International Comparison of Australia's Freight and Supply Chain Performance

Final Report

October 2019

Australian Government
Department of Infrastructure, Regional Development and Cities

L.E.K.

Agenda

- **Executive summary**
- Scope and rationale for the study
- Waste supply chain
- Wine supply chain
- Benchmarking supply chains – An approach for further supply chains
- Next steps
- Appendix

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Executive summary (1/2)

A pilot study

- This study is a first step towards developing a broader set of comparative global benchmarks for key Australian supply chains, providing improved performance data to the freight sector. It focuses on the 'materials management' components of supply chains, as these most significantly impact freight
- Two supply chains (waste and wine) were selected as initial 'proof of concept' pilots, with a subset of possible geographies and supply chain elements reviewed. International comparators were selected to enable a relevant 'like for like' comparisons
  - household waste in Melbourne and Sydney was compared with metropolitan areas in Denmark and Wales
  - the South Australian wine supply chain was compared with California (USA), and Bordeaux (France)

The waste supply chain

- Australian's generate a significant amount of waste per capita but compare more favourably in terms of household waste. Furthermore, the waste generated per capita in metro areas compares well internationally
- Recycling rates are broadly similar in Australia and Europe, however Demark and Wales divert substantially more waste from landfill than Australia due to the use of waste to energy. This significantly reduces the amount of waste transported to landfill
- Despite many apparent inefficiencies in the overall waste sector, the freight component of the waste supply chain appears to be relatively efficient
  - the configuration and design of the waste ecosystem has a significant bearing on freight efficiency. There are trade offs between efficiently handling waste and achieving desired environmental outcomes
  - These 'ecosystem' factors are evident when benchmarking total costs for the 'refuse' (landfill) waste stream, with significantly larger transportation distances evident in Australia leading to higher overall costs
  - Australia compares more favourably in terms of unit cost (per tonne) for recycling and organics waste streams, where costs are more comparable
- Best practices with respect to transport of waste in other geographies indicate there is opportunity for improvement, particularly in terms of consistency of data collection, stakeholder alignment and more coherent planning for desired environmental outcomes

Executive summary (2/2)

The wine supply chain

- Of the c.1.4b litres of wine produced in Australia, two-thirds is exported (with bulk nearly half the volume) predominantly to the UK, China, and the US
- Inherent differences between the South Australia, Californian and Bordeaux wine supply chains impact the nature of the supply chain. These differences include:
  - the role of distributors in the three tier system in the United States
  - the differences in lot size in the Bordeaux region
  - the level of integration in the supply chain (i.e. separation of vineyards, wineries and bottling facilities)
- Notwithstanding these differences, the Australian wine supply chain appears to be reasonably efficient against the geographies reviewed from a unit cost perspective
- The flows of finished goods (particularly export) in Australia enter the general container freight supply chain and the efficiency of the supply chain along that dimension is influenced more by general freight providers, as opposed to wine specific factors
- Industry participants indicate that they see the materials movement elements of the supply chain (within Australia) as relatively efficient, with appropriate Government support in international trade facilitation roles

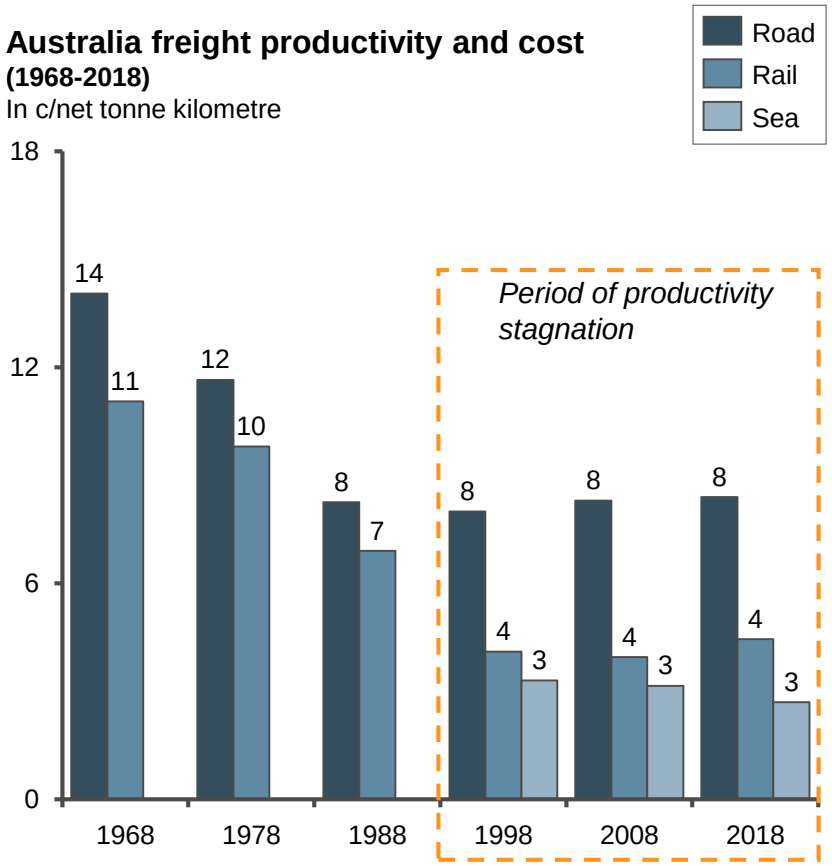
Future supply chain benchmarking studies

- While the differences in commodity supply chains are considerable, a potentially repeatable methodology has been developed to benchmark supply chains internationally
- A selection framework has been developed to assist with prioritisation of additional supply chains to study, and a range of supply chains have been identified as potential future candidates

This study is a first step towards developing a set of comparative global benchmarks, providing improved performance data to the freight sector

Freight productivity gains in Australia have plateaued in recent years

Australia freight productivity and cost
(1968-2018)
In c/net tonne kilometre



The National Freight and Supply Chain Strategy action plan calls for better freight location and performance data

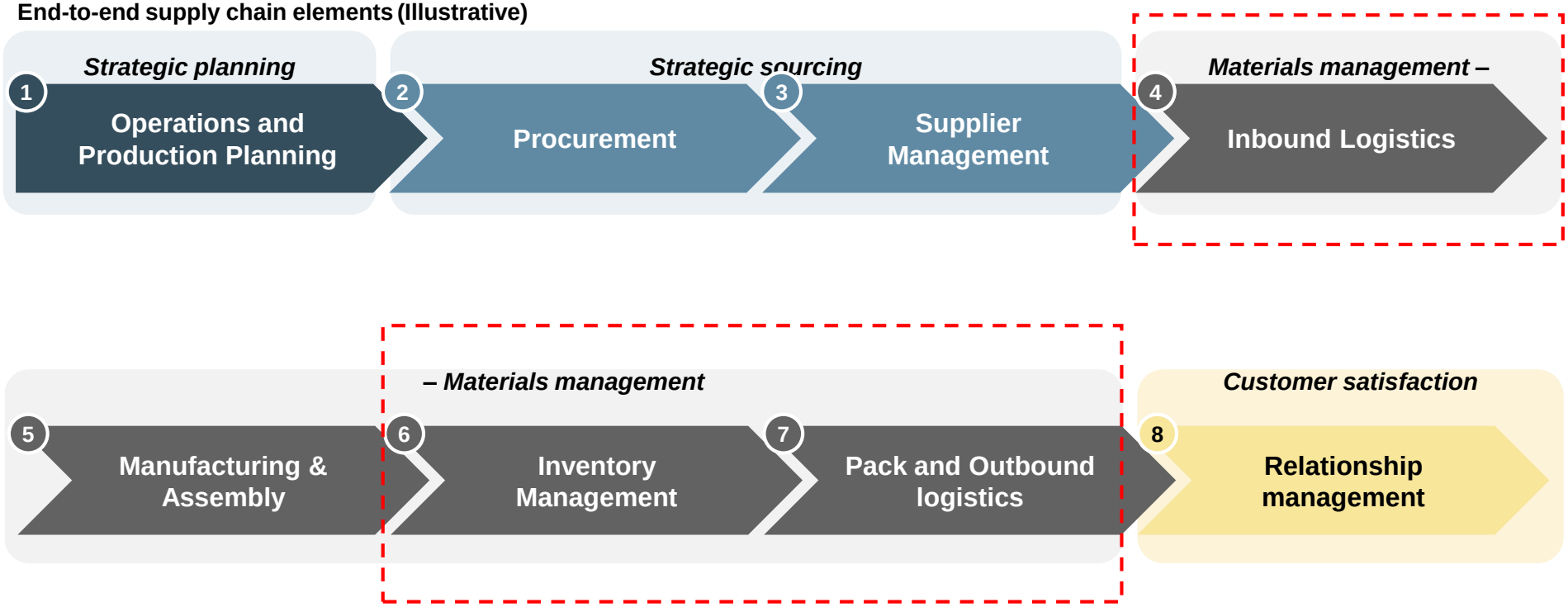
Overview of the National Freight Strategy national action plans:

1. ***Smarter and targeted investment***
2. ***Enable improved supply chain efficiency***
3. ***Better planning, coordination and regulation***
4. ***Better freight location and performance data***

Source: National freight and Supply Chain Strategy; L.E.K analysis

This study focuses on the 'materials management' components of supply chains, as these most significantly impact freight

End-to-end supply chain elements (Illustrative)



End to end supply chains incorporate a number of elements that impact freight movements, but involve very different types of activities (e.g., procurement, sales planning etc.). The focus of this study is on the materials movement elements of supply chains

Source: L.E.K analysis

Two supply chains were selected as initial 'proof of concept' studies

	Why Waste?	Why Wine?
Size and growth	55m tonnes; $A6.9b; 28k employees; 6% vol. CAGR	1.3b litres; $A40b*; 172k employees; 3% vol. CAGR
Freight importance	• Cost of freight is **~50-60%** of the total service cost *Freight* | *Others*	• Cost of freight estimated at **~2-10%** of product value *Freight* | *Others*
Export Importance	• c.6-7% of waste generated exported (c.2018) • Exports expected to **decrease materially** going forward *Export* | *Others*	• **~$2.8bn** AUD (c.66% by volume) of wine exports • Fifth largest global exporter of wine *Export* | *Others*
Geographic scope	• Metro / regional areas of Sydney (NSW) and Melbourne (VIC) are key generators of waste *NSW* | *VIC* | *Others*	• South Australia is ~50% of the winegrape crush, with smaller regions in NSW, VIC, WA and TAS *SA* | *MD-SH*** | *NSW* | *Others*
Known efficiency / public interest	• Recent legislative changes limiting waste exports • Crisis in Victoria's recycling sector • Considerable public attention • Need to develop a mature local re-use market for recyclables • Shift towards waste-to-energy	• Limited data available on relative efficiency vs. international geographies

Adherence to selection criteria

○ Low ● High

Note: * Economic contribution to the broader wine industry; ** Murray Darling (Located in north-west of VIC) and Swan Hill (Located in north-west VIC and western NSW)
Source: National waste report; ABC; L.E.K. analysis

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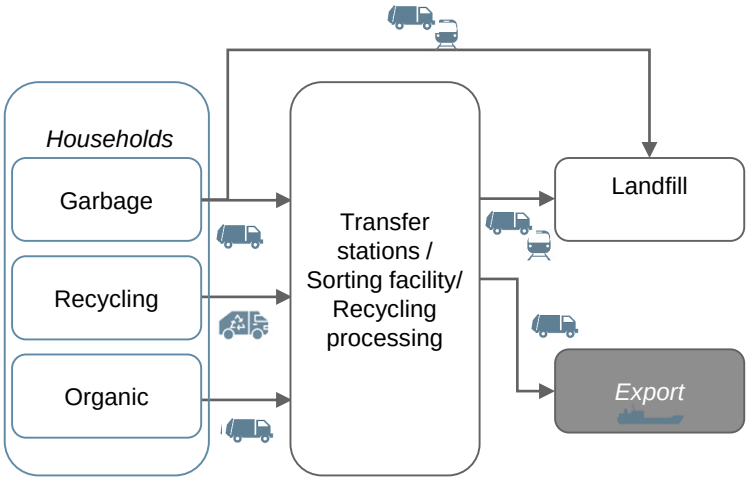
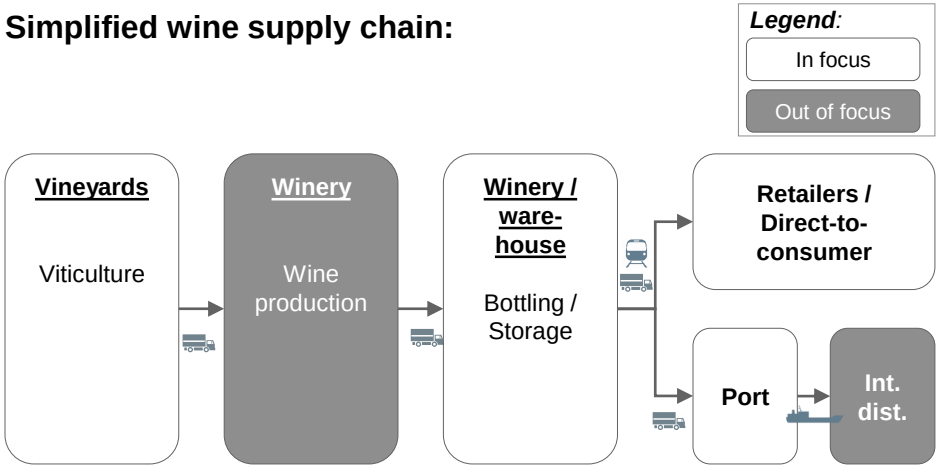
As a ‘pilot’ this study examined a subset of geographies and supply chain elements

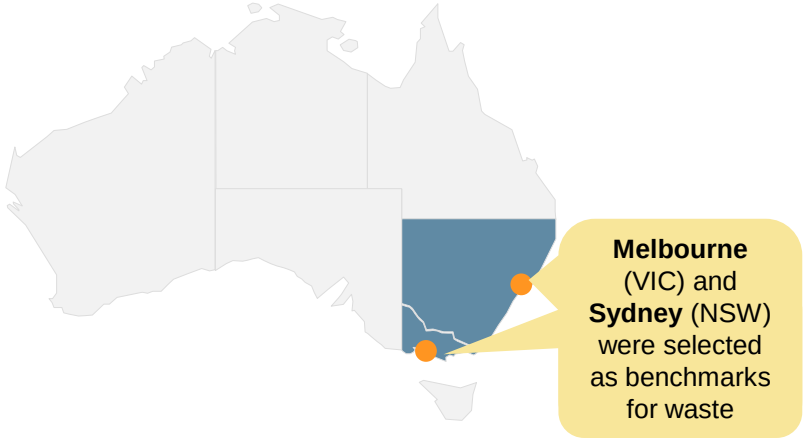
Simplified waste supply chain:



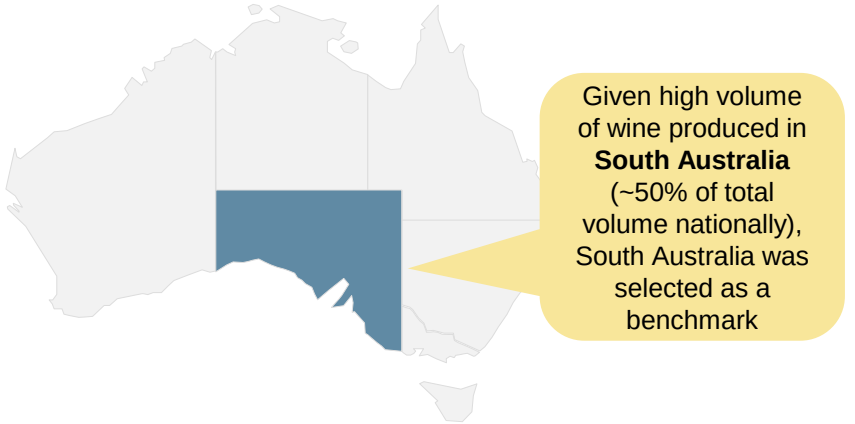
Simplified wine supply chain:



Geographic scope for waste:



Geographic scope for wine:



International comparators were selected to enable a relevant ‘like for like’ comparison for waste and wine

Waste

Key waste management international comparators:

= Countries
= States
= Cities

		Australia			U.S.	Denmark	UK	Canada			Germany		Norway
		NSW	VIC	QLD	NYC	Denmark	Wales	Ontario	British Columbia	Québec	Munich	Berlin	Norway
Per-capita HH waste volume (kg)	Garbage	223	188		845	312	183						199
	Recyclables	91.5	94.7	n/a	158	142	151	n/a	n/a	n/a	n/a	n/a	193
	Organics	71.2	74.1		125	124	89.6						64.3
	Total	385	357	545	367	577	424	366	338	502	n/a	312	457
Recycling rate		49%	46%	32%	17%	42%**	52%	38%	41%	28%	55%	38%	44%*
% sent to landfill		51%	54%	68%	n/a	2%**	24%	62%	59%	72%	1%	62%	21%*
% waste to energy		-	-	-	n/a	56%**	24%	n/a	n/a	n/a	44%	-	35%*
# of key landfills**		369	92	265	27**	-	15	800**	92**	104**	-	n/a	-
# of key resources recovery facilities**		121	233	88	n/a	n/a	23	53	8	16	n/a	n/a	n/a
# of key transfer stations**		166	239	236	167	8	81	13	6	n/a	12	n/a	n/a
Population (million)		7.5	6.5	5.0	8.0	5.8	3.1	14.0	5.0	8.0	1.4	3.5	5.5
Population density per km²		10	29	2.7	28,400	138	151	15	5	6	4,500	3,800	15

- **Household waste** was selected as the primary focus due to current public exposure and policy attention
- **International priority** was given to waste supply chains that possess:
  - similar per capita generation rates
  - relatively similar waste collection schemes
  - **superior diversion (from landfill) rates** and environmental outcomes
- Based on these factors, **Wales and Denmark** were selected as candidates for comparison

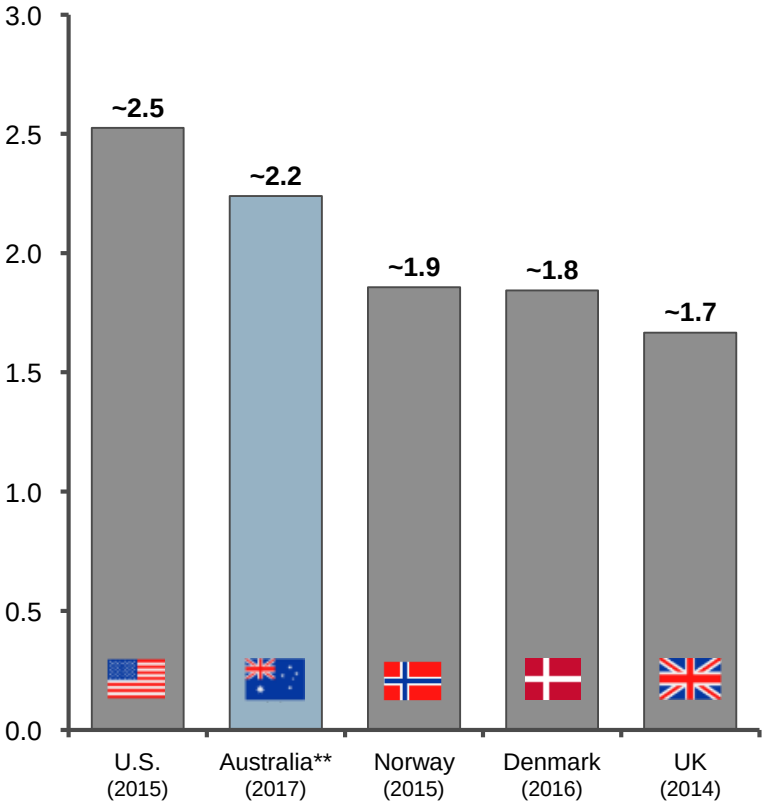
Wine

	South Australia	California	Bordeaux region
Number of key winery regions	1	~2*	1
Production volume (Millions of litres)	~610	~2,700**	~484
Export volume (Millions of litres)	~510	~349	~213
Domestic consumption vs. export ratio	~17% / ~83%	~87% / ~13%	~56% / ~44%
Bulk vs. bottled ratio	~6% / ~94%**	~10-15% / ~85-90%	~10% / ~90%*
Average price per bottle (AUD)	~$4**	~$20	~$5-$25
Number of wineries	~700	~3,900	~7,400
Population density (Per km²)	~2	~94	~5,000
Urbanisation of population (% of population)	~80%	~95%	~80%
National price of diesel fuel* (USD per litre)	$1.00	$0.79	$1.61

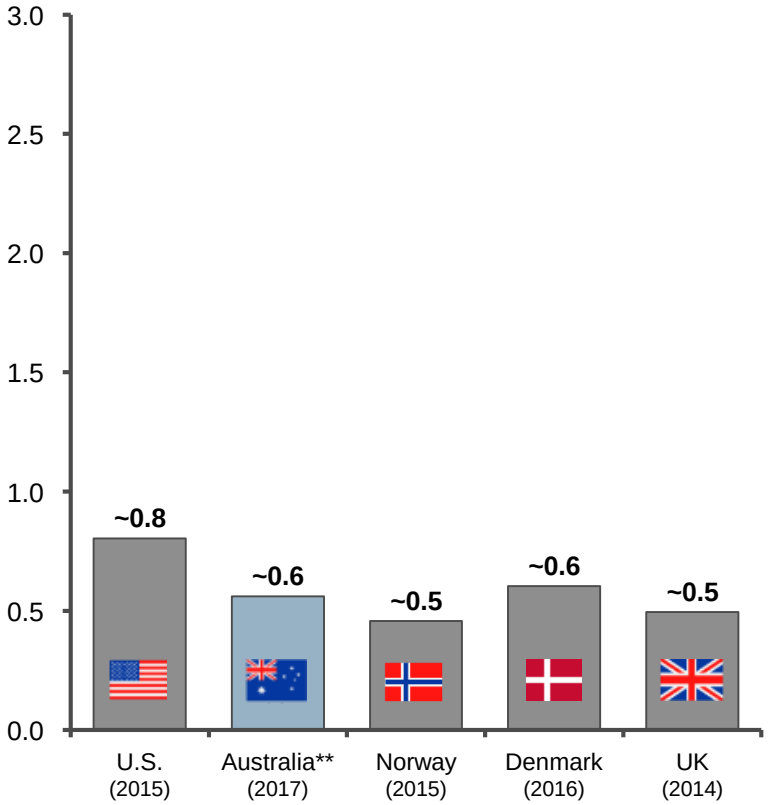
- **International wine regions for comparison** were selected based on the:
  - total volume of wine produced
  - similarity of export / domestic split
  - similarity in the average price per bottle
  - selection of wine regions that Australia competes against in global markets
- Based on these factors, **California and the Bordeaux region** were selected as the primary comparator set to the South Australian wine region

Australian's generate a significant amount of waste per capita but compares more favourably in terms of household waste (MSW)

Total* per-capita waste (MSW, C&I, C&D) volume**
(2014-17)
In tonnes



Total* per-capita waste MSW volume**
(2014-17)
In tonnes



Note: * Total volume includes Municipal Solid Waste, Commercial and Industrial, and Construction and Demolition; ** Excludes ash
Source: National Waste Report 2018; Statistics Canada; Statistics Norway; Department for Environment Food & Rural Affairs (UK); U.S. EPA; L.E.K. analysis

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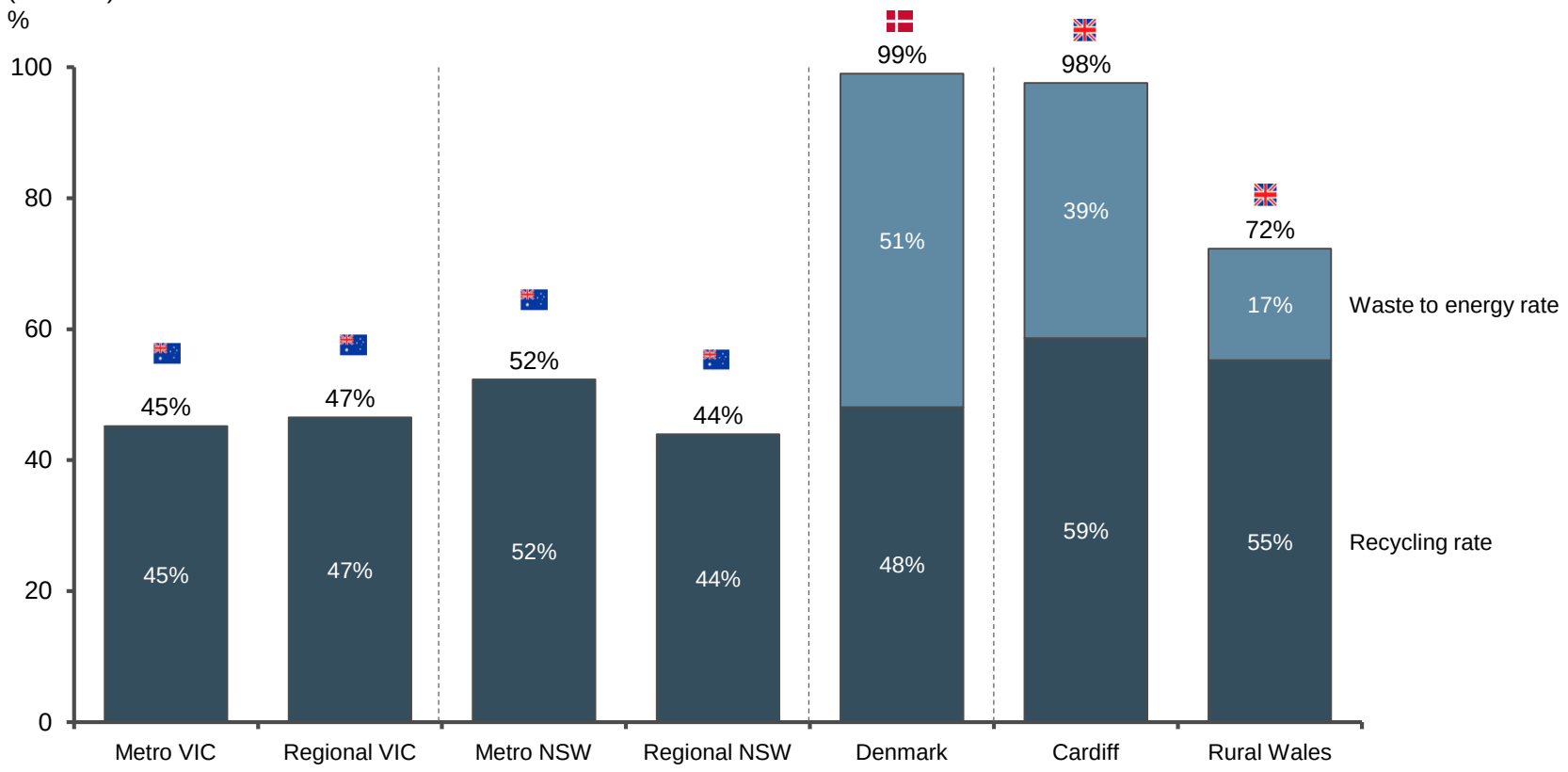
While recycling rates are broadly similar, EU comparators divert substantially more waste from landfill than Australia due to greater waste to energy

Household waste / MSW diversion rate (from landfill)
(2014-18)
%



Year of data	2016	2016	2014	2014	2016	2018	2018

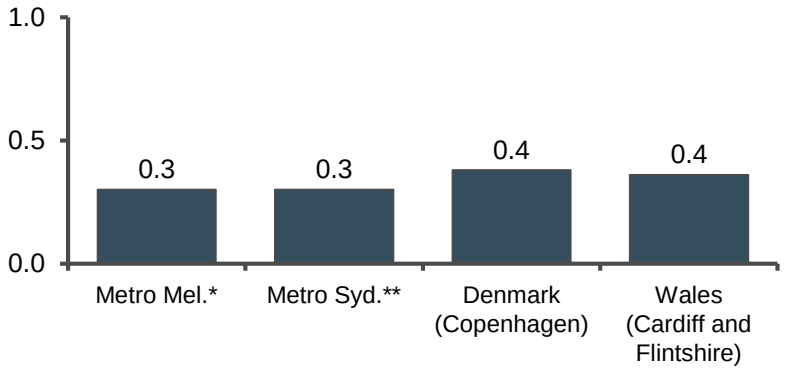
Notes: * MSW % sent to landfill and %incinerated for Wales and Cardiff
Source: Sustainability Victoria; NSW local government; The Local Denmark, The Guardian, Danish government; Welsh government; L.E.K. analysis

L.E.K.

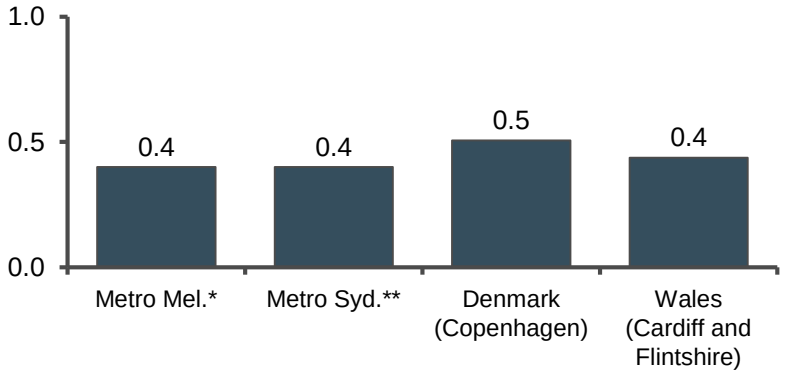
Despite many apparent inefficiencies in the overall waste sector, the freight component of the waste supply chain appears to be relatively efficient

- The unit costs for waste freight are relatively consistent globally, particularly when differences in fuel costs and labour rates are considered
- As the collection and disposal of household waste is typically tendered and contracted to 3rd parties, competitive forces have resulted in reasonable 'per km' efficiencies
- Industry stakeholders support this finding and point to other factors as contributing to inefficiencies in material movement:
  - significant distances between collection and disposal, particularly in Sydney
  - increasing difficulties navigating high density areas (i.e. ease of access to bins) contributing to route inefficiency
  - restrictive curfews related to pick up times (both efficiency and safety related)
  - slow progress in shifting to alternative fuel trucks to reduce fuel costs
  - inconsistent 'bin' regimes across local councils

Estimated cost per ton per kilometre of household waste (Semi - Compacted waste on long haul trucks)
(2019)
AUD



Estimated cost per ton per kilometre of household waste (Uncompacted waste on collection trucks)
(2019)
AUD



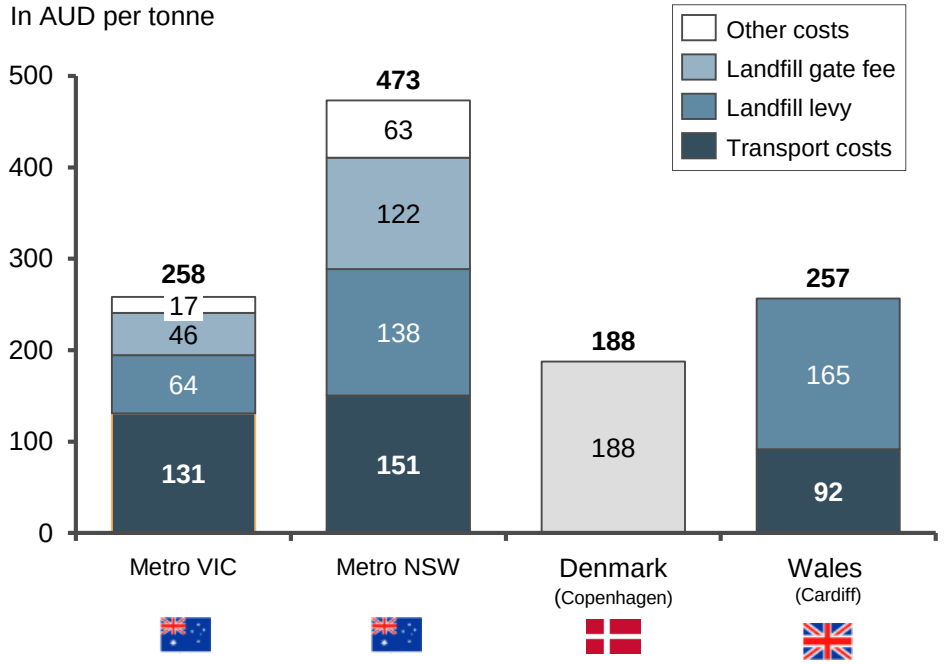
However, the configuration and design of the waste ecosystem has a significant bearing on freight efficiency

- While transport costs account of the majority of waste management costs (30 to 50%), decisions about waste collection, disposal and associated regulation have the greatest bearing on overall costs
- Within the waste supply chain there is also a trade-off between being an efficient, simple supply chain (i.e. diverting all waste to landfill only) and another with superior environmental outcomes that will likely be more complex, expensive and by some measures, inefficient. This is an important consideration
- Other 'ecosystem' factors that drive freight efficiency include:
  - The location of critical 'nodes' in the supply chain, particularly landfills or waste to energy facilities
  - An increased number of bins in the household to support source separation and improve landfill diversion, may drive additional pick up runs or different trucks and decreased efficiency
  - Landfill levies in Australia range from $50-140 per tonne, which are comparable globally at the lower end (i.e., $50). The key difference in Australia is the difference in levies between geographies creates the economic incentives to transport waste to lower cost disposal sites, increasing costs and unnecessary transportation of waste
  - The availability of 'waste' exports has influenced the maturity of the recycling infrastructure. Once implemented, the ban on most waste exports from Australia will shift this dynamic
  - The availability of 'waste' exports influences the maturity of the recycling infrastructure. Once implemented, the ban on most waste exports from Australia will shift this dynamic

These ‘ecosystem’ factors are evident when benchmarking total costs for the ‘refuse’ (landfill) waste stream….

