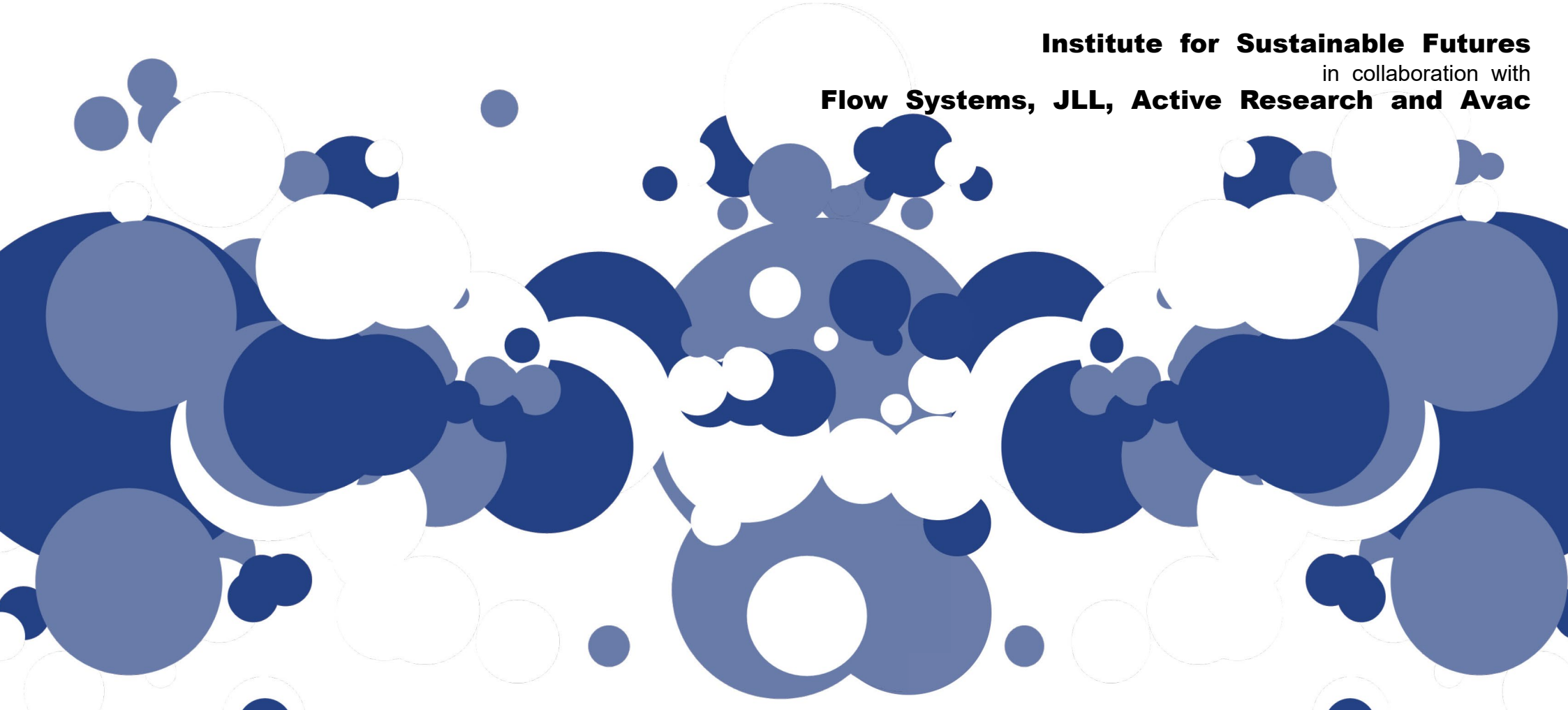
Central Park Precinct Organics Management Feasibility Study

EXECUTIVE SUMMARY

Institute for Sustainable Futures
in collaboration with
Flow Systems, JLL, Active Research and Avac



About The Authors

The Institute for Sustainable Futures (ISF) was established by the University of Technology Sydney in 1996 to work with industry, government and the community to develop sustainable futures through research and consultancy. Our mission is to create change toward sustainable futures that protect and enhance the environment, human wellbeing and social equity. For further information visit: www.isf.uts.edu.au

Flow Systems http://flowsystems.com.au

Jones Lang LaSalle (JLL) http://www.jll.com.au/australia/en-au

Active Research http://www.activeresearch.com.au

Avac http://www.avac.com.au/about-us.aspx

Research team:

Andrea Turner and Dena Fam (Institute for Sustainable Futures)
Lisa McLean and Max Zaporoshenko (Flow Systems)
Anna Kalkanas (JLL)
David Halliday (Active Research)
Marc Buman and Melanie Lupis (Avac)

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About The Research

The 'Central Park Precinct Organics Management Feasibility Study' has been prepared by the Institute for Sustainable Futures (ISF), University of Technology Sydney (UTS). The research, conducted by ISF, was funded through a City of Sydney (CoS) Innovation Grant (2016) and Flow Systems (Flow) in collaboration with JLL (retail managers at Central Park), Active Research (anaerobic digestion specialists) and Avac (vacuum system specialists).

