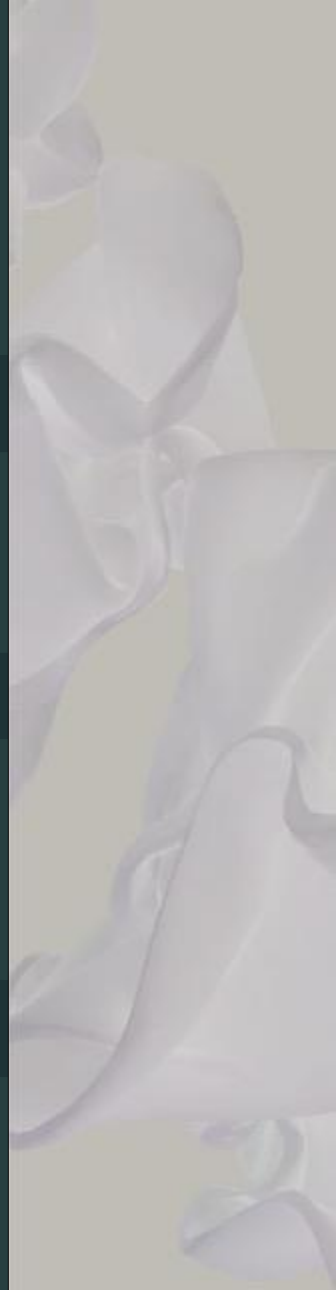
Life cycle Assessment for the Australian Almond Industry

Commissioned by Hort Innovation, AL20005 – Pathway to carbon neutral – life cycle analysis (LCA) in almond orchards



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BEN HETHERINGTON | EDGE IMPACT

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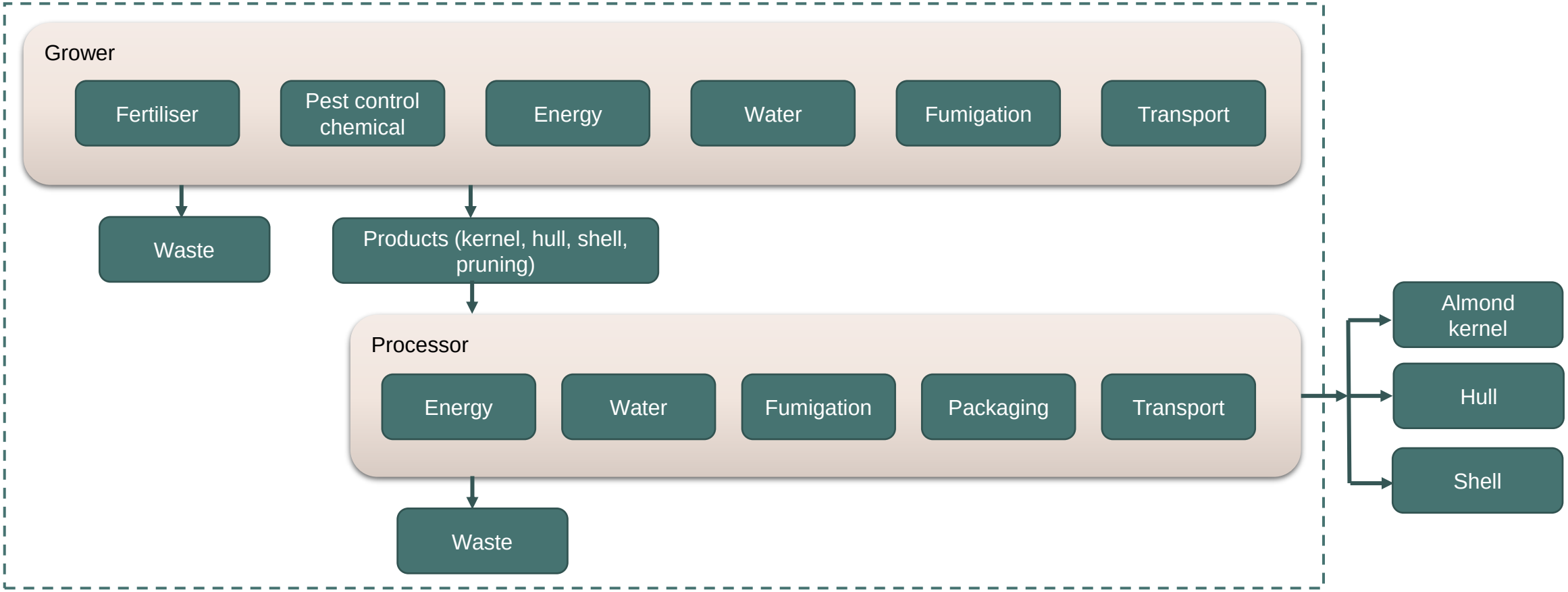
LCA scope

