



# Coffee Ground Recovery Program Summary Report

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January 2016



Positive environmental actions, for everyone.

# Feasibility study report: Summary

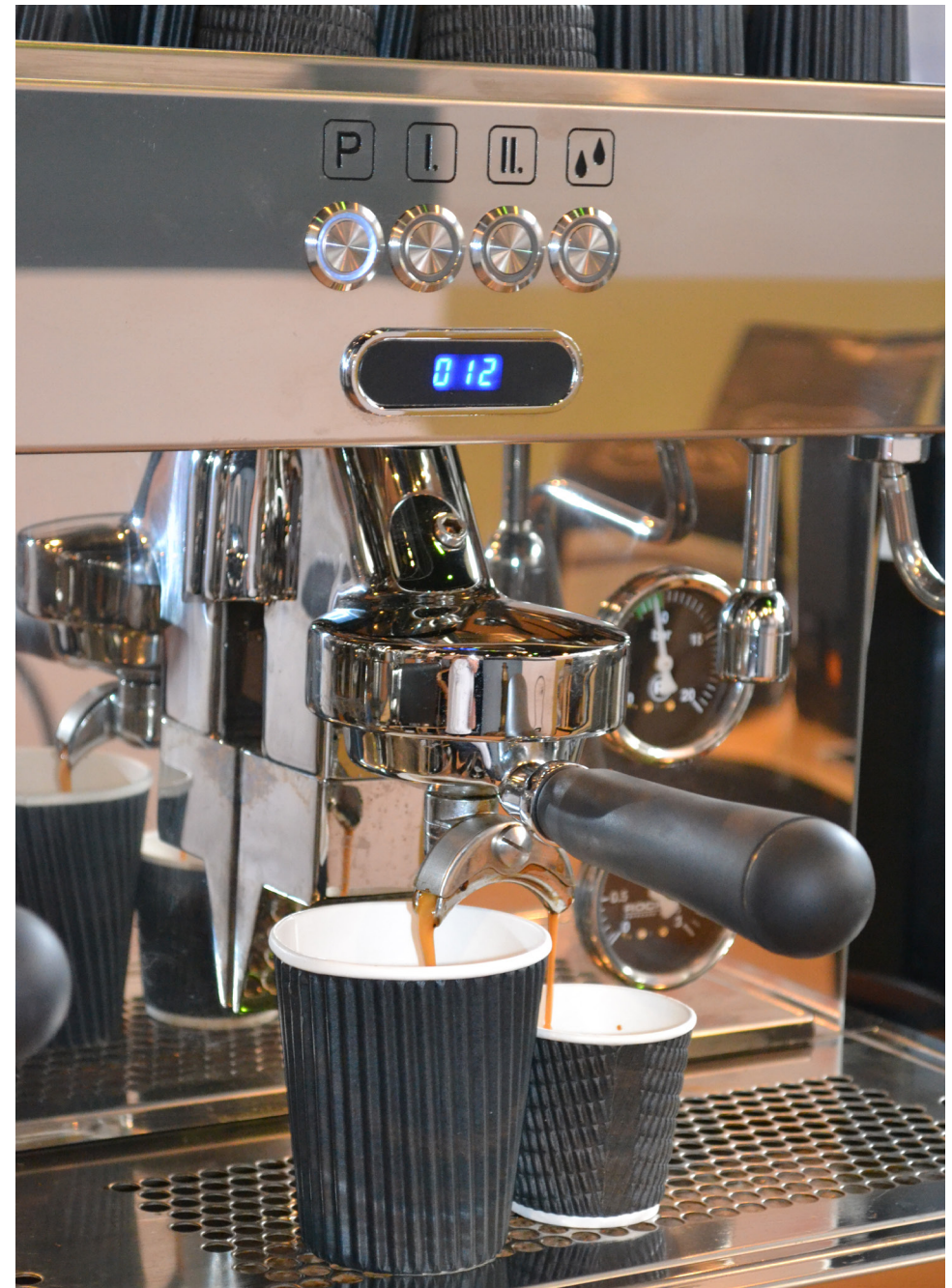
This document is a summary of the findings of a six-month feasibility study into the commercial viability of recycling spent coffee grounds produced by cafes and coffee shops within the City of Sydney. Planet Ark Environmental Foundation conducted the study with funding from the City of Sydney.

