water efficiency

- Identifying a sample size
- Significance of production output
- Performance evaluation

## Metering and monitoring

Adopting an ISO 50001 approach for metering is recommended. While full certification is not necessary, the following elements should be metered:

- Main meters:
  - » Electricity mains: Monitor overall electrical consumption in processing plants, cold storage, and distribution centres.
  - » Water mains: Track overall water usage from municipal and borehole sources, focusing on irrigation and washing of produce.
- Significant energy users: Meter key energy-consuming equipment such as refrigeration units, processing machinery, and lighting systems.
- Significant water users: Meter significant water-consuming areas such as irrigation systems, washing stations, and cooling systems.

## Accounting and economics

- Importance of financial evaluation
- Comprehensive financial metrics framework
- Project financial metrics
  - » Simple payback: Time required to recoup the initial investment based on net annual savings.
  - » Return on investment: The percentage of net gain earned from the total investment cost.

- Present value of savings.
- Net present value: The difference between the present value of cash inflows (benefits) and the present value of cash outflows (costs).
- Savings to investment ratio: The ratio of the present value of savings to the present value of costs, indicating the economic feasibility of an investment.
- Lifecycle costing.
- Internal rate of return: The discount rate at which the net present value of an investment becomes zero, determining the profitability of the project.
- After-tax cash flow: The annual savings minus the taxable portion of the savings (after accounting for annual depreciation).
- Minimum acceptable rate of return: MARR is the lowest return on an investment that a manager or company is willing to accept before starting a project. It's often determined by the company's cost of capital plus a risk premium.

### Behavioural and operational changes

- Encourage water- and energy-saving habits and raise awareness about water conservation. Promotes long-term sustainable water and energy use practices in companies and production plants.

## Brewery sector-specific interventions

***South African breweries are currently well positioned by international standards, excelling in water and energy efficiency. However, to sustain competitiveness and ensure future growth, it is essential to pursue renewable energy sources. Reducing carbon emissions is crucial to remain competitive in the face of the impending carbon tax and evolving consumer trends. Given that South Africa's energy mix is largely dependent on coal, adopting renewable energy offers a feasible approach to achieving cleaner production in breweries.***

| Focus | Suggested interventions |
|---|---|
| **Significant energy users** | |
| **Refrigeration** | • Optimise production and lead times: Minimise storage time by producing only what is needed and when it is needed. This ensures that products spend minimal time in storage.<br>• Regular maintenance and cleaning<br>» Regularly clean condenser and evaporator coils to ensure efficient heat exchange.<br>» Check and replace air filters, and ensure that fans and other moving parts function properly.<br>• Temperature control and optimisation<br>• Insulation<br>» Insulate refrigerated spaces and piping to minimise heat gain.<br>» Repair any damaged insulation promptly.<br>• Equipment upgrade<br>» Replace old refrigeration units with energy-efficient models.<br>» Install high-efficiency compressors, condensers, and evaporators.<br>• Variable speed drive (VSD): Install VSDs on compressors, pumps, and fans to match the load requirements and reduce energy consumption.<br>• LED lighting: Use LED lighting in refrigerated spaces, as they generate less heat compared to traditional lighting, reducing the refrigeration load. |

| Focus | Suggested interventions |
|---|---|
| **Significant energy users** | |
| **Water treatment** | • Efficient washing systems: Implement efficient bottle and keg washing systems that use less water.<br>• Advanced filtration: Reverse osmosis (RO) removes impurities and ensures high-quality water for brewing processes.<br>• Treat and reuse water from cleaning and rinsing operations for non-potable uses, such as cleaning floors or cooling, and capture and reuse condensate from steam and refrigeration systems. |
| **Compressed air** | • Ensure that compressors and air receivers are appropriately sized for the brewery's requirements and select energy-efficient compressors and associated equipment.<br>• Conduct routine inspections to identify and fix leaks in the compressed air system.<br>• Install VSDs on compressors to adjust the motor speed to match the air demand, reducing energy consumption during lower demand periods. |
| **Boiler and steam distribution** | • Use of spent grain for fuel.<br>• Ensure boilers are properly sized to match the brewery's steam and hot water demands and implement strategies to manage and distribute loads efficiently, avoiding frequent cycling.<br>• Perform regular steam leak and maintenance. |
| **Significant water users** | |
| **Brewhouse operations** | • Optimise water-to-grain ratio.<br>• Use efficient lautering systems.<br>• Recover and reuse hot water from the boiling process.<br>• Use water-efficient heat exchangers.<br>• Recover cooling water. |
| **Fermentation and conditioning** | • Implement water-efficient cleaning practices.<br>• Reuse cleaning water. |
| **Packaging** | • Use air rinsing where possible.<br>• Optimise rinsing systems to reduce water use.<br>• Use automated keg washers with water-saving features. |
| **Cleaning and sanitation** | • Use dry cleaning techniques where possible.<br>• Install water-efficient cleaning systems.<br>• Optimise cleaning-in-place systems for water efficiency.<br>• Reuse final rinse water. |
| **Cooling and refrigeration systems** | • Use closed-loop cooling systems.<br>• Optimise cooling tower operations. |
| **Wastewater treatment** | • Implement water recycling and reuse systems.<br>• Improve wastewater treatment efficiency. |
| **Utility water** | • Use condensate recovery systems.<br>• Optimise boiler blowdown procedures. |