The project supports various state and local government initiatives. The project strongly aligns with the NSW Waste Avoidance and Resource Recovery Strategy (WARR) 2014-2021, by providing background information and data on the viability of innovative organic waste management systems and the potential for new markets for recycled materials. By including an analysis of the feasibility of recycling organic food waste (combined with organics in wastewater and trade waste), this project explicitly supports WARR's goal of diverting 75% of waste from landfill and increasing recycling rates for municipal solid waste (MSW) and commercial and industrial waste to 70% by 2021-22, of which organic food waste is a critical component. The project also provides direct benefits to the CoS, by supporting the City to meet its strategic goals. These benefits are related to the 2030 Sustainable Sydney Strategy and the Master Plans developed to support that Strategy (especially the Decentralised Water Master Plan, in which ISF was centrally involved (with GHD)) and the Advanced Waste Treatment Master Plan.

Disclaimer

The authors have used all due care and skill to ensure the material is accurate as at the date of this report.

INSTITUTE FOR SUSTAINABLE FUTURES
University of Technology Sydney
PO Box 123 Broadway, NSW, 2007
www.isf.edu.au

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Flow Systems is a private multi-utility business that provides potable water, recycled water, wastewater and more recently energy services to greenfield and urban infill communities.

The CoS, ISF, and Flow Systems are part of the 'Smart Locale' group (http://www.smartlocale.com.au), which has a mission to accelerate the transformation of the Ultimo-Pyrmont area local economy into an internationally recognised showplace for smart, safe, sustainable living by 2020.

Project Partners

ISF and Flow Systems provided the core investigative team for the feasibility study. Active Research and Avac provided in-kind support and expertise specifically associated with AD and vacuum technology with JLL providing data on commercial waste flows and commitment to trialling commercial food waste collection with the food related retail outlets throughout the project.

Introduction

The 'Central Park Precinct Organics Management Feasibility Study' has involved conducting a high level assessment of the feasibility of organic waste management using anaerobic digestion (AD) at **One Central Park, Sydney.**

The newly developed One Central Park site has been specifically chosen due to the significant potential to incorporate an AD system within its existing recycled water plant facility, the site's connection to the tri-generation central energy plant, and the ISF's direct involvement and experience in research in organic waste management.

Flow Systems manages the A$13million, 1 ML/day, water recycling plant at One Central Park, the largest water recycling facility in the basement of a residential building in the world.

As a private utility pioneer, Flow Systems is interested in pursuing the feasibility of energy generation through a building scale AD to assist in on-site organic waste management and expansion of their private multi-utility business model.

As the utility manager of One Central Park, Flow Systems are uniquely placed to investigate a building scale AD system in a dense urban setting in combination with their existing world leading on-site water recycling facility and central energy plant. They are keen to investigate the feasibility of piloting an AD plant at Central Park to demonstrate on-site organics management and associated socio-cultural and technological innovations such as minimising contamination of food waste streams through vacuum systems and the generation and utilisation of energy on-site.

There are currently very few successful examples of organic waste management (e.g. food waste, sewage and trade waste) systems at a single large building/precinct scale using AD. While technologies already exist to manage organics in more sustainable and beneficial ways, significant gaps in knowledge exist in closing the loop on organic waste streams through on-site AD in a dense urban setting. These gaps include, for example, identifying the:

- volume and type of organics available for an on-site AD plant in a mixed-use dense urban setting,
- volume and type of organics required for such a system to operate efficiently,
- range of costs and benefits of AD to residential and commercial customers,
- preferred technical options for Central Park in particular.

FINDINGS AT A GLANCE

ENERGY GENERATION

POTENTIAL ENERGY from treatment of the organics on-site can supply up to:

upto **20%** ELECTRICITY needs

OR

upto **50%** HOT WATER needs

AVOIDED COSTS

Treatment of the organics on-site has the **POTENTIAL TO AVOID**:

upto **85k/annum** WASTE REMOVAL costs

&

upto **80k/annum** ELECTRICITY 'or' HOT WATER costs

PAYBACK PERIOD

Based on estimated upfront capital costs and avoided costs **PAYBACK PERIODS**

could be as early as **5 years**

ADDITIONAL BENEFITS

Significant **ENVIRONMENTAL BENEFITS** can be harnessed by:

avoiding over **10,000km/annum** TRUCK & RAIL movement

With Sydney expected to grow from 5 to 8 million people over the next 30 years, on-site treatment of organic waste using anaerobic digestion (AD) unlock significant potential in both retrofit and new developments.

Waste Management at One Central Park

The Central Park precinct is built on the former Carlton United Brewery (CUB) site next to Central Station on the southern edge of Sydney's CBD and directly adjacent to Ultimo, currently, the densest urban area in Australia, with some 15,100 people/km2 (ABS 2016). One Central Park, on the western edge of the development, with its distinctive East and West towers draped in green vegetation, is the focal point of this feasibility study.

For the feasibility study, current waste management systems and practices were investigated for both the residential and commercial areas at One Central Park. Figure 1 below illustrates the various waste streams along with the management and treatment of each waste stream, including garden organics (GO), food waste (FW) (residential & commercial/retail), UCO, FOG, sewage and trade waste (TW). A more detailed assessment of the volume of waste containing organics was developed to assist in assessing the potential of an AD system on-site at One Central Park. Volumes of individual streams containing organic waste are shown in Figure 2. Figure 3 shows the current waste stream routes and destinations highlighting the fragmented nature of organic waste management and significant potential impacts.