- For waste destined for landfill in Australia, the total costs vary dramatically based on the state
  - In NSW, it costs $473/ton to dispose of waste. Freight costs contribute $151/ton (23%) and landfill gate fees and levies $260/ton (54%)
  - In Victoria, the total cost is substantially lower at $258/ton, with $131/ton (50%) related to transport costs due to shorter average haulage distances
- In Wales, the total cost is comparable to Victoria, with a lower proportion of freight (35%) due to shorter haulage distances
  - Additional non-transport costs are related to operations of waste to energy facilities
- The total cost in Denmark is considerably lower than in Australia, primarily due to short haulage distances, and a considerable reliance on waste to energy creating a simple and efficient supply chain

Total cost of landfill / refuse waste stream
In AUD per tonne



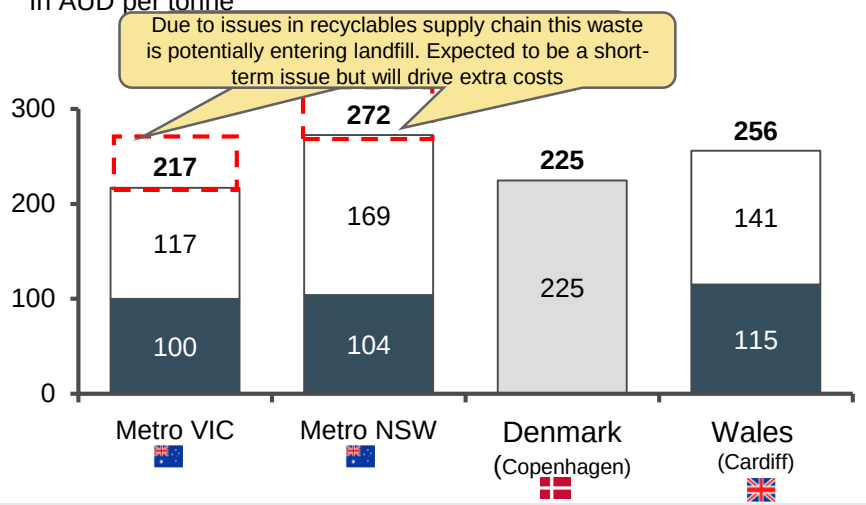
Key facts	Metro VIC	Metro NSW	Denmark (Copenhagen)	Wales (Cardiff)
Average total distance	***~39 km***	***~156 km***	***~16 km***	***~24 km***
Total volume refuse	***~910k tonnes***	***~770k tonnes***	***~138k tonnes***	***~180k tonnes***

Australia compares more favourably in terms of unit cost for recycling and organics waste streams

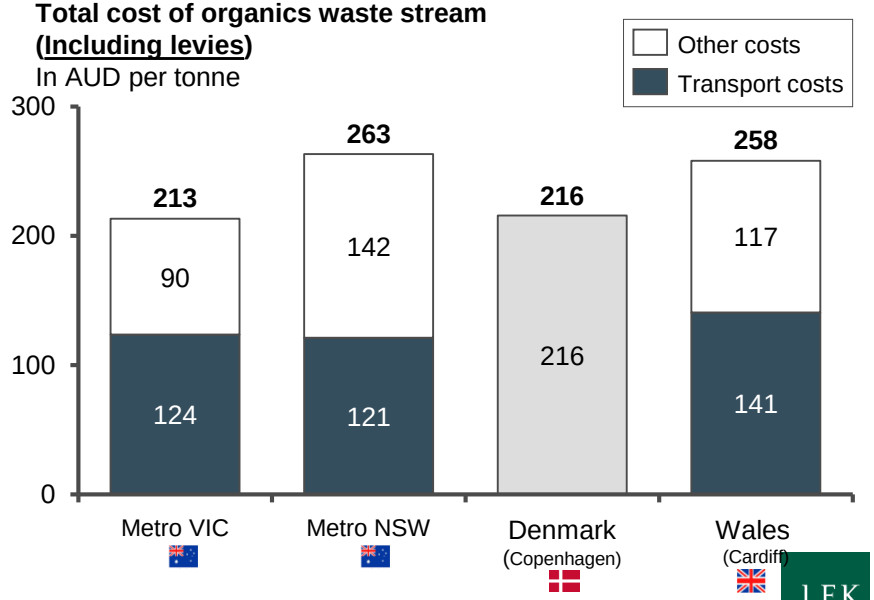
Waste

- The total costs across the recyclable waste streams were relatively similar, across the reviewed geographies
  - in part, this is due to the similar haulage distances as recycling and sorting facilities are less of a community impost, smaller in footprint than landfill and organics facilities, and are located closer to the centre points of waste generation
  - a cost balance exists between the advanced sorting of highly contaminated waste streams and increased source separation driving a more complex supply chain
- Total costs in Australia will likely under-represent current reality, where significant volumes of recyclables are diverted to landfill (and attracting levies) as the recycling industry manages export bans
- Organics facilities (particularly composting facilities) are difficult to locate within metropolitan areas due to community concerns (such as odour)
- In general, the transport related costs are similar to peers, whereas other costs varied
  - Green waste from Metro NSW tends to be handled at more 'nodes' driving up 'other costs'
  - In Wales, green and food waste is separated in the home and collected in a separate waste stream, driving additional collection costs

Total cost of recyclable waste stream (Including levies)
In AUD per tonne



Total cost of organics waste stream (Including levies)
In AUD per tonne



Best practices with respect to transport of waste in other geographies indicate there is opportunity for improvement

- In Australia, responsibilities across the different levels of Government are extensive:
  - Local government usually manages the collection of household waste and it is typically their third or fourth biggest expenditure for local government
  - State Governments also have a range of direct responsibilities for waste
  - Surpluses from waste levies collected by the states are used to fund a range of projects to improve the waste supply chain
  - The federal Commonwealth Government has a number of departments and agencies in the supply chain. However, more direct responsibilities sits within the state and local governments

- The management of waste in both Denmark and Wales flows from high level European Union directives, in a manner that is more consistent and collaborative than in Australia
  - Waste KPIs are set and cascaded from the EU, down to local government
  - International best practice is to avoid waste generation in the first instance, thus reducing the burden on the supply chain, followed by increased source separation earlier on in the supply chain (i.e. in the home) drives increase in material handling and waste collection costs
  - Depending on the maturity of the ‘re-use’ industry, or ‘circular’ economy, increased collection costs can be partially offset where landfill is avoided, or via product revenues
  - Robust collection of waste data appears to be linked to both improved environmental and freight efficiency outcomes

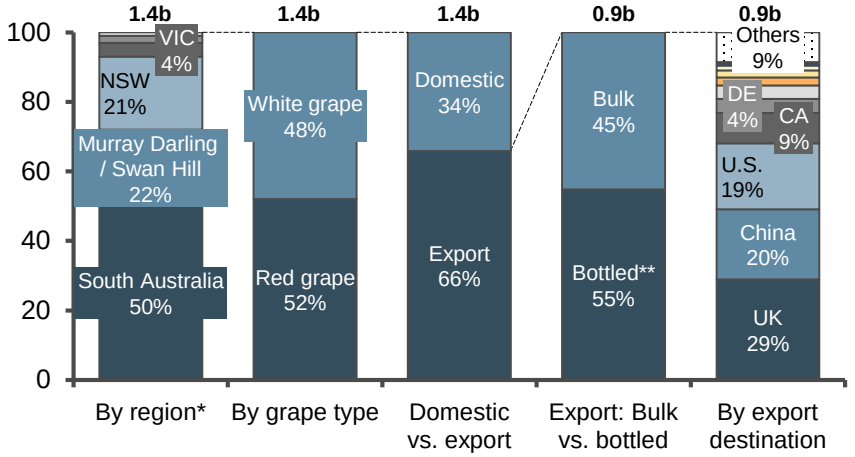
- A number of suggested improvements focussed on freight efficiency have been made within this report. Consideration needs to be given to the trade off between environmental outcomes and freight efficiency

Of the c.1.4b litres of wine produced in Australia, two-thirds is exported (with bulk nearly half the volume) predominantly to the UK, China, and the US

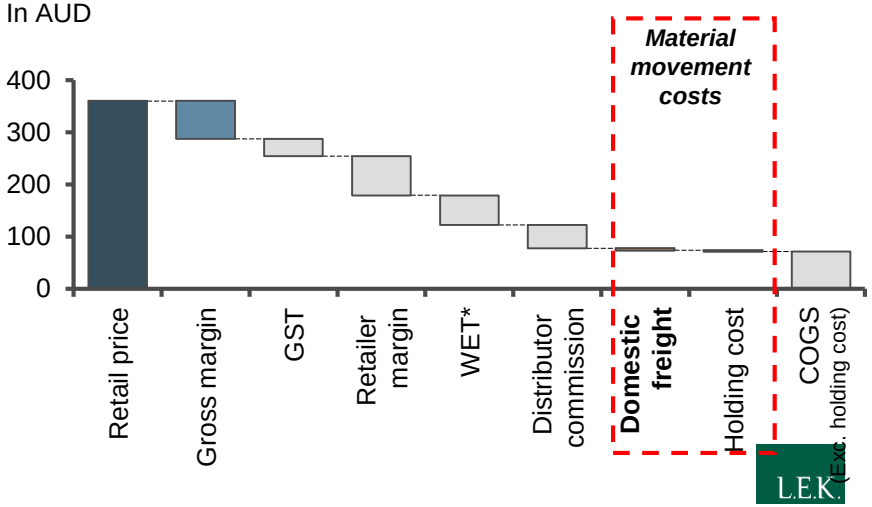
- Wine is an important export industry for Australia with over ~$40b AUD of economic impact annually, and ~173k employees
- South Australia accounts for nearly half of all wine production, and was the focus of this study
- Much of the movement of wine is concentrated within South Australia, Victoria, and NSW, with a combination of sea, rail, and road freight used
  - the movement of grapes around the country is by road, and predominantly occurs within production regions
  - finished goods movement is usually of sufficiently small scale that the 'general' freight chain is utilised domestically
  - export flows (both bulk and bottled) are containerised and mirror 'general' freight flows, dynamics and handling points
- Generally, the freight cost of wine accounts for a small proportion of its retail price (even considering sea freight for exported wine)
  - improvements to the cost performance of the supply chain is therefore unlikely to materially change the competitiveness of Australian wine internationally

Note: * Wine Equalisation Tax

Australian wine market
(2018)
Percentage of volume / litres



Example*: **Cost composition of SA wine per 9LE****
(~$30 AUD retail value / 750ml bottle)
(2019)
In AUD



Inherent differences between the South Australia, Californian and Bordeaux wine supply chains impact the nature of the supply chain

- The movement of finished goods is relatively consistent across regions reviewed:
  - For domestic transport trucks remain the predominant mode, except for longer haul distances in Australia and the US, where intermodal facilities and the general rail freight flow is used
  - Supply restricted, super premium wine that require customers to subscribe to multi year waiting lists, is generally air freighted from Bordeaux, but this represents a relatively small (volume) share
  - Bulk wine (bottled in the market of consumption rather than production) is transported in containers fitted with an internal bladder

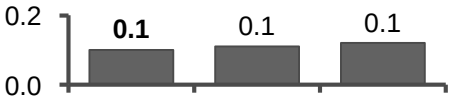
- Temperature controlled freight is reserved for only the highest quality wines, with industry participants indicating that:
  - the cost of temperature control was 2-3x the price of ‘ambient’ transport
  - temperature control for wine is only necessary over years to preserve quality, and the relative impact of the supply chain transport duration is unlikely to have any noticeable quality impact

- Despite California crushing a higher volume of grapes, the unit costs of transporting grapes to wineries appears to be relatively consistent across regions, if not marginally cheaper in Australia
  - The industry is of significantly larger scale in California than in Bordeaux and South Australia in terms of finished goods production
  - Domestic consumption (as a % of overall production) is significantly lower in Australia than in California or Bordeaux, which emphasises the need for export competitiveness
  - The nature of the supply chain (location of warehousing, market structure) is also inherently different. For example, holding costs at distributors in the USA are higher than in other regions in part due to the increased market power held by US distributors

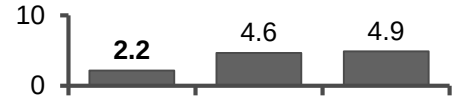
Notwithstanding these differences, the Australian wine supply chain appears to be reasonably efficient against the geographies reviewed from a cost perspective

Domestic consumption

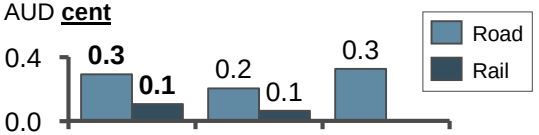
Total grape transport cost per 9LE
AUD



Total wine holding cost per 9LE
AUD



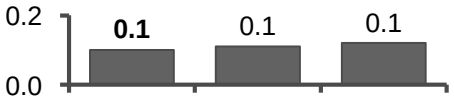
Cost of domestic freight per km / 9LE
AUD cent



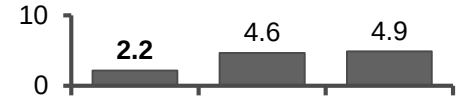
	South Australia	California	Bordeaux
Ave. total distance*	*1,477km*	*2,966km*	*532km*
Total vol. freighted	*102m litres*	*2,349m litres*	*291m litres*

Export (bottled)

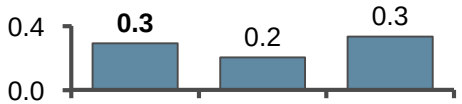
Total grape transport cost per 9LE
AUD



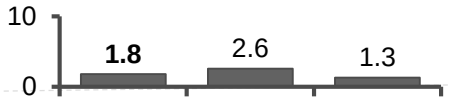
Total wine holding cost per 9LE
AUD



Cost of freight to port per km / 9LE
AUD cent



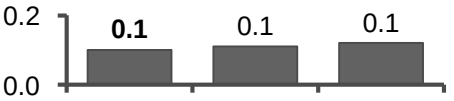
Total cost of sea freight per 9LE
AUD



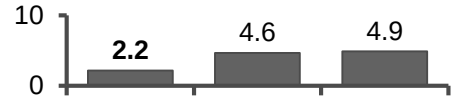
	South Australia	California	Bordeaux
Ave. total distance*	*209km*	*214km*	*653km*
Total vol. freighted	*178m litres*	*44m litres*	*0 litre*

Export (bulk)

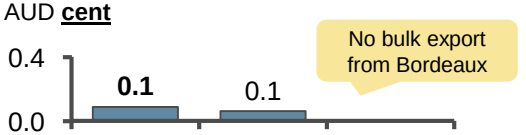
Total grape transport cost per 9LE
AUD



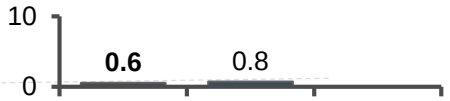
Total wine holding cost per 9LE
AUD



Cost of freight to port per km / 9LE
AUD cent



Total cost of sea freight per 9LE
AUD



	South Australia	California	Bordeaux
Ave. total distance*	*209km*	*214km*	*653km*
Total vol. freighted	*330m litres*	*307m litres*	*229m litres*

Note: * Estimated average distance transported from wineries to market; distance travelled during sea freight not included
Source: L.E.K. analysis

Industry participants indicate that they see the materials movement elements of the supply chain as efficient, with appropriate Government support

Wine

Australian industry participants indicate that the supply chain is efficient…..

- Wine industry participants (peak bodies, vineyard operators, wine producers and supply chain services providers) expressed a consistent level of satisfaction with the supply chain efficiency
  - the competitiveness of the domestic 'general' freight supply chain and concentration of major customers supports cost effective intra country movement of wine
- Industry bottlenecks typically exist only during vintage, as surge capacity of trucks in wine regions are required to transport grapes to production facilities
- As finished goods enter the 'general' freight supply chain any inefficiencies are shared across several other domestic and export 'dry' freight categories
  - efficiency of delivering and loading export containers through container ports
  - infrequency of container vessel arrivals at Port Adelaide
  - efficiency of the empty container circular supply chain
  - the ease of country of destination import facilities

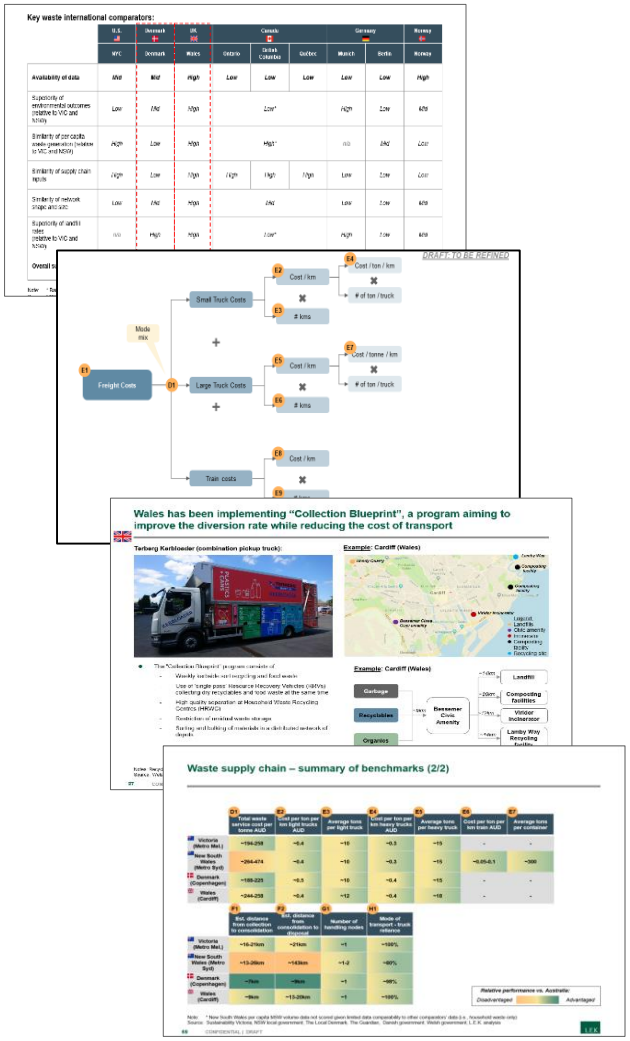
…and that the policy, planning and infrastructure landscape supports efficiency

- There are several types of taxes / levies imposed related to the movement of wine to / and from Australia. These fees appear to have limited impact on supply chain operations or efficiency
  - The wine equalisation tax (WET) is a 29% imposed on all wine sold in Australia
  - Levies collected from wine producers in Australia are mainly utilised to fund Wine Australia's operations
  - Wine Australia provides a number of critical initiatives and guidance for Australian winemakers to enable wine export
- The government of South Australia has a number of additional responsibilities to support the stakeholders within the South Australian wine industry, predominantly focussed on supporting tourism and export
- Overall, there is limited legislative policy or planning involvement in the wine supply chain

A potentially repeatable method has been developed to benchmark supply chains internationally

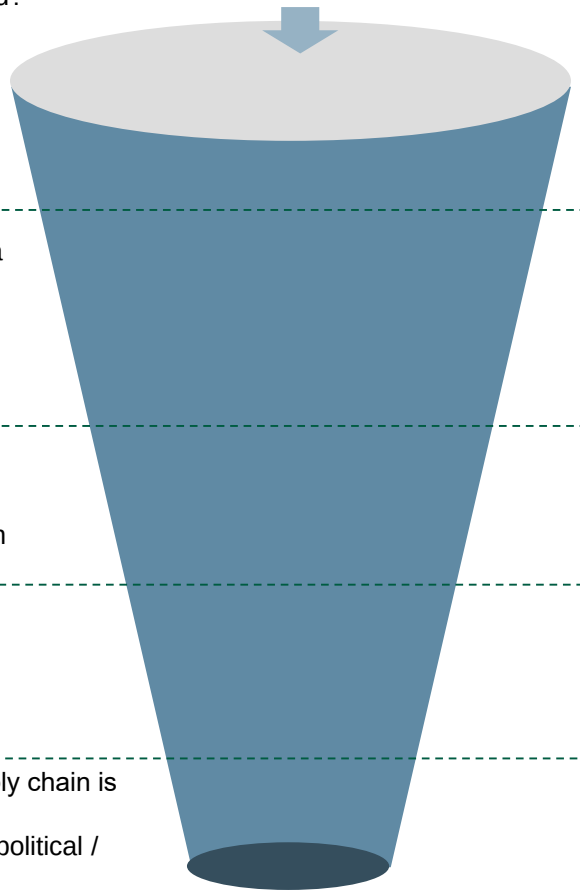
- All supply chains are inherently complex in terms of geographic spread within a country, key participants, materials handling and flow, regulations and physical constraints
- These studies required diverse data sets and are complicated by data availability and data quality challenges as well as confidentiality requirements both within Australia and Internationally
- Despite these challenges, a seven step methodology has been defined to assist in repeating this work across any supply chain

1. **Identification of relevant supply chains**
2. **Preliminary research on the supply chain**
3. **Formulation of a value driver tree to determine essential metrics**
4. **Development of a framework for selection of international comparators**
5. **Accumulation of publically available data**
6. **Methods for filling data gaps**
7. **Synthesis of findings and implications**



As the choice of future supply chains will be critical to future work a selection framework has been developed to assist prioritisation

	Considerations	Rationale
Size and growth	• What is the total volume moved? • What is the total value of the goods moved? • Is the industry a significant employer? • Is the industry on a significant growth trajectory	• The supply chain/industry needs to be large enough to warrant investment or reform • Supply chains that support rapidly growing industries are likely to need research through the growth phase to ensure development
Freight importance	• What is the cost of freight as a percentage of product value?	• Where freight cost is a more significant proportion of a product's value, efficiency improvements will have more impact • Will an improvement in the 'speed' of the supply chain allow Australian product to reach new markets (i.e. fresh horticulture)
Export Importance	• What is the split of import / export versus domestic? • How competitive is Australia in the international market?	• Industries where the cost of the supply chain are a significant contributor to Australia's competitiveness provide more robust investment cases
Geographic scope	• How does the activity split metro vs regional? • Is the supply chain relevant in multiple geographies?	• The quantum of community impact may vary based on the metro / Regional split • Supply chains that effect more end markets are of higher priority
Known efficiency / public interest	• Is it 'well known' that the supply chain is inefficient? • Is this supply chain receiving political / industry / media attention? • Is there sufficient fragmentation of the supply chain to indicate that intervention will generate value?	• Supply chains with known inefficiencies are of higher interest • Without being reactive, higher priority will naturally fall to attention generating industries (i.e. waste)



Source: L.E.K. analysis

Based upon economic importance, proportion of freight cost and import dependence, we have suggested 10 potential supply chains for consideration

Short-listed supply chains	Economic impact	Freight component	Bulk	Containerised	Liquid	General	Comments
Cement	◕	◑	✓				
Dairy products ** *(e.g., milk)*	◕	◑	✓		✓	✓	Refrigerated
Grains *(e.g., wheat, oats, coarse grains, etc.)*	●	◑	✓	✓			
Horticulture *(e.g., apples, bananas, oranges, tomatoes)*	◔	◕		✓		✓	Refrigerated
Lithium	◔	◔		✓		✓	
Meat *(i.e., beef, lamb, pork, poultry)*	●	◑		✓		✓	Refrigerated
Petrol	●	◑			✓		Hazardous
Steel	◔	◑		✓		✓	
Timber	◔	◑	✓	✓		✓	Bulk = wood chips
Wool	◑	◑		✓		✓	

Note: * Overall assessment of the size of the domestic market and the margin of freight cost relative to the value of goods, and degree of import dependence. Coal and Iron Ore not included in the list; ** Milk is moved nationally and finalized good are also exported

Source: L.E.K. analysis

L.E.K.

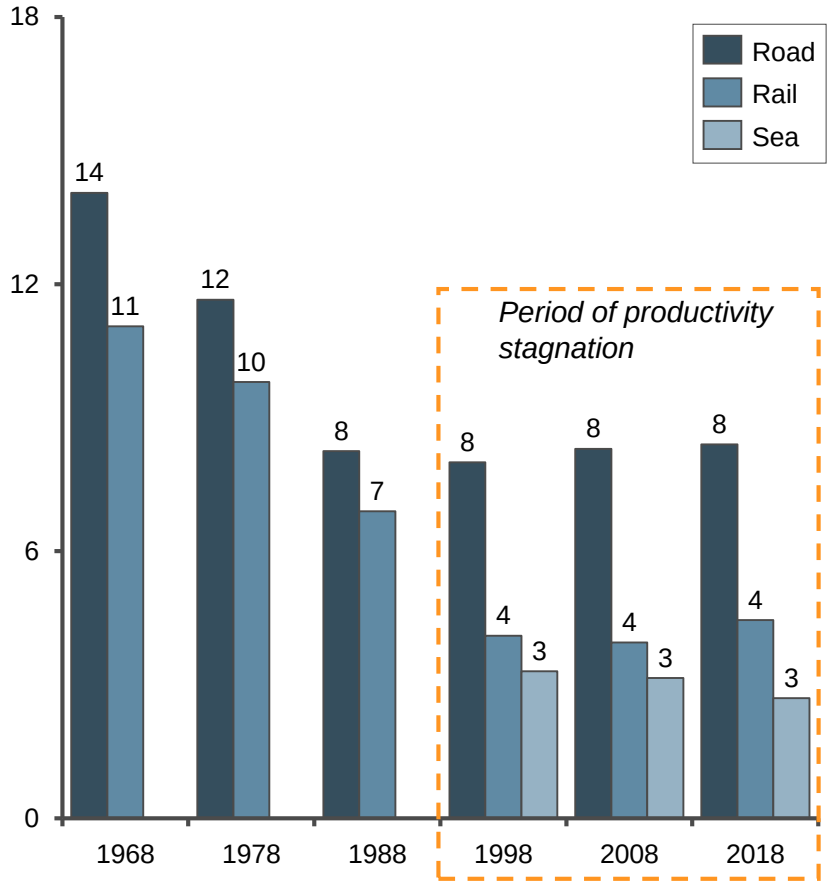
Agenda

- Executive summary
- **Scope and rationale for the study**
- Waste supply chain
- Wine supply chain
- Benchmarking supply chains – An approach for further supply chains
- Next steps
- Appendix

L.E.K.

This study is a first step towards developing a set of comparative global benchmarks, providing improved performance data to the freight sector

Australia freight productivity and cost
(1968-2018)
In c/net tonne kilometre

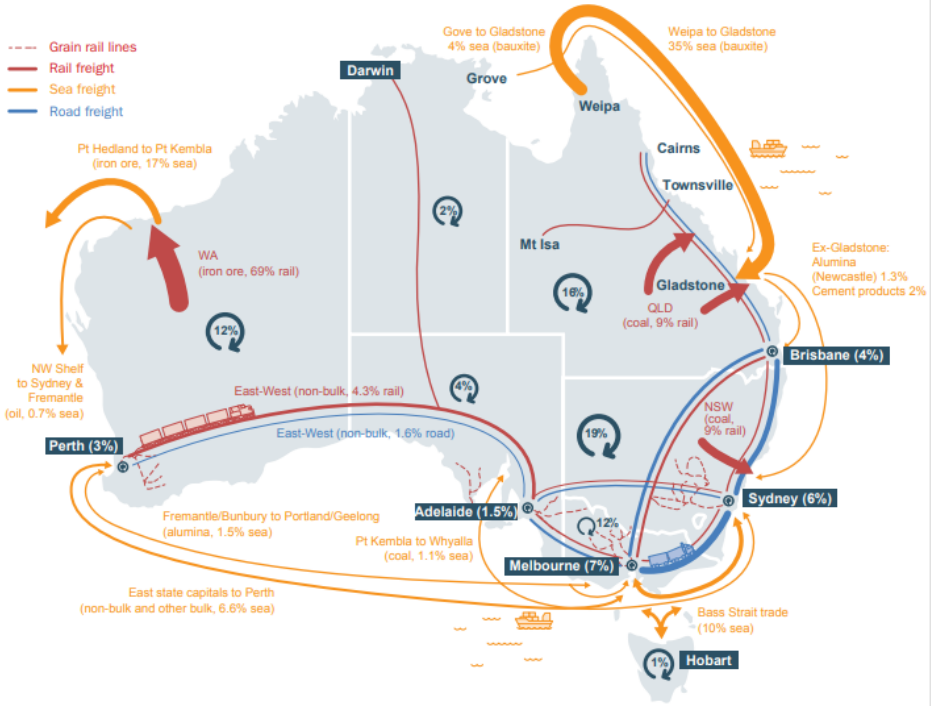


- In c/tonne terms, freight productivity in Australia has stagnated since the 1990s, as the benefits of competition reforms and availability of new vehicles have eased
- There is a need to increase the competitiveness of supply chains in Australia both domestically and internationally given:
  - Urban infrastructure reaching capacity due to road congestion, increasing environmental regulation domestically
  - There is strong demand growth for exports to Asia; so maintaining international competitiveness is increasingly important
- Going forward, the Transport and Infrastructure Council estimates that a ~1% improvement in productivity and cost could generate between ~$8-20bn AUD in savings to the Australian economy over 20 years
  - As such, identification of key areas for improvements, and implementing actions required for those improvements will be critical

Source: National freight and Supply Chain Strategy; L.E.K analysis

This aligns to the key priorities identified in the National Freight and Supply Chain Strategy action plan

Illustrative: Major Freight Flows in Australia*:



Overview of the National Freight Strategy national action plans:

1. ***Smarter and targeted investment***
2. ***Enable improved supply chain efficiency***
3. ***Better planning, coordination and regulation***
4. ***Better freight location and performance data***

Goals	Actions
• Availability of relevant freight data in a timely manner to improve the performance of freight and decision-making among both the federal government as well as relevant industry stakeholders	• Develop an evidence based of key freight flows and supply chains and their comparative performance to help business and governments improve day-to-day freight and network operations, make better investment decisions, and monitor and evaluate the performance of the freight system

Note: * Percentages in the diagram are Australia's domestic freight task by mode, and thicker arrows indicate larger volume. Percentages illustrated within circular arrows indicate internal movement within states

Source: National Freight and Supply Chain Strategy; L.E.K analysis

L.E.K.

This study focuses on the 'materials management' components of a broader integrated supply chain, as these most significantly impact freight

End-to-end supply chain elements (Illustrative)

Strategic planning

1 Operations and Production Planning

- Forecast demand
- Plan production
- Forecast inventory
- Strategic supplier management
- Develop operations procedures
- Set quality standards

Strategic sourcing

2 Procurement

- Centralise procurement
- Strategically source suppliers
- Negotiate price
- Manage vendors
- Coordinate material specifications

3 Supplier Management

- Move to Just-In-Time
- Vendor Management Inventory
- Integrate suppliers into manufacturing operations
- Ensure compliance with specifications and standards
- On-time supplier support

Materials management –

4 Inbound Logistics

- Leverage a global supply base
- Live track inbound shipments
- Delivery at the lowest cost
- Control inbound material flow
- Minimise material movement and handling
- Assure quality of inbound goods

5 Manufacturing & Assembly

- Material Requirements Planning (MRP); SAP
- Apply LEAN in manufacturing
- Plan Economic Order Quantity
- Optimise changeovers
- Minimise product rework
- Control quality of finished goods

– Materials management

6 Inventory Management

- First-in-first-out inventory
- Track and tag inventory
- Control flow of finished goods
- Track and control inventory
- Audit quality
- Unproductive stock management

7 Pack and Outbound logistics

- Allocate stock
- Automated packaging
- Pack to minimise space
- Route optimisation
- Consolidate delivery
- Rework management

Customer satisfaction

8 Relationship management

- Best-in-class service
- Customer feedback capture
- Customer-driven change initiatives
- Monitor and report on KPIs
- Capital investment to rive improvements

Source: L.E.K analysis

L.E.K.

Two supply chains were selected as initial 'proof of concept' studies

	Selection criteria	Why Waste?	Why Wine?
Size and growth	• What is the total volume moved? • What is the total value of the goods moved? • Is the industry a significant employer? • Is the industry on a significant growth trajectory?	• ~55m tonnes produced (2018) • ~$6.9bn industry • ~28k employees • Waste produced growing at ~6% CAGR since 2007	• ~1.29b litres of wine produced (2018) • ~$40bn industry • ~172k employees • Wine production growing at ~3% CAGR since 2010
Freight importance	• What is the cost of freight as a percentage of product value?	• Cost of freight is ~50-60% of the total service cost (depending on the waste type)	• Cost of freight estimated at ~1-10% of product value (depending on the wine quality and destination)
Export Importance	• What is the split of import / export versus domestic? • How competitive is Australia in the international market?	• Waste exports were c.6-7% (2018) • Expected to decrease exports materially going forward (particularly plastic and cardboard recyclables)	• Wine exports were ~$2.8bn AUD (c.66% by volume) in 2018 • Australia is the fifth largest global exporter with China, the U.S., and the UK accounting for ~68% of exported volume
Geographic scope	• How does the activity split metro vs regional? • Is the supply chain relevant in multiple geographies?	• Both metro and regional • Impacts all areas of the country	• Initially regional, then distributed • South Australia is ~50% of the winegrape crush, with smaller regions in NSW, VIC, WA and TAS
Known efficiency / public interest	• Is it 'well known' that the supply chain is inefficient? • Is this supply chain receiving political / industry / media attention? • Is there sufficient fragmentation of the supply chain to indicate that intervention will generate value?	• Recent legislative changes limiting waste exports • Crisis in Victoria's recycling sector (i.e., SKM bankruptcy) • Considerable public attention • Need to develop a mature local re-use market for recyclables • Shift towards waste-to-energy - Facility in WA due to be completed in 2021 - ~700m for facilities in Ballarat and Brisbane	• Limited data available on relative efficiency vs. international geographies

Adherence to selection criteria

○ Low ● High

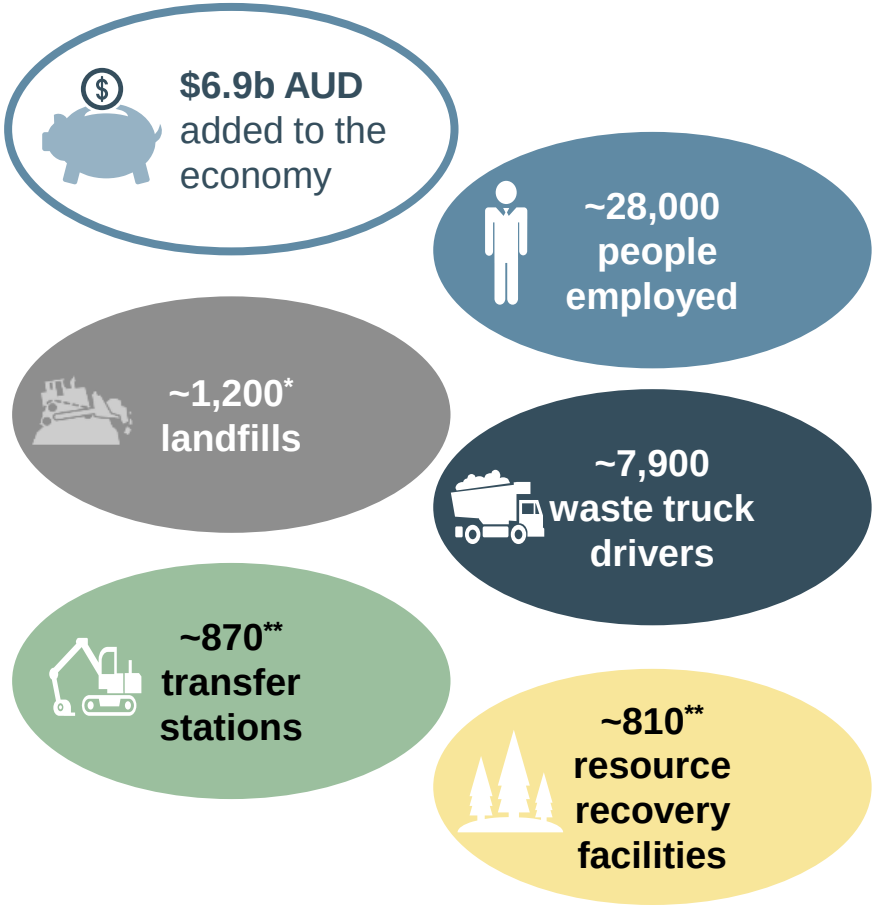
Source: National waste report; ABC; L.E.K. analysis

L.E.K.

Agenda

- Executive summary
- Scope and rationale for the study
- **Waste supply chain**
  - **Australia**
  - Global comparators
  - Freight network and supply chain metric performance comparison
  - Freight network and supply chain planning, governance and investment comparison
  - Identification of areas of improvement within the Australian supply chain
- Wine supply chain
- Benchmarking supply chains – An approach for further supply chains
- Next steps
- Appendix

The waste industry in Australia is an essential service, employing ~28,000 people nationally



Key stakeholders (Not exhaustive)

Federal government

Australian Government – Department of the Environment and Energy

Australian Government – Department of Infrastructure, Regional Development and Cities

Australian Government – Infrastructure Australia

State governments

Sustainability Victoria

Victoria

NSW Government

NSW EPA

EPA Victoria

Local governments

City of Melbourne

City of Sydney

Private operators (examples)

Cleanaway

Veolia

Suez

J.J. Richards & Sons

Visy – For a better world

Bingo Industries – Cleaning up

Genesis – Xero Waste

Note: * As of April 2018; ** As of August 2013
Source: Australian Bureau of Statistics; Australian Government; L.E.K. analysis

L.E.K.

Waste can be categorized across a number of different dimensions

Generation Source

Household waste / Municipal Solid Waste (MSW)

- Generated predominantly from households

Commercial and Industrial (C&I)

- Generated from all businesses including manufacturing, retail, agriculture, transport etc.

Construction and Demolition (C&D)

- Generated from construction / demolition activities

Material Type

- **Organics**
- **Plastic**
- **Paper**
- **Metals**
- **Glass**
- **E-waste** (e.g., computers, smartphones, printers)
- **Liquids** (e.g., sewage, hazardous liquids etc.)
- **Hazardous** (e.g., asbestos)
- **Medical** (e.g., syringes etc.)
- **Masonry materials** (e.g., concrete, bricks)

Collection Model

General refuse

Comingled recycling (e.g., paper, glass, plastic etc.)