The names of all businesses and people consulted as a part of this study have been kept confidential. All enquires relating to this report should be directed to [coffee@planetark.org](mailto:coffee@planetark.org).

## Definitions

**Spent coffee grounds (SCG):** 'Spent coffee grounds' refers to coffee grounds after they have been used. They are the primary waste product produced by the espresso coffee extraction process.

**Coffee grounds (CG):** 'Coffee grounds' refers to coffee beans that have been ground, but have not yet been used, i.e. the form they are in prior to the extraction of coffee.



# Aim of the study

Planet Ark conducted this feasibility study in order to determine whether a collection and processing program can be established for spent coffee grounds for the City of Sydney that is financially self-sustaining and develops an environmentally beneficial product.

This study seeks to address the following:

1. Determine the volume of spent coffee grounds produced by cafes within the City of Sydney and the current waste disposal methods being employed by Sydney cafes.
2. Gauge the level of interest from cafes willing to participate in a coffee grounds recycling/landfill diversion program.
3. Gauge the willingness of the general public to pay for their coffee grounds to be diverted from landfill.
4. Investigate the various collection services available to Sydney cafes and their associated costs.
5. Determine the chemical composition of spent coffee grounds through laboratory testing.
6. Investigate the various opportunities for processing and end use for spent coffee grounds.

