

Processing and preserving of fruits and vegetables

CLIMATE & EFFICIENCY INVESTMENTS



Decarbonising food processing: A strategic imperative

By 2050, the global population is expected to approach 10 billion, increasing food demand by over 50%.¹ At the same time, the food sector contributes roughly 25%² of global CO₂ emissions while accounting for about 12% of global GDP and over 40% of employment³. This creates a critical challenge: meeting rising demand while reducing environmental impact. Food processing plays a key intermediary role in addressing this complex decarbonisation issue. By adopting innovative technologies and sustainable practices, the sector can help drive the transition towards a net-zero future.



Processing and preservation of fruits and vegetables

The processing and preservation of fruits and vegetables involves transforming fresh produce into products such as canned, frozen, dried, juiced, or pickled items. It requires significant energy and resources, operates in continuous or seasonal cycles, and follows strict hygiene, quality, and food safety standards.

Fruit and vegetable processing generates greenhouse gas emissions across **Scope 1 and Scope 2**, mainly from on-site fuel use and electricity demand, which necessitates a comprehensive decarbonisation strategy tailored to these facilities.

Key emissions drivers in the processing and preservation of fruits and vegetables

Scope 1 – Direct emissions

Scope 1 emissions in fruit and vegetable processing mainly come from on-site fossil fuel use for heat-intensive processes, with smaller contributions from equipment and refrigerant losses.

Scope 2 – Indirect emissions

Scope 2 emissions come from purchased electricity used across processing, refrigeration, and packaging operations, which is essential for maintaining continuous production, product quality, and food safety. sorting equipment, including separation systems, conveyors, magnetic separators, and optical sorting technologies.

¹ Creating a Sustainable Food Future | World Resources Report

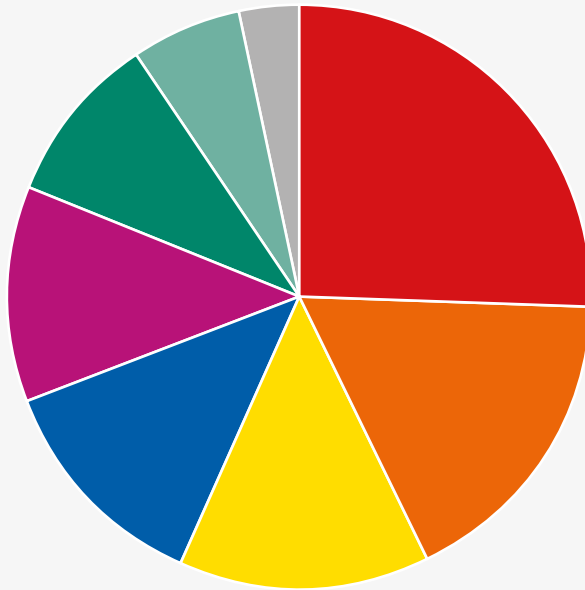
² Reducing food's environmental impacts through producers and consumers | Science

³ Here's how we can protect food systems against global shocks | World Economic Forum