Organics

Source separated materials

Liquids

Skips / Front load

End Use

Re-use

- Re-use is typically the most environmentally beneficial outcome, assuring efficient processing / sorting
- Reutilisation of materials (e.g., plastics, glass etc.) through processing or sorting, and used as a raw material input

Waste to Energy

- Different methods are adopted to recover energy from waste; Incinerators are the most common form, particularly in the EU
- Some scale landfills in Australia employ a “gas capture” system which can be used to generate power

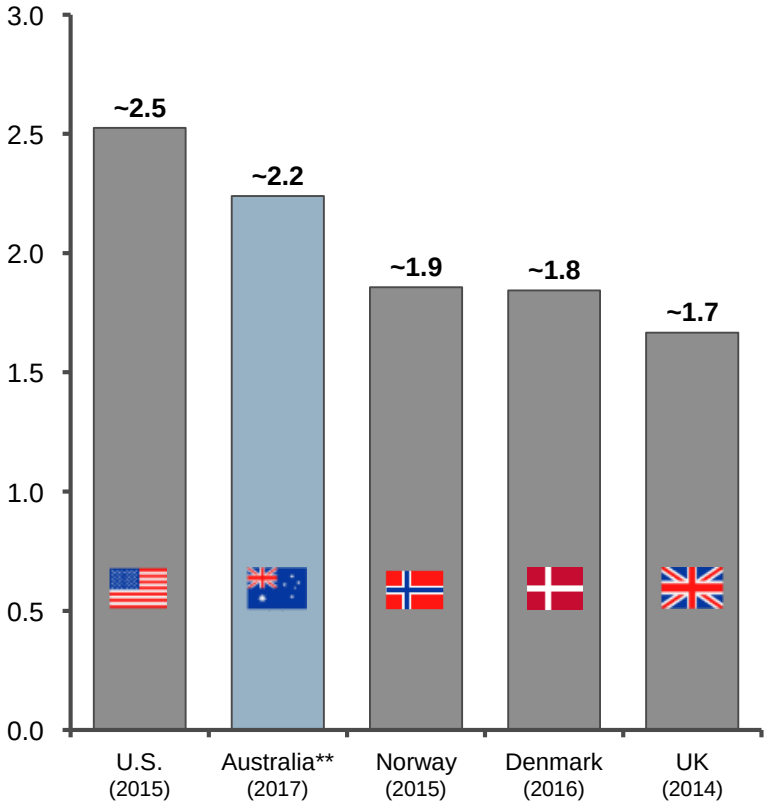
Disposal

- Waste that cannot be re-used, or converted to energy is ultimately landfilled. Industry participants view this outcome as the least preferable

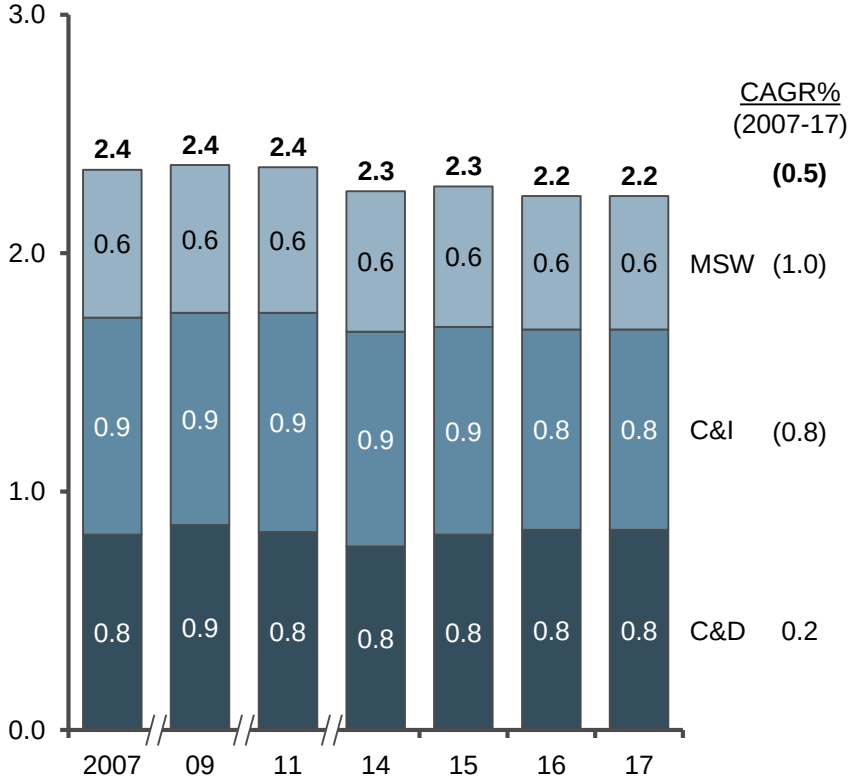
Source: National waste report; Veolia website; L.E.K analysis

On a total basis (including C&I and C&D), Australians are a significant per capita generators of waste by international standards, falling slowly over time

Total* per-capita waste (MSW, C&I, C&D) volume**
(2014-17)
In tonnes



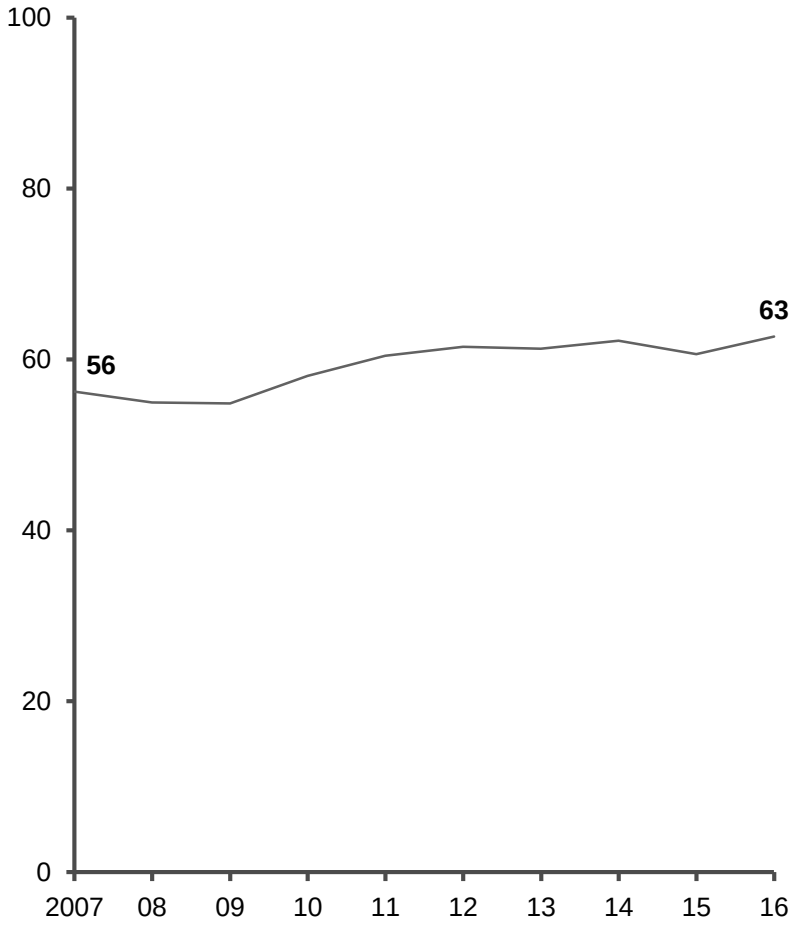
Australia total* per capita waste generation
(2007-17)
In tonnes



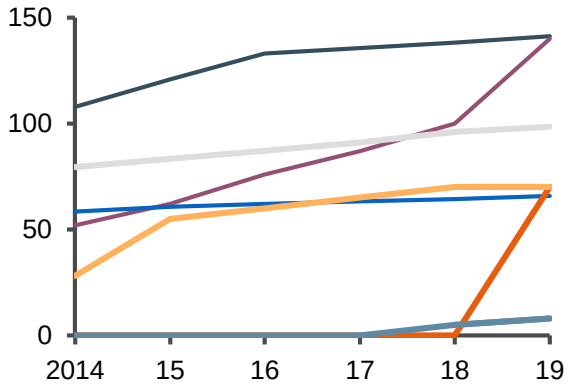
Note: * Total volume includes Municipal Solid Waste, Commercial and Industrial, and Construction and Demolition; ** Excludes ash
Source: National Waste Report 2018; Statistics Canada; Statistics Norway; Department for Environment Food & Rural Affairs (UK); U.S. EPA; L.E.K. analysis

Diversion (from landfill) rates in Australia have been slowly improving, as landfill levies have been increased to encourage recycling

Australian total waste diversion rate
(2007-16)
Percentage

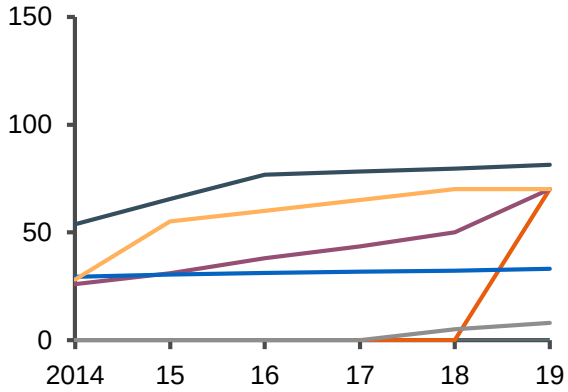


Australian landfill levies – Metro areas
(2014-19)
AUD per tonne



	CAGR% (2014-19)
NSW	5.5
SA	21.9
VIC	2.4
QLD	n/a
WA	20.1
Tas	n/a
ACT	4.4
NT	n/a

Australian landfill levies – Non-metro areas
(2014-18)
AUD per tonne



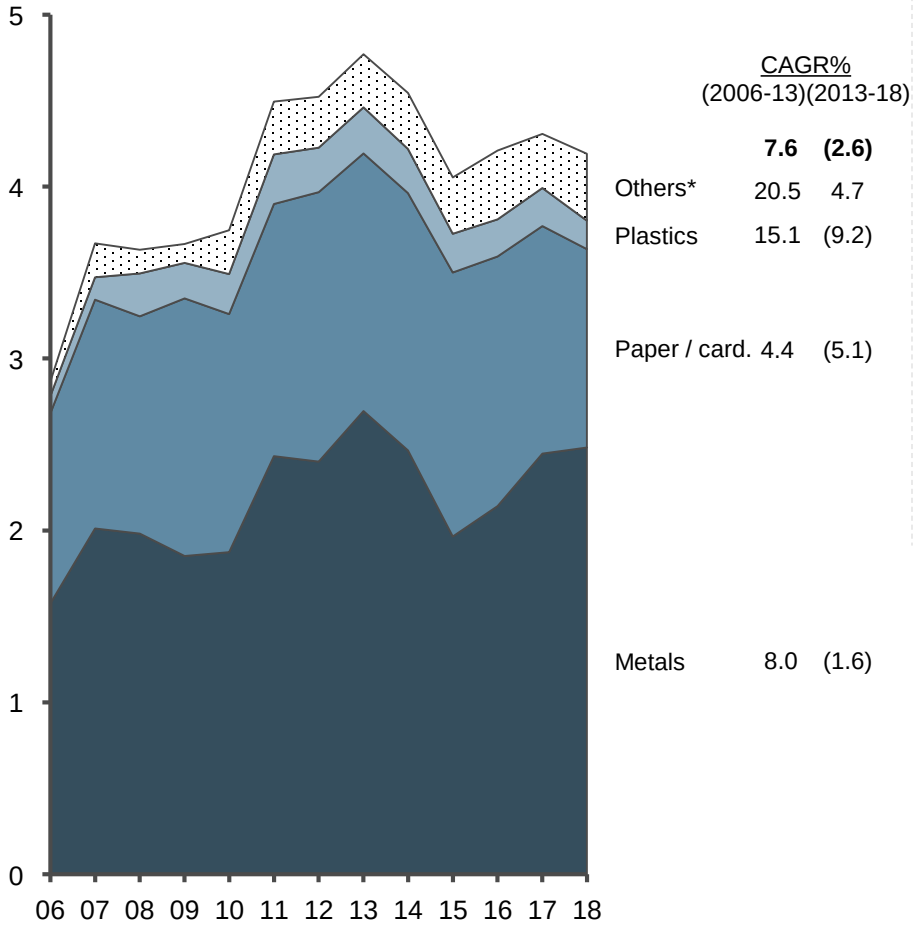
	CAGR% (2014-19)
NSW	8.6
QLD	*n/a*
SA	21.9
WA	20.1
VIC	2.4
TAS	*n/a*
NT	*n/a*

Source: Environment Australia; National waste report; L.E.K. Analysis

L.E.K.

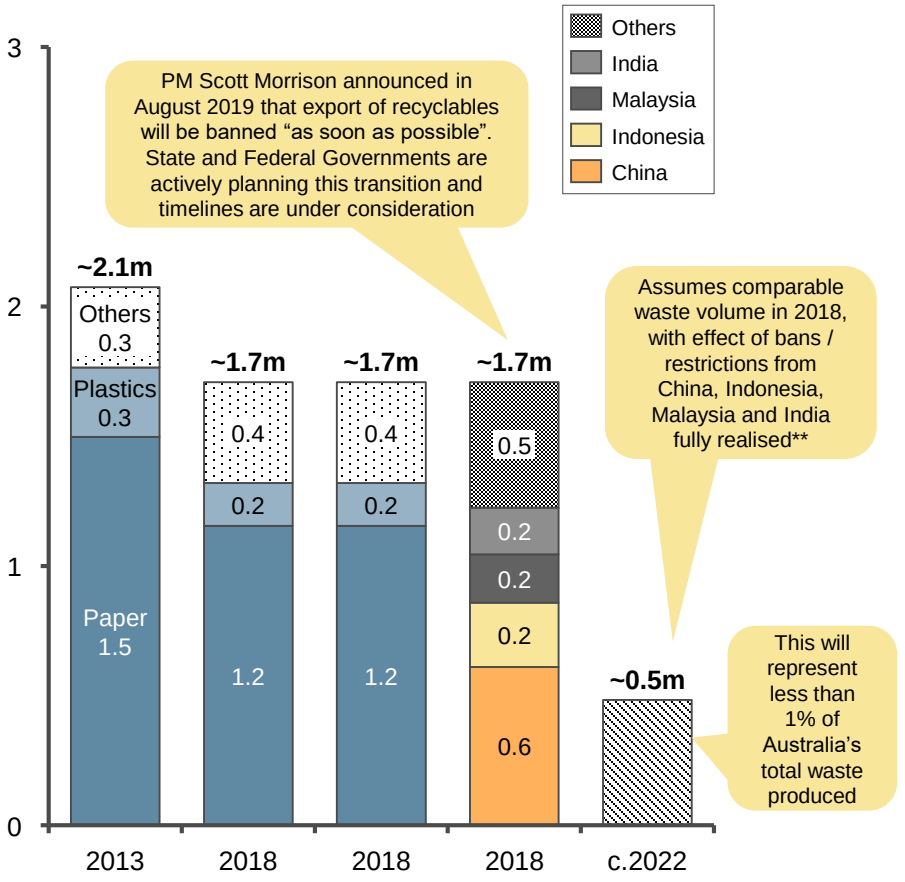
Waste exports peaked in 2013, but are expected to decline significantly over the next 3 years (excluding metal) to less than 1% of waste produced

Total Australian waste export by material type
(2006-2018)
In millions of tonnes



	CAGR% (2006-13)	CAGR% (2013-18)
	7.6	**(2.6)**
Others*	20.5	4.7
Plastics	15.1	(9.2)
Paper / card.	4.4	(5.1)
Metals	8.0	(1.6)

Total Australian waste export by material type (excluding metals)
(2013-22F)
In millions of tonnes



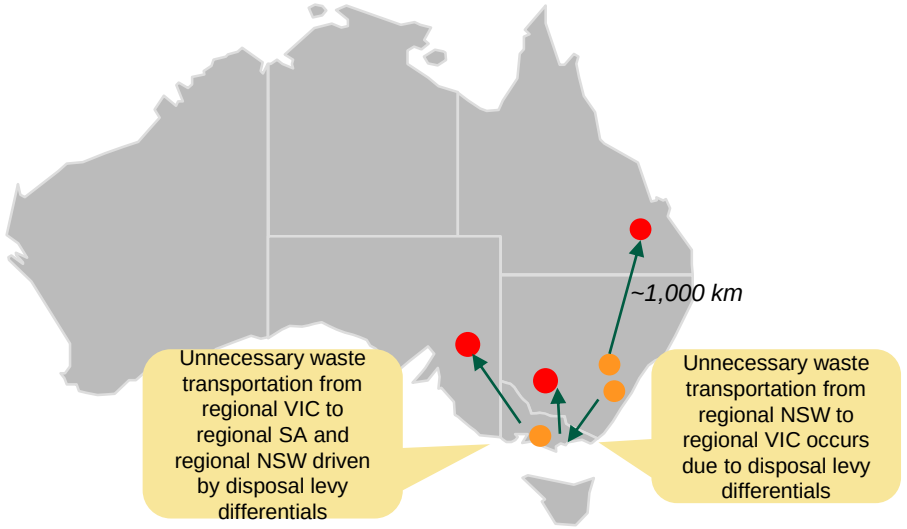
Note: * Includes hazardous materials; ** The timeline for export bans are currently under review. 2022 selected as timeline estimate
Source: National Waste Report 2018; The Sydney Morning Herald; Australian Bureau of Statistics; 2016-17 Australian Plastics Recycling Survey; L.E.K. analysis

L.E.K.

Current trends are placing a significant burden on the waste sector impacting transport costs and environmental outcomes

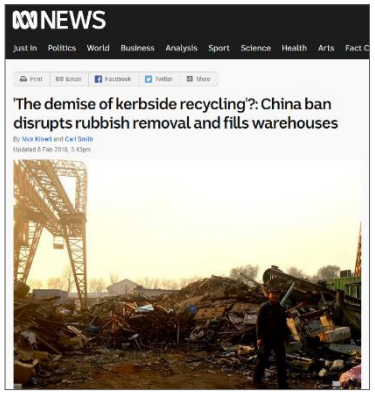
Unnecessary waste transportation

- Economic incentives and regulation can drive "inefficiencies" due to unnecessary waste transportation
  - E.g., extensive movement of commercial waste from NSW to Queensland has been driven by lower levies in Queensland (~$70 per tonne) vs. metro NSW (~$140 per tonne)
- The absence of landfill levies in Queensland until 2018 meant that a substantial volume (~900k tonnes in 2017) was being freighted to Queensland



International measures to prevent cross-border waste flows

ABC New (Feb. 2018)



- Led by the Chinese government in 2017 (reduced contamination threshold for plastics), several key importers of Australian waste in Asia (e.g., Indonesia, Malaysia etc.) have also imposed restrictions related to the import of waste

COAG agreement on waste export bans

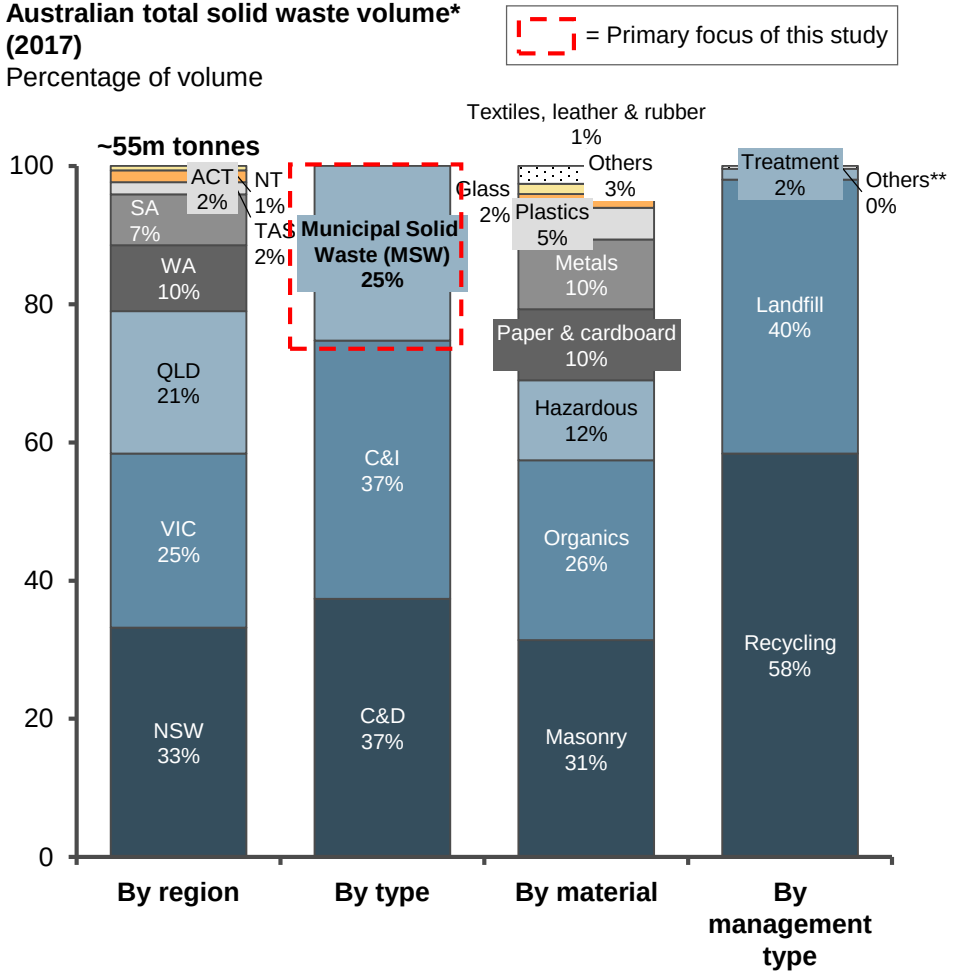
- The Council of Australian Government (COAG) recently stated its intention to ban the export of recyclable waste to overseas (August 2019)

Note: * Includes hazardous materials
Source: National Waste Report 2018; ABC News; L.E.K. analysis

This pilot study has focused on household waste (MSW)

Household waste contributes c.25% of the total waste generated…

Australian total solid waste volume* (2017)
Percentage of volume



… and is of considerable public interest

Household waste is highly visible and very topical

- There is considerable community interest of how household waste is managed and the associated visibility of the freight task on public roads and in communities
- Management of recyclables is of current public interest as Australia navigates the implications of the China's "National Sword" program, including an under-developed domestic processing market
- The measurement of household waste is typically more consistent and reasonably well reported globally

Future studies should consider other waste streams including C&I and C&D

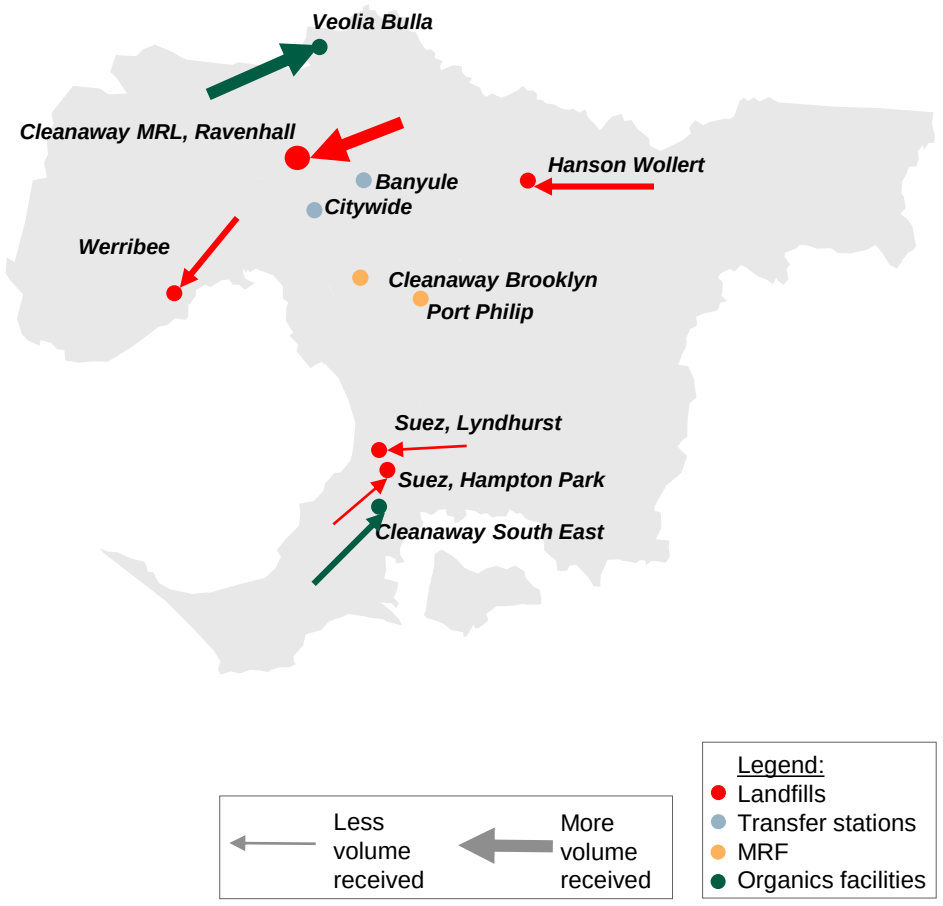
- Further waste categories (i.e., C&I, C&D waste) could be reviewed following this study completing the full picture of waste

Note: * Excludes ash; ** Others include energy from waste facility etc.; Household waste, the waste generated for households, is the main component of Municipal Solid Waste (MSW) which also encompasses solid waste disposed in street bins, beaches and others
Source: National Waste Report 2018; L.E.K. analysis

While there are a number of key waste facilities in metro Melbourne and Sydney, their geographic spread is very different

Illustrative: Key waste facilities serving metro Sydney

Illustrative: Key waste facilities serving metro Melbourne

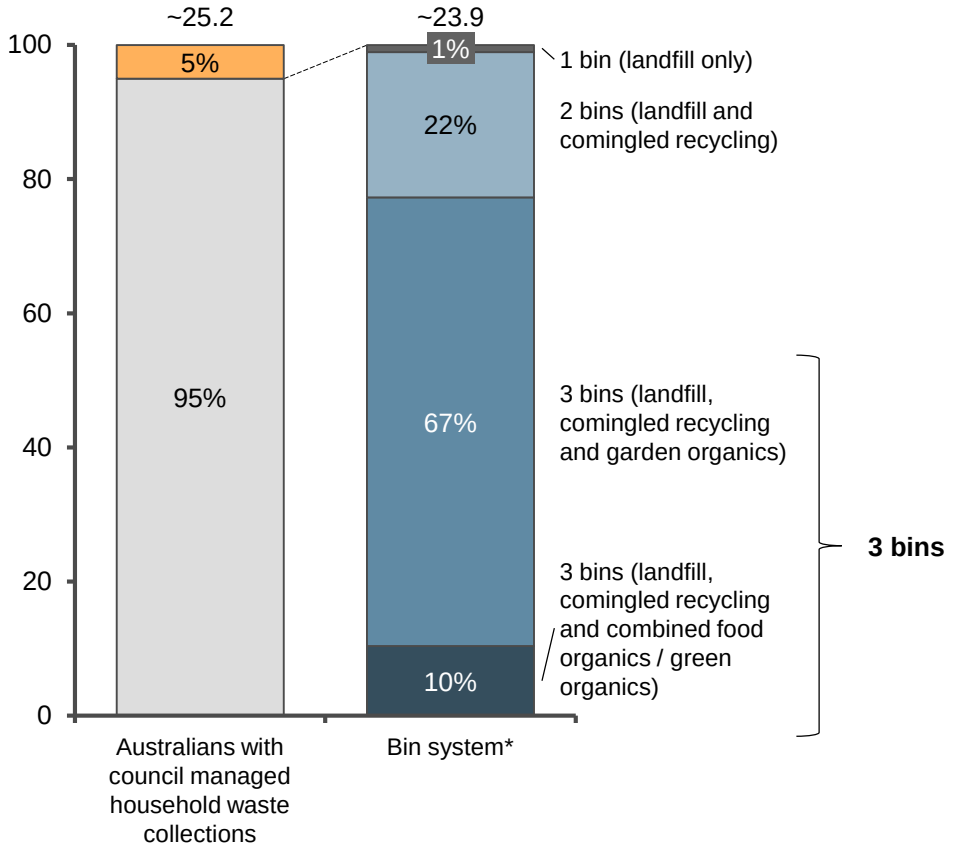


Source: NSW Local Government; Victorian Local Government; L.E.K. analysis

The majority of the Australian population is serviced by a 3-bin system

The number of bins in the household has progressively increased as individual councils seek to improve environmental outcomes…

Waste collection scheme by population (2019)
Percentage



…a number of councils are proposing further changes primarily to increase recycling / decrease landfill

Examples

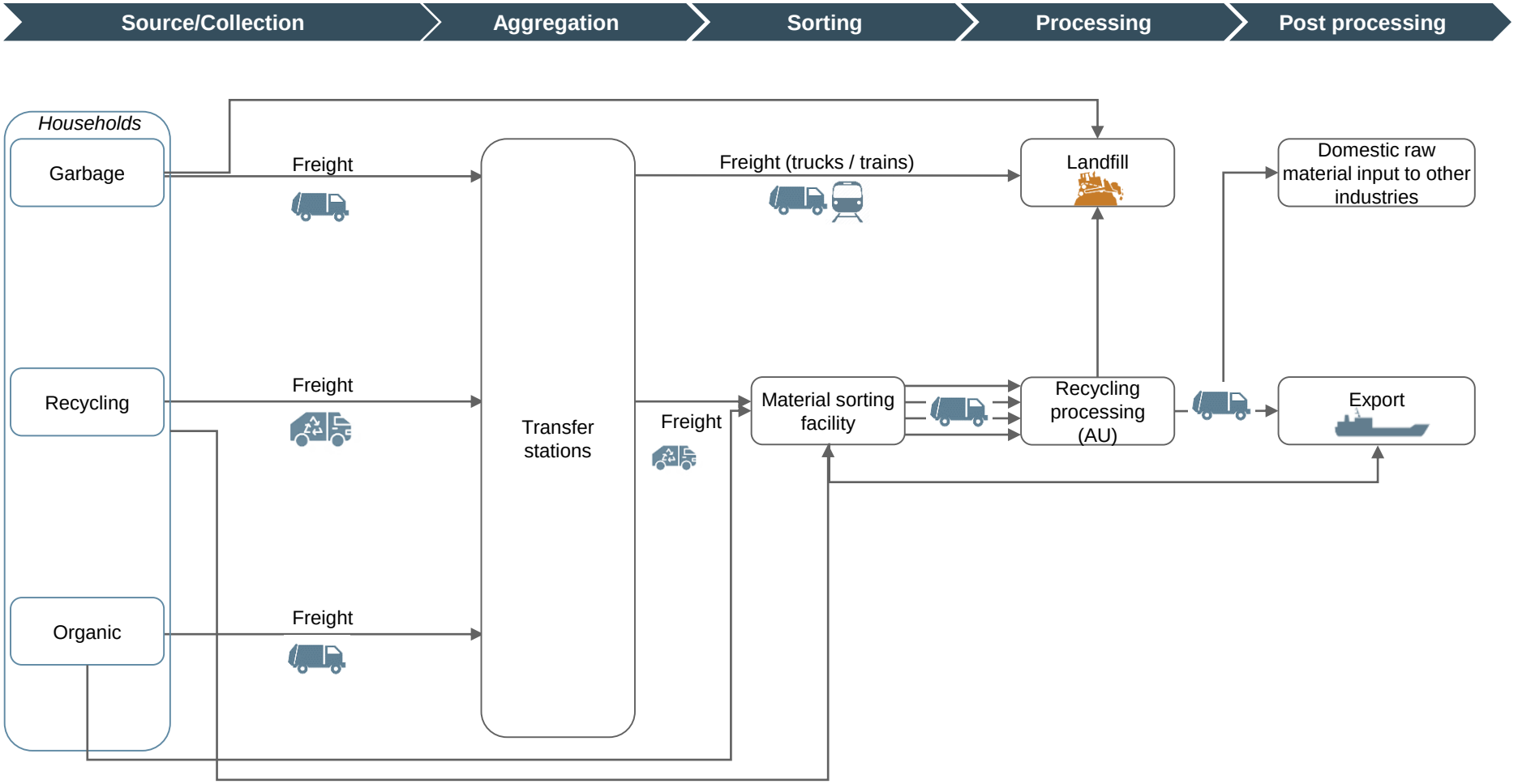
- The Yarra City Council in Victoria started a one year trial of four bins
  - A 'purple' bin is used to source separate glass
  - Glass is the 'next' material to be targeted for source separation as it is a major contributor to contamination of co-mingled waste streams, increasing the cost of recovery / decreasing the value of the output stream
- The Surf Coast Shire council in Victoria is planning a trial of five bins, splitting the current recycling bins into bins for glass and cardboard and adding a new bin for food organics
  - A paper/cardboard bin with a 240-litre capacity would be provided and collections would happen monthly
  - A food organics collection service would also be added with residents collecting compostable waste in smaller basket-style bins

Source: Department of the Environment and Energy; Geelong advertiser; SMH website; The Age website; L.E.K. analysis

The supply chain for household waste varies based on the 'bin type' but follows similar, but distinct paths

Australian waste supply chain:

ILLUSTRATIVE

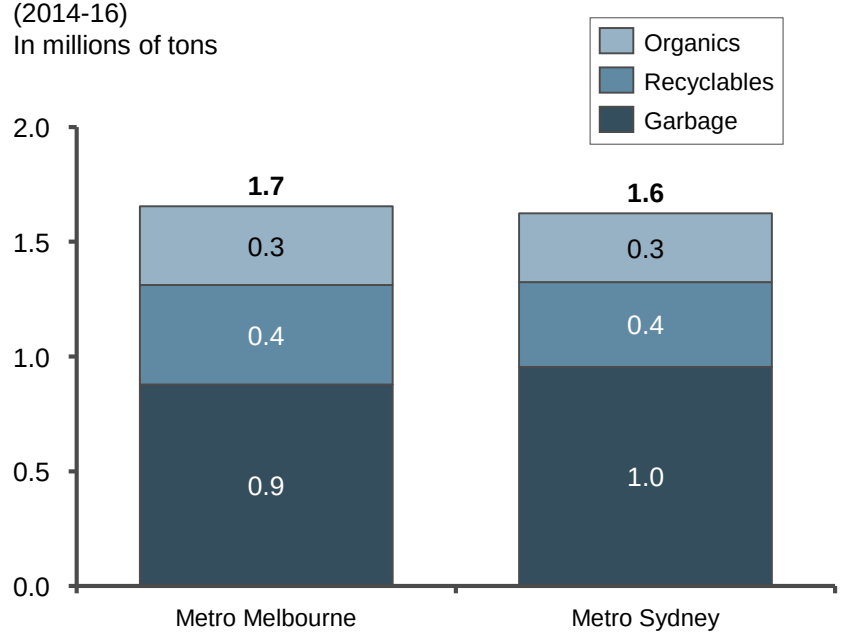


Source: L.E.K. analysis

Melbourne and Sydney have been reviewed as key 'sub markets' for this study, each generating c.1.6-1.7m tonnes of waste p.a., or ~370kg per person

Household waste generation (Metro Mel. / Syd.)