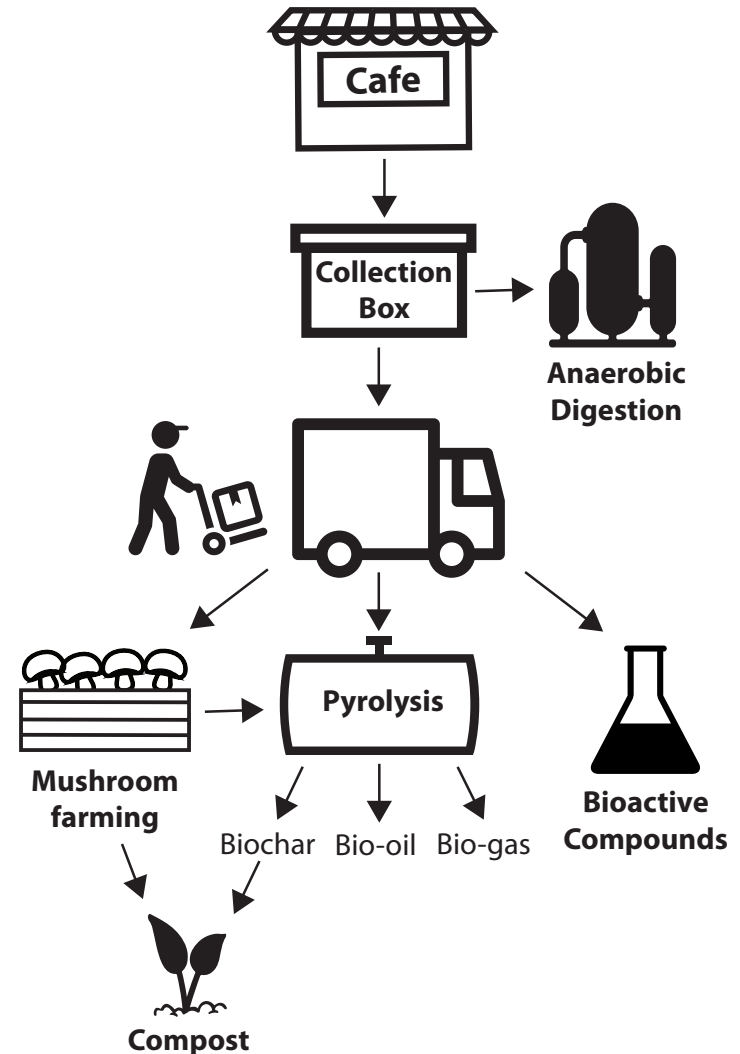


# Report at a glance

## Current system of coffee waste in the City of Sydney today (Linear)



## Proposed spent coffee grounds collection system and end-uses (Circular)



# What's the problem with spent coffee grounds?

## A potent waste with negative impacts

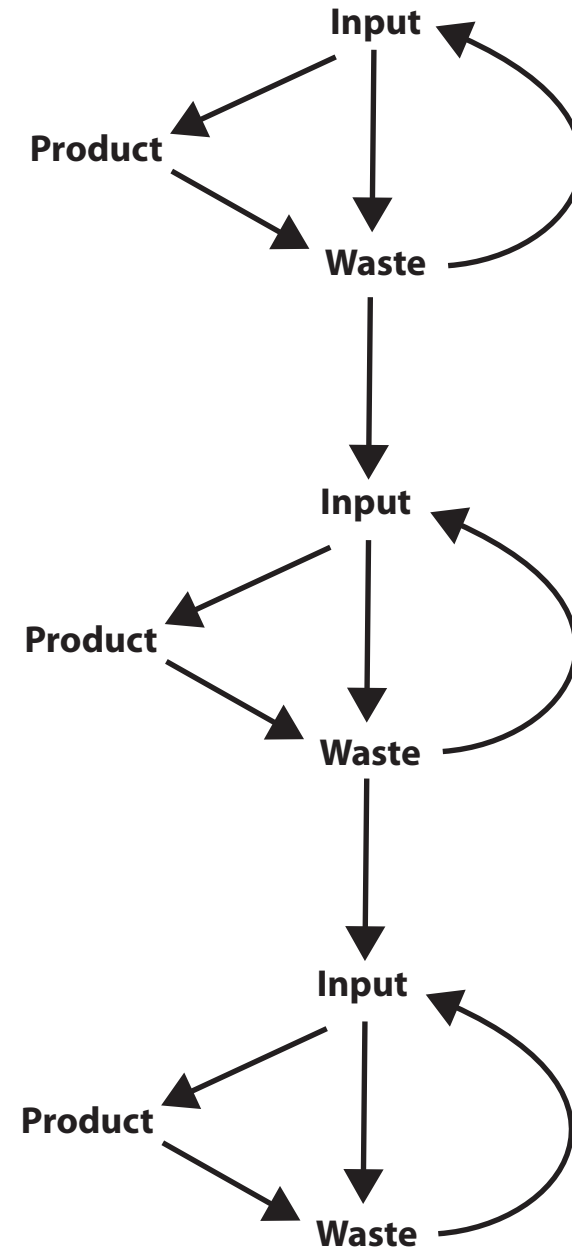
- Australians consume 6 billion cups of coffee every year. The grounds that make these coffees are used only once and then immediately discarded.
- When spent coffee grounds are sent to landfill they can produce methane and carbon dioxide, greenhouse gases that contribute to global warming.
- The waste coffee grounds also contribute towards the huge financial cost on tax payers of running and maintaining landfills in Australia.
- While many coffee brands promote the ethical treatment of their growers and the sustainability of their farms, little attention is paid to the environmental impact of the organic waste at the end of the coffee chain in Australia.



# A valuable resource

## Spent coffee grounds are a relatively unique organic waste stream

- Cafes and coffee shops collect spent grounds separately to other waste in containers next to the espresso machines, with little to no contamination.
- The brewing process to extract coffee uses high temperatures that sterilise the grounds. This produces a relatively clean waste and greatly enhances the value of the spent coffee grounds to processes that require the input of sterile materials.
- Spent coffee grounds are nutrient rich and have the potential to be used as a value added product in multiple different processes (discussed further on pages 11-15).
- This system creates a circular economy, where the waste from one process is used as an input by another. Within this setup the use of resources are optimised, waste generation is minimised and there is an economically viable role for every product of a manufacturing process.