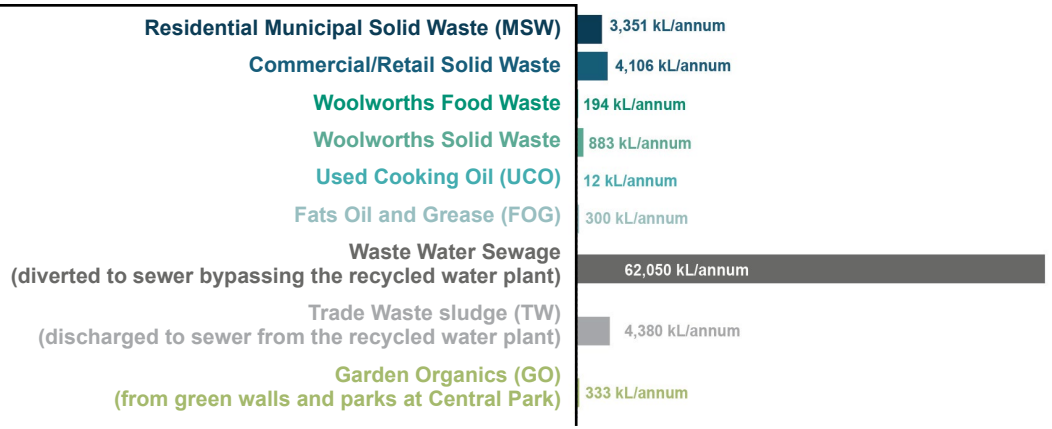


Figure 2

One Central Park waste streams (excl. recyclables) **containing organics in kL/annum based on 2017 data** (through assumed and actual data collection)