(2014-16)
In millions of tons



	Metro Melbourne	Metro Sydney
Recycling %	***~45***	***~52***
Landfilling %	***~55***	***~48***
Waste to Energy %	*0*	*0*
Per capita volume	~359kg*	~376kg*
Population	~4.6m	~4.3m

Typical waste separation schemes overview (indicative)

	Metro Melbourne	Metro Sydney
Garbage bin	✓	✓
Recycling bin	✓	✓
Garden Organics bin	✓	✓
Oversized items*	Two collections available annually	Pick-ups available
E-waste	Drop offs available	Pick-ups or drop off available
Household chemicals	Drop offs available	Periodic collections at collection stations

Examples:

Notes: * Differences in per capita volume relative to Municipal Solid Waste (MSW) figures are primarily due to (a) inclusion of waste generated from businesses (e.g., office based businesses etc.), (b) inclusion of timber in MSW figures, and (c) regional areas' propensity to generate larger waste volume relative to metropolitan areas
Source: NSW Local Government; Victorian Local Government; Australian Bureau of Statistics; L.E.K. analysis

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Five categories were used to assess the suitability of international markets for comparison

Environmental outcomes

- A trade-off exists between the efficiency of a waste supply chain, and the resultant environmental outcomes
- The study focused on comparators with superior, or aspirational outcomes; as opposed to efficient supply chains that achieve environmentally inferior outcomes

Per capita waste generation

- The rate of household per-capita waste is generated was considered an important factor
- Markets where considerably more (or less) waste is generated were considered to be less likely to be conducive for an apples-to-apples comparison

Supply chain inputs

- The manner in which households are configured in terms of number of bins, bin volumes, collection frequency and make-up of waste stream impact the resultant supply chain make-up
- Typically, higher degrees of source separation (i.e. more bins) are correlated with superior environmental outcomes; but not necessarily a simpler supply chain

Network shape and size

- In order to have a more reliable basis of comparison, markets with similar population density and network make-up were considered

Landfill rates

- Landfill is considered the least desirable outcome within a waste supply chain. Landfill can be avoided via recycling, or waste to energy
- Markets with lower landfill rates were prioritized

Source: L.E.K. analysis

A number of potential comparators were reviewed at a regional level, to assess suitability as benchmarks

Key waste management international comparators:

= Countries
= States
= Cities

		Australia			U.S.	Denmark	UK	Canada			Germany		Norway
		NSW	VIC	QLD	NYC	Denmark	Wales	Ontario	British Columbia	Québec	Munich	Berlin	Norway
Per-capita HH waste volume (kg)	Garbage	223	188	*n/a*	84	324	*183*						199
	Recyclables	91	95	*n/a*	158	150	151	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	193
	Organics	71	74	*n/a*	125	130	90						65
	Total	**385**	**357**	**545**	**367**	**604**	**424**	**366**	**338**	**502**	*n/a*	**312**	**457**
Recycling rate		*49%*	*46%*	*32%*	*17%*	*51%*	*52%*	*38%*	41%	28%	*55%*	*38%*	*44%^*
% sent to landfill		*51%*	*54%*	*68%*	*n/a*	*1%*	*24%*	*62%*	59%	72%	*1%*	*62%*	*21%^*
% waste to energy		-	-	-	*n/a*	*48%*	*24%*	*n/a*	n/a	n/a	*44%*	-	*35%^*
# of key landfills**		369	92	265	27^^	-	15	800^^	92^^	104^^	-	*n/a*	-
# of key resources recovery facilities**		121	233	88	*n/a*	*n/a*	23	53	8	16	*n/a*	*n/a*	*n/a*
# of key transfer stations**		166	239	236	167	8	81	13	6	*n/a*	12	*n/a*	*n/a*
Population (million)		7.5	6.5	5.0	9.0	5.8	3.1	14.0	5.0	8.0	1.4	3.5	5.5
Population density per km²		10	29	2.7	26,400	138	151	15	5	6	4,500	3,800	15

Note: * Data is compiled for different years (c.2014 to 2019) and sources due to limitations on data availability;** Number of landfills, resources recovery facilities and transfer stations based on either local permit database or Google map search; ^ National data for all waste utilised due to data availability; ^^ State-wide figures; ^^^ Household waste only

Source: NSW Local Government; Victorian Local Government; Queensland Local Government; Toronto Local Government; Metro Vancouver; Statistics Canada; Australian Bureau of Statistics; L.E.K. analysis

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Wales and Denmark were selected for more detailed comparison based on a broad like-for-like comparability and more aspirational environmental outcomes

Key waste international comparators:

	U.S.	Denmark	UK	Canada			Germany		Norway
	NYC	Denmark	Wales	Ontario	British Columbia	Québec	Munich	Berlin	Norway
Availability of data	***Mid***	***Mid***	***High***	***Low***	***Low***	***Low***	***Low***	***Low***	***High***
Superiority of environmental outcomes (relative to VIC and NSW)	*Low*	*Mid*	*High*	*Low**			*High*	*Low*	*Mid*
Similarity of per capita waste generation (relative to VIC and NSW)	*High*	*Low*	*High*	*High**			*n/a*	*Mid*	*Low*
Similarity of supply chain inputs	*High*	*Low*	*High*	*High*	*High*	*High*	*Low*	*Low*	*Low*
Similarity of network shape and size	*Low*	*Mid*	*High*	*Mid*			*Low*	*Low*	*Mid*
Superiority of landfill rates (relative to VIC and NSW)	*n/a*	*High*	*High*	*Low**			*High*	*Low*	*Mid*
Overall suitability	***Mid-High***	***High***	***High***	***Low***	***Low***	***Low***	***Low***	***Low***	***Mid-High***

Note: * Based on national data (Canada)

Source: NSW Local Government; Victorian Local Government; Queensland Local Government; Toronto Local Government; Metro Vancouver; Statistics Canada; Australian Bureau of Statistics; L.E.K. analysis

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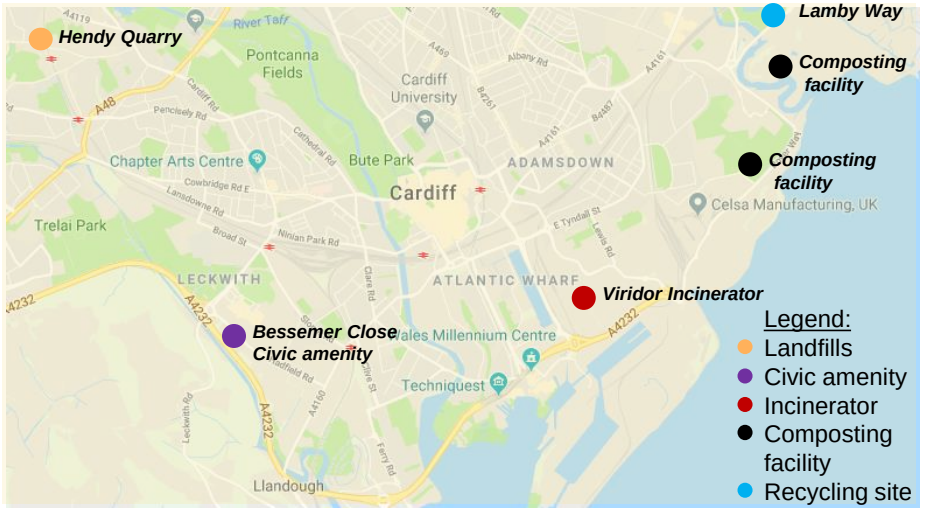
Wales has been implementing "Collection Blueprint", a programme aiming to improve the diversion rate from landfill while reducing the cost of transport

RRV* Terberg Kerbloader (combination pickup truck):

- The "Collection Blueprint" program consists of:
  - Weekly kerbside recycling and food waste collection
  - Use of '**single pass**' **Resource Recovery Vehicles** (RRVs) collecting dry recyclables and food waste concurrently
  - High quality separation at Household Waste Recycling Centres (HRWC)
  - Restriction of residual waste storage
  - Sorting and bulking of materials in a distributed network of depots
- As of fall 2019, the "Collection Blueprint" programme is adopted in **16** out of 22 councils in Wales
- RRVs are 7.5t or 12t in capacity; separate heavy trucks are utilised for freight from consolidation node (e.g., Bessemer Civic Amenity etc.) to incinerators / recycling facilities etc.

Example: Cardiff (Wales)



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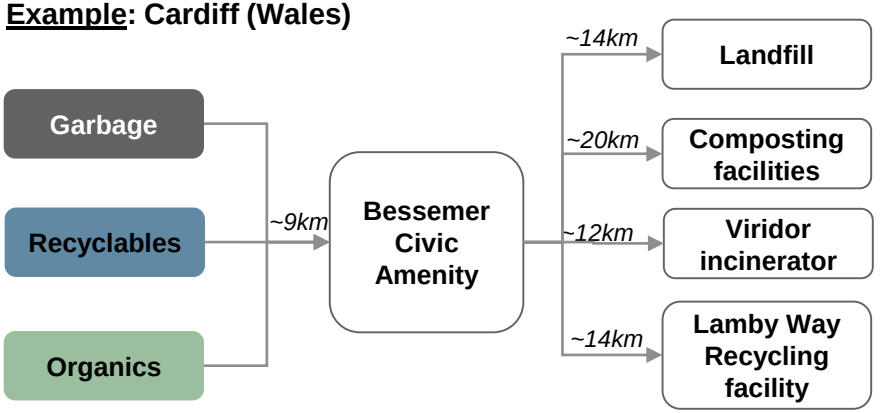
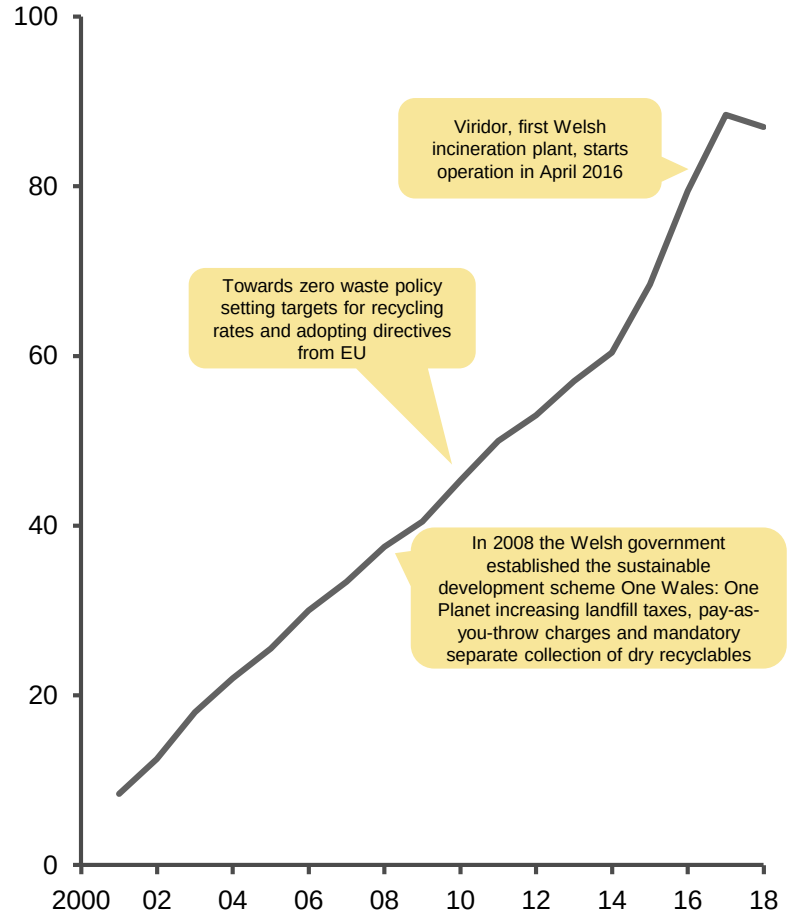


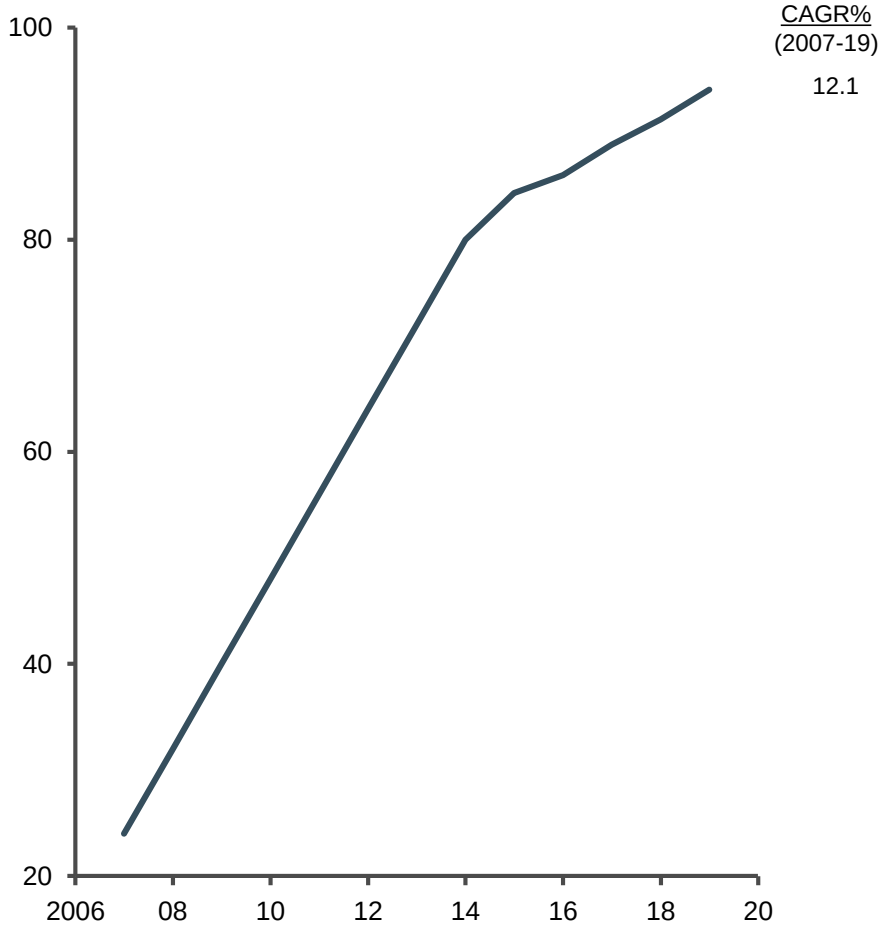
Notes: * Resource Recovery Vehicles
Source: Welsh government; Interviews; L.E.K. analysis

Wales has significantly increased its diversion rate in part driven by higher landfill levies and the recent introduction of waste to energy facilities

Metro Wales municipal solid waste diversion rate
(2001-18)
Percentage



UK landfill tax rate per tonne
(2007-19)
£ per tonne



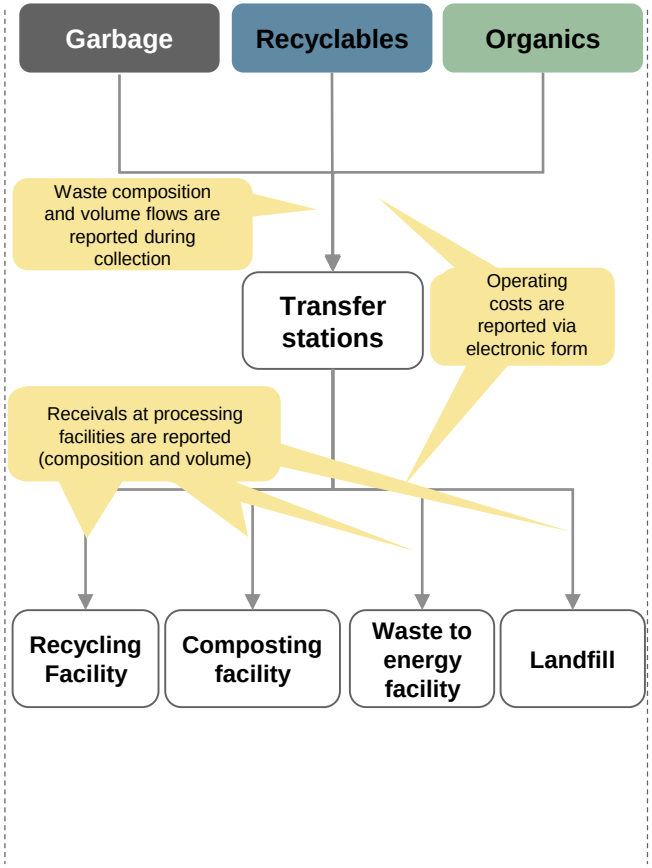
Source: Welsh government; The Guardian; Institute for European Environmental Policy; Office for budget responsibility; ONS website; L.E.K. Analysis

A key enabler of the changes in the efficiency and environmental outcomes in Wales has been improved data collection across the supply chain

Consolidated "waste data flows" are mandated by the national Government

- Waste Data Flow is the web based system for MSW data reported by UK local authorities to government
- Waste Data Flow was created to replace the various and repetitive waste questionnaires issued to local authorities by different government, department and agencies with one consistent data set
- Natural Resources Wales measures the collection, transport, processing and disposal of waste on behalf of the Welsh government
- Contaminants are identified and removed during the process assuring a more accurate waste flow

Operators with "waste permits" are required to report at each transfer / receival* point



Data is collected and reported at a national level

- Information about the volume and composition of local authority municipal waste collected from households, non-household sources and the levels of recycling is reported quarterly through Waste Data Flow
- Volume and flow data is published and publically available
- The financial data collected is used to construct the annual waste finance report. This report endeavours to internally benchmark the supply chain performance to drive overall efficiency and environmental outcomes

Note: * Refers to the act of receiving or state of being received
Source: National Resources Wales; Wales Waste Finance report; Welsh local government; L.E.K. interview and analysis

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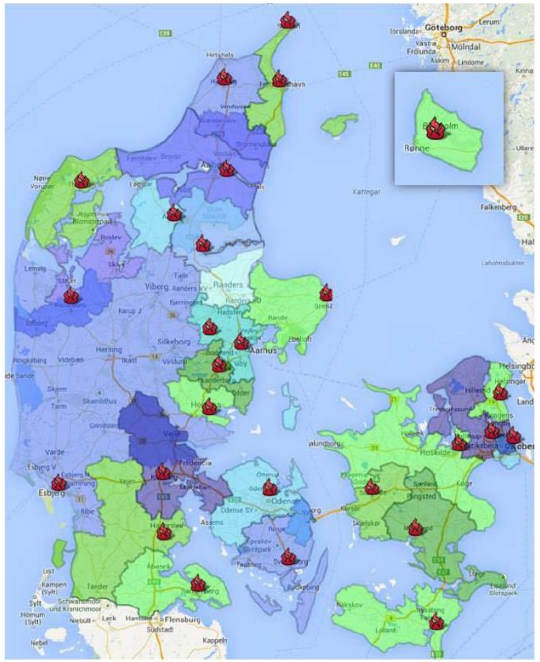
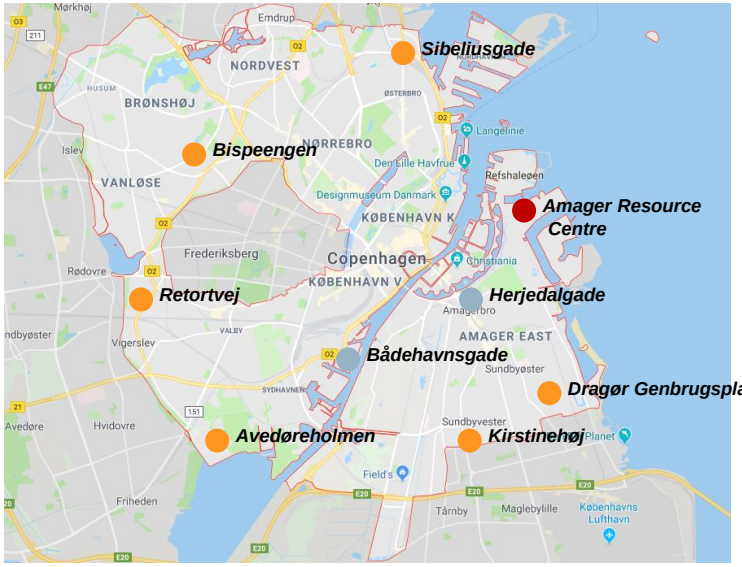
Incineration is the main source of household waste treatment in Denmark with nearly 30 waste-to-energy facilities across the country

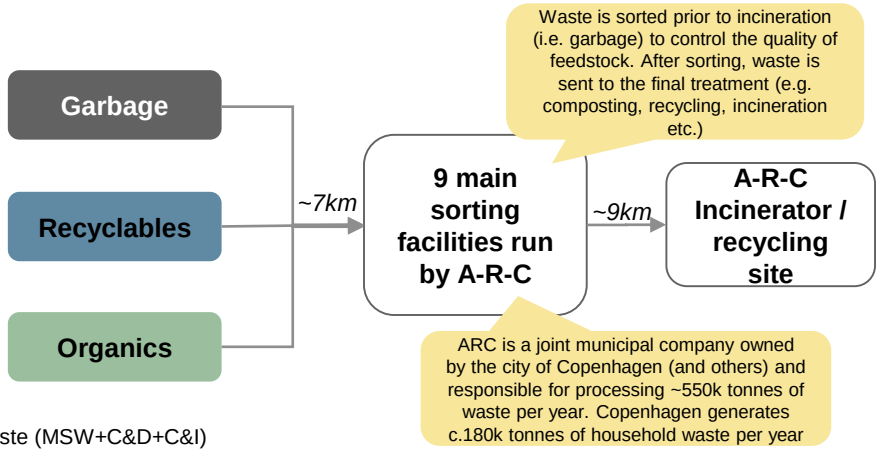
Waste-to-energy plants and area of collection



- In 2015 Denmark had 27 waste-to-energy dedicated facilities of which 21 were publicly owned by municipalities and 6 owned by energy companies
- Facilities are normally situated close to waste generation sources and are size matched to the district heating demand of those cities

Example: Copenhagen (Denmark)

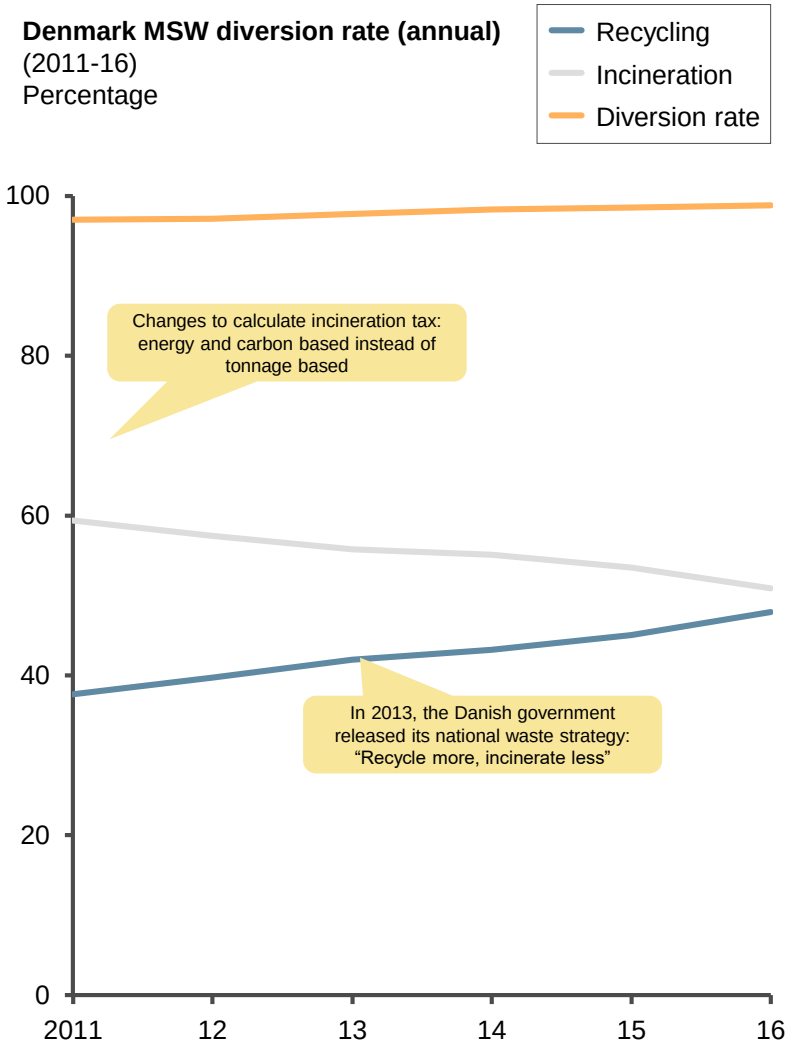




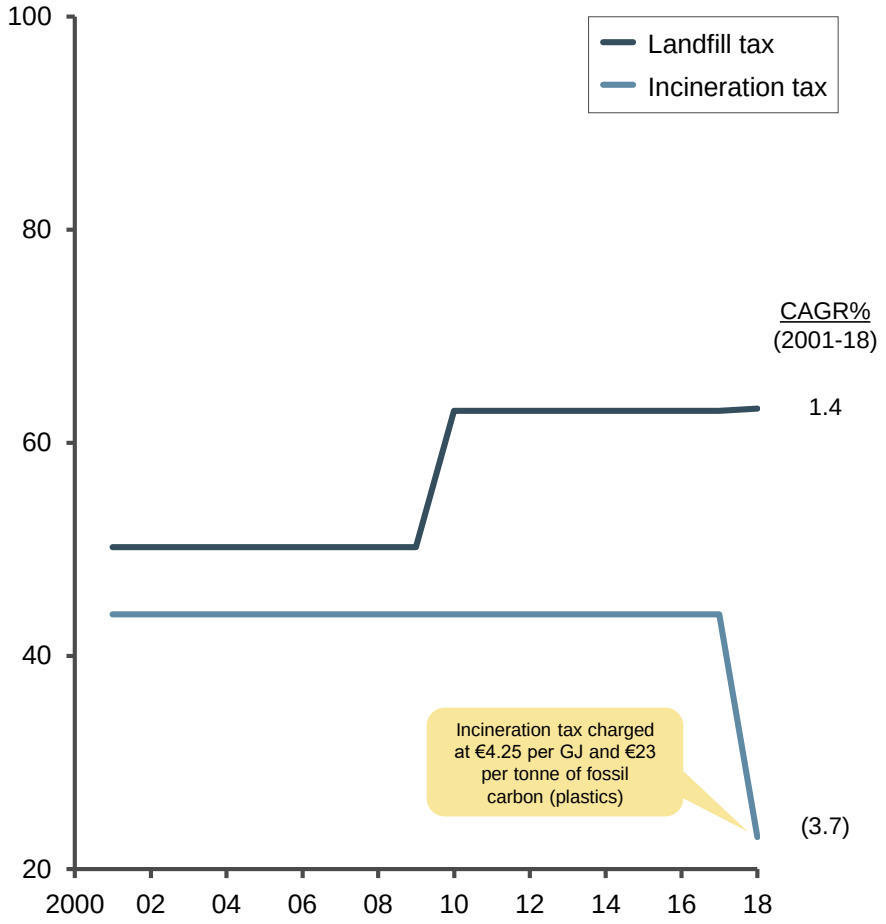
Notes: A-R-C is managed by Copenhagen municipality and is responsible for handling ~50% of total waste (MSW+C&D+C&I)
Source: Dansk Affaldsforenining 2014 report; Municipal waste Europe; A-R-C annual report; L.E.K. analysis

Danish waste policies have resulted in very high diversion rates (99%), growing recycling rates and decreasing incineration since 2011

Denmark MSW diversion rate (annual)
(2011-16)
Percentage



Denmark landfill and incineration tax rate per tonne
(2001-18)
Euro per tonne



Notes: *2016 is most recent data available for Denmark; FX 0.133 € / DKK
Source: Danish government; Nordic Council of Ministers; MSW management in Denmark; Danish waste association; L.E.K Analysis

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Three categories of metrics are typically used to monitor supply chain performance

Cost

- Key drivers include:
  - Shape of the network (number of handling nodes, distance between nodes)
  - Cost to transport waste on a per kilometer / ton basis
  - Capacity of trucks / type of trucks
- Cost of transport is very important in waste:
  - A low cost supply chain gives more headroom to invest in superior environmental outcomes
  - The distance that waste travels (due to network shape) greatly impacts cost

Quality

- Types of Metrics:
  - Environmental outcomes (i.e., diversion rate)
  - Safety: injury rates (e.g., fatality, non-fatal injuries)
  - Reliability: e.g., number of bin collections missed
- Quality performance is of a high degree of importance to waste:
  - Safety and environmental performance are critical measures
  - Reliability of service is of lesser importance

Speed / time

- The speed / time related to the freight of waste is a function of the shape of network, size of the geography, and the degree of population concentration
- Medium degree of importance to waste
  - Notwithstanding the potential impacts in holding costs and the build up of waste along the supply chain, speed / time metrics are not typically reported across waste supply chains

Source: L.E.K. analysis

L.E.K.

Eight specific metrics were investigated for waste

		Metric type	What it is	Importance / relevance
Quality	A	***Environmental outcomes***	The proportion of waste diverted from landfill by type of waste (e.g. Garbage, Recyclables, and Organics)	A successful circular economy can be measured by the proportion of waste that is recycled, incinerated rather than sent to landfill
	B	***Safety***	Number of fatal and non-fatal injuries on a standardised basis (e.g., per 100k hours worked)	Key focus in all supply chains
	C	***Reliability***	Number of collections missed on a standardised basis (e.g., per 100k collections)	Indicator of the efficiency related to collection of waste
Cost	D	***Total waste servicing cost***	Total cost related to collection, sorting, processing, and disposal of waste	Measure of total cost to the community
	E	***Cost of freight***	Average cost of freight per ton / kilometre travelled	Measure of unit efficiency
	F	***Location of nodes***	The freight distance from collection to consolidation and consolidation to disposal / diversion	The location of critical assets drives the average distance travelled by freight modes; this becomes a key indicator at network shape & size
	G	***Number of nodes***	The number of times the waste is handled along the collection to disposal chain	Indicator of supply chain efficiency (i.e. less is better)
	H	***Modes of freight***	The mix of freight mode by trucks, trains, and ships	Each mode will have a different base efficiency, with the mix contributing to the efficiency of the entire chain

Data availability has varied across the geographies reviewed (1/2)

Metric category	Metric type	Metric Number	Metric Name	Units	Data availability				Data source
					Victoria	NSW	Denmark	Wales	
Quality	Environmental outcomes	A1	Tons of household waste / MSW generated per capita	tons/capita	●	●	●	●	• Government reported data
		A2	Household waste / MSW Diversion (from landfill) rate	%	●	●	●	●	• Analysis from publically available information
		A3	% of waste disposed through Waste to Energy	%	●	●	●	●	• Government reported data
	Safety	B1	Safety: Injury frequency rate*	# of lost time accidents*	◔	◔	○	◑	• Government reported data
	Reliability	C1	Reliability: Collections missed	% of missed bin collection**	◔	◔	○	◑	• Government reported data
Cost	Total waste servicing cost	D1	Total waste collection & disposal cost per tonne	$ / ton	●	◑	◔	●	• Government reported data • No cost data available for NSW and Denmark
	Cost of freight	E1	Total freight cost per ton	$/ton	◔	◔	◔	◔	• Analysis from publically available information and interviews
		E2-3	Light truck cost / ton / km **x** # of ton	$ / ton / km	◔	◔	◔	◔	• Analysis from publically available information and interviews
		E4-5	Heavy truck cost / ton / km **x** # of ton	$ / ton / km	◔	◔	◔	◔	• Analysis from publically available information

Source: L.E.K. analysis

● = Data collected ○ = Data unavailable

Data availability has varied across the geographies reviewed (2/2)

Metric category	Metric type	Metric Number	Metric Name	Units	Data availability				Data source
					Victoria	NSW	Denmark	Wales	
Cost	Cost of freight (cont'd)	E6-7	Rail cost / ton / km **x** # of ton	$ / ton / km	*Not applicable*	◐	*Not applicable*	*Not applicable*	• Analysis from industry reports
	Location of nodes	F1	Average distance from collection point to consolidation node	km	◔	◔	◔	◔	• Analysis from publically available information and interviews
		F2	Average distance from consolidation node to disposal point	km	◔	◔	◔	◔	
	Number of nodes	G1	Number of handling nodes	#	●	●	◔	●	• Analysis from publically available information, Industry reported data and interviews
	Modes of freight	H1	% of waste transported by mode	%	●	●	●	●	• Analysis from publically available information, Industry reported data and interviews

Note: * Number of lost time accidents per million hours worked; ** Number of kerbside garbage and recycling collection bins missed / Number of scheduled kerbside garbage and recycling collection bin lifts] x10,000

Source: L.E.K. analysis

● = Data collected ○ = Data unavailable

L.E.K.

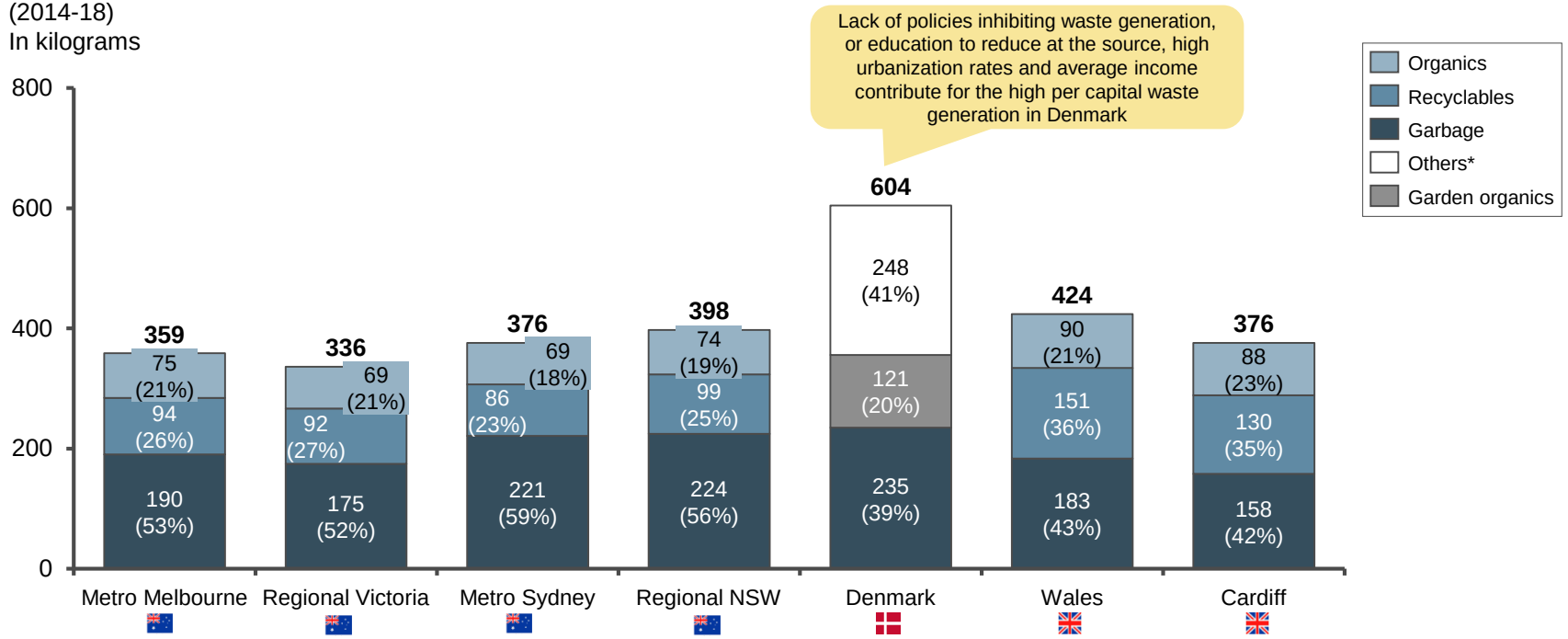
Per capita generation of household waste in VIC and NSW is lower than international comparators

A1

Quality | Cost

Per capita household waste generation

(2014-18)
In kilograms



	Metro Melbourne	Regional Victoria	Metro Sydney	Regional NSW	Denmark	Wales	Cardiff
Year of data	2016	2016	2014	2014	2016	2018	2018
Total HH waste volume	~1.7m tonnes	~0.6m tonnes	~1.6m tonnes	~1.3m tonnes	~3.4m tonnes	~1.3m tonnes	~0.1m tonnes
Population	~4.6m	~1.7m	~4.3m	~3.2m	~5.7m	~3.1m	~0.4m
Source	Sustainability Victoria	Sustainability Victoria	NSW local government	NSW local government	Danish government	Welsh government	Welsh government

Note: * Others includes batteries, tyres, waste suitable for landfill, refrigerators freon, organic waste, electronics, packaging cardboard and other cardboard, packaging glass, metals, wood, paper, waste suitable for incineration etc.

Source: Sustainability Victoria; NSW local government; The Local Denmark, Euronews; Green Biz; The Guardian, Danish government; Welsh government; L.E.K. analysis

L.E.K.