# How much coffee waste are we producing?

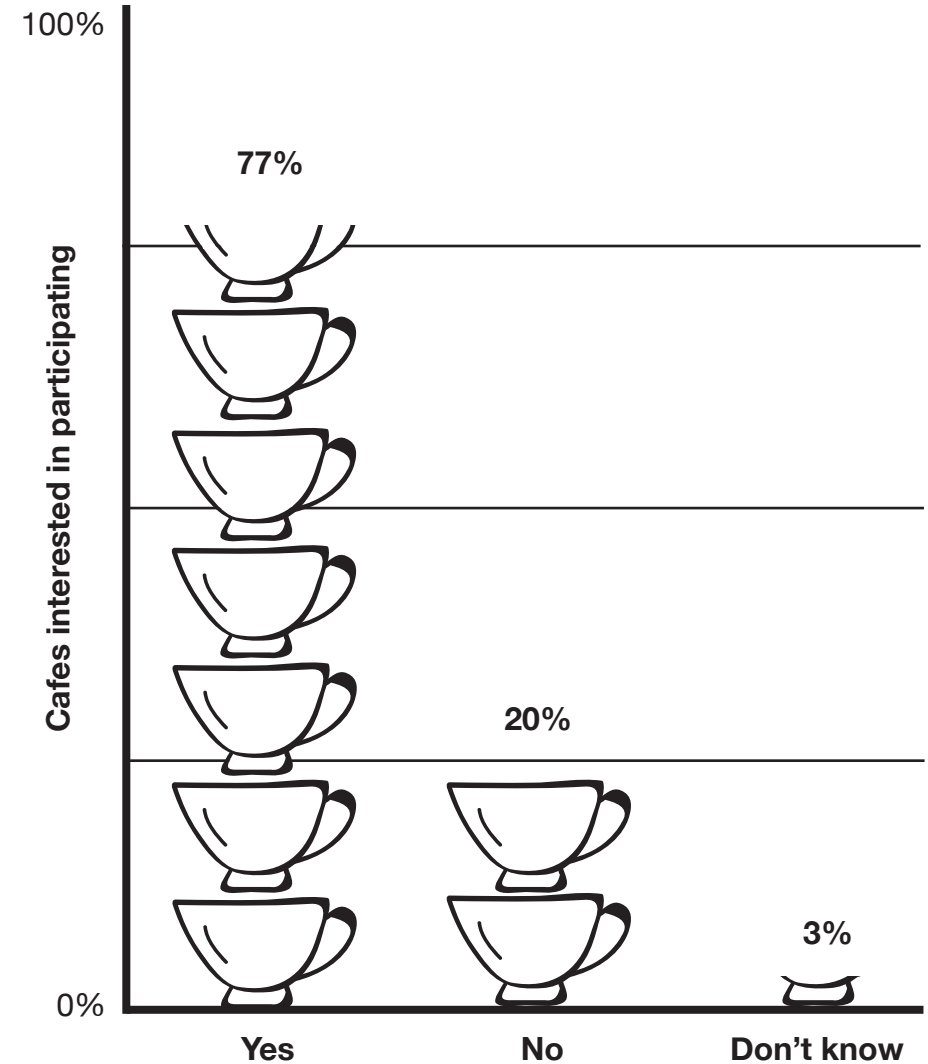
- 921 cafes and coffee shops within the City of Sydney.
- An average cafe uses 32kg of coffee beans in a week, producing 60kg of spent coffee grounds a week.
- Nearly 3,000 tonnes of spent coffee grounds are produced each year.
- 93% of cafes send their spent coffee grounds to landfill.
- 7% of cafes have their spent coffee grounds collected by an organic waste processor or by customers for composting.
- Spent coffee grounds are collected in cafes separately to other waste streams, with low levels of contamination.



# Cafe participation

- 77% of cafes and coffee shops surveyed said that they would be interested in participating in a coffee grounds recovery program.
- The main concerns for cafes was space for an additional bin and if extra work would be required.
- 50% of cafes have their waste collected daily, 33% have collections 2-3 times a week and 17% have collections weekly.
- A typical cafe trading six days a week uses 5.1kg of coffee beans in a day and pays approximately \$900 a year in waste collection costs to send their spent coffee grounds to landfill.