# Fruit and vegetable sector-specific interventions

*The fruit and vegetable processing sector is energy-intensive due to the heating, cooling, and mechanical operations required. It presents numerous opportunities for efficiency improvements. By implementing these common energy- and water-saving techniques, companies can significantly reduce their energy consumption, lower operating costs, and contribute to environmental sustainability. These steps not only improve a production plant's efficiency but also align with broader environmental goals, creating a win-win situation for the facility and the planet.*

| Focus | Suggested interventions |
|---|---|
| **Energy efficiency** | |
| **Boiler efficiency** | • Insulating steam pipes; reducing flue gas temperature; using a tarpaulin over stored coal. |
| **Alternative drying tunnel technology** | • Implementing new technologies to reduce energy consumption in drying processes. |
| **Control of old Danfoss refrigeration system** | • Updating control systems to improve energy management. |
| **Lighting** | • Encouraging the practice of switching off lights when not in use. |
| **Micro-hydro power** | • Utilising small-scale hydropower systems. |
| **Optimise refrigeration control** | • Improving control systems to optimise refrigeration processes. |
| **Pump control** | • Enhancing the efficiency of pump systems.<br>• Installing heat pumps to improve the efficiency of water heating systems. |
| **Repositioning of drying tunnel blower** | • Adjusting the position of blowers to improve drying efficiency. |
| **Lighting** | • Maximising the use of daylight to reduce the need for artificial lighting.<br>• Installing sensors and timers to control lighting usage. Reduces energy waste by ensuring lights are only on when needed.<br>• Replacing traditional lighting with energy-efficient LED lights. |
| **VSDs** | • Installing VSDs on motors and pumps to adjust their speed based on demand. Reduces energy consumption by matching motor speed to the actual load required. |
| **Building insulation and envelope improvements** | • Enhancing the insulation and sealing of buildings to reduce heat loss or gain. Lowers heating and cooling energy requirements, leading to significant energy savings. |
| **Combined heat and power systems** | • Using a single fuel source to generate both electricity and useful heat. Increases overall energy efficiency by utilising waste heat. |
| **Water efficiency** | |
| **Cooling tower** | • Water minimisation by reducing the water used in cooling towers. |
| **Expansion of overflow water storage** | • Increasing storage capacity to capture and reuse overflow water. |
| **Prevent evaporation** | • Implementing measures to reduce water loss through evaporation. |

| Focus | Suggested interventions |
|---|---|
| **Water efficiency** | |
| **Rainwater harvesting system** | • Collecting and storing rainwater for later use, typically for irrigation and non-potable purposes. |
| **RO plant** | • Using RO plants to treat and reuse water. |
| **High-pressure, low-volume sprays** | • Using high-pressure, low-volume sprays for cleaning surfaces and equipment. |
| **Water recycling and reuse** | • Recycling wastewater for non-potable uses such as irrigation, cooling, or cleaning. |
| **Efficient irrigation systems** | • Deliver water directly to the root zone of plants, minimising evaporation and runoff. |
| **Leak detection and repair** | • Implement a rigorous leak detection and repair programme, identifying and fixing leaks. |
| **Low-flow fixtures** | • Installing low-flow faucets, showerheads, and toilets that use less water per use. |
| **Greywater systems** | • Reusing greywater from sinks, showers, and laundry for irrigation or toilet flushing. |
| **Advanced water treatment technologies** | • Using technologies such as RO, ultrafiltration, and UV disinfection to treat and recycle water. |
| **Smart water management systems** | • Implementing integrated water management systems that use sensors, automation, and data analytics to optimise water use. |