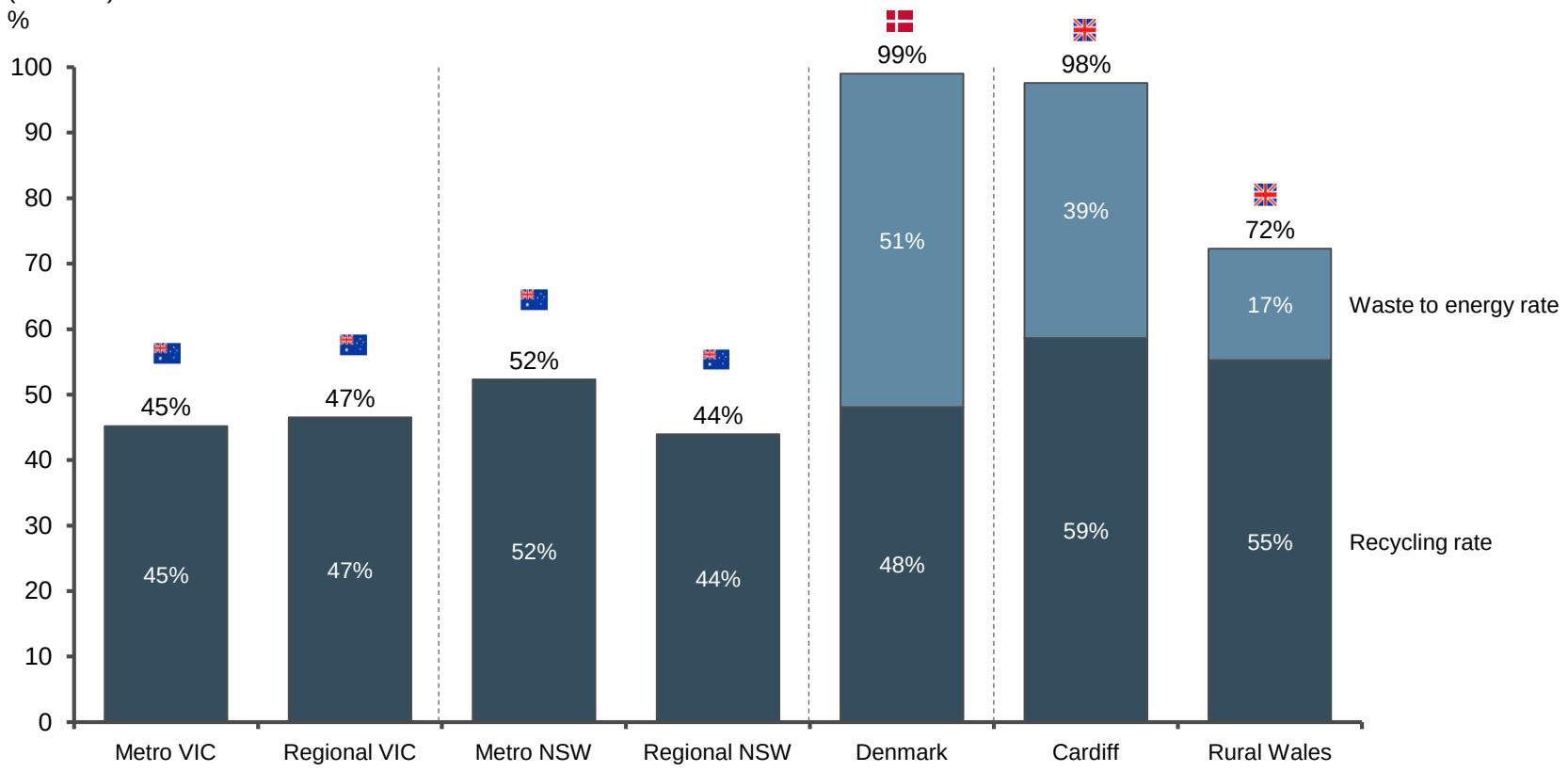
While recycling rates are broadly similar, EU comparators divert substantially more waste from landfill than Australia due to greater waste to energy conversion

A2

A3

Quality | Cost

Household waste / MSW diversion rate (from landfill)
(2014-18)
%



Year of data	2016	2016	2014	2014	2016	2018	2018

Notes: * MSW % sent to landfill and %incinerated for Wales and Cardiff
Source: Sustainability Victoria; NSW local government; The Local Denmark, The Guardian, Danish government; Welsh government; L.E.K. analysis

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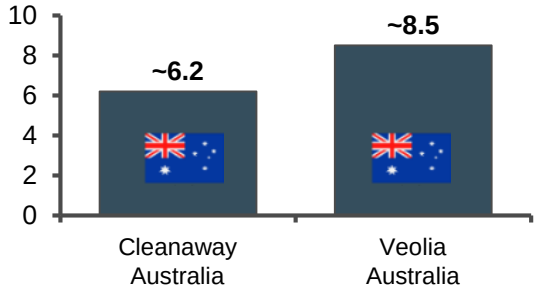
B1

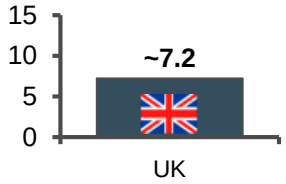
Reported safety metrics are not to readily comparable across regions

Quality | Cost

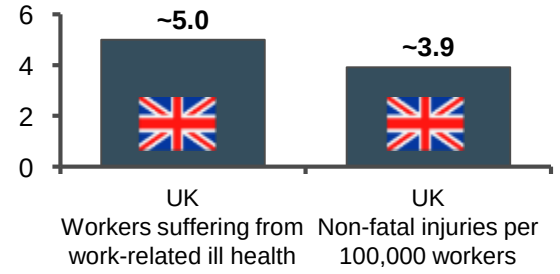
Number of lost time accidents per million hours worked
# of accidents



Fatal injuries per 100,000 workers (waste industry)
# of injuries



Non-fatal injury related metrics (waste industry)
Thousands of injuries



- Industry participants indicated that safety within the waste industry is a critical issue. The collection of household waste is a continual area of focus, with safety issues associated with the time of collections, large trucks with poor visibility in narrow suburban streets and maintaining public safety all contributing to safety outcomes

Victoria / New South Wales

- There is no waste specific safety data published at an industry level
  - Typically, listed companies publish safety data (i.e., Number of lost time accidents / million hours worked) annually which covers all of their operations

Wales:

- Safety metrics (i.e., fatality rate and non-fatal injury metrics) are available for the waste industry in the UK as a whole only
- Fatality rates in the waste industry have been 16 times higher than the average rate across all industries over the past 5 years, and is a major focus within the industry

Denmark:

- Limited data availability related to safety of the waste industry

"… The Danish government has the capabilities to monitor safety and reliability metrics, but less than 10% of municipalities do so; And even when they do, these metrics are not normally published …"
Former MD and CFO, Waste management company, September 2019

To align with global metrics, regular reporting against "fatal" and "non-fatal" metrics would better support comparisons

Notes: *Data available from 2018 utilised given data availability
Source: Health and safety waste statistics in the UK; APSE UK; Cleanaway annual reports; Veolia annual reports; L.E.K. analysis

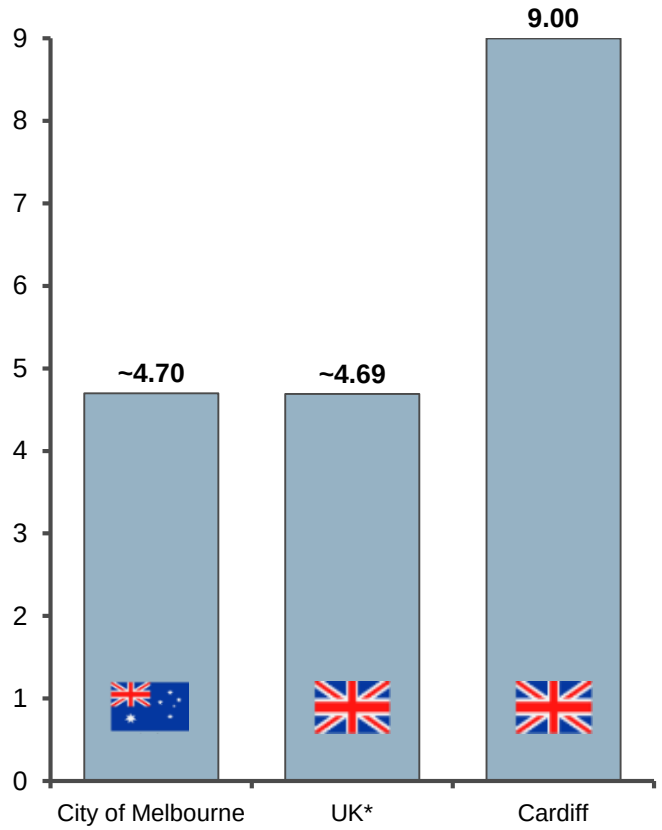
While reliability is sometimes reported in terms of 'missed collections', these metrics are not readily available or comparable

C1

Quality | Cost

Overview of available reliability metrics:

Missed collections per 10,000
Number of collection missed



NSW and Victoria

- Selected municipalities publish service level information for waste collections
  - In the City of Melbourne missed collections were c.4.7 for every 10,000 collections scheduled in 2018

Wales:

- Limited data related to reliability specifically for Wales

  "… Each council collects reliability data separately. However, the Association for Public Services Excellence does consolidate it for the UK (nationally) …"
  Former Assistant Director at the Welsh Government, September 2019

- In Cardiff missed collections were c.9 for every 10,000 in 2018, an increase of c.65% of missed collections since 2014
  - Factors such as bad weather, budget cuts and councils facilitating a streamlined complaints process have contributed to the rise

- On a national basis, the following reliability metrics are available for the UK:
  - Missed collections (4.69 for 10,000 in 2014)
  - Staff absence within the waste management industry (c.6% in 2014)
  - Households covered by recycling collections (c.99.8% in 2014)

Denmark:

- Reliability data is not published

Notes: * UK data (2014) utilised given data availability
Source: Health and safety waste statistics in the UK; APSE UK; Office for National Statistics; BBC; L.E.K. analysis

L.E.K.

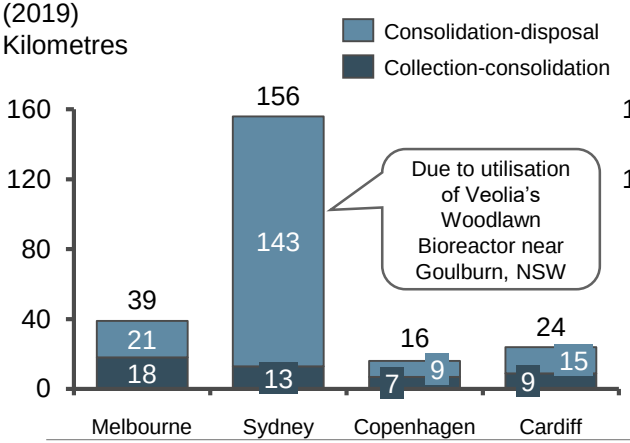
The location of waste facilities, and shape of the networks in Melbourne and Sydney, lead to waste travelling greater distances

F1

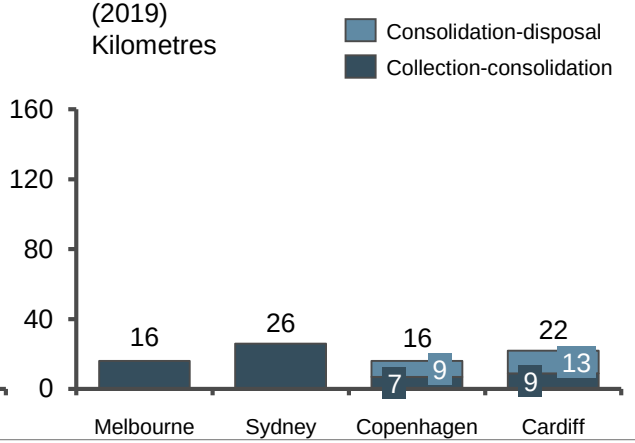
F2

Quality | **Cost**

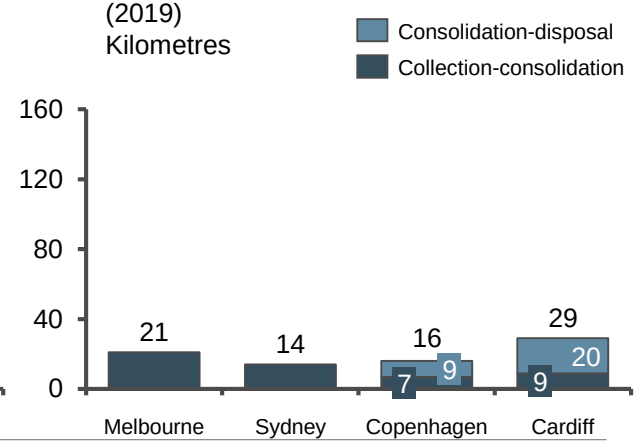
Total average distance for household garbage transportation
(2019)
Kilometres



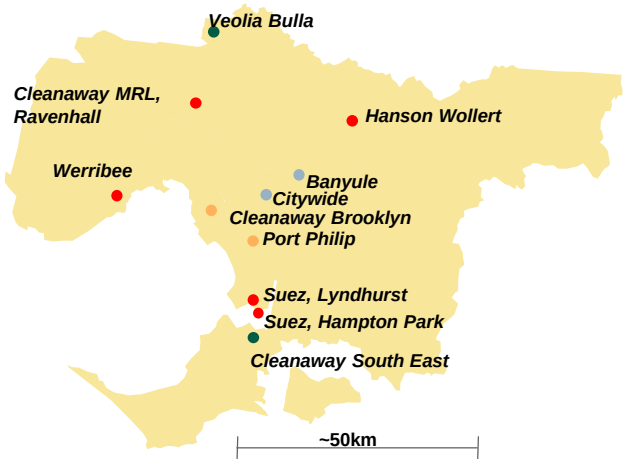
Total average distance for household recyclable transportation
(2019)
Kilometres



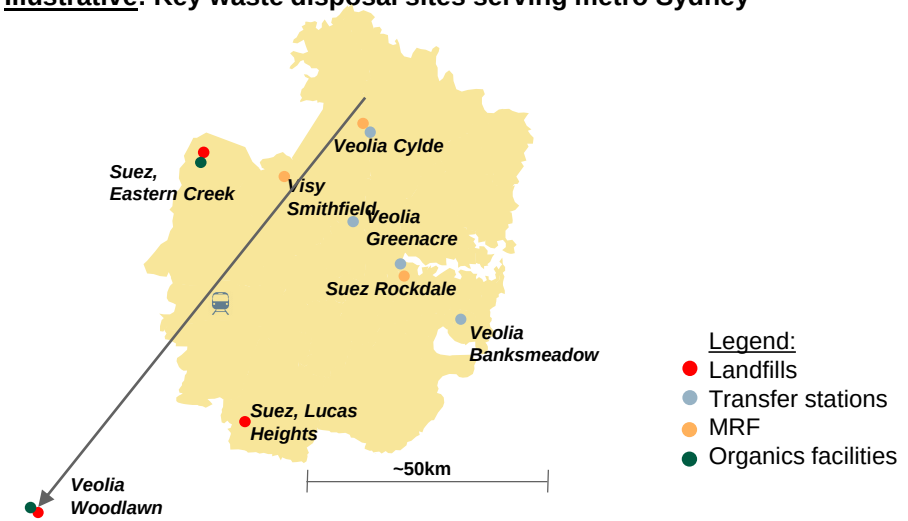
Total average distance for household organics transportation
(2019)
Kilometres



Illustrative: Key waste disposal sites serving metro Melbourne



Illustrative: Key waste disposal sites serving metro Sydney



Note: * Banyule, Casey, Darebin, Greater Dandenong, Frankston, Manningham, Whittlesea, Wyndham, and Yarra local councils utilised a sample; ** Penrith, Campbelltown, Randwick, Ryde, Canada Bay, North Sydney, and Lane Cove local councils utilised as a sample

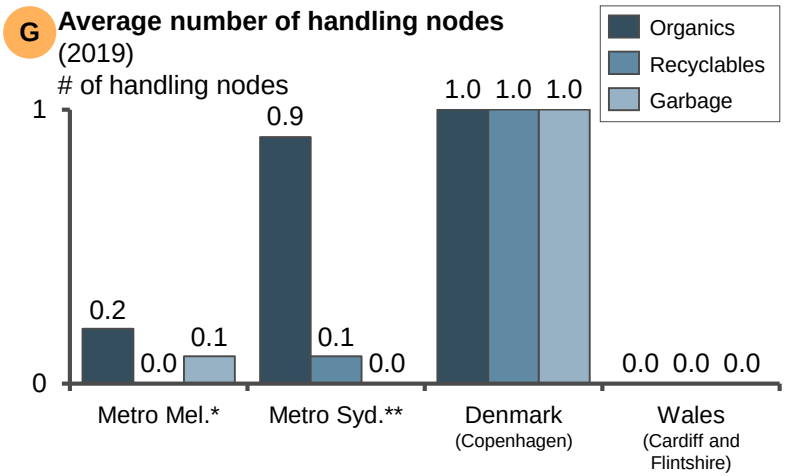
Source: Sustainability Victoria; NSW local government; The Local Denmark, The Guardian, Danish government; Welsh government; L.E.K. analysis

L.E.K.

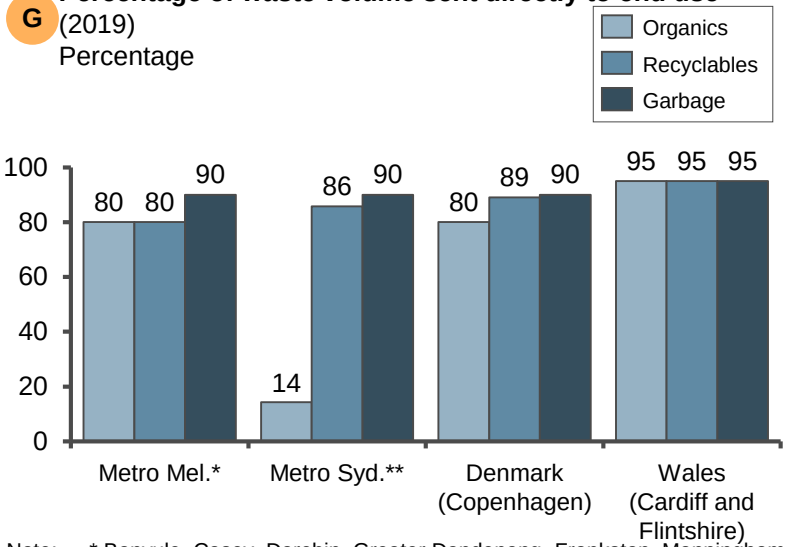
Melbourne's local councils, (like comparable geographies) tend to utilise more direct to final destination" model vs. a consolidation model in Sydney

Quality | **Cost**

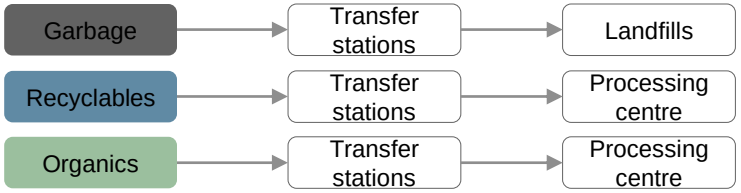
G **Average number of handling nodes**
(2019)
# of handling nodes



G **Percentage of waste volume sent directly to end use**
(2019)
Percentage



Example flow 1: Consolidation at transfer stations



Example flow 2: Direct to final destination

The direct model is more common among Metropolitan Melbourne

Example flow 3: Drop-off hybrid model in (Denmark) Copenhagen

~20% of waste being dropped off by consumers / households rather than collected

Note: * Banyule, Casey, Darebin, Greater Dandenong, Frankston, Manningham, Whittlesea, Wyndham, and Yarra local councils utilised a sample; ** Penrith, Campbelltown, Randwick, Ryde, Canada Bay, North Sydney, and Lane Cove local councils utilised as a sample
Source: L.E.K. analysis

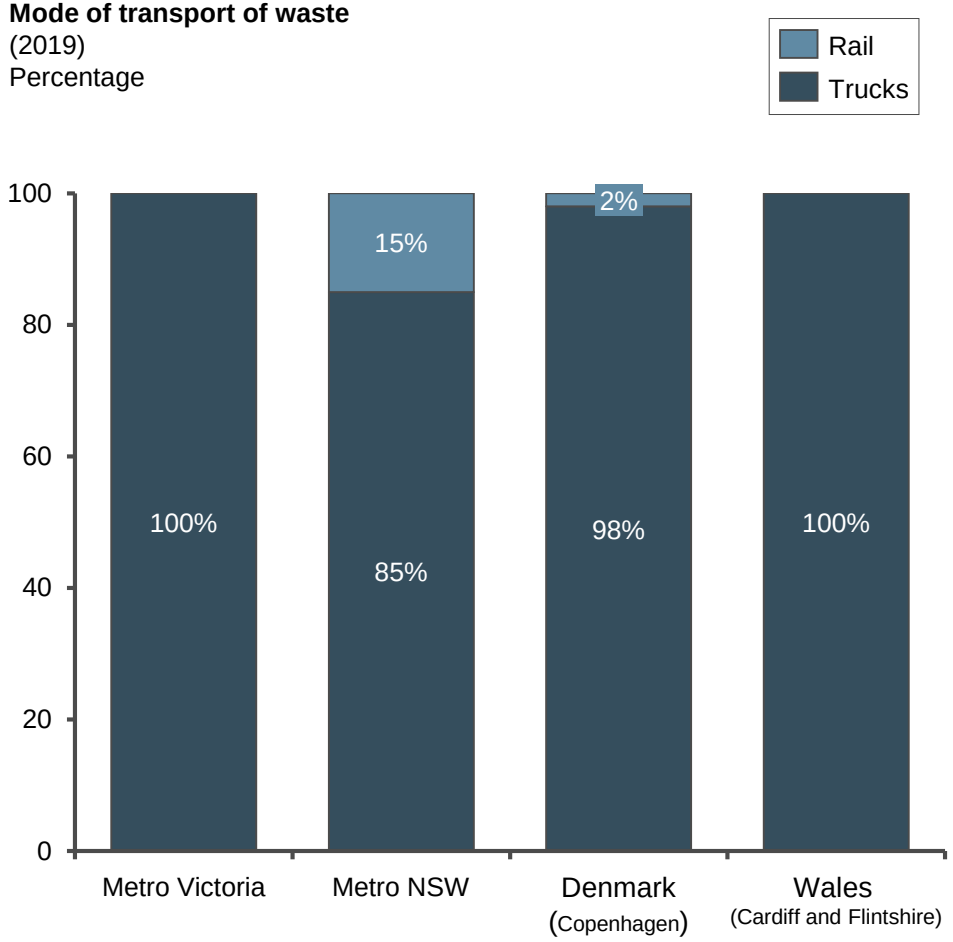
L.E.K.

Trucks are typically the preferred mode of freight for household waste within the comparator set

H1

Quality | **Cost**

Mode of transport of waste
(2019)
Percentage



Metro New South Wales:

- The majority of household waste is transported by trucks. However, c.752k tonnes p.a. of waste is moved via train to Veolia's Woodlawn Bioreactor near Goulburn (estimated to account for ~10-20% of Sydney's waste)

Denmark:

- Trucks are utilised for all freight of waste in Denmark except for a marginal proportion sent by train to be incinerated in Germany

Wales:

- The vast majority of household waste is transported by truck

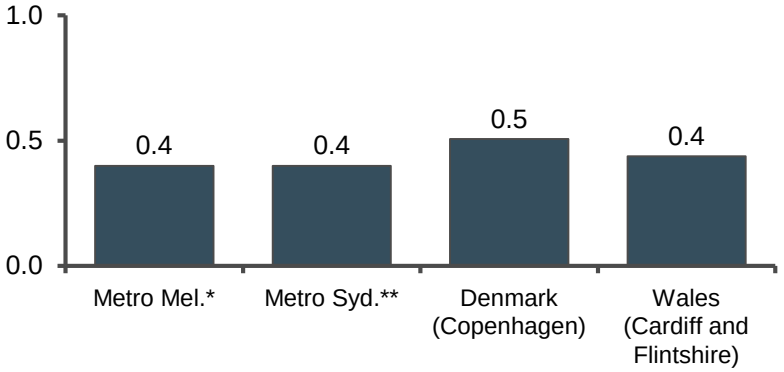
Source: Sustainability Victoria; NSW local government; The Local Denmark, The Guardian, Danish government; Welsh government; L.E.K. analysis

L.E.K.

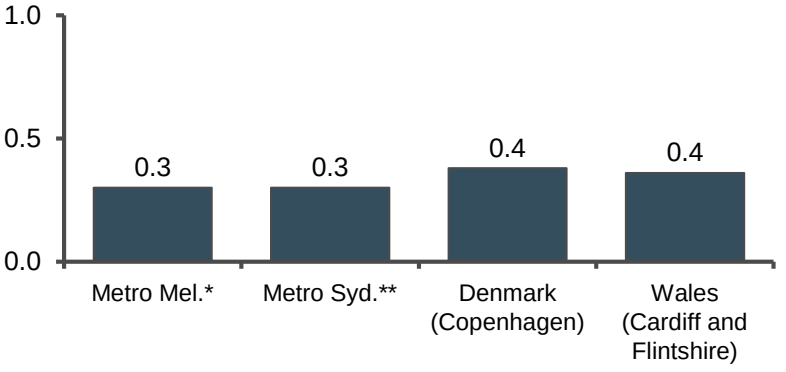
Unit cost data is not publically available, but has been assembled via interviews with industry participants. Australian cities appear efficient on unit costs

Quality | **Cost**

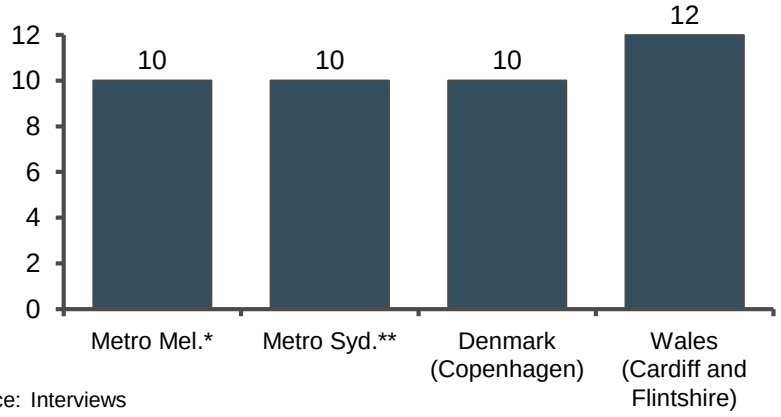
E2 **Estimated cost per ton per kilometre of household waste (Uncompacted waste on collection trucks)**
(2019)
AUD



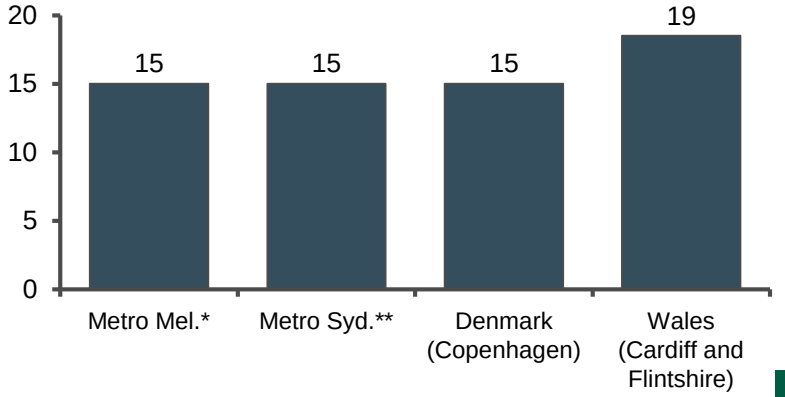
E4 **Estimated cost per ton per kilometre of household waste (Semi - Compacted waste on long haul trucks)**
(2019)
AUD



E3 **Estimated average number of tons per truck (light trucks)**
(2019)
Tons



E5 **Estimated average number of tons per truck (heavy trucks)**
(2019)
Tons



Source: Interviews

L.E.K.

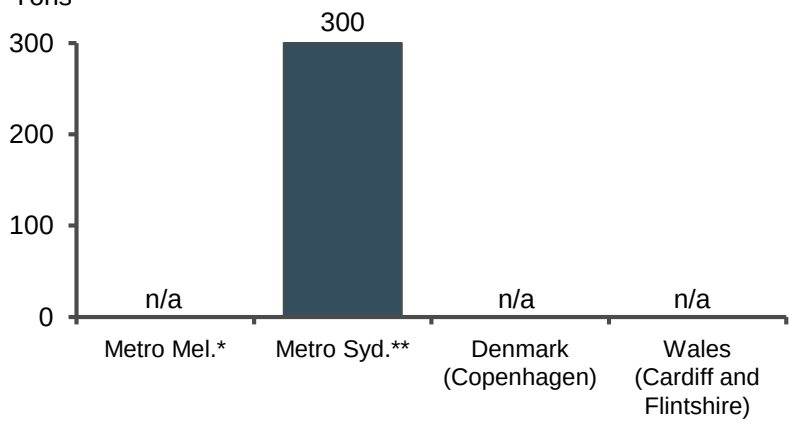
The cost/ton/km of rail transport is significantly lower than road transport, however this will vary considerably by distance transported

Quality | **Cost**

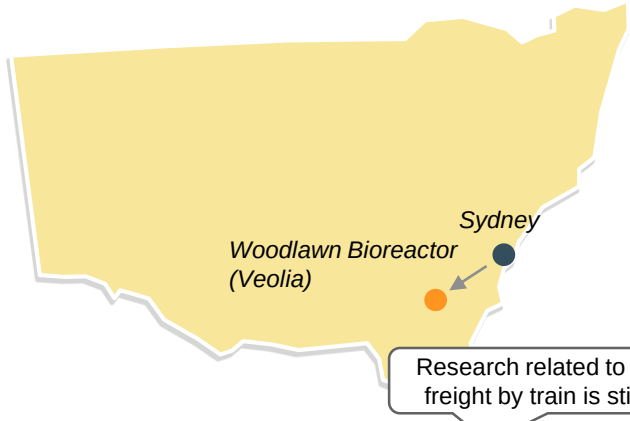
E6 **Estimated cost per ton per kilometre of waste by type (trains)**
(2019)
AUD

	Metro VIC	Metro NSW	Denmark (Copenhagen)	Wales (Cardiff)
Cost per ton per kilometre	***n/a***	***$0.05-0.1***	***n/a***	***n/a***

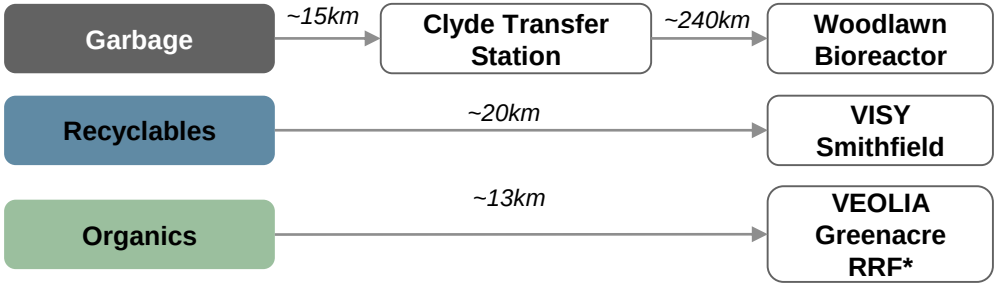
E7 **Estimated average number of tons per train**
(2019)
Tons



Location of key garbage disposal facilities via train freight in NSW:



Example: Canada Bay Council (New South Wales)



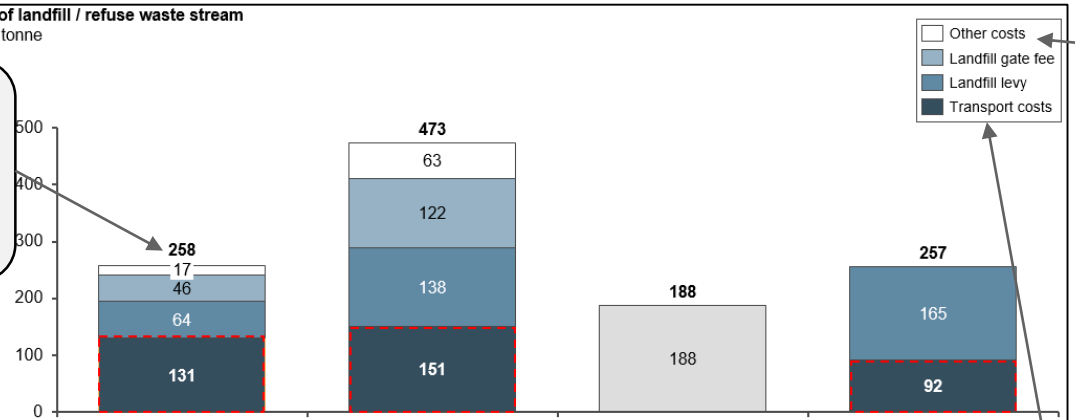
- In NSW, c.10-20% of household waste generated is transported via train to Veolia's Woodlawn Bioreactor for processing and disposal

Notes: MSW density ~240-415 kg/m3; Volume per container 32,000 ft3
Source: EPA Victoria; Veolia website; Local Government Councils; L.E.K. interviews and analysis

An aggregate cost has been used to assess the waste supply chain holistically. Some interpretative considerations are important

Quality | **Cost**

Total cost of landfill / refuse waste stream
In AUD per tonne



Key facts

	Metro VIC	Metro NSW	Denmark (Copenhagen)	Wales (Cardiff)
Average total distance	~39 km	*~156 km*	*~16 km*	*~24 km*
Total volume refuse	~910k tonnes	*~770k tonnes*	*~138k tonnes^^*	*~180k tonnes*

Total costs indicate the end-to-end costs of collection, movement, consolidation, processing and transfer of the waste type

We have highlighted physical differences that impact the efficiency of the supply chain

Other costs include non-transport costs such as:

- Cost of operating landfills
- Cost of operating transfer stations
- Costs of operating sorting
- Costs of operating resource recovery facilities
- Costs of operating waste-to-energy facilities

Transport costs include:

- Collection and movement by:
  - heavy trucks
  - light trucks
  - rail

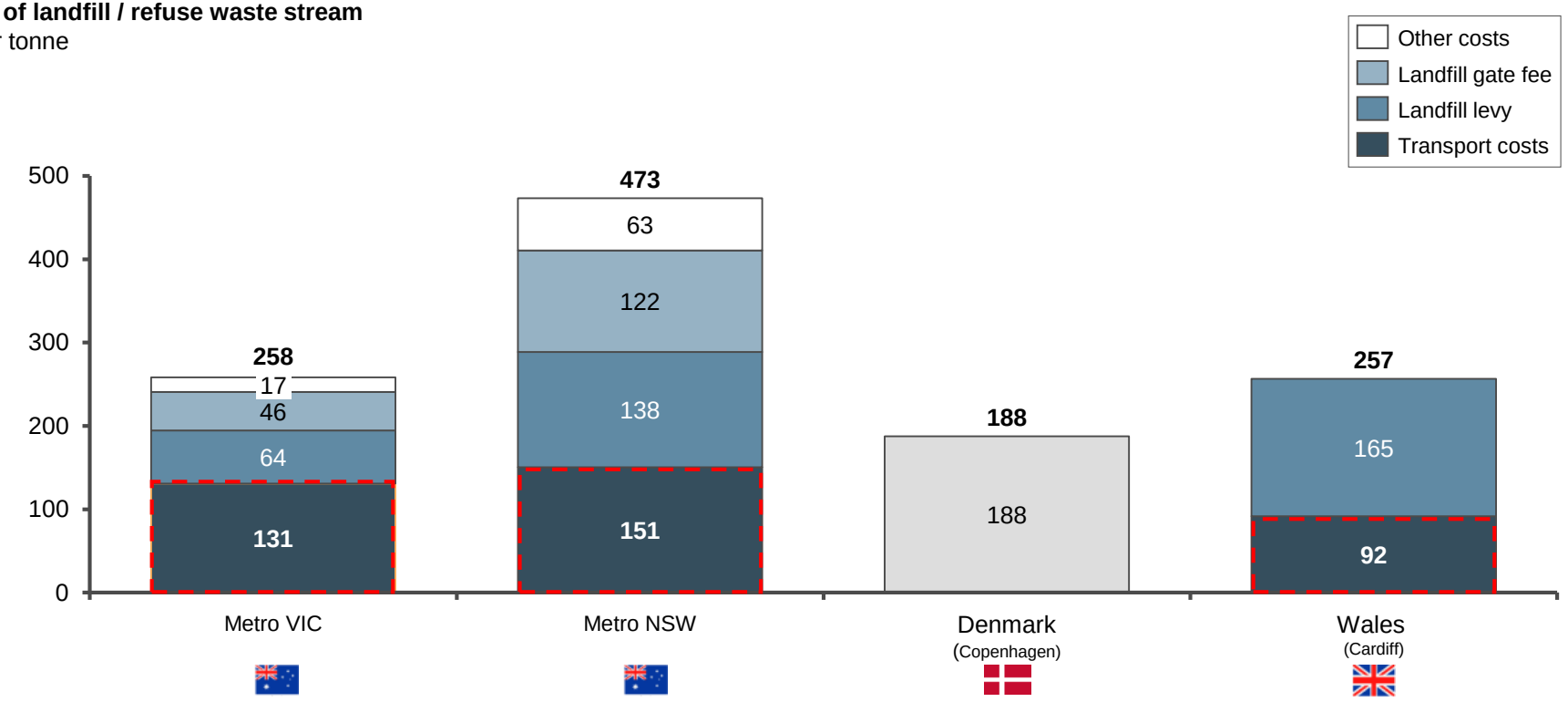
Source: L.E.K. analysis

Despite lower unit rates, transport costs across Australian landfill/refuse waste streams are higher than international examples due to longer distances

D1

Quality | **Cost**

Total cost of landfill / refuse waste stream
In AUD per tonne



Key facts

	Metro VIC	Metro NSW	Denmark (Copenhagen)	Wales (Cardiff)
Average total distance	***~39 km***	***~156 km***	***~16 km***	***~24 km***
Total volume refuse	***~910k tonnes***	***~770k tonnes***	***~138k tonnes^^***	***~180k tonnes***

Note: * GBP/AUD = 1.83 (5 year avg.); ** EUR/AUD = 1.50 (5 years avg.) *** Data availability for Denmark is low with limited breakdown; ^ Data availability of transport costs for NSW are limited; ^^ Data for Denmark due to lack of data for Copenhagen

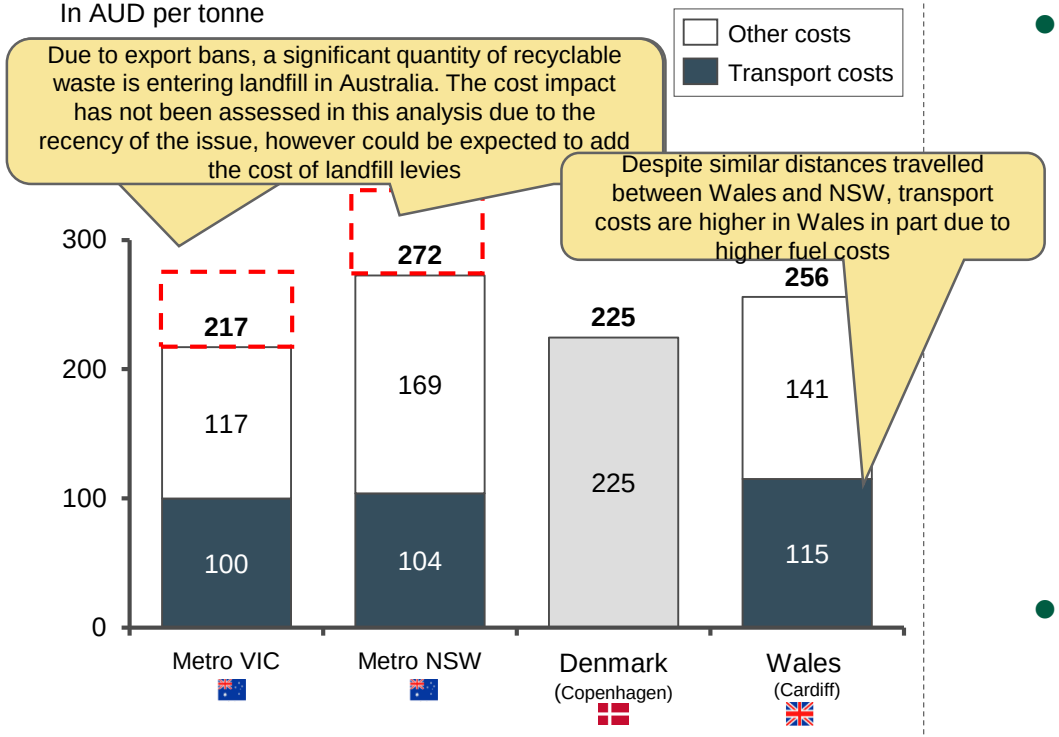
Source: Sustainability Victoria; NSW local government; The Local Denmark, The Guardian, Danish government; Welsh government; L.E.K. analysis