The scope of the LCA is cradle to (processing) gate and it considers the farming and processing related emissions.



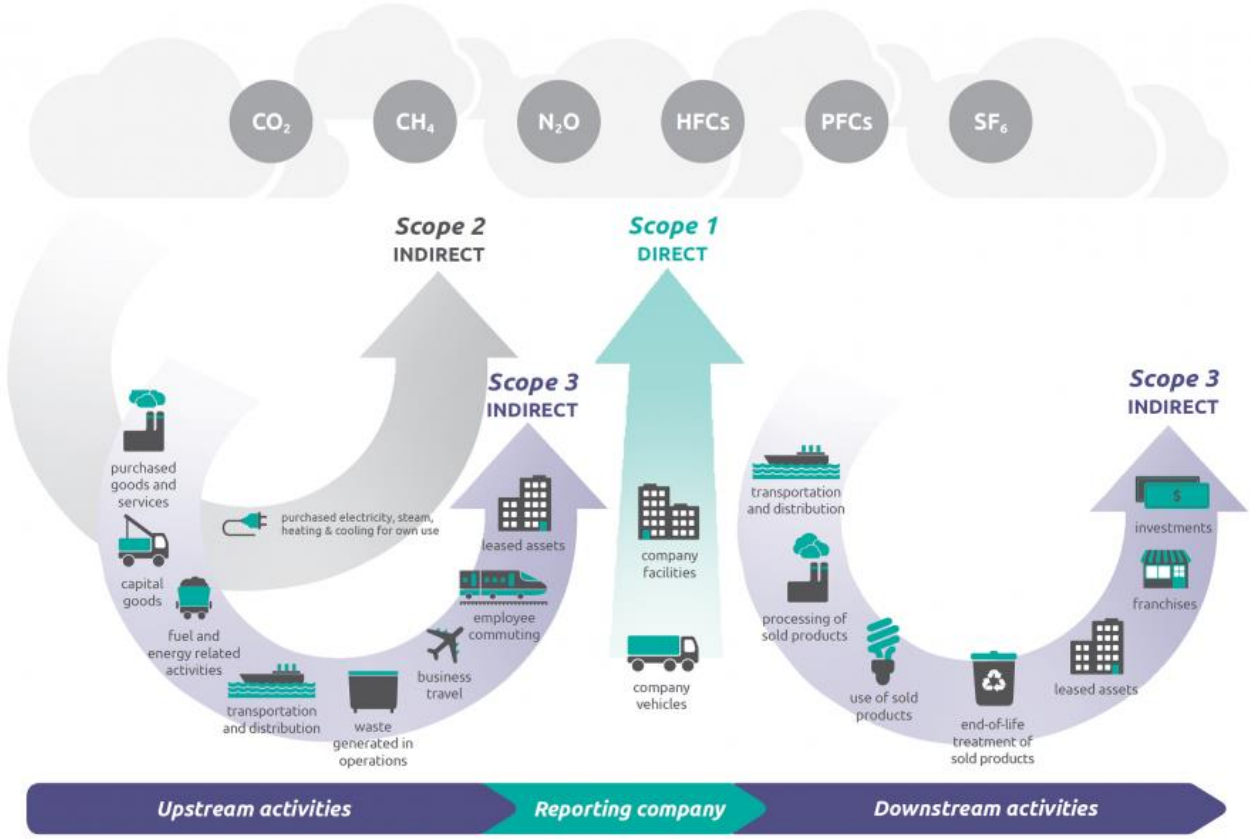
Scope 1, 2 and 3 emission sources

In this analysis, Scope 1, 2 and 3 emissions are mapped and reported.