## Poultry sector-specific interventions

*The poultry industry is the largest agricultural sector in South Africa. Energy consumption increases with the level of automation and mechanisation of the facility. Effective water conservation in the poultry industry requires a multifaceted approach, incorporating dry-cleaning techniques, pressure washing, water metering, pressure reducers, personnel training, and equipment modifications. These strategies provide a robust framework for reducing water and energy usage and enhancing sustainability in poultry processing operations. Integrating these measures into industry practices can lead to significant environmental and economic benefits.*

| Significant energy users and other focus areas | Suggested interventions |
|---|---|
| **Refrigeration systems** | Implement enhanced control systems, install VSDs, and optimise insulation and maintenance routines. |
| **Processing equipment** | Upgrade to energy-efficient models, implement regular maintenance schedules, and automate processes to reduce energy waste. |
| **Heating and cooking equipment** | Transition to biomass boilers or geothermal heat pumps, and utilise heat recovery systems. |
| **Water heating systems** | Install solar water heaters or high-efficiency electric geysers, and insulate pipes to minimise heat loss. |
| **Compressed air systems** | Optimise system pressure, fix leaks, and install VSDs to match air supply with demand. |

| Significant energy users and other focus areas | Suggested interventions |
|---|---|
| **Anaerobic digestion as energy source** | Utilising anaerobic digestion to generate energy, with two options explored – thermal/gas and electrical. |
| **Electronic condensate drain trap or equivalent** | Implementing electronic condensate drain traps to improve system efficiency. |
| **Install a solar water pump and use the natural spring on the farm** | Using solar power to operate water pumps and utilise natural water sources. |
| **Install boiler stack economiser** | Adding economisers to boiler stacks to recover waste heat and improve efficiency. |
| **Install light occupancy sensors** | Installing sensors to automatically control lighting based on occupancy. |
| **Install new incubators and hatchers** | Upgrading to more energy-efficient incubators and hatchers. |

| Significant water users and other focus areas | Suggested interventions |
|---|---|
| **Chilled water system** | Implement closed-loop systems, optimise cooling cycles, and use water-efficient chillers. |
| **Facility cleaning** | Use high-pressure, low-volume cleaning systems, implement dry cleaning methods where possible, and optimise cleaning schedules. |
| **Processing equipment cooling** | Utilise recirculating cooling systems, improve heat exchanger efficiency, and optimise cooling processes. |
| **Boiler make-up water** | Use condensate return systems, implement water treatment to reduce blowdown, and use efficient boiler operation practices. |
| **Sanitation and hygiene** | Install low-flow fixtures, use automated and timed water dispensers, and implement water recycling and reuse systems. |
| **Dry-cleaning techniques** | The adoption of dry-cleaning methods over traditional wet cleaning can significantly reduce water usage in poultry abattoirs. Techniques such as scraping fat and grease off conveyor belts, installing strainers along the evisceration line, and sweeping or shovelling materials off the floor before wet cleaning are effective. |
| **Water-efficient devices** | The implementation of water-efficient devices in various stages of poultry processing is a common recommendation. This includes high-efficiency nozzles for cleaning and disinfection, as well as advanced humidification systems in hatcheries. |
| **Leak detection and repair** | Regular inspection of plumbing systems to detect and repair leaks promptly. |
| **Advanced water treatment technologies** | Using technologies such as RO, ultrafiltration, and UV disinfection to treat and recycle water. |