Transport costs for recyclables and organics are more comparable due to shorter distances

D1

Quality | **Cost**

Total cost of recyclable waste stream (Including levies)
In AUD per tonne



	Metro VIC	Metro NSW	Denmark (Copenhagen)	Wales (Cardiff)
Average total distance	***~16km***	***~26km***	***~16km***	***~22km***
Total volume recycled	***~400k tonnes***	***~340k tonnes***	***~3,400 tonnes^^***	***~134k^^ tonnes***

- The total costs across the recyclable waste streams were relatively similar, across the reviewed geographies
  - in part, this is due to the similar haulage distances as recycling and sorting facilities are less of a community impost, smaller in footprint than landfill and organics facilities, and are located closer to the centre points of waste generation
  - a cost balance exists between the advanced sorting of highly contaminated waste streams and increased source separation driving a more complex supply chain
- It is expected that the total costs in Australia under-represent the current reality, where significant volumes of recyclables are being diverted to landfill (and attracting levies) as the recycling industry manages the export bans

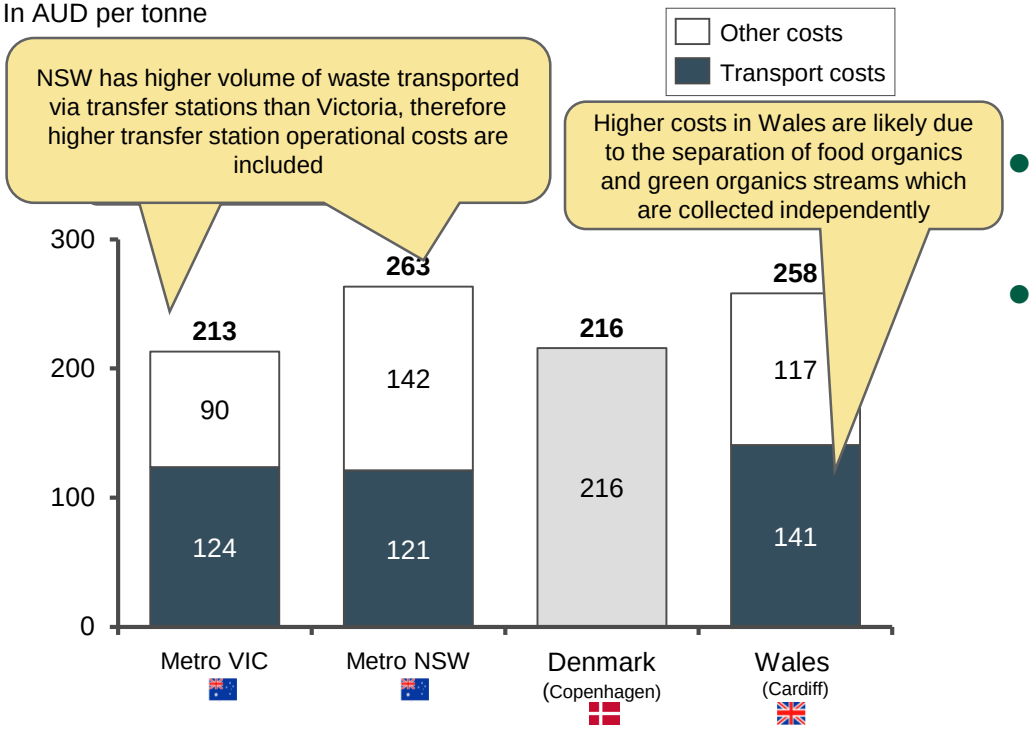
Note: * GBP/AUD = 1.83 (5 year avg.); ** EUR/AUD = 1.50 (5 years avg.) *** Data availability for Denmark is low with limited breakdown; ^ Data availability of transport costs for NSW are limited; ^^ Recycled and incinerated. Denmark volume since Copenhagen only is not available; ^^^ Including levies
Source: Sustainability Victoria; NSW local government; The Local Denmark, The Guardian, Danish government; Welsh government; L.E.K. analysis

Transport costs for recyclables and organics are more comparable due to shorter distances

D1

Quality | **Cost**

Total cost of organics waste stream (Including levies)
In AUD per tonne



	Metro VIC	Metro NSW	Denmark (Copenhagen)	Wales (Cardiff)
Average total distance	***~21km***	***~14km***	***~16km***	***~29km***
Total volume composted	***~340k tonnes***	***~280k tonnes***	***~3,400 tonnes^^***	***~34k tonnes***

- Organics facilities (particularly composting facilities) are difficult to locate within metropolitan areas due to community concerns (such as odour)
- In general, the transport related costs are similar, whereas other costs varied
  - Green waste from Metro NSW tended to be handled at more 'nodes' driving up 'other costs'
  - In Wales, green and food waste is separated in the home and collected in a separate waste stream, driving additional collection costs

Note: * GBP/AUD = 1.83 (5 year avg.); ** EUR/AUD = 1.50 (5 years avg.) *** Data availability for Denmark is low with limited breakdown; ^ Data availability of transport costs for NSW are limited; ^^^ Including levies

Source: Sustainability Victoria; NSW local government; The Local Denmark, The Guardian, Danish government; Welsh government; L.E.K. analysis

L.E.K.

Waste benchmarking findings

- Within the waste supply chain there is a trade-off between being an efficient, simple supply chain (i.e. diverting all waste to landfill only) and another with superior environmental outcomes that will likely be more complex, expensive and by some measures, inefficient. This is an important consideration

- The quality of publically available data on waste generation, processing and disposal volumes varies by region
  - there appears to be some correlation between robust data collection and improved environmental outcomes

- Outside of volume data, a more tactical approach had to be used to determine costs, quality and network shape information with data availability variable by region

- Key macro findings include:
  - Australia generates a significant amount of waste in the household by global standards but less compared to Denmark and Wales (except Metro Sydney) on a per capita basis
  - International best practice remains to avoid waste generation in the first instance, thus reducing the burden on the supply chain
  - International best practices of increased source separation earlier on in the supply chain (i.e. in the home) drives increased material handling and waste collection costs
  - Depending on the maturity of the ‘re-use’ industry, or ‘circular’ economy, increased collection costs could be partially offset if landfill is reduced, and with usable materials produced at the end of the supply chain
  - A significant determinant of the supply chain efficiency is the distance required to transport waste from collection, to consolidation to processing/disposal. Melbourne and particularly Sydney perform relatively poorly on this dimension
  - Agencies with responsibility for setting environmental targets, policy, land use regulation and planning decisions all impact the efficiency of a waste network

Waste supply chain – summary of benchmarks (1/2)

	A1 Per capita household waste volume	A2 Diversion rate	A3 Waste to Energy rate	B1 Number of lost time accidents per million hours worked	B1 Fatal injuries per 100,000 workers	B1 Non-fatal injuries	C1 Missed collections per 10,000 collections	C1 Households covered by recycling collections
Victoria (Metro Mel.)	~359kg	*~45%*	-	~6-9	*n/a*	*n/a*	~5	*n/a*
New South Wales (Metro Syd)	~376kg	*~52%*	-	~6-9	*n/a*	*n/a*	~5	*n/a*
Denmark (Copenhagen)	~604kg	*~99%*	*~51%*	-	*n/a*	*n/a*	*n/a*	*n/a*
Wales (Cardiff)	~424kg	*~98%*	*~24%*	-	~7.2	~4-5k	~9	~100%

Relative performance vs. Australia:

Disadvantaged — *Advantaged*

Note: * New South Wales per capita MSW volume data not scored given limited data comparability to other comparators' data (i.e., household waste only)
Source: Sustainability Victoria; NSW local government; The Local Denmark, The Guardian, Danish government; Welsh government; L.E.K. analysis

Waste supply chain – summary of benchmarks (2/2)

	D1 Total waste service cost per tonne AUD	E2 Cost per ton per km light trucks AUD	E3 Average tons per light truck	E4 Cost per ton per km heavy trucks AUD	E5 Average tons per heavy truck	E6 Cost per ton per km train AUD	E7 Average tons per container
Victoria (Metro Mel.)	~194-258	~0.4	~10	~0.3	~15	-	-
New South Wales (Metro Syd)	~264-474	~0.4	~10	~0.3	~15	~0.05-0.1	~300
Denmark (Copenhagen)	~188-225	~0.5	~10	~0.4	~15	-	-
Wales (Cardiff)	~244-258	~0.4	~12	~0.4	~18	-	-

	F1 Est. distance from collection to consolidation	F2 Est. distance from consolidation to disposal	G1 Number of handling nodes	H1 Mode of transport - truck reliance
Victoria (Metro Mel.)	~16-21km	~21km	~1	~100%
New South Wales (Metro Syd)	~13-26km	~143km	~1-2	~80%
Denmark (Copenhagen)	~7km	~9km	~1	~98%
Wales (Cardiff)	~9km	~13-20km	~1	~100%

Relative performance vs. Australia:

Disadvantaged — *Advantaged*

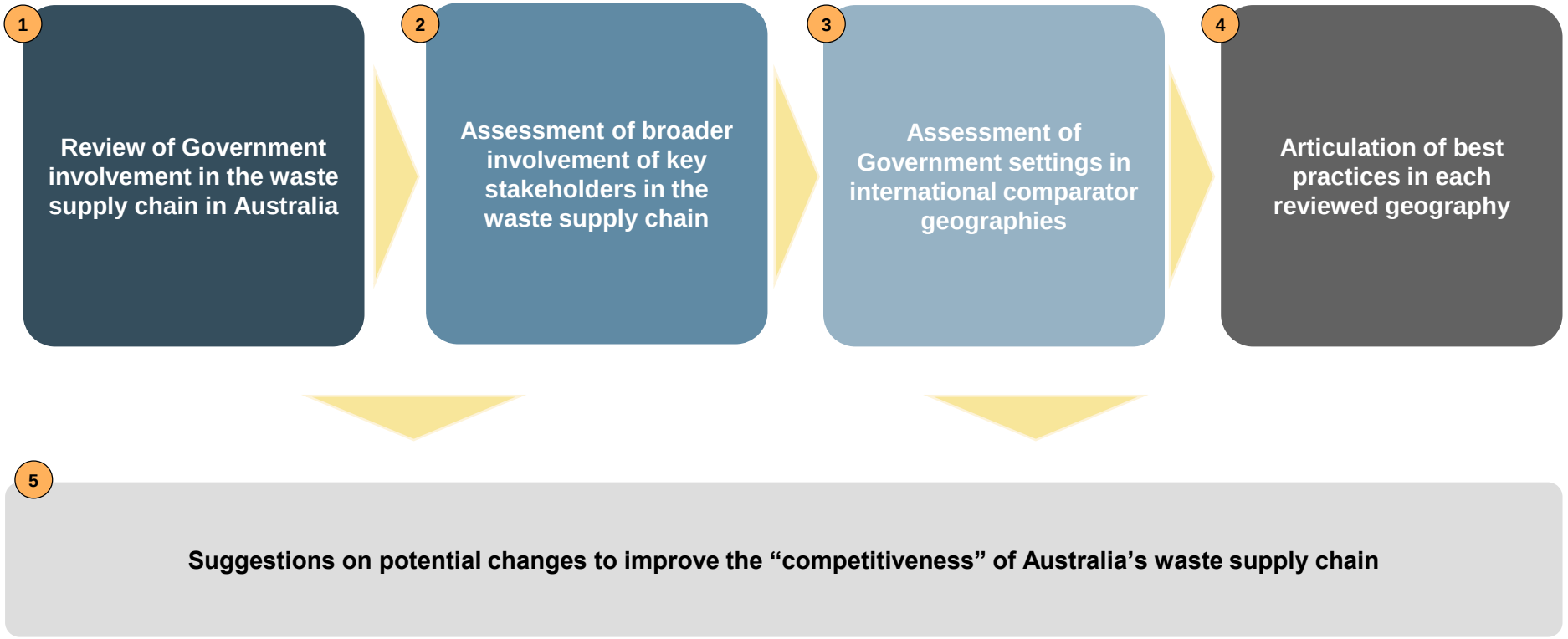
Note: * New South Wales per capita MSW volume data not scored given limited data comparability to other comparators' data (i.e., household waste only)
Source: Sustainability Victoria; NSW local government; The Local Denmark, The Guardian, Danish government; Welsh government; L.E.K. analysis

L.E.K.

Agenda

- Executive summary
- Scope and rationale for the study
- **Waste supply chain**
  - Australia
  - Global comparators
  - Freight network and supply chain metric performance comparison
  - **Freight network and supply chain planning, governance and investment comparison**
  - Identification of areas of improvement within the Australian supply chain
- Wine supply chain
- Benchmarking supply chains – An approach for further supply chains
- Next steps
- Appendix

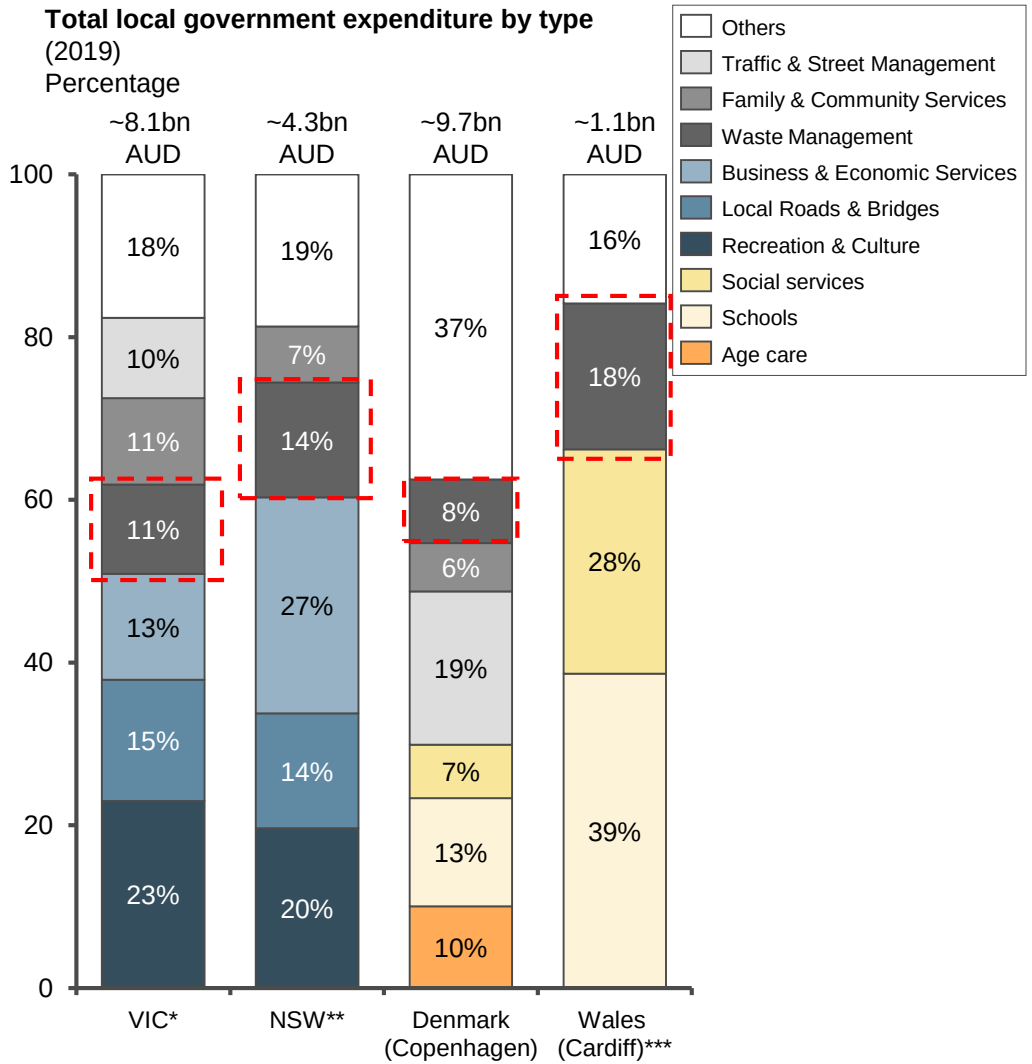
Planning, governance and investment across the waste supply chain is complex in nature. A five stage approach was used to define the landscape



L.E.K.

1 Local government usually manages the collection of household waste and it is typically their third or fourth biggest expenditure

Total local government expenditure by type
(2019)
Percentage



- Both in Australia and the comparator geographies waste management is an important service provided by local government
  - e.g. In Victoria waste services are the fourth highest budget component, behind recreation & culture, local roads & bridges and business & economic services
- Local governments play an important role in providing household waste collection and recycling services by:
  - Managing and operating landfill sites, delivering education and awareness programs, and providing and maintaining litter infrastructure
  - Providing data on the kerbside collection of packaging materials to state and territory departments and agencies
- The importance of waste to the operations of local government is significant, and drives a number of activities within councils:
  - Budgetary risk due to the changing recyclable disposal arrangements (e.g. councils are bearing the increased costs of sending recyclables to landfill as processors reject receivals)
  - Waste complaints management and handling is significant and includes reporting of illegal dumping, waste issues, noise complaints etc.
  - Councils will typically employ a waste officer / waste team responsible for improving waste outcomes and community education
- Councils across Australia typically utilize 3rd party contractors to provide waste services. Contracts are awarded as collection or disposal only, or as an end-to-end solution

Notes: *Victoria includes MSW+C&D+C&I; **NSW data from Sydney only; *** Includes waste management, highways, street lighting, economic regeneration, libraries and transport
Source: Local government report; NSW local government Acts; Local councils waste strategy; L.E.K. analysis

1

State Governments also have a range of responsibilities for waste

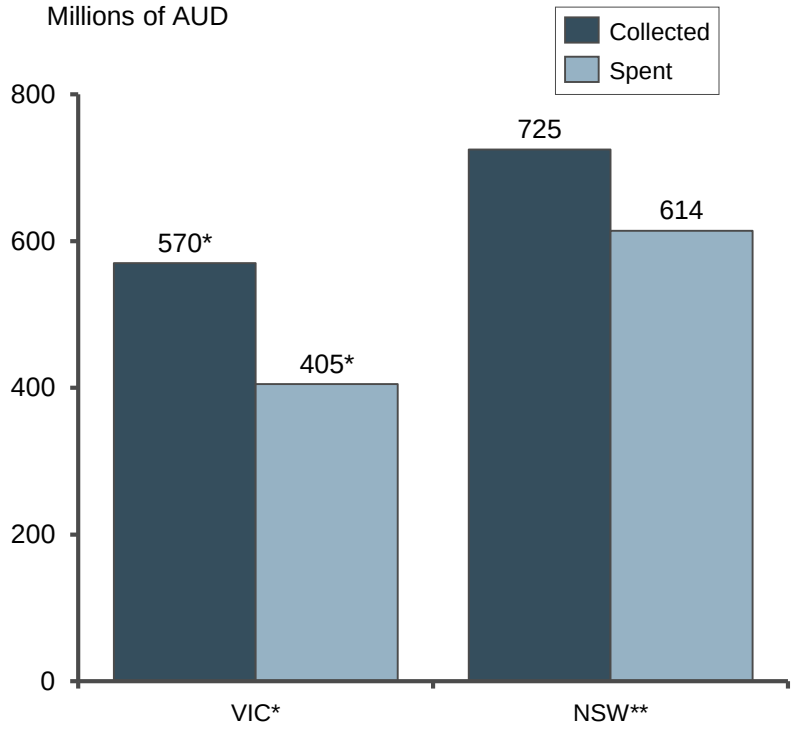
	State-based EPAs	Agencies	Others
Example Agencies	• Environmental Protection Authority (EPA) agencies (i.e. EPA NSW; EPA VIC; EPA SA; EPA EA; NT EPA)	• Sustainability Victoria • NSW Environment, Energy and Science	• Infrastructure Victoria • Victoria Grants Commission
Typical roles and responsibilities	• EPAs regulate and license waste management by: - Monitoring and assuring industry compliance - Establishing management and licensing requirements for waste facilities operators (i.e. landfill operation, processing facilities) - Defining offences and setting penalties - Defining waste levies which have the purpose of increasing recycling and limiting the need for new landfills, reducing landfill disposal and turning waste into valuable resources - Community education and awareness in relation to resource efficiency and waste management	• Agencies facilitate and promote environmental sustainability in the use of resources. Among other functions, agencies aim to: - Develop tools to measure, monitor and report on Government waste, water and energy targets - Contribute to the development of strategies and measures for the implementation of policies - Allocate budgets and administer grant programs (i.e. NSW government has allocated c.$800m over 9 years to the Waste Less, Recycle More program)	• The Victoria Grants Commission allocates financial assistance grants from the Federal Government to local councils in Victoria; and monitors net expenditures, fees and charges in the waste management industry • Infrastructure Vitoria provides advice to government on different aspects related to infrastructure, developing tools to measure, monitor and report on the required infrastructure to handle waste - The department is currently working on a report about recycling and resource recovery infrastructure in Victoria in response to the lack of recycling infrastructure

Source: Dataroom file 05; Environment Protection; Sustainability Victoria; Infrastructure Victoria; Victoria Grants commission; L.E.K. analysis

L.E.K.

1 Surpluses from waste levies collected by the states are used to fund a range of projects to improve the waste supply chain

Levies collected vs levies spent
(2016-19)
Millions of AUD



Difference between collected and spent	**~165m**	**~110m**
Year	2016-18	2017-18

- In Victoria, levies are allocated to the sustainability fund to invest in best practices in waste management and community action or innovation in reduce greenhouse gas emissions
- In NSW, any surplus from waste operations is held as a restricted asset to fund future capital expenditure or process improvements to domestic waste collection
  - Part of the surplus is used for educational projects, to reduce waste in junior schools as performed by the Blacktown City Council, however this represents a small portion of the total amount collected
  - In FY17 EPA NSW funded 356 projects in different waste initiatives but the funding amount was c.$18m

Examples

Love Food Hate Waste ~$35m over 4 years

Roadside litter ~$30m over 4 years

Innovation in mattress recycling~$5m over 4 years

Notes: * HH waste in metro Victoria; Figures for levies collected and levies spent are 2017-18 and 2016-17 data, respectively; ** Total waste expenditure in metro NSW estimated based upon most recent annual reports from ~38 local councils representing metro Sydney
Source: Victoria Local Government report; BBC; Welsh government; Victoria council budgets; Sydney Councils Annual reports; Budget Victoria;; NSW EPA; L.E.K. analysis

L.E.K.

While the Commonwealth government does not possess constitutional authority, different departments and agencies provide leadership at the national level

1

Department of the Environment	• The National Waste Policy, developed by the department, provides a national framework for waste and resource recovery in Australia outlining roles and responsibilities for collective action • The policy sets clear directives underpinning waste management including: - Waste avoidance, improving of resource recovery, increasing use of recycled material and building demand and markets for recycled products, better managing material flows and improving information to support innovation, guide investment and enable informed consumer decisions
Department of Infrastructure, Transport, Cities and Regional Development	• The department provides strategic policy advice to assist the government to shape the framework underpinning road, rail, maritime and aviation transport in Australia which indirectly impact the waste supply chain, given cost of freight is one of the main cost components • The Australian Government committed to developing a National Freight and Supply Chain Strategy to increase the productivity and efficiency of Australia's freight and supply chains • Governments play a central role in the long-term planning, provision and management of transport networks that service Australia's growing freight task
Office of the Prime Minister	• The Morrison Government is taking practical steps toward a cleaner environment with a new $20 million commitment for innovative projects to grow Australia's domestic recycling industry. This initiative is aligned with the commitment to work with states to establish a timetable to ban the export of waste *"… By engaging industry and researchers we can make sure we're seeing these changes introduced in a way that cuts costs for businesses and ultimately even creates jobs. …"* *Prime minister, September 2019*
Infrastructure Australia	• Infrastructure Australia has responsibility to strategically audit Australia's nationally significant infrastructure, and develop 15 year rolling infrastructure plans that specify national and state level priorities - The 2019 Audit covers transport, energy, water, telecommunications and for the first time, waste and social infrastructure
CSIRO	• As part of a broader project the CSIRO has mapped supply chains and modelled the transport cost savings available using inland rail. The purpose of this is to develop better understanding of the supply chain impacts and benefits of inland rail freight, including waste transported in that corridor

In addition, the Commonwealth government ensures compliance with international treaties and co-ordination across all parts of the government

Source: Department of Infrastructure and Regional Development; Infrastructure Australia; Department of the Environment and Energy; Prime minister of Australia website; L.E.K. analysis

L.E.K.

2 The responsibility (direct and indirect) across the waste supply chain in Australia is diffuse. Relatively few levers impact supply chain efficiency directly (1/3)

Valid Australian (Commonwealth) laws will prevail if in conflict with state or LGA laws / legislations

	Household			Collections					
	Community education	Bin configuration and pick up frequency	Bin volume / size	Type of trucks	Truck registration	Truck design requirements	Time / day of collections	Collection route	Road design / maintenance
Transport Policy, Planning or regulation				LGA own truck fleets in some instances	State transport authorities manage truck registrations	The Australian Design Regulations (ADRs) are set by DIRDC	LGAs specify the windows for collection timing through procurement of collection services	Collections managed by LGAs define optimal routes	LGAs manage 70% of roads State Transport and Fed departments manage major network
Environment / land use Policy, planning or regulation	Multiple bodies (e.g. LGAs, peak bodies, EPAs) conduct education / awareness programs	LGAs specify number of bins and collection frequency	LGAs dictate the size of the household bins						
Public Infrastructure									
Private Infrastructure / Operations				Private contractors win contracts and fulfil with own fleet			Private contractors have some flexibility within windows	Collections managed by private contractors define optimal routes	
Relative impact on supply chain quality (i.e. environmental outcomes)	◕	◕	◑	◔	○	◔	○	○	○
Relative impact on overall waste management cost	◔	◑	◔	◔	◔	◔	◔	◕	◔
Relative impact on logistics costs	◔	◕	◑	◑	◔	◔	◑	◕	◔

Greater source separation requires more (or different) trucks on the road. More separation drives additional logistics routes, but improves environmental outcomes. Inconsistencies in approach across LGAs drives inefficiency further down the supply chain.

Optimisation of collection routes is a key driver of logistics costs

○ Low relative cost

● High relative cost

2 The responsibility (direct and indirect) across the waste supply chain in Australia is diffuse. Relatively few levers impact supply chain efficiency directly (2/3)

Valid Australian (Commonwealth) laws will prevail if in conflict with state or LGA laws / legislations

	Aggregation		Long Haul Transfer		Sorting	
	Transfer station licensing/ location	Transfer station operations	Road load limits	Waste distance requirements	Diversion targets	Sorting facility licensing and location
Transport Policy, Planning or regulation			LGA's, State and Federal transport authorities define the load limits			
Environment / land use Policy, planning or regulation	The location of transfer stations is driven by EPA requirements, state and local planning authorities and community sentiment			The distances that waste can travel are restricted in some jurisdictions by EPA regulations	Federal Department of Environment and Energy are in the process of setting national targets. State governments and LGAs may also set its' own targets	The location of transfer stations is driven by EPA requirements, state and local planning authorities and community sentiment
Public Infrastructure		LGA may operate their own transfer station				
Private Infrastructure / Operations		Private operators may operate LGA owned stations, or operate their own				Private operators may operate LGA owned sorting facilities, or operate their own
Relative impact on supply chain quality (i.e. environmental outcomes)	●	●	○	◔	●	●
Relative impact on overall waste cost	◕	◑	◔	◕	◕	◕
Relative impact on logistics costs	◕	◔	◔	◕	◔	◕

Transfer stations located close to the waste generation source allows freight to be transferred from higher cost light trucks, to lower cost long haul trucks

In NSW, legislation restricting the distance and modes that waste can travel has had an impact on the shape of the supply chain

Storing facilities located at lower distances to the waste generation source drive more cost effective outcomes

○ Low relative cost

● High relative cost

2 The responsibility (direct and indirect) across the waste supply chain in Australia is diffuse. Relatively few levers impact supply chain efficiency directly (3/3)

Valid Australian (Commonwealth) laws will prevail if in conflict with state or LGA laws / legislations

	Resource Recovery			Disposal				
	Export rules	Contamination level requirements	Site Location	Landfill operations	Landfill annual capacities	Landfill location	Landfill levies	W2E standards / requirements
Transport Policy, Planning or regulation								
Environment / land use Policy, planning or regulation	Export rules have been agreed on by COAG and will be implemented at a state level		The location of transfer stations is driven by EPA requirements, state and local planning authorities and community sentiment	License for landfill operations are provided by EPA agencies (i.e., state governments)	Landfill annual capacities are set as part of state based EPA licencing requirements	The location of landfills is driven by EPA requirements, state and local planning authorities and community sentiment	Landfill levies are set and administered by state governments. Levies collected typically enter a recycling fund.	Licencing, policy and regulation for waste to energy is typically set by the EPA
Public Infrastructure								
Private Infrastructure / Operations		Private Operators or Local Councils will set the acceptability levels of their own facilities	Private Operators may decide on optimum location for their facilities	Landfill operations are mostly managed by private operators, following guidance and levies defined by EPAs		Private operators may operate LGA owned landfills, or operate their own		
Relative impact on supply chain quality (i.e. environmental outcomes)	◕	●	◑	●	◑	◑	●	●
Relative impact on overall waste cost	◕	◑	◕	◕	◑	◕	●	◔
Relative impact on logistics costs	◔	◑	◕	◕	◔	◕	◔	◔

The export ban on co-mingled recycling and lack of local recycling markets has caused increased waste flows to landfill

Location of end destination facilities drives the distance travelled and the efficiency of the overall network

○ Low relative cost

● High relative cost

3

The management of waste in both Denmark and Wales flows from high level European Union directives, in a manner that is more consistent than in Australia

	Denmark	Wales
European Union	• The European Union sets the basic concepts and definitions related to waste management such as the definition of waste, recycling and recovery. The EU directives issues that member states adopt waste management plans and waste prevention programmes • The last directive from 2010 proposed recycling and recovery targets to be achieved by 2020 including: - 50% recycling rates by 2020 - 10% max. to be landfilled by 2026	
National level	• The Danish Environmental Protection Agency is responsible for the macro regulation and adaption of European directives into local practices. The national strategy is not mandatory at the local level, but achieves a high compliance level • The agency defines the national strategy and performs activities including: - Data collection - Inspecting incineration facilities - Defining statutory orders on waste (i.e. assigning the obligation of local authorities to manage waste)	• The Welsh government is responsible for setting policies and targets for councils and businesses in order to comply with European Union directives. Under the 2010 waste strategy *'Towards Zero Waste'*, the Welsh Government has an aspiration to reach 100% recycling rate by 2050, with a statutory target for municipal solid waste • Natural Resources Wales measure waste flows on behalf of the Welsh government and assists Local Authorities (LAs) to continually improve the accuracy of reported end destinations • Welsh government co-invests with LAs in order to increase the industry efficiency (e.g., Incinerator gate fees subsidized to assist with achieving targets)
Local level	• Local Governments have autonomy on a local level and perform activities including: - Local regulation - Assignment of waste for incineration and landfilling - Inspections of waste producers and treatment facilities - Ownership of incineration plants and landfills - Waste collection	• LAs implement the strategy with autonomy on how to pursue the targets (e.g. some LAs use contractors to collect waste, some manage the operations themselves etc.) • LAs are responsible for activities including - Local regulation - Assignment of waste for incineration and landfilling - Ownership of incineration plants and landfills

Source: Copenhagen waste report; Welsh government; European Commission; Nordic council of Ministers; L.E.K. interviews; research & analysis

L.E.K.