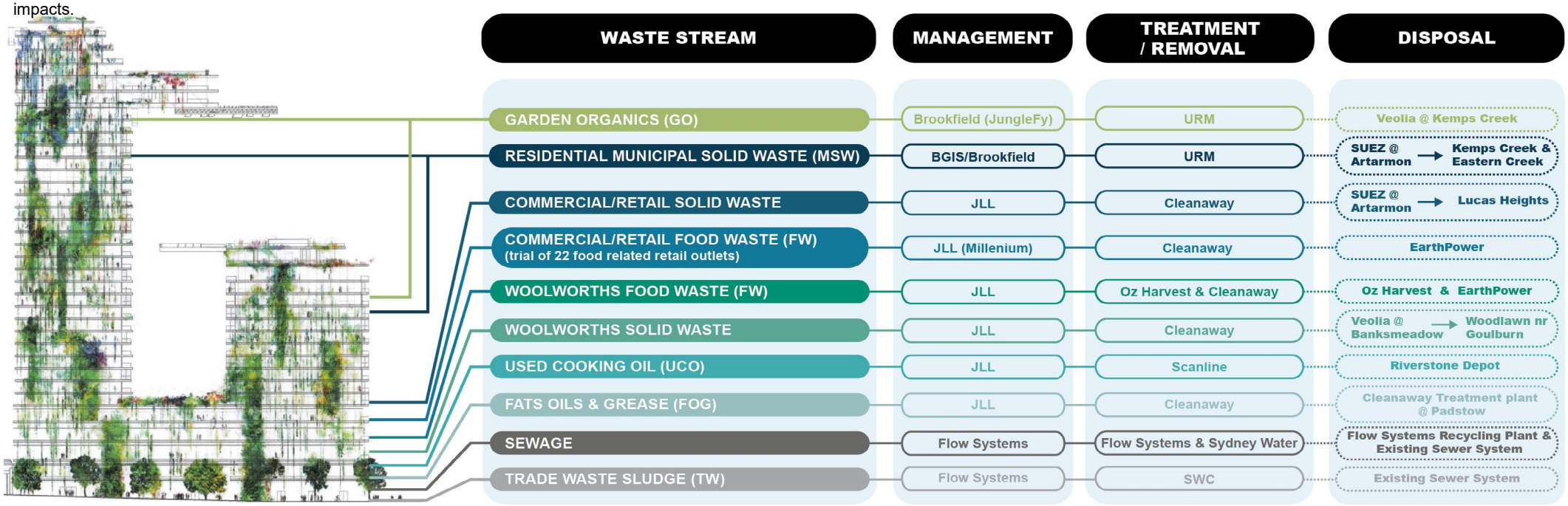


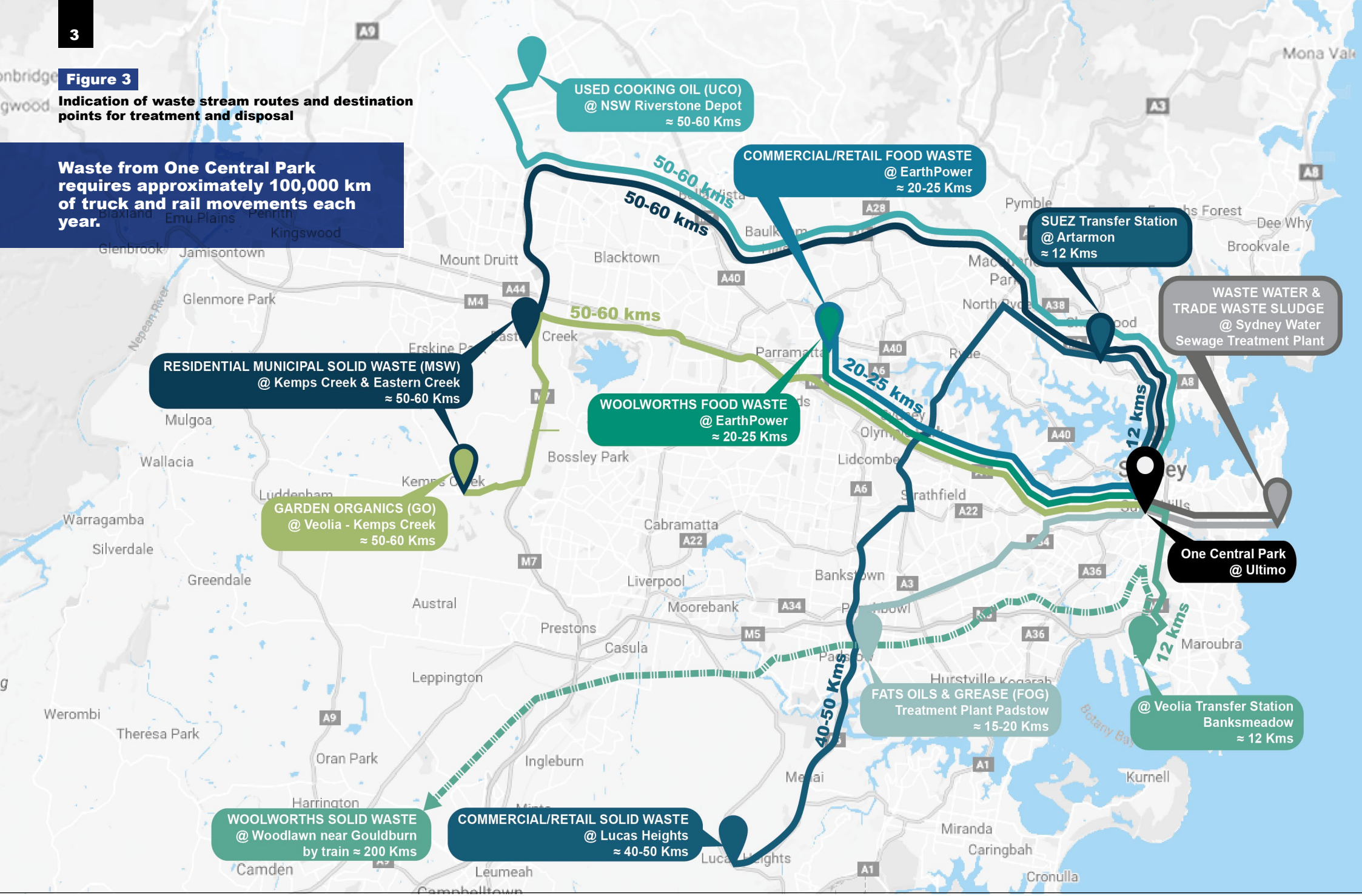
Figure 1

Waste streams and management at One Central Park (excl. recyclables)

Figure 3

Indication of waste stream routes and destination points for treatment and disposal

Waste from One Central Park requires approximately 100,000 km of truck and rail movements each year.



Technological Options

A total of six potential options were identified for assessment which took into consideration a spectrum of opportunities relevant to retrofitting One Central Park but also new precinct scale developments.

Figure 4
Estimated organics waste streams with Trade Waste Sludge

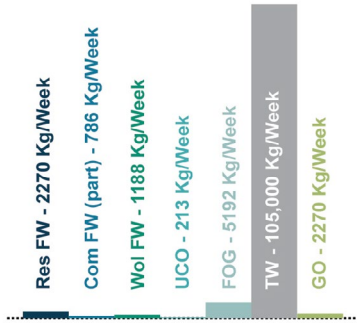
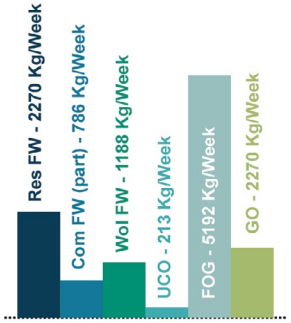


Figure 5
Estimated Organics waste streams w/o Trade Waste Sludge



The study revealed that there is currently limited food waste and other organics source separation occurring at One Central Park, yet there are potentially significant volumes of organic waste available and, if captured and combined, can be used as a feedstock for an on-site AD system. Such opportunities are amplified due to the specific characteristics of the site, including sludge produced from the on-site waste water recycling plant and potential connection to the central energy plant. Figures 4 & 5 show estimated organics available with and without sewage and trade waste sludge while Figure 6 shows the organics vs. potential energy production for each of the options.

All options include commercial/retail food waste, Woolworth's food waste, UCO, and FOG but excludes GO.

Options 1 to 4 include varying volumes of residential food waste (from 15% to 75%) from the 623 flats at One Central Park plus all trade waste sludge.