Scope 1 emission sources – emissions that an organization controls directly

Scope 2 emission sources – emissions sources not directly controlled by an organization, but what is purchased and used

Scope 3 emission sources – all indirect emission sources



LCA methodology

How was the carbon footprint calculated?

Process LCA

- There are different methods for measuring carbon footprints (e.g., GHG Protocol, Process LCA, ISO 14064) suited to different applications.
- The Process LCA method was chosen for this study as it is best suited to understand the emissions associated with almond production. This focuses specifically on the production of almonds and does not include the whole emissions profile of an organisation.

Data		Environmental impact factors		Output
Physical data *(e.g., kWh electricity, material used)*	x	**LCA databases**	=	**Carbon footprint (GHG emissions) (kg CO_2-e/kg almond kernel)**
Known as 'primary data' obtained from growers and processors.		Several LCA databases were used which contain environmental impact inventories for activities, products, and calculation methods.		Known as the Global Warming Potential (GWP).

Grower & processor engagement

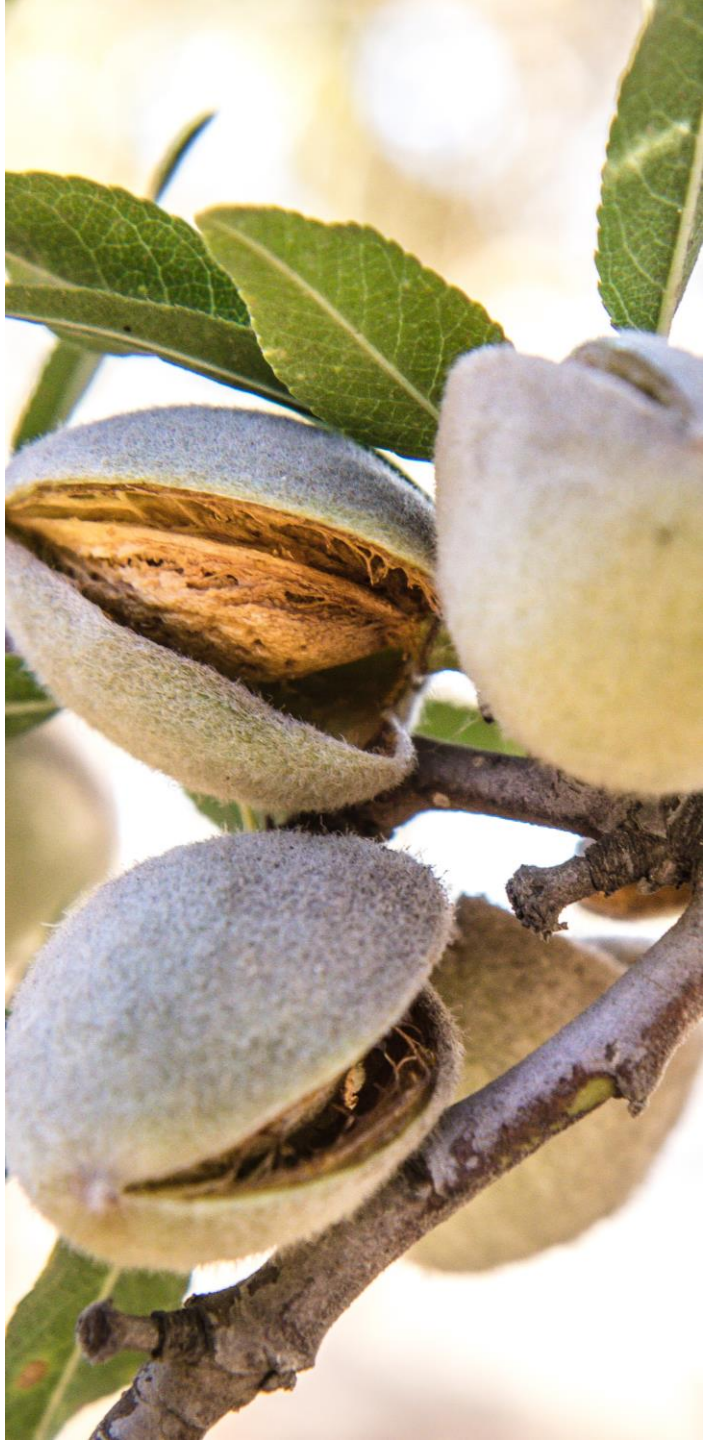
Primary data

Primary data representative of the industry was provided by 11 growers (covering 19 orchards) and 3 processors, spanning the Riverland, Sunraysia and Riverina regions.

Data was captured via request for information (RFI) data sheets specific to growers and processors, with queries and follow-up engagements conducted remotely.

Mitigation workshop

18 participants engaged in a mitigation strategies workshop, representing 12 organisations. The workshop helped facilitate meaningful discussion and provided valuable insights into experiences and perceptions of the selected strategies. These insights are currently being refined to help select the key strategies for in-depth analysis.