## Sugar cane sector-specific interventions

*Several trends are shaping the future of the sugar cane milling industry in South Africa. There is a growing focus on sustainability and environmental responsibility, with mills investing in renewable energy sources such as biomass from cane waste. Additionally, there is a trend towards diversification, with sugar companies exploring the production of biofuels and bioplastics as alternative revenue streams. Technological advancements in precision agriculture and automation are also being adopted to improve efficiency and reduce costs.*

| Focus | Suggested interventions |
|---|---|
| **Energy efficiency** | |
| **Process optimisation** | • Crushing operations can be optimised by replacing fixed-speed motors with variable frequency drives (VFDs), which adjust motor speed to match process demands.<br>• Transitioning to diffusers from traditional milling increases extraction efficiency. Regular calibration and maintenance of extraction equipment ensure optimal performance. Monitoring extraction efficiency and adjusting operational parameters based on real-time data can further enhance energy savings. |
| **Boiler and steam systems** | • Upgrading to high-efficiency boilers involves selecting units with better heat transfer, lower excess air levels, and enhanced combustion controls. Automated boiler controls optimise fuel-to-air ratio, improving combustion efficiency. Regular maintenance, including cleaning of heat exchanger surfaces and proper insulation also contributes to energy savings.<br>• Combined heat and power systems generate electricity and useful heat simultaneously. By using bagasse as a fuel source, mills can produce both power and process steam, maximising energy utilisation.<br>• Insulating steam pipes minimises heat loss. |
| **Electrical systems** | • Energy-efficient motors offer lower losses compared to standard motors. VFDs provide precise control of motor speed and torque, optimising energy use. |
| **Cooling and refrigeration** | • Regular maintenance ensures cooling and refrigeration systems operate at peak efficiency. This includes cleaning heat exchangers, checking refrigerant levels, and ensuring proper airflow. |
| **Lighting systems** | • Replacing incandescent and fluorescent lights with LED fixtures provides higher efficiency and longer lifespan. |
| **Building and facility management** | • Insulating buildings and processing areas involves using materials with high R-values to reduce heat transfer. Reflective roofing materials minimise solar heat gain, reducing the load on HVAC systems. Proper insulation maintains consistent temperatures. |
| **Water efficiency** | |
| **Process optimisation** | • Optimising juice extraction processes can significantly reduce water use. This includes using high-efficiency extraction equipment and recycling process water. Continuous monitoring and control ensure that water use is minimised while maintaining extraction efficiency.<br>• Upgrading to high-efficiency washers and optimising the washing process can reduce water use<br>• Recycling wash water and using counter-current washing techniques can further enhance water savings. |
| **Cooling and boiler feed water** | • Cooling water systems can be optimised by implementing closed-loop cooling systems, which recycle cooling water.<br>• Efficient boiler feed water treatment reduces the need for blowdown, which in turn saves water. Implementing RO and demineralisation systems for water treatment can improve water quality, reducing scale formation and blowdown frequency. |
| **Effluent treatment and reuse** | • Advanced effluent treatment systems, such as membrane bioreactors and anaerobic digesters, treat wastewater to high standards, allowing it to be reused in the plant. |
| **Leak detection and repair** | • Regular leak detection and repair programmes help identify and fix water leaks promptly. |

The Sustainable Decarbonisation Roadmap for South African Priority Agro-processing Sub-sectors identifies four main pillars essential for decarbonisation:

- Energy efficiency: Improving energy consumption patterns to minimise waste.
- Industrial electrification: Transitioning to electric power for industrial processes, reducing reliance on fossil fuels.
- Low-carbon fuels, feedstocks, and energy sources: Integrating alternative fuels and renewable sources that minimise carbon emissions.
- Carbon capture, utilisation, and storage: Implementing technologies to capture $CO_2$ emissions produced during industrial processes and utilise or store them to prevent atmospheric release.

Decarbonisation is not just an environmental imperative but a strategic necessity for South Africa's agro-processing and broader industrial sectors. As global markets increasingly prioritise low-carbon products, industries that proactively reduce their carbon footprints will gain significant competitive advantages, including enhanced market access, improved brand reputation, and compliance with international regulations. The transition to cleaner technologies, renewable energy, and more efficient processes presents an opportunity for South Africa to not only mitigate its environmental impact but also drive economic growth, job creation, and energy security.

This executive summary provides a brief overview of the four target sectors and recommends several interventions to help industry move towards decarbonisation and a greener, sustainable future. More comprehensive information can be obtained at www.saia-project.co.za.

***By embracing adaptation strategies towards decarbonisation, South African industries can not only safeguard their future but also position themselves as leaders in the global shift towards sustainability. This transition is not without challenges, but the rewards of a cleaner, more resilient economy far outweigh the costs, making decarbonisation a vital and urgent priority.***

# Get in touch – get involved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