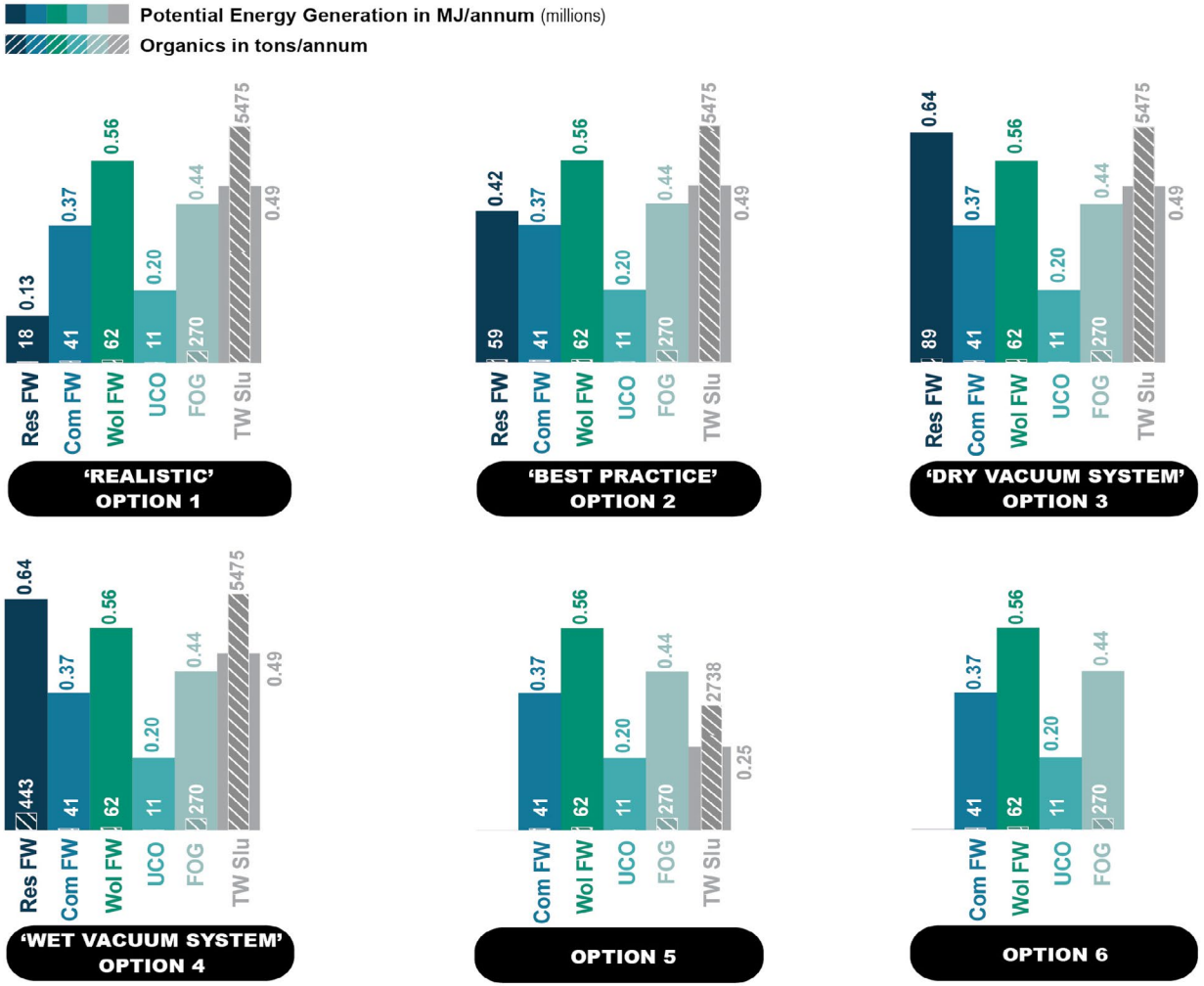
Option 5 excludes residential food waste and includes only 50% of trade waste sludge.

Option 6 excludes both residential food waste and trade waste sludge representing a more commercial/retail focused example of precinct scale development.

The options were analysed for potential biogas production revealing that Options 3 and 4 provide the highest energy potential.

> *The potential energy versus the quantum of organics needed to generate the energy highlights the significant opportunities of waste streams such as food waste, UCO, and FOG compared to trade waste sludge*

Figure 6
Organics vs. Potential energy production for each option.



As the Central Park precinct has a tri-generation central energy plant located on-site, there is the opportunity to use the energy generated from the AD plant to either contribute towards the needs of electricity **or** hot water for the residential flats on-site. Figure 7 provides a comparison summary of the six options.

Options 3 and 4 have the potential to capture the largest volume of organic waste on-site which could provide sufficient renewable energy for about 20% of the 623 flats at One Central Park for electricity or approximately 50% of flats for hot water per annum.