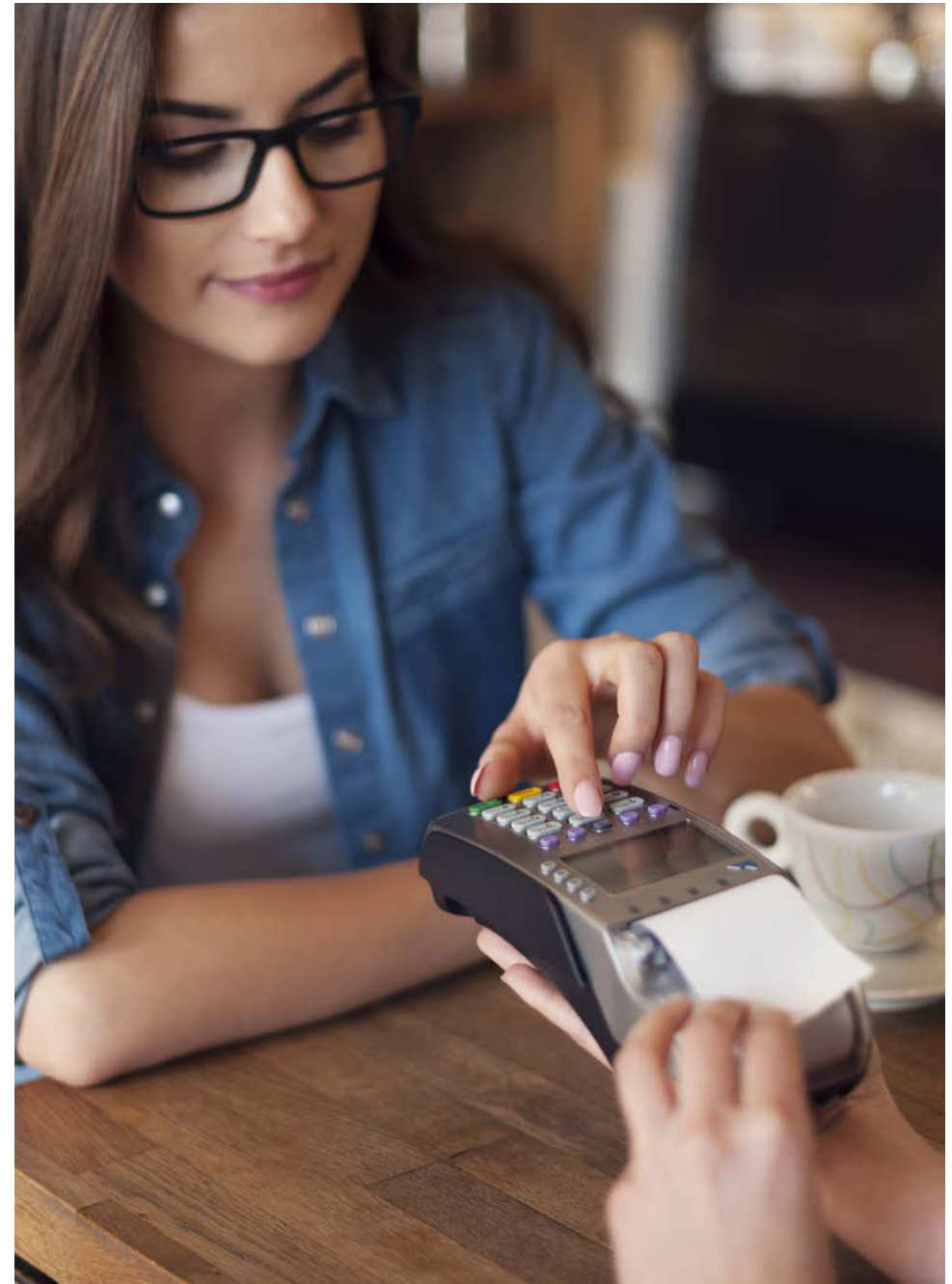
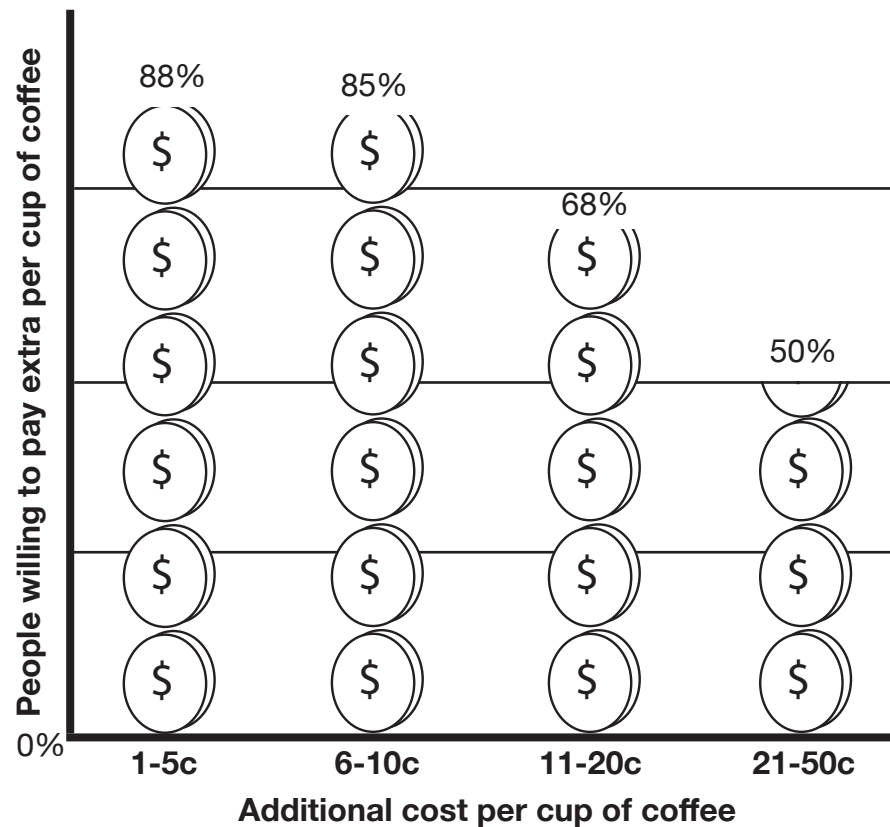
***An average cafe spends \$900 a year sending their spent coffee grounds to landfill***