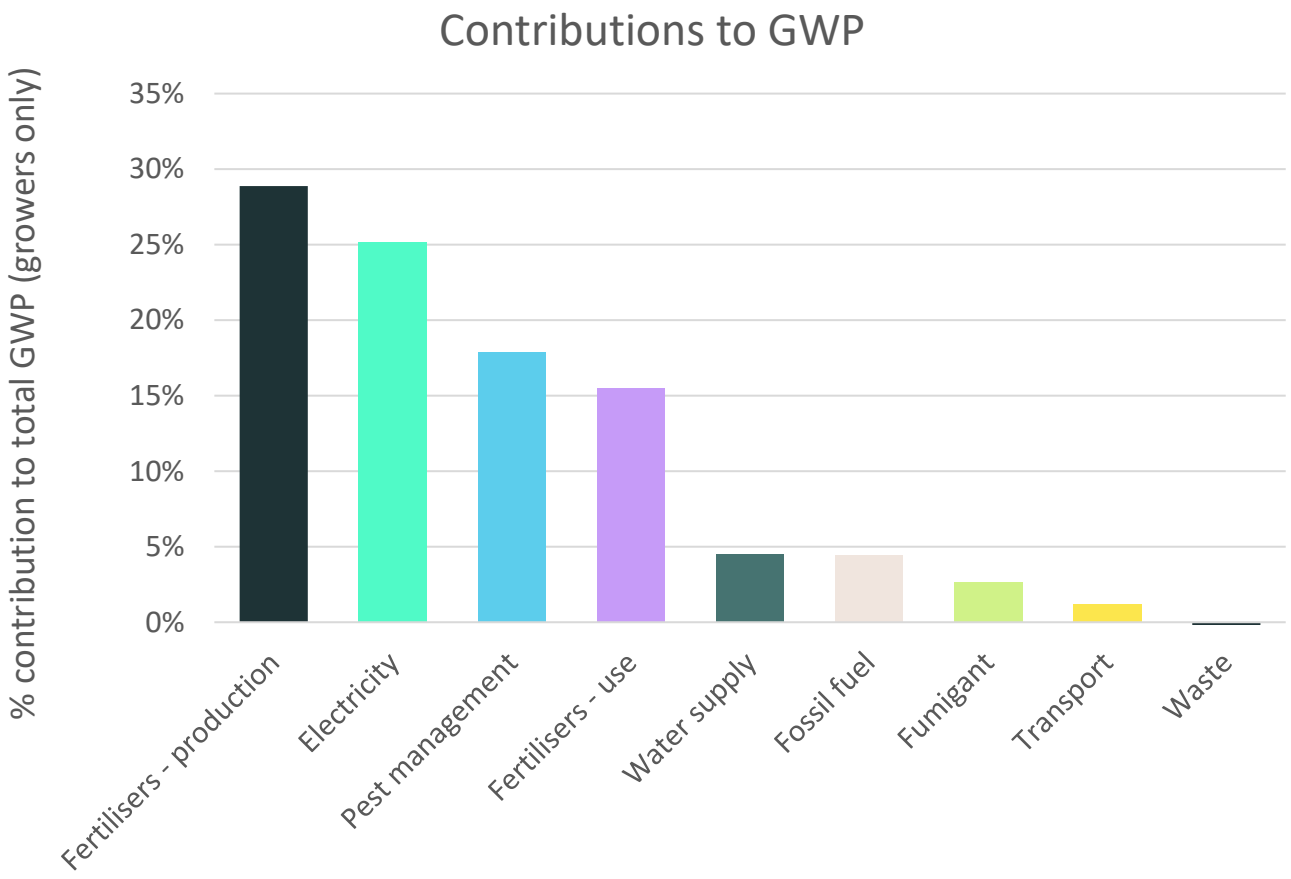
GWP analysis

The Global Warming Potential (GWP) is a comparable figure used to illustrate the emissions intensity of a product, calculated based on the types of gases released and the total number of years required to break down the relevant gases.

It is measured in CO_2 equivalent, with CO_2 holding a GWP of 1, typically across a 100 year timeframe. A GWP_{100} of 2 kg CO_2 eq. indicates a gas holding twice the global warming potential of CO_2 over a 100-year time frame.

GWP analysis is an important tool for understanding the impacts of different greenhouse gases on the climate, helping identify carbon hotspots and prioritise carbon mitigation initiatives.