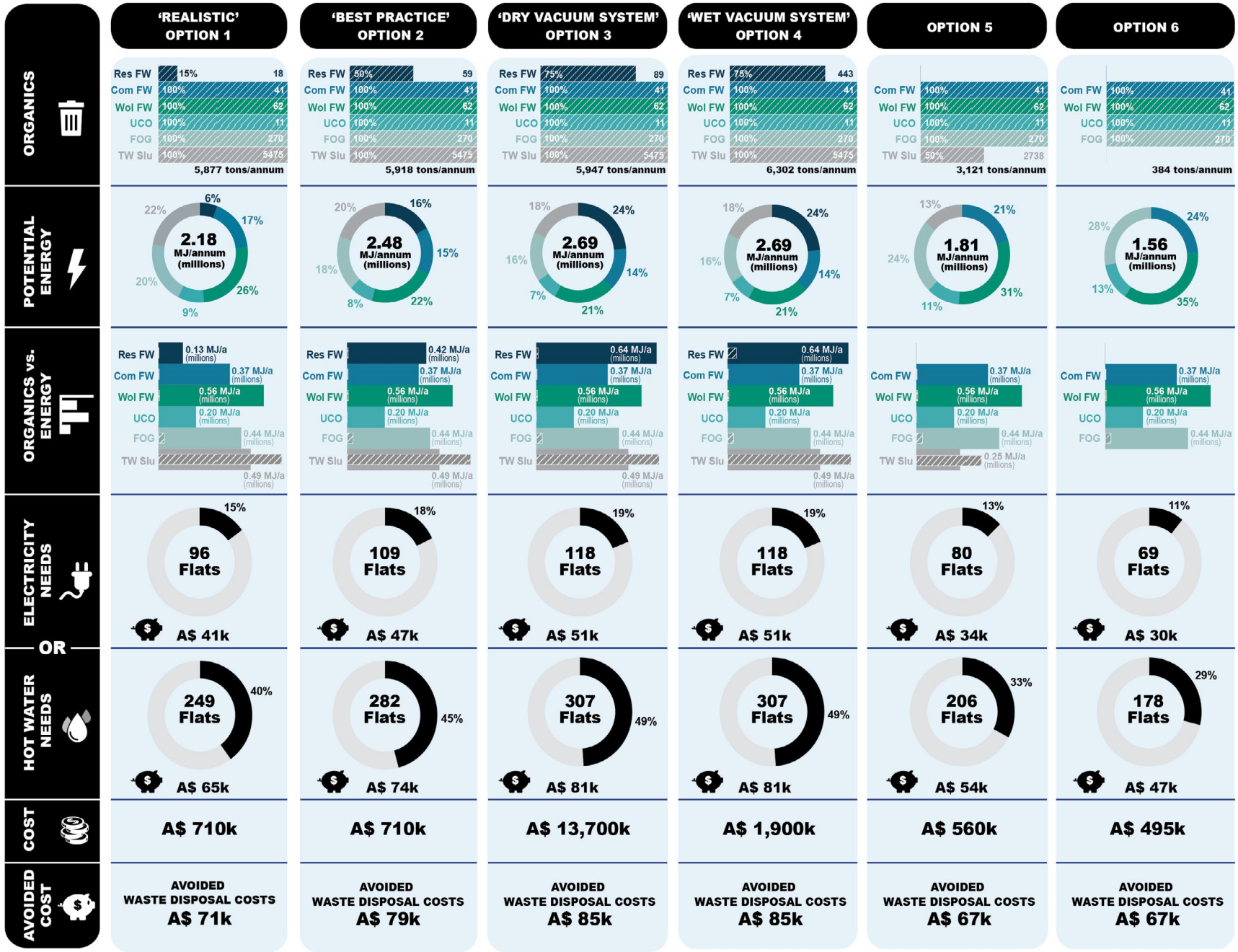


Figure 7
Comparison Summary of the six technological options

Capital Costs & Potential Benefits

Whilst the costs of incorporating AD and the associated collection/ transportation systems at One Central Park vary, the potential for annual avoided cost benefits are significant. This combined with grant funding opportunities and the involvement of a progressive private multi-utility business such as Flow Systems, provide a major opportunity to set up a world leading AD system at One Central Park.

The estimated upfront/capital costs of the retrofit systems are summarised in Figure 8. These costs are high level estimates and require further detailed assessment. (Note with both Woolworths and the commercial/retail areas already separating food waste through kitchen caddies and bins, no additional costs have been considered.)

The costs of the options vary significantly with Option 3 - 'dry vacuum system' high compared to the other options with little or no additional organics capture compared to Options 1,2, and 4. If wet vacuum systems were retrofitted for residential and commercial/retail or fitted in a new build, major cost savings could be made.

Whilst dry vacuum costs are high, well designed wet vacuum systems in new buildings have real potential. All the non vacuum retrofit options assessed have a viable business case with a payback period of approx. 5 years.

The AD system costs do not vary significantly despite the size differences between the Options. A large component of the cost of the system is for pre-treatment, that is, removal of plastics and metal contamination to protect the AD plant and minimise maintenance issues.

Estimated benefits are also summarised in Figure 8. These are high level estimates and require more detailed assessment. There are significant quantifiable annual benefits, including the avoidance of approx. 20% of current BAU waste management costs and production of renewable energy leading to reduced costs for hot water OR electricity costs for flats. Non-quantifiable annual benefits include, for example, reduced greenhouse gases from truck movements and landfill.