4 A range of waste "best practices" were observed across the geographies reviewed (1/3)

Policy type	Description	Copenhagen	Wales	Metro VIC	Metro NSW	Examples of policies in operation	Impact on freight efficiency	Impact on env. outcomes
Waste management targets	• Definition of environmental outcomes targets (e.g. diversion rate)	✓	✓		✓	• **Copenhagen** and **Cardiff** adopt European Union directives and targets, aiming to recycle 65% of household waste and reduce landfill to a maximum of 10% by 2035 • In Australia, **NSW** plans to increase landfill waste diversion to 75% by 2022 and increase recycling rates for MSW to 70% while **Victoria** has no numerical targets included in its waste plan strategy	◔	◕
Ban on landfilling of biodegradable waste	• Adopting landfilling bans of waste that can be composted / incinerated	✓				• **Copenhagen** only landfills ~1.8% of the total amount of waste and none of it is biodegradable waste • The EU landfill directive places a statutory obligation on **Wales** to reduce the amount of biodegradable waste sent to landfill	◑	◕
Landfill tax/levy	• Charging a levy based on volume of waste landfilled	✓	✓	✓	✓	• Comparable geographies impose a uniform tax on landfill per tonne. In **Australia**, levies are different per state with NSW currently imposing the highest levy, leading to unnecessary movement of waste	◕	◕
Mandatory separation of waste prior to collection	• Source separation of waste by type (e.g. recyclable, residual, organics etc.)	✓	✓	✓	✓	• **Copenhagen** adopts source-separation of a large number of materials with different bins for each type, including small electronics, metals, plastics, paper, cardboard and residual waste • **Cardiff** provides the five-bin sourcing type with bins for recycling, general waste, food, glass and garden organics. Incorrect source separation results in fixed penalty notice of up to £100 • In **Australia**, most states adopt the three-bin source separation system with some councils adopting four- and five-bin source separation. There is no national directive and each council is independent to choose which kind of separation to adopt	●	●
Bio-waste specific collection	• Food organics and Garden organics source separation and collection	✓	✓			• **Copenhagen** and **Cardiff** provide a separate collection service for bio-waste to all residential buildings • There are some trials to collect bio-waste separately in **Victoria** and **NSW** but still at initial stages	◑	◑
Carbon emissions	• Targets to reduce the waste supply chain footprint		✓			• **Wales** climate change strategy sets targets to reduce carbon emissions from the waste sector	○	◕

Source: Nordic Council of Ministers; Wales Online; Cardiff council; Welsh government; UK EPA; United Kingdom House of Commons; European Commission; Copenhagen Post; CEWEP; L.E.K. analysis

4 A range of waste "best practices" were observed across the geographies reviewed (2/3)

Policy type	Description	Copenhagen	Wales	Metro VIC	Metro NSW	Examples of policies in operation	Impact on freight efficiency	Impact on env. outcomes
Packaging waste	• Policies regarding packaging (e.g. plastics, papers etc.)		✓			• In **Wales**, businesses that put packaging on the market have to meet packaging recycling targets under EU and UK legislation	◔	◑
Recycling stations	• Drop-off stations for Household waste	✓	✓	✓	✓	• **Copenhagen** has 5 large stations accessible by car where residents can bring 32 fractions of source-separated waste and 5 small stations, accessible on foot or by bike, receiving 11 material streams • Every council in **Wales** has fixed sites known as civic amenities or household waste recycling centre where residents bring their waste • Both metro **NSW** and **Victoria** have recycling drop-off points but operate mostly as a way to recycle items that can't go into home recycling bins	●	◑
Bring sites	• Low volume drop-off sites for specific types of waste	✓	✓	✓	✓	• In **Wales**, bring sites are usually located in supermarkets, car parks and areas with high flows of people • **Copenhagen** has a number of igloos for glass packaging placed around on the streets and squares and bring schemes such pharmaceuticals to the pharmacy and paints and varnish to the paint shop • Both **NSW** and **Victoria** have bring schemes for specific types of waste only, such as chemicals	◑	◔
Tax / ban on single-use plastics	• Policies to ban or tax single-use plastic (e.g. plastic bags)	✓	✓	✓	✓	• The **Danish** PM seeks to ban free plastic bags and double the current tax payable on buying disposable cutlery and plastic bags by 2020 • **Wales** was the first country in the UK to charge for plastic bags in 2011. In 2019, a new law was introduced banning shops from selling bathroom products containing plastic microbeads • Single-use shopping bag ban to be introduced in 2019 in **Victoria.** No current bans in **NSW**, but "ban the bag" bill under discussion	◑	◕
Refundable container deposit schemes	• Deposit scheme to refund citizens who return certain packaging types	✓			✓	• **Copenhagen** has a deposit-return scheme for beverage containers of glass, metal and PET, ensuring ~89% return rate for these packaging types • **Wales** is considering a deposit-return scheme in 2019, following other countries in the UK • Return and Earn is the largest litter reduction scheme introduced in **NSW** in 2017	◔	◔

Source: Nordic Council of Ministers; Wales Online; Cardiff council; Welsh government; UK EPA; United Kingdom House of Commons; European Commission; Copenhagen Post; CEWEP; L.E.K. analysis

4 A range of waste "best practices" were observed across the geographies reviewed (3/3)

Policy type	Description	Copenhagen	Wales	Metro VIC	Metro NSW	Examples of policies in operation	Impact on freight efficiency	Impact on env. outcomes
Developing infrastructure to encourage the use of refillable bottles	• Infrastructure to refill water bottles (e.g. water fountains)		✓			• **Wales** is supporting water companies and businesses to establish more refill points around the cities to encourage refillable bottle use over plastic bottles, aiming to turn the country into the world's first "refill nation"	○	○
Extended producer responsibility (EPR)	• Manufacturer of the product is responsible for the waste management	✓	✓			• **Welsh** local authorities adopted EPR and use fixed penalty notices to increase recycling rates • **Danish** local authorities decided to adopt EPR in very few cases including waste electrical and electronic equipment's and end-of-life vehicles	◔	◔
Single recycling system	• Same recycling system adopted across the country		✓			• **Wales** adopt a single recycling system across the country rather than separate systems in every local authority • In **Australia**, different states adopt different waste strategies from landfill taxes to use of transfer stations to bin system	◑	◕
Funds for infrastructure investment in recycling & recovery	• Education programs and infrastructure investment to improve environmental outcomes	✓	✓	✓	✓	• The **NSW Waste and Recycling Infrastructure Fund** seeks to accelerate investment in infrastructure for the processing of recyclable waste • The **UK Waste and Resources Action Program** has several funding programs to reduce waste and increase recycling and recovery • The **Danish** government offers support and loan options for programmes and initiatives within future green solutions through the Danish Green Investment Fund	◔	◔
Waste flow quality measurement	• Waste volume data flows and waste costs data flow	M	H	H	M	• **NSW** EPA has been developing, and transitioning to, a rigorous method of measuring recycling performance and waste generation • In **Denmark** waste flow is only measured during collection which might result in lower recycling rates than actually reported by the government • Natural Resources manage waste data flow on behalf of the **Welsh** government, measuring volume and expenditures in every step of the process • Sustainability **Victoria** has surveyed local authorities about their waste and recycling services over the past years, reporting the findings annually	◔	◔
Financial penalties	• Statutory recycling target with applicable fines		✓			• ***'Towards Zero Waste'*** – A **2010 waste strategy r**atified by the **Welsh gov.** targets 100% recycling rate by 2050, with a **statutory** target for **municipal solid waste** • **LGAs** that fail to **meet their recycling targets** can be fined **~200 GBP** per tonne	◔	●

Source: Nordic Council of Ministers; Wales Online; Cardiff council; Welsh government; UK EPA; United Kingdom House of Commons; European Commission; Copenhagen Post; CEWEP; L.E.K. analysis

Agenda

- Executive summary
- Scope and rationale for the study
- **Waste supply chain**
  - Australia
  - Global comparators
  - Freight network and supply chain metric performance comparison
  - Freight network and supply chain planning, governance and investment comparison
  - **Identification of areas of improvement within the Australian supply chain**
- Wine supply chain
- Benchmarking supply chains – An approach for further supply chains
- Next steps
- Appendix

The study has identified opportunities to improve freight efficiency, environmental outcomes or a combination of the two

Impact both freight efficiency and environmental outcomes

- **Most opportunities** within the waste supply chain have an **impact on both freight efficiency and environmental outcomes**
- While the relative impact may improve both freight efficiency and environmental outcomes, circumstances exist where **an improvement to freight efficiency may be detrimental to environmental outcomes**
- This study has **focussed it's findings towards freight efficiency** where possible, and has not necessarily sought to balance the impact of environmental outcomes

Impact freight efficiency only

- **A key finding of the study is the interconnection** between freight efficiency and environmental outcomes
- Due to the linkage and balance of these factors, a smaller number of opportunities identified that directly impact the efficiency of the waste freight task with a low likelihood of impacting environmental outcomes

Impact environmental outcomes only

- The mandate of this study was not to develop opportunities only related to environmental outcomes
- However, in the course of the study and discussions with Government and Industry, relevant findings have been documented

Opportunity Summary: 21 opportunities for improvement have been identified

Approach to determining suggestions / opportunities

- During the course of the study interviews with a diverse set of industry stakeholders were conducted
- Given the "pilot" nature of the effort, and the sub-components of the supply chain (and geographies), suggestions / improvements have been focused on this scope and are by nature, not exhaustive
- Key to the suggestion set is the need to consistently trade-off supply chain efficiency, cost, community need and environmental outcomes

Suggestions / opportunities for improvement

Initiative	Initiative	Impact on freight efficiency	Impact on environmental outcomes
1A	Increased source separation	◕	●
1B	Waste flow data is not sufficiently captured	◔	◑
1C	Data capture is too infrequent	◔	◕
1D	Inconsistency of cost data	●	◔
1E	Inconsistency of volume data	●	◑
1F	Waste to energy	◑	◕
2A	Shape of network / Distance to disposals	●	○
2B	Pick-up curfews / timing of pick-ups	◑	○
2C	Types of truck	◕	○
2D	Truck efficiency	●	○
2E	Un-necessary movement of waste	●	○
2F	Inconsistent approaches by local councils	◑	◑
2G	Understanding total costs	●	○
2H	Safety	●	○
3A	Consistency and adherence to top-down targets	○	●
3B	Complaints data	◔	◕
3C	Compliance activity	○	●
3D	Education programs	◕	○
4A	Review other waste streams		
4B	National Benchmarking		
4C	Regional areas		

Type of impact:
- = Freight efficiency and environmental outcomes
- = Freight efficiency only
- = Environmental outcomes

= Future supply chain benchmarking

Source: L.E.K. interviews and analysis

L.E.K.

1

Opportunities related to freight efficiency and environmental outcomes (1/3)

Freight efficiency and environmental outcomes

	Issue	Examples / impact	Opportunity	Impact on freight efficiency	Impact on env. outcomes
A **Increased source separation**	• The number and type of trucks required impacts the waste supply chain efficiency	• Collecting waste in narrow streets, particular at times of high traffic, pedestrians and cars lead to longer pick-up times, therefore higher fuel consumption	• The need for bespoke education by local authorities rather than a top down approach should be encouraged leading to superior collaboration among local councils • A consistent approach adopted by local authorities should be developed with collaboration of Government, industry and local authorities, and applied nationally		
B **Waste flow data is not sufficiently captured**	• The path waste takes along a given supply chain from generation to processing/disposal is not captured or widely understood • Anecdotal evidence and estimation techniques can be used to infer the freight pathways for waste, however these are not definitive	• Waste is transported significant distances contributing to both the cost and community impacts. The ability to measure and reduce this is a desirable outcome • Unnecessary transportation of waste caused by scarcity of landfill / perverse economic incentives is known to occur, without an understanding of the full extent of the issue	• A consistent approach to define the source, supply chain path and destination of waste flows should be established. • This would require both Government and industry stakeholders to measure waste via a holistic and co-ordinated approach rather than partial or ad-hoc inputs • Best practice within benchmarked geographies (e.g. Wales) is a modern data flow collection system leading to superior data quality		

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Opportunities related to freight efficiency and environmental outcomes (2/3)

Freight efficiency and environmental outcomes

	Issue	Examples / impact	Opportunity	Impact on freight efficiency	Impact on env. outcomes
C **Data capture is too infrequent**	• Data is collected and reported with different frequencies in Australia – Australia has reported comparable data nationally every two years since 2010; and annually through local councils and state agencies – Wales collects and reports data quarterly, and in Denmark data is reported with a two year lag	• Although the rate of waste generation shifts with macro drivers (i.e. population, education, community sentiment), the processing and end use outcomes can change rapidly • Measuring and reporting data more frequently would give stakeholders more recent data to inform decision making	• Report waste data on a more frequent basis. International benchmarking suggests that a quarterly frequency is achievable	◔	◔
D **Inconsistency of cost data**	• There is not a consistent approach to the reporting or collection of waste management costs in Australia for household waste • Local councils may report macro cost data as part of their overall financial reporting	• The lack of cost data availability creates / impedes the ability to benchmark against other countries and compare the efficiency of managing waste across Australia • There is no standard framework for data capture across stakeholders within the supply chain (i.e. Local Government, providers of 3rd party contracting services to LGAs)	• This report has developed a framework for the key metrics that could be used as a basis for comparison in the waste industry • A consistent approach to the collection of waste cost data should be developed, and applied across the waste network • Partnership with Government agencies in international markets where 'like' data collection exists (i.e. Wales) could provide an ongoing international benchmark data stream	●	◔

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1

Opportunities related to freight efficiency and environmental outcomes (3/3)

Freight efficiency and environmental outcomes

		Issue	Examples / impact	Opportunity	Impact on freight efficiency	Impact on env. outcomes
E	**Inconsistency of volume data**	• There is no consistent approach to the collection of volume or material data across local, state and federal governments • The data is rolled up to a national level by the Department of Environment, however this is a manual exercise of collating variable state based data	• Definitional variability exists across the definitions of waste streams (i.e. MSW versus household waste can either include or exclude street bin collections) • The reliability of data associated with the materials found within each waste stream remains unconfirmed. Composition data is critical for the management of recycling/reuse/processing facilities which rely on a consistent feedstock for efficient operations	• A consistent approach to the collection of waste volume data should be developed, and applied across the waste network • An example of best practice is the method by which the Welsh government has adopted a single, consistent platform to collect waste volume data		
F	**Waste to energy**	• Waste to energy technology is mature internationally, but with a small number of facilities in construction or proposed for Australia	• Waste to energy facilities increase diversion rates significantly while reduce logistics costs due to shorter distances travelled by trucks since facilities can be built near metropolitan areas	• An approach considering wider adoption of waste-to-energy facilities should be explored • A thoroughly risk analysis should be performed prior to adoption • Best practice within benchmarked geographies (e.g. Wales) has adopted waste-to-energy to increase diversion rates		

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2

Opportunities related to freight efficiency only (1/4)

Freight efficiency only

		Issue	Examples / impact	Opportunity	Impact on freight efficiency	Impact on env. outcomes
A	**Shape of network / Distance to disposals**	• The shape of network affects the logistics costs of waste management in Australia	• NSW landfill restrictions result in trucks travelling further distances to dispose of waste • Lack of waste to energy facilities in metropolitan areas, as occurs in Europe, require longer distances to dump waste	• A consistent approach to national practices should be developed to ensure that the shape of network is optimized regarding logistics costs • This will require both Government and industry to promote alternative disposal strategies (e.g. Cleanaway is building a waste to energy facility in Western Sydney)	●	○
B	**Pick-up curfews / timing of pick-ups**	• Industry participants have indicated that the curfews associated with household waste collection are both variable, and restrictive • Curfews lead to freight inefficiency and safety concerns	• Collections occurring during periods in which both traffic of pedestrians and cars are high tend to increase risks of accidents • Transporting waste during peak traffic periods result lead to increased pick-up time, therefore superior fuel consumption	• A consistent approach with more flexible pick-up times should be adopted, and applied across the waste network • Adopting more flexible pick-up times has the potential to increase industry efficiency both in terms of safety and costs • Opening out times for collection would optimize collection time, hence reduce fuel consumption	◑	○

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2

Opportunities related to freight efficiency only (2/4)

Freight efficiency only

	Issue	Examples / impact	Opportunity	Impact on freight efficiency	Impact on env. outcomes
C **Types of truck**	• The type of truck adopted impact the waste supply chain efficiency	• Collecting waste in narrow streets, particular in hours with high traffic of pedestrians and cars lead to higher pick-up times, therefore higher fuel consumption	• Industry stakeholders could adopt different types of truck to maximize supply chain efficiency • The Welsh Government has adopted the blueprint collection consisting of modern and adapted trucks to pick-up more types of waste at the same time which reduced collection costs - One of the truck types utilized (i.e. CWS narrow access vehicle) is particularly useful in narrow streets	◕	○
D **Truck efficiency**	• In the waste supply chain, fuel consumption and noise complaints are common challenges of quantitative and qualitative nature, respectively	• Fuel consumption is a critical component of the cost in the waste management industry • Noise from trucks during waste collection is one of the main sources of complaints in the waste industry	• A consistent approach to investigate more efficient trucks (i.e. electric / hybrid / hydrogen) should be adopted to reduce emissions and running costs, and also lower noise concerns • Partnerships between Government and industry stakeholders could lead to a more complete understanding of the way that market forces and technological advances are changing the waste industry worldwide	●	○

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2

Opportunities related to freight efficiency only (3/4)

Freight efficiency only

	Issue	Examples / impact	Opportunity	Impact on freight efficiency	Impact on env. outcomes
E **Un-necessary movement of waste**	• Increased distances commuted result in increased transport costs due to unnecessary movement of waste • Increased distances travelled also results in more trucks on the road	• Unnecessary transport of waste caused by perverse economic incentives is known to occur (e.g. Waste transported from NSW to QLD to avoid landfill fees; Waste transported from regional Victoria to regional NSW and regional SA)	• Government and industry stakeholders could work towards more consistent legislative approach to reduce the movement of waste • Best practices should include targeting the major “unnecessary movements” and reduction of these movements, potentially through a combination of: - Levy harmonisation - Charging levies based on the source of the waste rather than the disposal site which would require better waste tracking	●	○
F **Inconsistent approaches by local councils**	• There is not a consistent approach among local councils in the way they handle waste management • Different councils adopt different bin systems (e.g. 3 bins, 4 bins, FOGO etc.), different bin sizes (e.g. 240L bin, 140L bin etc.), collection pick-up curfews etc.	• The lack of consistency among collection systems result in lower environmental outcomes (i.e., different bin systems increase the level of contamination of recyclable waste)	• A harmonised and consistent approach in regards to bin systems (i.e., number of bins / size of bins) can drive superior environmental outcomes	◑	◑

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2

Opportunities related to freight efficiency only (4/4)

Freight efficiency only

	Issue	Examples / impact	Opportunity	Impact on freight efficiency	Impact on env. outcomes
G **Understanding total costs**	• Waste management costs are not consistently collected and reported among states - Victoria collects and reports annually waste management costs - NSW does not report detailed waste management costs	• Measuring and understanding total costs more frequently and in a standardized way would give stakeholders more recent data to make better decisions	• A consistent approach to waste management costs could be worked towards nationally • This would require both Government and industry stakeholders to collaborate and define a holistic approach regarding total costs • Best practice within benchmarked geographies (e.g. Wales) regarding collection and reporting total costs would lead to superior practices	●	○
H **Safety**	• Safety outcomes are not reported at “industry” level meaning that benchmarks are different	• Lack of alignment with global data sets prevents a like-for-like comparison	• A more consistent alignment with global metrics should be implemented at “industry” level • An example of best practice is the reported data set in the UK in which “fatal” and “non-fatal” metrics are reported annually	●	○

L.E.K.

3

Opportunities related to environmental outcomes only (1/2)

Environmental outcomes only

	Issue	Examples / impact	Opportunity	Impact on freight efficiency	Impact on env. outcomes
A **Consistency and adherence to top-down targets**	• In Australia, states and local authorities have high independence to handle waste management and there is no national directive with top-down targets	• There is no co-ordinated national target that is aspirational • The lack of top-down consistency and adherence leads to many well meaning bodies working in a partially aligned manner, often with competing priorities	• A consistent approach to top-down targets could be established • An example of best practice is the method adopted in the European Union that sets directives weight-based targets, followed by Wales and Denmark. Statutory targets have driven a much improved recycling rate over time	○	●
B **Complaints data**	• There is not a consistent approach to measure and deal with complaints related to the waste supply chain	• Councils co-ordinate complains at an LGA level	• A consistent approach to define key metrics and platforms to deal with complaints could be adopted • An example of best practice is the streamlined method by which the Welsh government has migrated, increasing the consistency to collect and address recurrent complaints	◔	◔
C **Compliance activity**	• There is not a consistent waste management rule regarding education programs • Devolved accountability for education should be addressed	• Increased contamination is having downstream impacts on processing effectiveness	• Best practice within benchmarked geographies (i.e. Wales) have an efficient inspection system penalizing repeated offenders • This would require local Government informing residents when their bin contents is inappropriate	○	●

L.E.K.

3

Opportunities related to environmental outcomes only (2/2)

Environmental outcomes only

	Issue	Examples / impact	Opportunity	Impact on freight efficiency	Impact on env. outcomes
D **Education programs**	• The lack of inspection on waste source separation and transport impacts negatively the waste supply chain • Contamination levels increase through improper source separation	• EPAs, Local Governments and peak bodies have responsibility in waste education programs leading to lack of consistency and devolved accountability	• A consistent approach towards education programs should be developed, and applied across the country	◔	○

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4

Opportunities related to future supply chain benchmarking

Future studies

	Issue	Examples / impact	Opportunity
A Review other waste streams	• Review at a household waste level provides a partial view of the waste supply chain	• Household waste represents ~25% of the total waste generated in Australia • Improving the efficiency of other waste streams has the potential to increase the freight benefits untapped in the current work	• A review of all waste streams should be undertaken • An example of best practice is the annual audit benchmark method adopted by the Welsh government
B National Benchmarking	• Other states in Australia, when combining the amount of waste, generate as much household waste as the states of NSW and Victoria	• Although metro NSW and metro Victoria were chosen as focus for the current "pilot" project, they generate only ~26% of the MSW generated in Australia • Measuring and understanding the waste generation in national level would give stakeholders more data to perform better decision making	• This report has developed a framework for the key metrics that could be used as a basis for comparison in the waste industry • A similar approach should be adopted to extrapolate the study nationally • Partnership with government agencies and industry stakeholders could provide an ongoing benchmark update
C Regional areas	• Regional areas, not considered in the current work, generate a significant proportion of household waste	• In NSW, regional areas generate c.51% of the total household waste produced by the state • Regional Victoria generates c.576k tonnes of household waste corresponding to ~26% produced by the state	• The current benchmark study should expanded to include regional areas • An example of best practice is the method by which the Welsh government has adopted a single waste management system for both rural and urban areas

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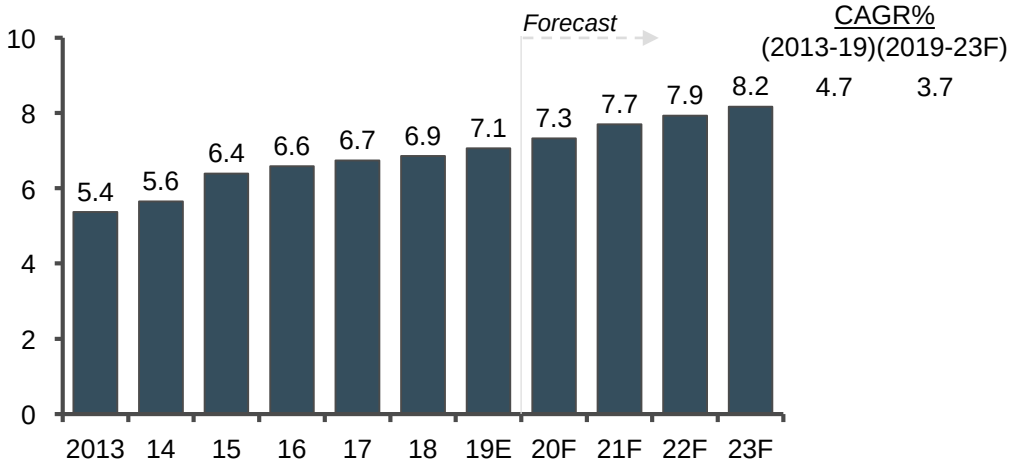
Wine is an important export industry for the Australian economy with industry revenues of over ~$7b AUD, and ~173k employees

Economic highlights of the Australian wine industry:

~$40b*AUD added to the economy

~173k people employed

Revenue of Australian wine producers
(2013-23F)
Billions of AUD

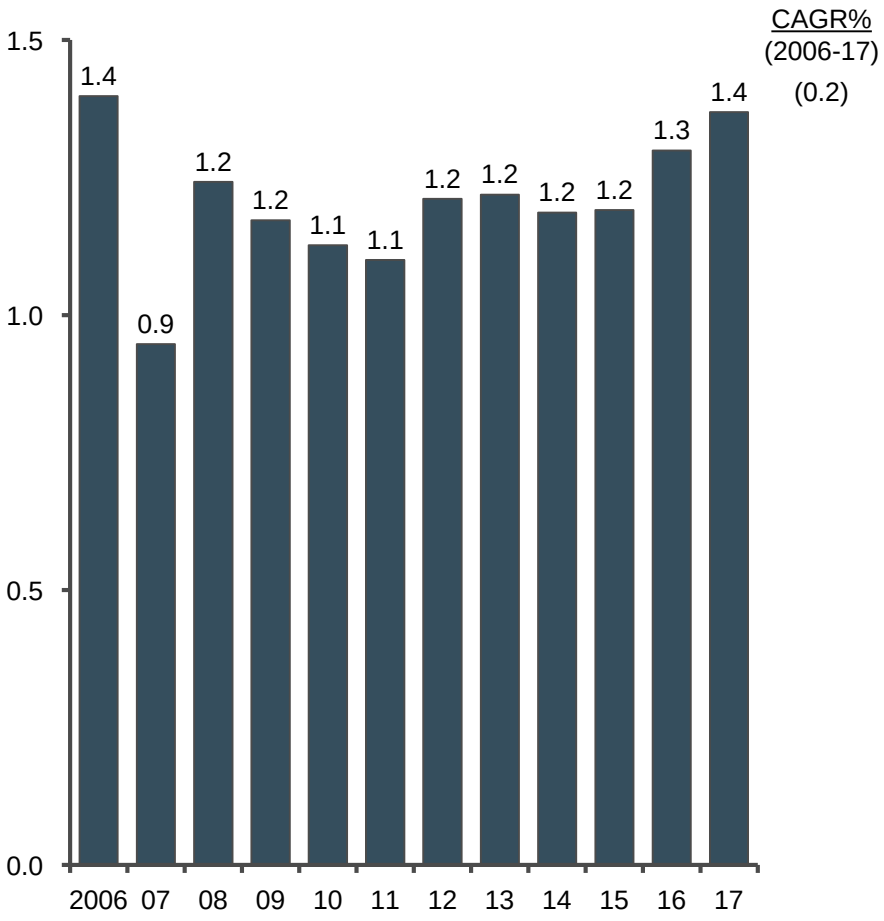


- The wine industry is estimated to add over ~$40b* AUD to the Australian economy; including economic activity related to the following:
  - Grape growing in vineyards
  - Wine production
  - Wine related tourism
- According to Wine Australia, the wine industry employed ~173k employees** in 2018
- Australian wine producers generated ~$7b AUD of revenue in 2018; going forward, continued revenue growth within this sector is expected given:
  - Growing demand globally, particularly from Asia
  - Depreciation of the Australian dollar driving increase of exports
  - Existing trade agreements between key export countries within Asia (e.g., ChAFTA***)

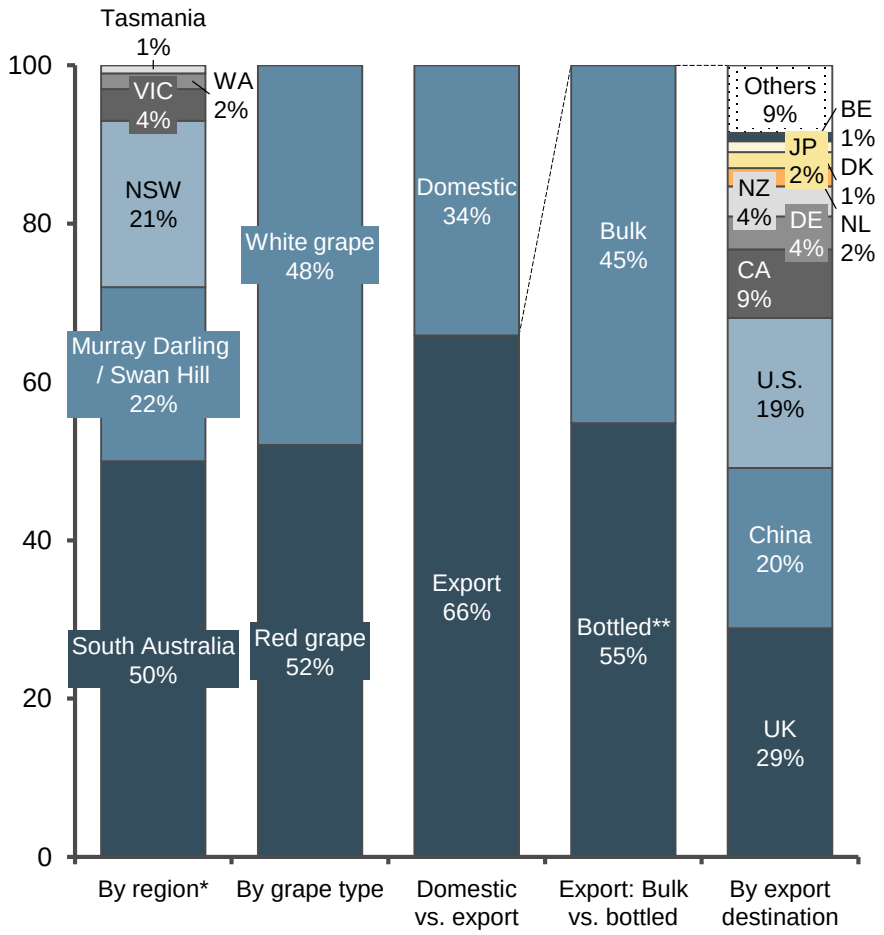
Note: * Estimated gross output from production / consumption induced economic impact, as well as impact from direct effect (includes $19.7b AUD in value and $10.4b AUD in wages); ** Both full and part-time employees; *** China-Australia Free Trade Agreement
Source: Wine Australia; IBIS World; L.E.K. analysis

Of the c.1.4b litres of wine produced in Australia, two-thirds is exported (with bulk nearly half the volume) predominantly to the UK, China, and the US

Total wine production in Australia
(FY2006-17)
In billions of litres



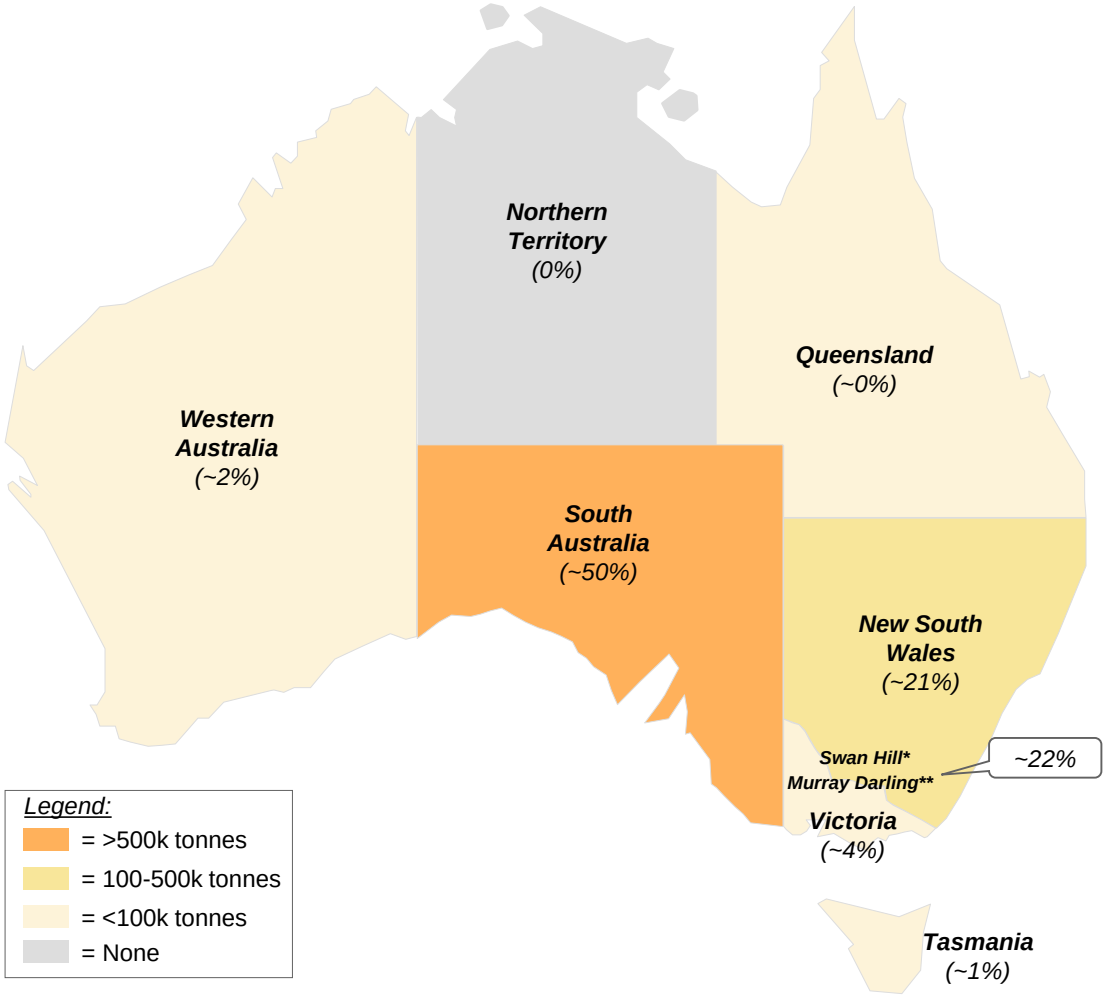
Australian wine market
(2018)
Percentage of volume



Note: * Proportion of *winegrape collection* by region **Bottled includes cask wine
Source: Wine Australia; L.E.K. analysis

South Australia accounts for nearly half of all wine production; the Swan Hill / Murray Darling region between the Vic / NSW border is also a key region

Total collected wine grapes in Australia by region (2018):



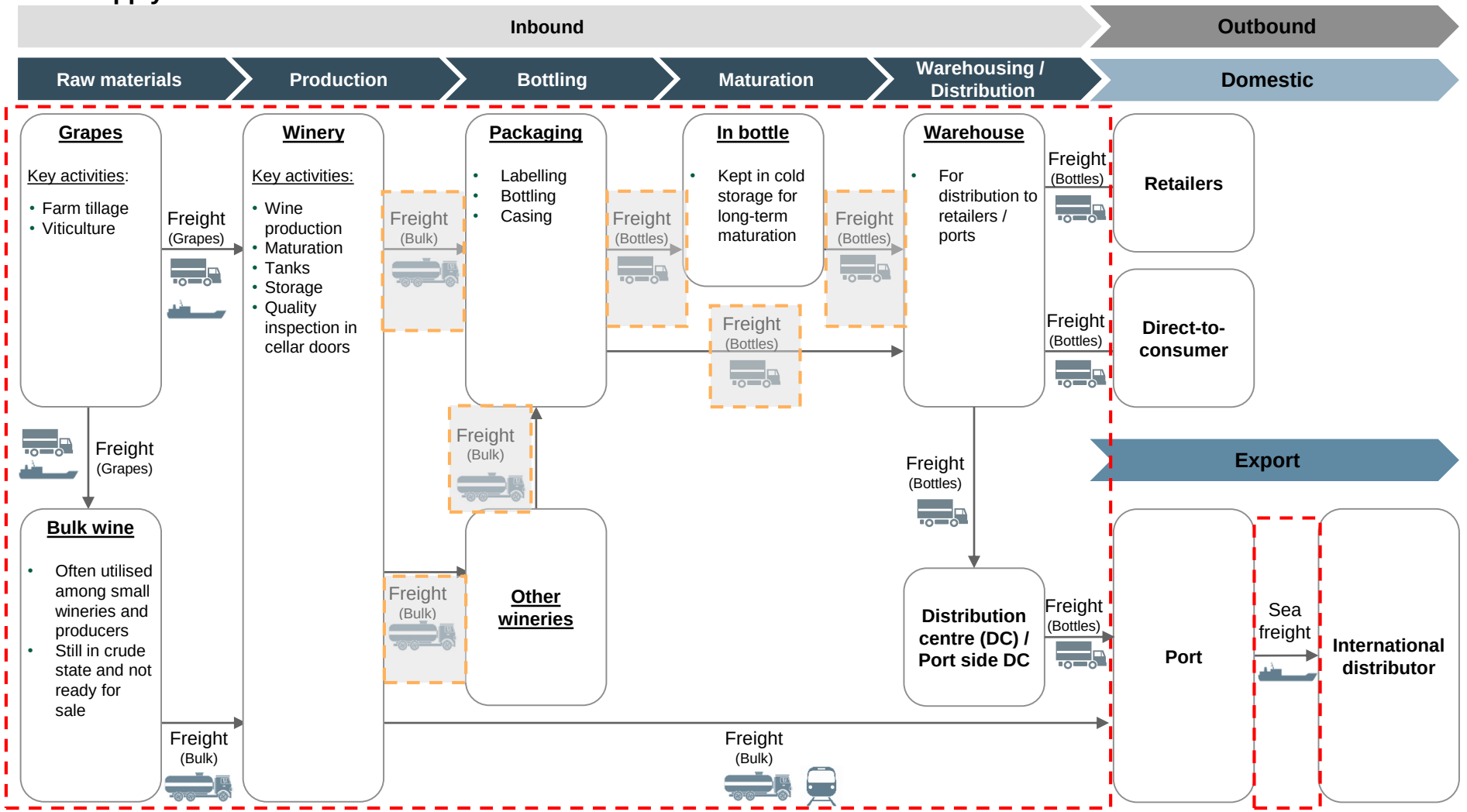
Region	Wine grapes collected (In thousands of tonnes)	% of total wine grapes collected
South Australia	769	*50%*
Murray Darling - Swan Hill	346	*22%*
New South Wales *(exc. MD-SH)*	321	*21%*
Victoria *(exc. MD-SH)*	67	*4%*
Western Australia	32	*2%*
Tasmania	12	*1%*
Queensland	1	*0%*
Total	1,547	*100%*

Note: * Located in the north-west of Victoria; ** Located in north-west Victoria and western New South Wales
Source: Wine Australia; L.E.K. analysis

L.E.K.