# Customer participation

- Nine out of ten coffee drinkers would be willing to pay up to 5c extra for a cup of coffee if they knew the spent coffee grounds were being diverted from landfill.
- A customer's willingness to pay extra was not affected by their level of environmental concern or annual household income.



# Waste collection

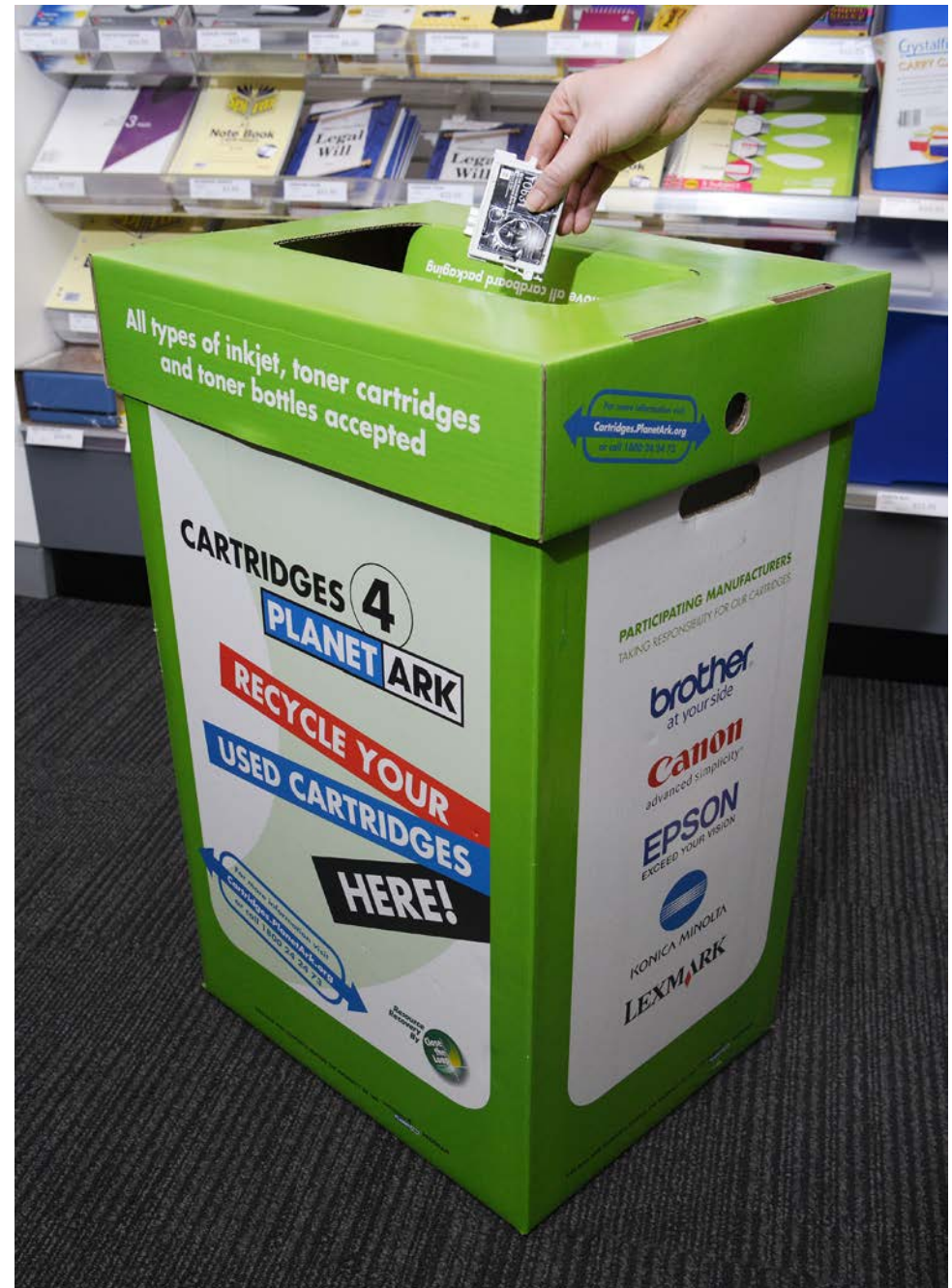
## Proposed collection service

Instead of using a conventional waste collection company, spent coffee grounds could be collected through a parcel collection service that collects and delivers up to 25kg. This system is similar to that of the 'Cartridges 4 Planet Ark' collection program run by Planet Ark for printer cartridges and ink toner.

## Benefits over conventional waste collection companies

- Cheaper with no lock-in contracts
- All collections are carbon offset
- The end destination of waste is controlled
- Can choose the day and frequency of collections
- Bins will not need to be put outside for collection where they could be contaminated by the general public

***Planet Ark collects 3 million printer cartridges through the 'Cartridges 4 Planet Ark' recycling program every year***



# Cost of the program

Initial financial modelling for the programme showed that the retail cost of a cup of coffee would be increased by 1-2c depending on the size of the drink. This fits well within the 'up the 5c extra' that nine out of ten consumers said they would pay to have their spent coffee grounds diverted from landfill.

This costing included collection, co-ordination and promotion. At this stage it does not include any potential revenue from the recycling of the grounds as this is expected to be negligible in the short to medium term. However over the longer term this could provide an income stream that would offset some of the program cost dependent on the volume and ultimate use of the grounds.