		'REALISTIC' OPTION 1	'BEST PRACTICE' OPTION 2	'DRY VACUUM' OPTION 3	'WET VACUUM' OPTION 4	OPTION 5	OPTION 6
ORGANICS		112,720 Kg/week	113,515 Kg/week	114,082 Kg/week	120,893 Kg/week	59,879 Kg/week	7,379 Kg/week
AD VOLUME		56k Litres	56k Litres	56k Litres	56k Litres	22k Litres	10k Litres
AD SIZE		3.8 m x 5 m Dia x Ht	3.8 m x 5 m Dia x Ht	3.8 m x 5 m Dia x Ht	3.8 m x 5 m Dia x Ht	2.5 m x 4.5 m Dia x Ht	1.8 m x 4 m Dia x Ht
ESTIMATE OF DIGESTATE		1,000 Kg/day	1,000 Kg/day	1,000 Kg/day	1,000 Kg/day	500 Kg/day	65 Kg/day
		ESTIMATE OF UP FRONT / CAPITAL COST					
RESIDENTIAL	CAMPAIGN	A$ 40,000	A$ 40,000	A$ 40,000	A$ 40,000		
	CADDIES	A$ 10,000	A$ 10,000				
	WET VACUUM				A$ 1,200,000		
	DRY VACUUM			A$ 13,000,000			
AD TREATMENT	INPUT PIPES/CON	A$ 25,000	A$ 25,000	A$ 25,000	A$ 25,000	A$ 25,000	A$ 25,000
	PRE TREATMENT	A$ 100,000	A$ 100,000	A$ 100,000	A$ 100,000	A$ 100,000	A$ 100,000
	AD UNIT	A$ 450,000	A$ 450,000	A$ 450,000	A$ 450,000	A$ 350,000	A$ 300,000
	POST TREATMENT	A$ 35,000	A$ 35,000	A$ 35,000	A$ 35,000	A$ 35,000	A$ 35,000
	OUTPUT PIPEWORK	A$ 50,000	A$ 50,000	A$ 50,000	A$ 50,000	A$ 50,000	A$ 50,000
TOTAL		A$ 710,000	A$ 710,000	A$13,710,000	A$ 1,900,000	A$ 560,000	A$ 495,000
		ESTIMATE ANNUAL AVOIDED COSTS					
WASTE DISPOSAL		A$ 71k	A$ 79k	A$ 85k	A$ 85k	A$ 67k	A$ 67k
FLAT HOT WATER		A$ 64k	A$ 73k	A$ 80k	A$ 80k	A$ 53k	A$ 46k
OR							
FLAT ELECTRICITY		A$ 64k	A$ 73k	A$80k	A$ 80k	A$ 53k	A$ 46k
TOTAL		A$ 135k	A$ 152k	A$165k	A$ 165k	A$ 120k	A$ 113kt
PAYBACK PERIOD YRS.		5.3	4.7	83	11.5	4.7	4.4

Figure 8
Summary of AD and estimated upfront capital costs and annual avoided costs excluding operational costs.

Issues for Consideration & Recommendations

In assessing the volume of organics available on-site and the associated costs and benefits of introducing an AD system at One Central Park, this feasibility study has highlighted a range of challenges, opportunities and issues for considerations.

These have been assessed using a social, technological, environmental, economic and political (STEEP) analysis. While the STEEP analysis provides insights specifically for One Central Park many of the insights can be considered more broadly for managing organic waste and developing AD systems in dense urban settings. Figure 9 provides a summary of the issues for consideration and associated recommendations.