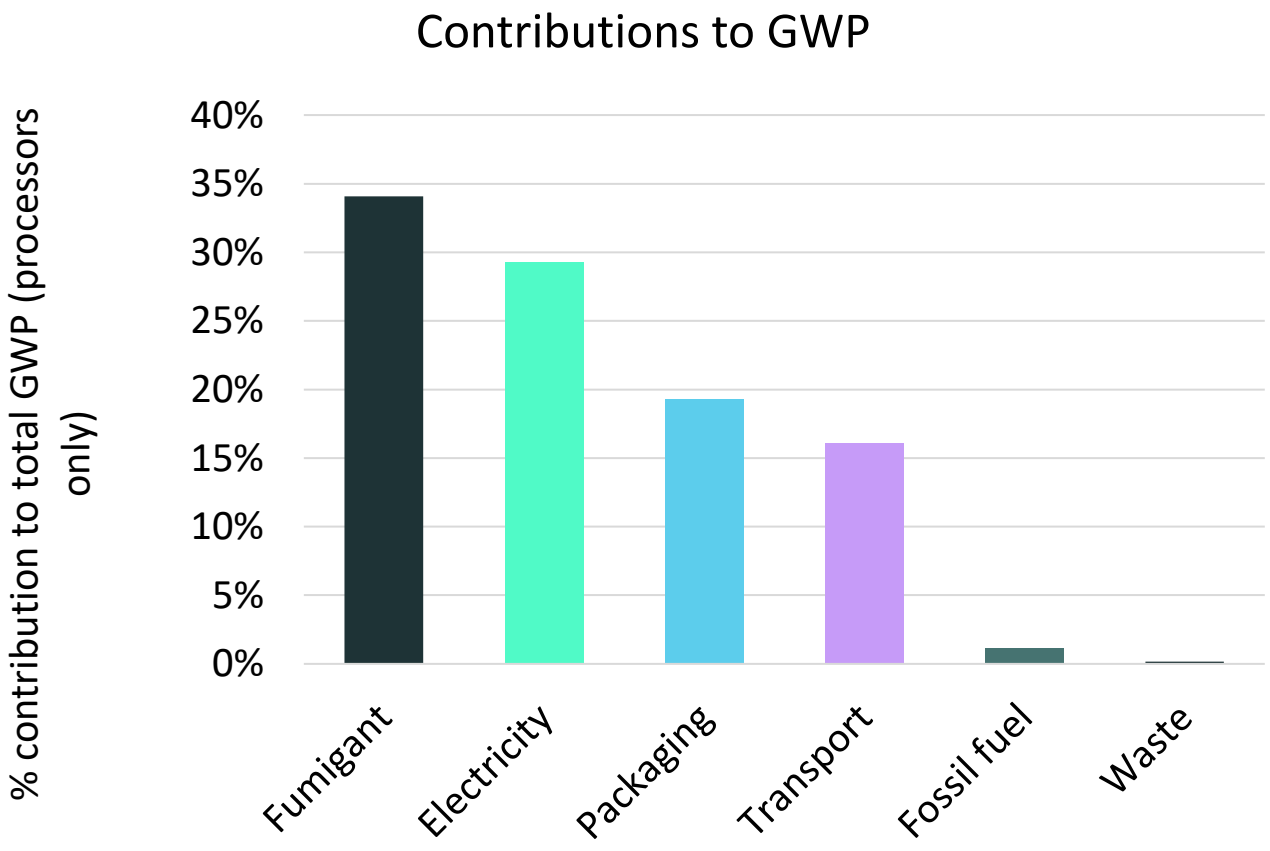
Contributions to GWP - growers



Analysis

- 87% of GWP impacts in the growing stage are associated to fertiliser production, electricity use, pest management and fertiliser use.
- Water supply accounts for impacts associated to externally sourced water only. Impacts from water sourced from natural reserves (rivers and/ or ground water) are captured in electricity and fossil fuel categories.
- Fumigant category refers to fumigants used on stockpiles at the grower's site, helping deal with longer wait times at processing facilities.
- Transport refers to truck transport between grower and processor facilities.
- Waste data was mostly unavailable due to limited records. Data that was provided has a small impact compared to other areas.

Contributions to GWP - processors



Analysis

- Fumigation has the highest impact (34%) out of all impact categories for processors, followed by electricity.
- The mitigation opportunities for fumigation and electricity are similar to that of growers.
- Packaging and transport involve packing and transporting almond kernel via truck or ship to customer destinations in Australia or overseas.
- Waste related impacts were again insignificant in comparison to other categories.

Next steps

The below next steps detail the trajectory and project deliverables throughout the remainder of the project.

IDENTIFY MITIGATION OPTIONS

- This stage is well underway. We are in the process of finalising the selected initiatives based on their likelihood of adoption and overall impact.
- The results will be summarised in a Carbon Mitigation Analysis Report.

CARBON MARKET METHODS AND MITIGATING TRANSITION RISK

- This stage will explore carbon offsets that can be generated in Australia.
- Discussions will be held with the Clean Energy Regulator on Australian Carbon Credit Units (ACCUs) and eligibility relevant to the almond industry.
- Certification as carbon neutral will also be pursued with Climate Active, helping identify opportunities and barriers for industry members to become carbon neutral.
- Existing literature, project results and discussions with the Regulator will be collated into a discussion paper for the industry's use in determining the most viable path towards carbon neutrality.

COMMUNICATION AND AWARENESS RAISING

- Following a three-pronged approach, key audiences will be identified along with their current and ideal state, informing a communication strategy.
- Template presentations will be developed, tailored for each stakeholder and audience, co-created with a representative working group.
- Webinars will be recorded using the presentation material, ensuring they are well understood.
- An article will be written for In A Nutshell sharing the project successes and ambitions to come.
- Create a carbon calculator tool for the industry's use, providing insights into impact categories helping inform the strategies and opportunities that can be taken by growers and processors.