The next stage of the program will trial options for the use of the spent coffee grounds, providing a more detailed economic model. Further research also needs to be done on this resource to maximise its commercial value.



# Alternative use: Compost

## Pros

- Spent coffee grounds have high nutrient levels, making them suitable for use in low-cost composting.
- Successful techniques used for coffee grounds include vermicomposting, aerated static composting and mechanical in-vessel composting.
- Compost derived from coffee can be used to enhance soil nutrients and increase resistance against pathogens.

## Cons

- There is already an abundance of compost produced in Australia. This may reduce the potential for coffee grounds to be used as a value-added product that generates adequate economic value to support a collection system.



# Alternative use: Mushroom growth

## Pros

- Studies have shown that spent coffee grounds can be used as a growth medium for mushrooms, producing high yields. Mushrooms grown with coffee grounds boast the same nutrient quality as mushrooms cultivated on mediums currently being used by the mushroom industry, such as straw.
- The mushrooms produced are free of caffeine and tannins.
- Our research suggests that oyster mushrooms are the most suitable for growing on spent coffee grounds.
- The coffee extraction process sterilises the coffee grounds, a process that is vital for the medium mushrooms are grown on to remove contaminants.
- There is high demand for locally grown and sustainable mushrooms in Australia.
- Urban mushroom farms currently being established in Australia are interested in partnering with Planet Ark to use spent coffee grounds in their production.