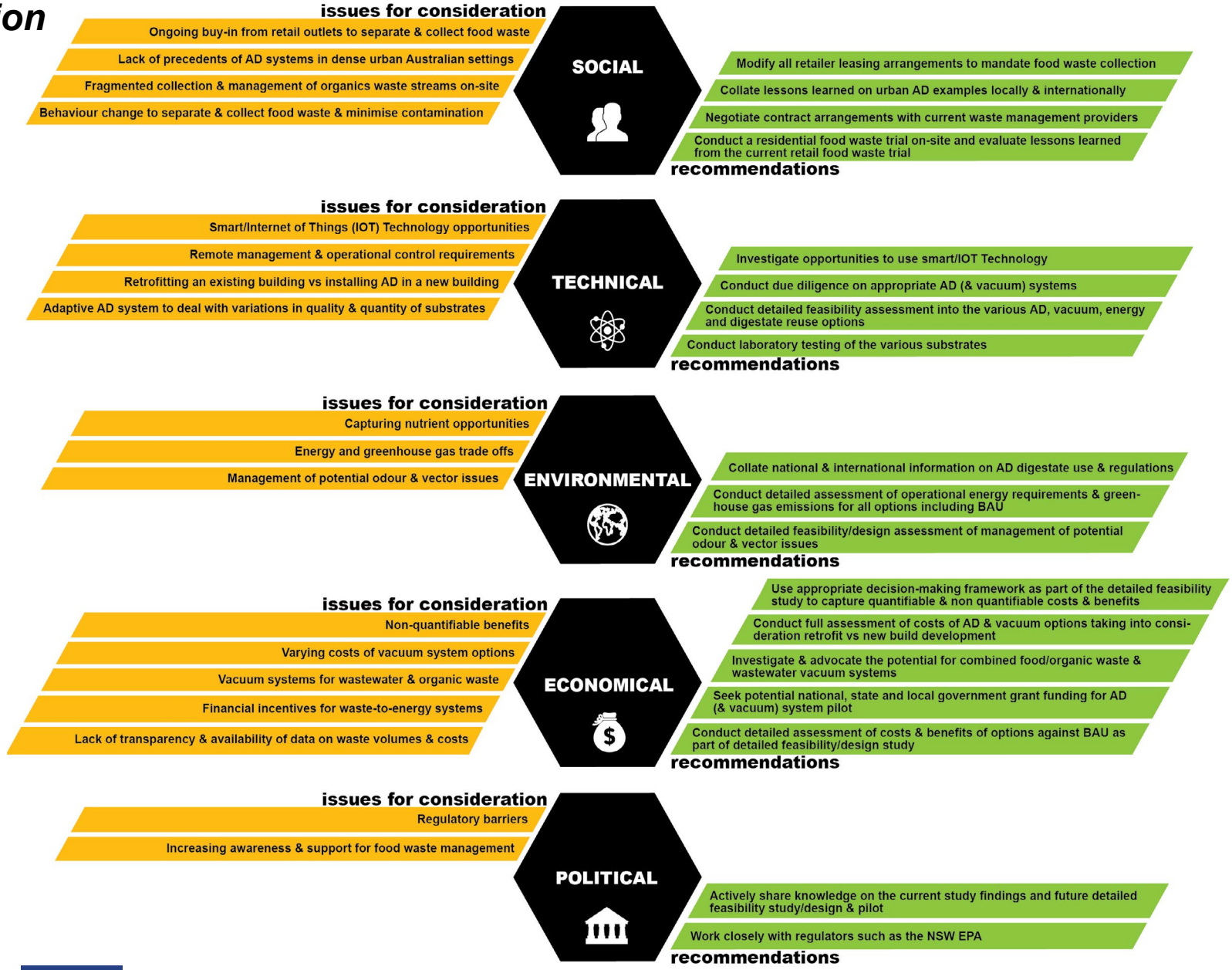


Figure 9

Summary of Issues for Consideration and Recommendations

Project Roadmap

There is currently significant opportunity and momentum to trial and demonstrate AD in Sydney, specifically at One Central Park. By using a collaborative approach, leveraging the research conducted to date, and conducting further investigations as indicated, the CoS, Flow Systems, and other project partners involved have the opportunity to provide national and international leadership on AD Organics Management.

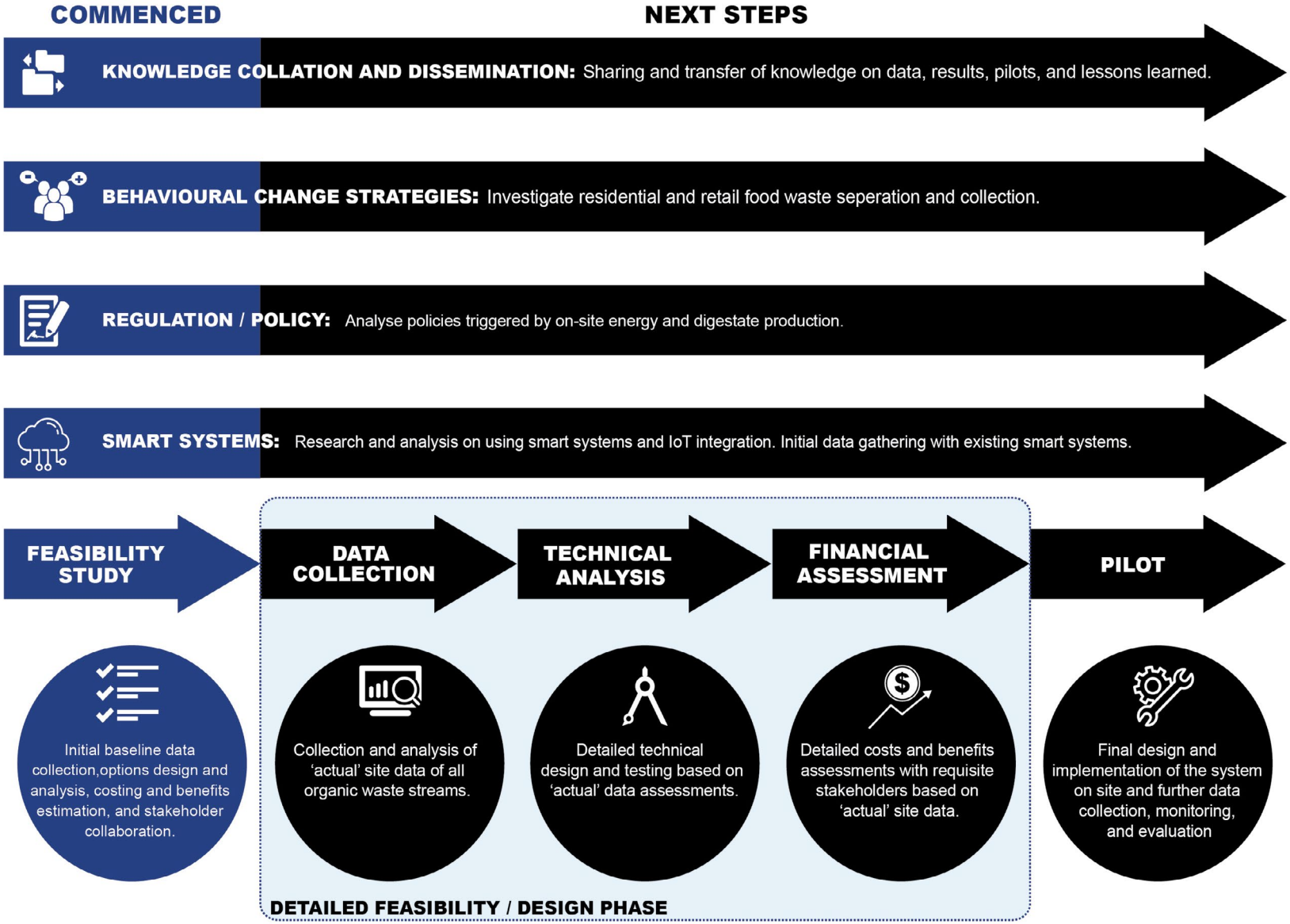


Figure 10
Project Roadmap