Thank you

Contact Us

Sydney

Suite 501, 39 East Esplanade
Manly, NSW 2095, Australia

+61 2 9438 0100

info@edgeimpact.global

Adelaide

60 Halifax Street
Adelaide. SA5000, Australia

+61 8 8232 4823

info@edgeimpact.global

Melbourne

80 Market Street
South Melbourne, VIC 3205, Australia

+61 2 9438 0100

info@edgeimpact.global

Santiago

Avenida Providencia 2315,
Oficina 602, Providencia, Chile

+56 9 7703 2645

info@edgeimpact.global

Boston

269 Cordaville Road,
Southborough, MA 01772, USA

+1 774 206 9172

info@edgeimpact.global

Auckland

Generator NZ, 12 Madden
Street, Auckland 1010, NZ

info@edgeimpact.global

Assumptions

The below details refer to the boundaries and assumptions made or applied to each impact area of the LCA. When applying life cycle inventory (LCI) database factors to primary data, GWP factors were applied including fossil, biogenic and land transformation impacts. These impacts are added to give the total GWP value.

WATER

- Water source was confirmed with each grower, with associated impacts calculated accordingly. Sources include:
  - River
  - Ground water
  - External supplier
- Impacts associated with river/ groundwater supply are captured in electricity and fossil fuel. This assumes no on-farm filtration process between water extraction and farm application.
- For supply from an external supplier, impact calculations include water treatment impacts such as biosolids treatment, filtration, electricity use and transport. These impacts are accounted for via an 'external water source' factor calculated by the Life Cycle Inventory (LCI) database Ecoinvent 3.8.

ELECTRICITY

- Electricity impacts were calculated using the primary data provided by growers and processors.
- Primary data collection did not differentiate between drivers of electricity use (irrigation/ office/ workshop/ home) due to data limitations. However, grower anecdotes indicate irrigation uses the highest portion of electricity.
- The spectrum of electricity sources is based on an Australia-wide average derived from the LCI database AusLCI, comprising 17% renewable and 83% non-renewable energy.
- Any surplus renewable energy generated on site and sold beyond the site's electricity requirements is not included within this scope (i.e., generating a net positive impact).
- All on-site electricity requirements were captured, with impact factors applied to the respective electricity source (e.g., grid, solar or other).

FERTILISER PRODUCTION & USE

- Impacts associated with fertiliser production and use are calculated from primary usage data.
- Fertiliser use impacts are associated to nitrogen-based fertilisers, well known to emit nitrous oxide gases.
- LCI factors are applied per chemical type for fertiliser production. Synthetic fertilisers will have a higher impact due to being largely fossil fuel derived.
- Usage impacts are derived from each chemical compound's GWP multiplied by its usage rate.

WASTE

- Waste impacts were calculated directly from waste volume data provided by growers and processors, multiplied by LCI database factors covering fossil, biogenic and land transformation impacts.
- Waste data from 9 of the total 19 orchards was provided, due to limitations in waste data tracking.
- Unreported waste volumes were left as zero.

Assumptions

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SCOPE 1,2 & 3

- Scope 1 emissions account for fertiliser use emissions, diesel fuel combustion and composting.
- Scope 2 emissions account for electricity used on site.
- Scope 3 emissions include pest control chemicals, fertiliser production, external water sourcing, product transport and waste management.

DOWNSTREAM TRANSPORT

- Transport distances from farm to processing facility were reported by growers. Fossil, biogenic and land transformation emissions factors were applied to each distance to calculate truck emissions.
- All transport between facilities is assumed to occur via trucks.

PEST MANAGEMENT INC FUMIGANTS

- Pest management includes impacts associated to chemical production, energy use and plant emissions associated to pest control.
- Pesticide, herbicide and fungicide primary data was captured for each grower and processor.
- Fumigant impacts were separated from pest management for additional insights. Factors from the LCI database Ecoinvent 3.8 were applied to the volume of each chemical used.
- Only chemical usage impacts (volume of chemicals) were included. Other application types and their associated impacts (i.e., equipment usage impacts beyond fuel usage) were deemed immaterial to the study.

FOSSIL FUELS

- Fossil fuel volumes were captured covering gasoline (fuel), diesel and natural gas. Based on their application, these volumes were multiplied by fossil, biogenic and land transformation LCI database factors to calculate the total GWP_{100} impacts.