Carbon footprint structure

Processing & preserving of fruits & vegetables



Key emissions drivers⁴

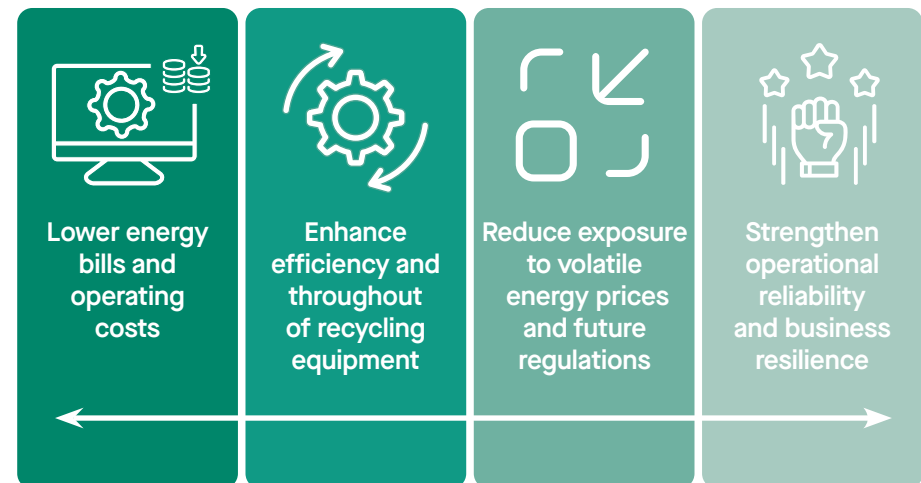
- CHP and/or cogeneration process 25.6%
- Process cooling and refrigeration 17.3%
- Machine drive 14%
- Conventional boiler use 12.5%
- Process heating 11.8%
- Facility HVAC 9.6%
- Others 6.0%*
- Facility lighting 3.3%

* Other facility support 1.8%, Other non-process use 1.3%, Other process use 1.1%, End use not reported 1.1%, Onsite transportation 0.6%, Electro-chemical processes 0.1%, Conventional electricity generation 0%

Why decarbonisation matters

Reducing emissions from on-site operations and energy use offers a strong opportunity for fruit and vegetable processing facilities to cut costs, mitigate risks, and strengthen long-term operational resilience. These facilities depend heavily on thermal energy as well as electricity, making energy a major driver of both operating costs and greenhouse gas emissions.

By targeting Scope 1 and 2 emissions, fruit and vegetable processors can:



Decarbonisation Roadmap

Processing and preserving of fruits and vegetables				
Investment measure	Energy cost savings (%)	Payback period (years)	CO ₂ reduction potential	Benefits
CHP combustion engine	20%	3 - 4	●	Combined heat and power (CHP) engines generate electricity and heat from a single fuel, boosting efficiency, reducing energy waste, and lowering emissions. When powered by low-carbon fuels like biogas or hydrogen, they further support a cleaner energy system.
CHP gas turbine	20%	3 - 4	✓	CHP gas turbines support net-zero goals by generating electricity and capturing waste heat, boosting efficiency. Powered by low-carbon fuels like biogas or hydrogen, they reduce emissions while providing reliable power and heat.
CHP fuel cell	20%	3 - 4	✓	CHP fuel cells support net-zero goals by generating electricity with high efficiency and supplying useful heat. Their low carbon intensity, quiet operation, and low maintenance enhance energy efficiency compared to conventional combustion systems.
Cooling and freezing chambers	20% - 30%	4 - 5	●	Cooling and freezing chambers maintain the precise low-temperature conditions essential for product quality and safety. Their efficient operation reduces energy use, promoting more sustainable temperature-controlled processes.
Fruit and vegetable peeling equipment	Case specific	4 - 5	●	Efficient peeling equipment minimises product loss and energy use, lowering costs while improving productivity, quality, and sustainability in processing.
Fruit and vegetable cutting equipment	10% - 20%	5 - 6	●	Efficient cutting equipment enables uniform cuts and faster production while reducing waste and optimising energy use, boosting productivity and supporting sustainable, high-quality processing.
Fruit and vegetable evaporation equipment	10% - 20%	5 - 6	●	Efficient evaporation equipment allows for the concentration of juices and extracts, improving shelf life while optimising energy use, reducing waste, and boosting productivity for consistent, high-quality, and sustainable processing.