# Alternative use: Pyrolysis and Biochar

## Pros

- Pyrolysis is a process that thermally decomposes organic materials through the application of intense heat in the absence of oxygen. Without oxygen the materials cannot combust and instead produce biogas, bio-oil and biochar.
- Biochar has potential to help mitigate climate change through carbon sequestration in soil and its use as a soil amendment.
- Studies have confirmed the suitability of spent coffee grounds for pyrolysis and the generation of biochar.

## Cons

- There are high initial costs to set up a pyrolysis system for spent coffee grounds.
- Low oil prices and the chemical composition of spent coffee grounds suggest that the biogas and bio-oil produced from coffee would not produce a suitable biofuel. The biogas and bio-oil could still be used though to power the pyrolysis process itself, removing the need for the input of external energy.



# Alternative use: Bioactive compounds

## Pros

- Coffee beans contain several classes of health-related chemicals, such as phenolic compounds, melanoidins, diterpenes, xanthines and vitamin precursors.
- As these compounds are only partially extracted during the brewing process, spent coffee grounds represent a potentially valuable source of bioactive compounds that have a wide range of applications in the food, cosmetic and pharmaceutical industries.

## Cons

- Although studies have clearly demonstrated the potential use of spent coffee grounds for extracting bioactive compounds, these processes are not yet being conducted on an industrial scale.



# Alternative use: Anaerobic digestion

## Pros

- Anaerobic digestion is the process of breaking down organic material by microorganisms in the absence of oxygen. The output is a methane-rich biogas that can be used as a fuel and a nutrient-rich fertiliser.
- Both large and small scale anaerobic systems can be set up to manage varying volumes of organic waste.
- For example, an anaerobic digester in Federation Square, Melbourne, receives organic waste from local cafes and restaurants and can process one tonne per hour, continuously. The biogas produced heats the building's water system and the digestate is available as a fertiliser.
- When an anaerobic digester is set up in a building with a large food court, the waste from cafes and restaurants onsite could be directed to the digester, removing collection and transport costs and reducing potential traffic in built up areas.

## Cons

- There is a large set up cost for anaerobic digestion, but it opens up the possibility of expanding the program to include all organic waste from cafes and restaurants.





# Conclusion

- Nearly 3,000 tonnes of spent coffee grounds are produced within the City of Sydney every year by cafes and coffee shops alone.
- Cafes and coffee shops are keen to join a program that will divert their spent coffee grounds from landfill and instead be used as a value added product.
- Nine out of ten coffee drinkers state that they are happy to pay up to 5c more per cup of coffee to ensure their grounds are diverted from landfill. Economic modelling for a collection program shows that costs to the consumer would only increase by 1c per standard coffee, or less than 3% to the wholesale price of coffee beans.
- A box collection system for the program, rather than a conventional waste collector, appears to provide the most cost effective, flexible and environmentally friendly arrangement.
- The possible end uses for spent coffee grounds are not mutually exclusive, meaning that the grounds could potentially go through a chain of several processes.
- The end destination that the spent coffee grounds go to can easily be altered at any stage of the project, with grounds potentially going to different facilities depending on the location of the cafe.



## Future work

The next stage of this project will be a pilot study. This will allow Planet Ark to work directly with a small number of cafes to develop and improve the collection system, and determine the most suitable end use(s) for spent coffee grounds.

Many Australian roasters focus heavily on the environmental impact of coffee bean production overseas, but few account for the impact of their product at the end of its life. It will therefore be important in further work for Planet Ark to engage with roasters and discuss product stewardship, through which companies take responsibility for the products they manufacture at their end of life.

## Acknowledgements

Planet Ark would like to thank all of the cafes, baristas and coffee shop patrons that participated in the research that informed this report. Support and information was also kindly provided from environmental and sustainability consultants, waste collection companies and fast food chains. An Australian university kindly shared data they had gathered from analysing spent coffee grounds, which was a great help in this study. Finally we would like to thank the City of Sydney for providing the funding to conduct this feasibility study.

For information on participating in a coffee ground recovery program with Planet Ark please contact the authors on [coffee@planetark.org](mailto:coffee@planetark.org)