CO₂ reduction potential ● Very low ● Low ● Medium ✓ High

Decarbonisation Roadmap

Investment measure	Energy cost savings (%)	Payback period (years)	CO ₂ reduction potential	Benefits
Fruit and vegetable sterilisation equipment	10% - 15%	7 - 8	●	Efficient sterilisation equipment extends shelf life and maintains quality and safety while reducing energy use and spoilage, boosting productivity and supporting sustainable, high-quality processing.
Fruit and vegetable juicing equipment	10% - 15%	8 - 9	●	Efficient juicing equipment maximises juice extraction with minimal waste, optimising energy use and productivity while ensuring consistent, high-quality, and sustainable processing.
Packaging machine	20% - 30%	Case-specific	●	Packaging machines ensure precise, hygienic, and consistent filling and sealing of goods. They maintain product quality and safety while minimising material waste. Their energy-efficient operation reduces electricity use, promoting sustainable production.
Battery electric vehicles (BEVs)	50%	5 - 6	●	Electric vehicles offer higher energy efficiency through advanced battery systems and regenerative braking, reducing overall energy consumption during operation. They offer a clean solution for transporting products, reducing fuel costs, and improving operational sustainability.
Electric forklifts	50%	2 - 3	●	Electric forklifts are battery-powered material-handling vehicles used to move ingredients, trays, and finished products within bakery facilities. They offer high energy efficiency by converting stored electrical energy directly into motion with minimal losses. This efficiency reduces fossil fuel use and CO ₂ emissions.
PV self-consumption	Up to 100% based on the system capacity and electricity demand	6 - 7	●	A PV (photovoltaic) system converts sunlight into electricity for on-site use. It provides clean, renewable energy to power production, refrigeration, and other operations, reducing reliance on grid electricity and lowering operational costs. Pairing a PV system with battery storage enables multi-shift companies to rely on renewable electricity while reducing exposure to electricity price volatility.
Li-ion batteries	Case-specific	4 - 8	Case-specific	Lithium-ion (Li-ion) batteries are energy storage systems that store electricity and release it when needed. Their energy-saving potential comes from maximising the use of on-site renewable electricity, reducing reliance on grid power during peak periods. This not only supports emissions reduction but also delivers tangible cost savings through improved energy management and lower operating expenses.

Investment measure	Energy cost savings (%)	Payback period (years)	CO ₂ reduction potential	Benefits
Industrial process chiller	20% - 30%	Over 10 years	✓	Industrial process chillers provide precise temperature control to maintain product quality and protect equipment. Their efficient operation reduces energy consumption, promoting more sustainable industrial operations.
Fruit and vegetable washing equipment	5% - 10%	Over 10 years	●	Washers in fruit and vegetable processing use advanced cleaning technologies to minimise water and chemical use, reduce energy consumption, and ensure food safety, supporting cost-effective and sustainable operations.
Water source heat pumps	20% - 30%	Over 10 years	●	Water source heat pumps are systems that use water as a medium to efficiently transfer heat for heating and cooling. They help companies reduce energy consumption and operational costs while lowering greenhouse gas emissions.
Air-to-air heat pumps	15% - 25%	Over 10 years	●	Air-to-air heat pumps provide efficient heating and cooling by transferring energy rather than generating it. Their high efficiency reduces electricity consumption, contributing to more sustainable building operations.
Air-to-water heat pumps	10% - 20%	Over 10 years	●	Air-to-water heat pumps are systems that extract heat from the air to provide efficient heating and hot water. They help companies reduce energy use, cut costs, and lower emissions.
Ground source heat pumps	15% - 25%	Over 10 years	●	Ground source heat pumps are systems that use the stable temperature of the ground to provide efficient heating and cooling. They help companies reduce energy consumption, lower costs, and cut greenhouse gas emissions.
Ventilation system	10% - 20%	Over 10 years	●	A ventilation system manages the flow of air by bringing in fresh air and expelling stale or contaminated air to maintain a healthy indoor environment. By reducing energy use and improving air quality, efficient ventilation systems support lowering a facility's overall carbon footprint.
Building insulation materials	50%	4 - 5	✓	Building insulation reduces heating and cooling costs, boosts energy efficiency, and supports decarbonisation by lowering emissions and environmental impact.
LED lighting	5% - 10%	5 - 6	●	LED lighting provides high-efficiency illumination with lower energy consumption compared to conventional lighting solutions. Its reduced electricity demand supports decarbonization and enhances building performance.

For more detailed information on how to reduce costs and lower your CO₂ footprint, along with additional measures tailored for your business, contact the bank.