As part of this pilot study, the inbound and outbound logistics of wine were assessed

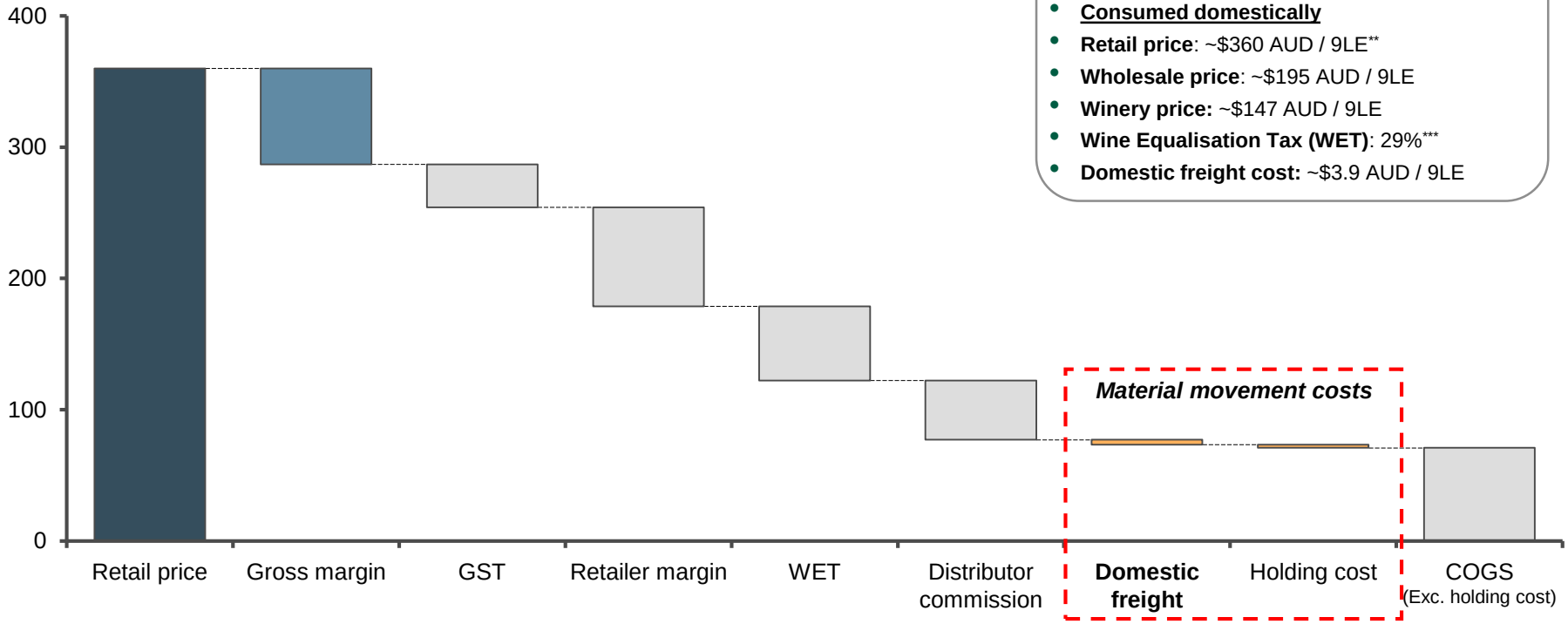
Wine supply chain:



Source: L.E.K. analysis

Generally, the freight cost of wine accounts for a small proportion of its retail price …

Example*: **Cost composition of SA wine per 9LE** (~$30 AUD retail value / 750ml bottle)**
(2019)
In AUD



Key assumptions:

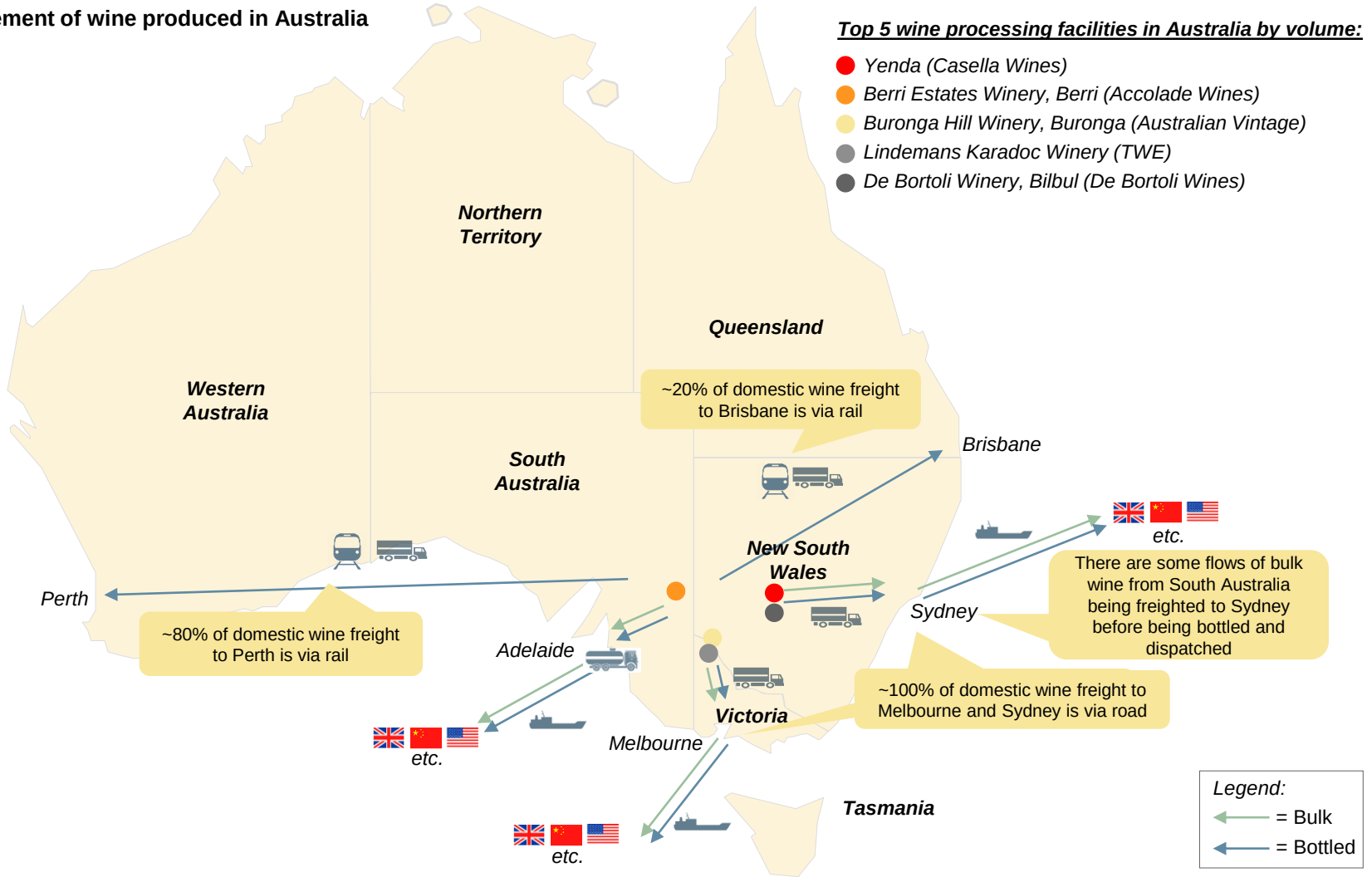
- **Consumed domestically**
- **Retail price**: ~$360 AUD / 9LE**
- **Wholesale price**: ~$195 AUD / 9LE
- **Winery price:** ~$147 AUD / 9LE
- **Wine Equalisation Tax (WET)**: 29%***
- **Domestic freight cost:** ~$3.9 AUD / 9LE

Typically, the costs related to the material movement of wine is ~1-10% of its retail price

Note: * Assumes the Shiraz variety from Barossa Valley produced at a large winery (5,000-20,000 tonnes); ** 9 litres (standard metric within the wine industry; equivalent to twelve 750ml bottles); *** Of wholesale value
Source: Wine Australia; L.E.K. analysis

Much of the movement of wine is concentrated within South Australia, Victoria, and NSW, with a combination of sea, rail, and road freight being used

Illustrative: Movement of wine produced in Australia



Source: Wine Industry Directory 2019; L.E.K. interviews and analysis

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Global comparators for wine were selected based upon a number of factors

Relative priority of categories

Production volume	Production volume is a key consideration due to correlation between scale and supply chain efficiency; given this, comparators with a comparable production volume were prioritised
Domestic consumption vs. export	The shape and the mode of the supply chain greatly differs based on the end destination. Given this, the level of domestic consumption vs. export was considered
Degree of fragmentation	Fragmentation of wineries within each market is a key consideration given its direct impact on supply chain efficiency
Quality / price of wine	The general quality of wine (i.e., price per bottle) for each potential comparator was considered
Comparators in direct competition with Australian wine	Comparators directly competing in international markets with the Australian wine supply chain were prioritised

Source: L.E.K. analysis

L.E.K.

Upon assessing a number of international benchmarks at the national level, the United States and France were prioritised for further consideration

Key wine international benchmarks by country (c.2018):

	Australia	United States	South Africa	Spain	France
Number of key winery regions	5*	4**	3	7	12
Production volume (Millions of litres)	1,290	3,360	950	4,440	4,640
Export volume (Millions of litres)	850	375	420	1,986	1,410
Domestic consumption vs. export ratio	*34% / 66%*	*89% / 11%*	*56% / 44%*	*55% / 45%*	*70% / 30%*
Average price per bottle* ** (AUD)	$22.6 AUD	$23.1 AUD	$24.8 AUD	$11.0 AUD	$19.7 AUD
Number of wineries	2.5k	10k	540	4k	27k
Population density (Per km^2)	3	36	48	94	122
Urbanisation of population (% of population)	*86%*	*82%*	*66%*	*80%*	*80%*
Price of diesel fuel^ (USD per litre)	$1.00	$0.79	$1.08	$1.36	$1.61

Note: * The Barossa Valley, Margaret River, Riverina, Hunter Valley, and the Yarra Valley/Mornington Peninsula; ** California (Coastal and Napa), Washington, Oregon; *** Average prices of locally produced wine (c.2016); ^ As of Aug. 2019

Source: International Organisation of Vine and Wine; Wine Australia; Wine Institute; Wines of South Africa; Foods and Wine from Spain (FWS); SHAREaCAMPER Wine Price Index; The World Bank; Global Petrol Prices; L.E.K. analysis

L.E.K.

The sub-regions of California (U.S.) and the Bordeaux region (France) were selected as comparators

	South Australia	California	Bordeaux region
Number of key winery regions	1	2*	1
Production volume (Millions of litres)	610	2,700	520
Export volume (Millions of litres)	508	351	229
Domestic consumption vs. export ratio	*17% / 83%*	*87% / 13%*	*56% / 44%*
Bulk vs. bottled ratio	*29% / 71%*	*10-15% / 85-90%*	*0% / 100%*
Average price per bottle (AUD)	$5-25	$20	$5-$25
Number of wineries	700	3,900	7,400
Urbanisation of population (% of population)	*80%*	95%	*80%*
National price of diesel fuel^ (USD per litre)	$1.00	$0.79	$1.61

Note: * Coastal and Napa; ** Wholesale prices
Source: The Wine Cellar Insider; Vinex; Gavin Quinney; Wine institute; Farm Progress; Government of South Australia; Wine Institute; International Organisation of Vine and Wine ;L.E.K. analysis

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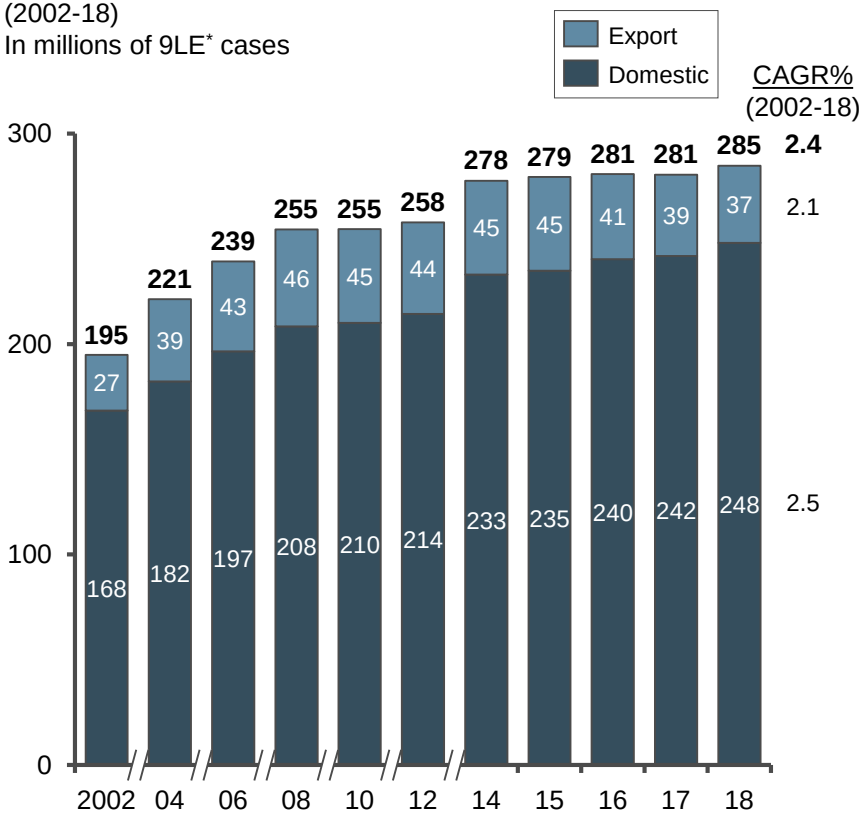
The vast majority of Californian wine is consumed domestically within the U.S.; ~13% is exported, mainly to the EU and Canada

California wine shipment volume by destination
(2002-18)
In millions of 9LE* cases



Retail value (B USD)	**22**	**22**	**27**	**27**	**30**	**31**	**34**	**35**	**37**	**39**	**40**
% exported	*14*	*18*	*18*	*18*	*18*	*17*	*16*	*16*	*14*	*14*	*13*

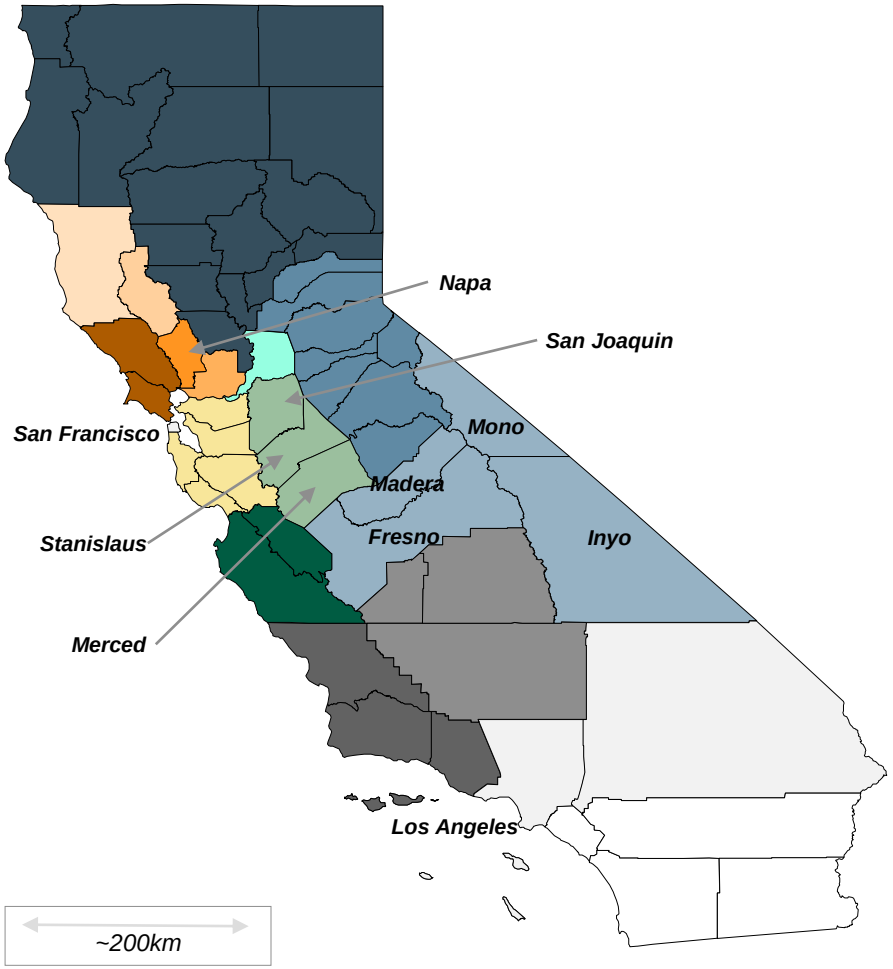
- California ships ~285 million cases (i.e., 9 litres) of wine annually, with an estimated retail value of ~40b USD
- The total shipment volume of wine has been increasing at ~2.4% p.a., primarily driven by:
  - Increase of the 21+ yrs. population in the U.S.
  - Consumers' preference towards more premium wines

  "… Consumer interest in premium wines continues to be the dominant trend …"
  President and CEO, Wine Institute, June 2019
- Domestic consumption accounts for ~87% of total shipped volume primarily shipped to large retailers (e.g., Costco, Trader Joe's etc.)
- Key export destinations for Californian wine include:
  - EU
  - Canada
  - Hong Kong
  - Japan

Note: * 9 litres (standard metric within the wine industry; equivalent to twelve 750ml bottles)
Source: Wine Institute; California Association of Winegrape Growers; L.E.K. analysis

Counties in central areas of CA account for ~60% of the total grape crush volume

California wine grape crush by county (2018):



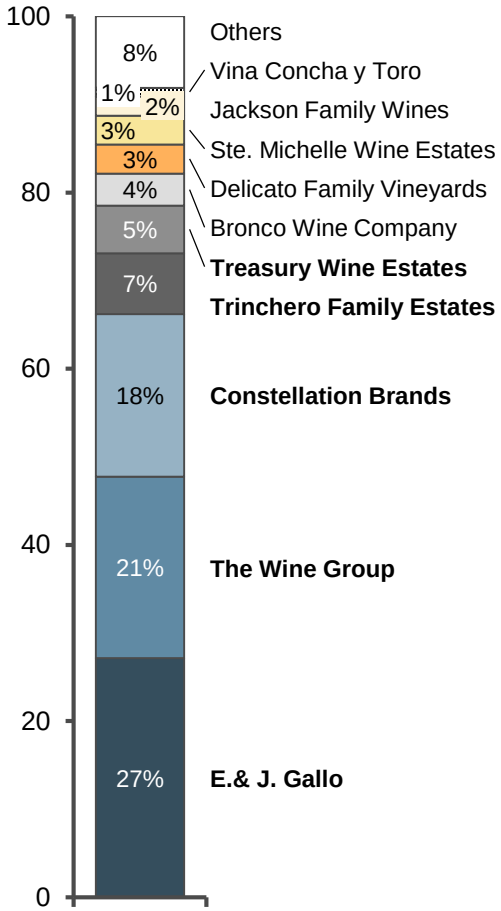
District #	Key counties	Grape crush (K tons)	% of Cali. total grape crush
1	Mendocino	82	*1.9%*
2	Lake	46	*1.1%*
3	Sonoma, Marin	276	*6.4%*
4	Napa	185	*4.3%*
5	Solano	24	*0.6%*
6	Alameda, Contra Costa, Santa Clara, San Francisco	34	*0.8%*
7	Monterey, San Benito	299	*7.0%*
8	San Luis Obispo, Santa Barbara	246	*5.7%*
9	Yolo, Sacramento (north), Del Norte	69	*1.6%*
10	Nevada, Placer, El Dorado	24	*0.6%*
11-12	San Joaquin (north), Sacramento (south), Stanislaus	1,206	***28.2%***
13	Madera, Fresno, Inyo, Mono	1,296	***30.3%***
14	Kings, Tulare	303	*7.1%*
15	Los Angeles, San Bernardino	0	*0.0%*
16	Orange, Riverside, San Diego	5	*0.1%*
17	Yolo County (south)	188	*4.4%*
Total		4,282	-

Source: California Department of Food and Agriculture; L.E.K. analysis

There are ~5 key wine producers in the U.S. market holding the majority share of its domestic market; The key regulatory wine bodies are Federal

U.S. top 30 wine producers' market share by domestic volume shipped (2016)
% of volume

California represents over ~80% of wine produced in the U.S; given this, market share at the national level is indicative of the CA market



Producer	Volume of 9LE* cases shipped	HQ
E&J Gallo Winery	~75m	Modesto, California
The Wine Group	~57m	Livermore, California
Constellation Brands	~51m	Victor, New York
Trinchero Napa Valley	~19m	South St. Helena, California
Treasury Wine Estates	~15m	Southbank, Melbourne

Key wine-related bodies:

Federal

Responsible for approval of application to become regions for viticultural areas

Bureau of Alcohol, Tobacco, Firearms and Explosives

United States Department of Agriculture

TTB Alcohol and Tobacco Tax and Trade Bureau, U.S. Department of the Treasury

Responsible for the "75% / 85% / 95%" rule

- **75%** of the wine must contain the varietal to be labelled as such (e.g., chardonnay etc.)
- **85%** of the grapes must come from the same viticultural area to list an appellation (e.g., Napa)
- **95%** of the grapes must have been grown and harvested in the same year to include a vintage year on the label

State

cdfa California Department of Food & Agriculture

Peak bodies

The Wine Institute

California Wines

California Sustainable Winegrowing Alliance

Napa Valley Grapegrowers Est. 1975

napa valley vintners 75 Years of Cultivating Excellence

Note: * 9 litres (standard metric within the wine industry; equivalent to twelve 750ml bottles)
Source: Wine Business Monthly; Forbes; L.E.K. analysis

L.E.K.

Most of the exported wine produced in California is sent to two key ports; domestic intermodal freight is used for cross-country transport

ILLUSTRATIVE AND DIRECTIONAL

Illustrative: Movement of wine produced in California

- Californian wine is freighted domestically via road and rail; intermodal freight is typically utilised for cross country freight (e.g., rail from California to Florida which is over 5,000km)
- In the U.S., if shipments contain only wine, those shipments enter the freight network specific to wine
- Californian wine for export is initially freighted to key ports (e.g., the port of Oakland and Los Angeles etc.) via road, then subsequently freighted overseas

Source: L.E.K. interviews and analysis

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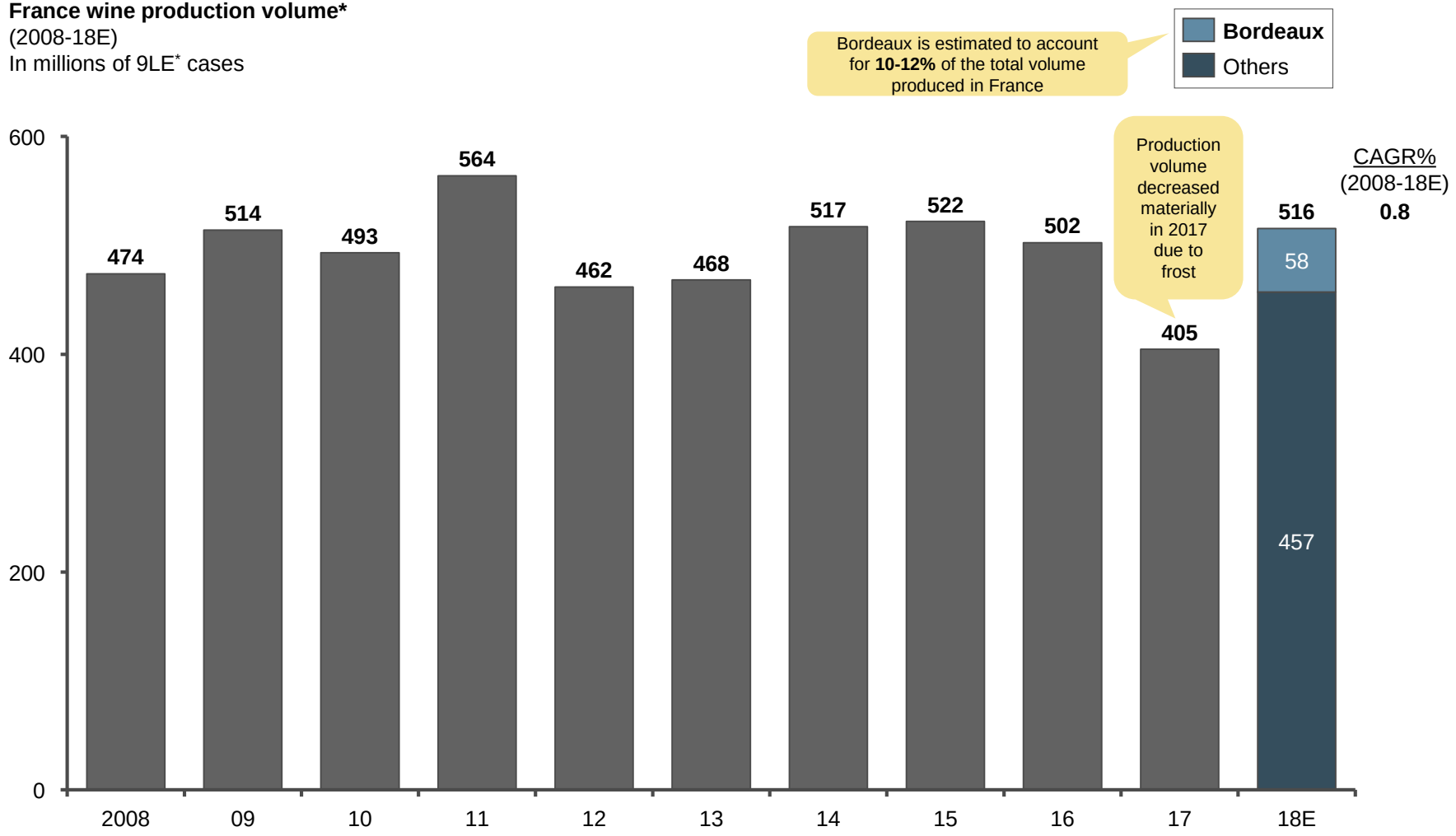
Wine produced in the Bordeaux region accounts for 10-12% of the total volume produced in France, with an annual retail value of over $3b AUD

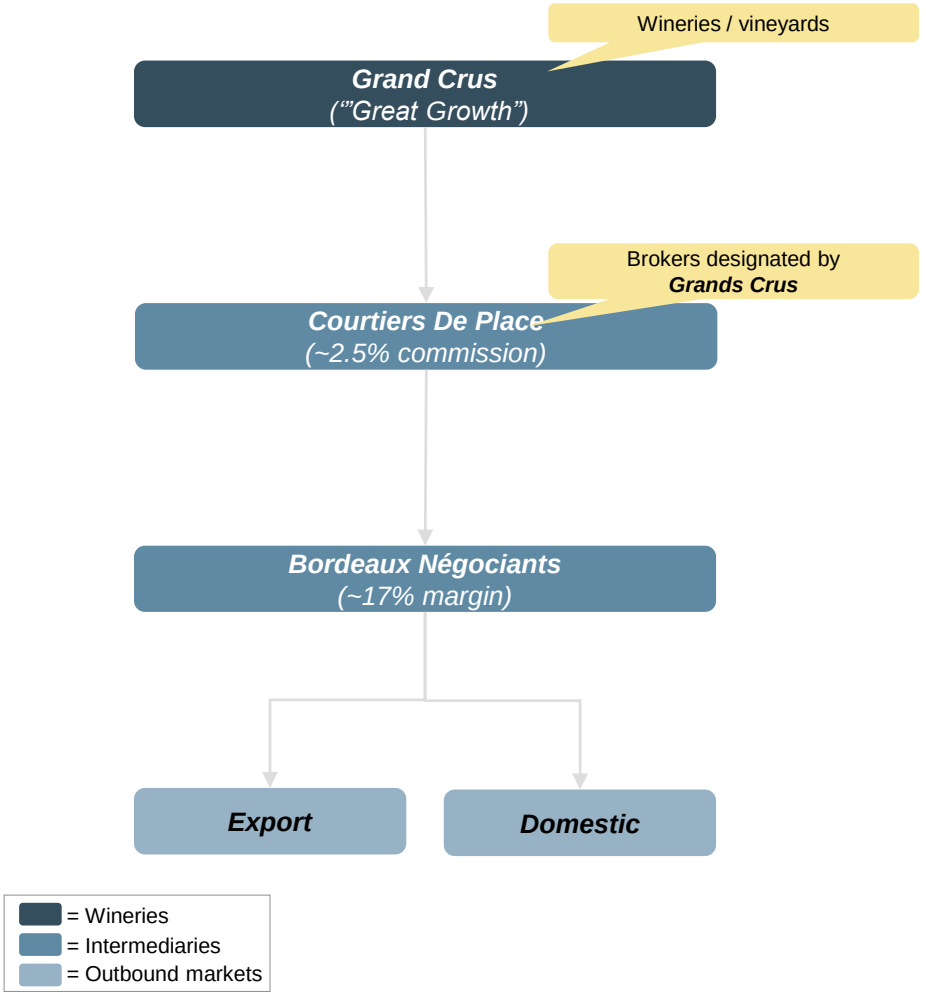
France wine production volume*
(2008-18E)
In millions of 9LE* cases



Note: * 2006-15 average production volume percentage utilised for estimated production; ** 9 litres (standard metric within the wine industry; equivalent to twelve 750ml bottles)
Source: OIV; The Wine Cellar Insider; L.E.K. analysis

The inbound movement of wine in Bordeaux is complex, with a number of intermediaries involved prior to its outbound freight

Overview of market structure within Bordeaux:

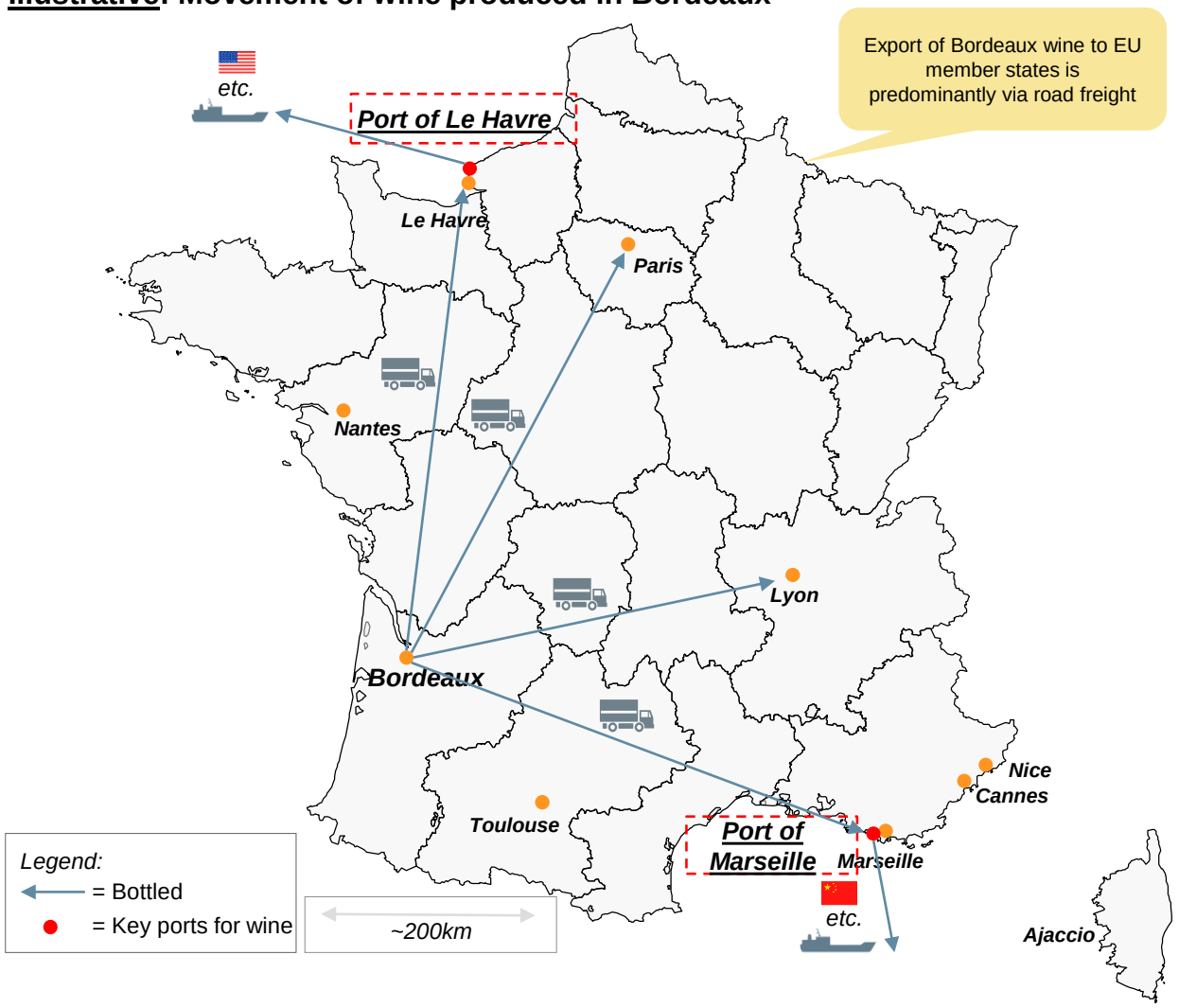


- **Grand Cru** ("Great Growth") is a non-official terminology which refers to esteemed wineries / vineyards with high reputation within the Bordeaux region
  - Châteaus considered as Grand Crus typically chooses its "Courtiers De Place"
- **Courtiers De Place** are brokers designated by Grand Crus, acting as middlemen between Grand Crus and Négociants
  - Approximately ~30% of each harvest is sold as Primeurs ("produce'), and the remaining ~70% is sold at the general marketplace (i.e., "Marché de Place")
- **Négociants** (i.e., merchants / traders) are distributors of wine collected from Bordeaux and distribute wine to both the domestic and international markets

Source: L.E.K. interviews and analysis

Le Havre and Marseille are the key export ports for wine from Bordeaux

Illustrative: Movement of wine produced in Bordeaux



Bulk / Bottled

- All wine produced in Bordeaux is **freighted as bottled wine** (both domestic and export)
  - Given the premium nature of the Bordeaux appellation, wine is not freighted in bulk

Mode of freight

- **Domestic**: only road freight is utilised
- **Export**: the majority of Bordeaux wine exported is sea freighted on a volume basis
  - While super premium wine (e.g., Château Lafite Rothschild etc.) is often freight via air, this represents a small portion of the total volume exported

Key export ports

- The ports of Le Havre and Marseille are key ports for the export of Bordeaux wine
- The Port of Le Havre is typically utilised for freight to North America, given its geographical advantage vs. the Port of Marseille
  - The Port of Marseille is often utilised for freight to Asia (e.g., China)

Source: L.E.K. interviews and analysis

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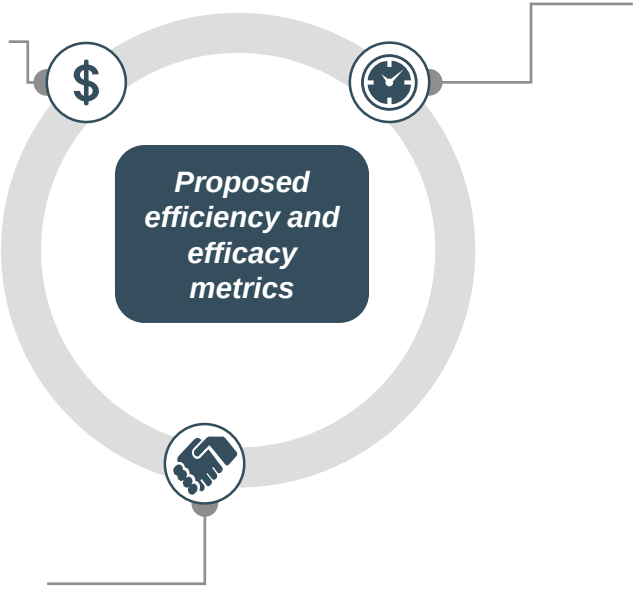
The supply chain of wine can be assessed through three types of metrics

Cost

- The following drivers have a large impact:
  - Shape of the network
  - Duration of storage (e.g., maturation)
  - Cost to transport wine on a per kilometer / 9LE* basis
  - Capacity of trucks / type of trucks / trains
- Low degree of importance to wine:
  - The distance that wine travels (due to network shape) impacts cost; however, freight cost is a relatively small portion of the overall cost for wine

Quality

- Types of Metrics:
  - Waste factor (% of wine lost during freight)
  - Customer complaints
  - Industry safety
- Medium degree of importance to wine:
  - While customer complaints / industry safety are of importance as an industry, these metrics are seldom reported for wine



Speed / time

- The speed / time related to the freight of wine is a function of the shape of network, size of the geography, and the degree of population concentration
- DIFOT (Delivery In Full On Time) is a key customer satisfaction metric
- High degree of importance to wine
  - The ability for wine producers to efficiently reach their end markets is important to meet customer needs

Note: * 9 litres (standard metric within the wine industry; equivalent to twelve 750ml bottles)
Source: L.E.K. analysis

21 types of metrics have been reviewed for wine (1/2)

		Metric type	What it is	Importance / relevance
Inbound	A	***Grape volume***	Volume of grapes as raw input to production volume	Understanding the flow of grapes prior to grape crush and vinification
	B	***Cost of grape freight***	Cost to freight grapes from vineyard to winery by the size of the winery	Difference in operational efficiency among wineries depending on production volume
	C	***Wine volume***	Volume of wine produced	Understanding the volume of wine produced
Outbound (domestic)	D	***Holding cost***	Warehouse cost per litre; includes cost for oak maturation *(if applicable)*	Identification of total cost during storage prior to outbound freight
	E	***Domestic%***	Volume and value of wine freighted domestically	Difference in the shape of the outbound network depending on destination
	F	***Mode of domestic freight***	Mode of freight utilised (i.e., trucks, trains) for domestic freight	Differences in the per litre cost depending on the mode of freight (i.e., trucks vs. train)
	G	***Average distance of domestic freight***	Distance travelled from warehouse to retailer	Input to the estimate of domestic freight cost
	H	***% of freight with temp. control***	Proportion of volume freighted with temp. control	Material differences in the cost of freight
	I	***Cost of domestic freight***	Cost of freight per kilometre per 9L of wine	Identification of freight cost on a per kilometre basis for domestic freight (by non-temp. control vs. temp. control)

21 types of metrics have been reviewed for wine (2/2)

		Metric type	What it is	Importance / relevance
Outbound (export)	J	***Export %***	Volume and value of wine exported	Difference in the shape of the outbound network depending on destination
	K	***Bulk vs. bottled %***	Proportion of bulk vs. bottled wine prior to sea freight	Differences in the mode / cost of freight depending on bulk vs. bottled wine
	L	***Cost of container packing***	Cost of container packing per 9LE	Identification of incremental packing cost
	M	***Holding cost at distribution centre(s)***	Total cost of storage at distribution centre(s)	Identification of holding cost prior to leaving port
	N	***Average distance to port***	Average distance from warehouse to port by mode of freight	Identification of distance travelled between warehouse to port
	O	***% of freight with temp. control***	Proportion of volume freighted with temp. control	Differences in cost during freight
	P	***Cost of freight to port***	Cost of freight per kilometre per 9L of wine from warehouse to port by mode / temp. control	Identification of freight cost on a per kilometre basis to port (by non-temp. control vs. temp. control)
	Q	***Average cost of sea freight***	Cost of sea freight per 9L of wine	Differences in the cost of sea freight by destination country
Quality	R	***Waste factor***	Proportion of wine (in litre terms) lost during freight	Reliability metric related to freight of wine
	S	***Customer complaints***	Number of customer / stakeholder complaints within the broader industry	Reliability metric for the broader wine industry
	T	***Industry safety***	Number of fatalities / non-fatal accidents within the broader industry	Safety metric for the broader wine industry
	U	***DIFOT***	Delivery In Full On Time	Customer satisfaction

Availability of data varied across metrics and regions

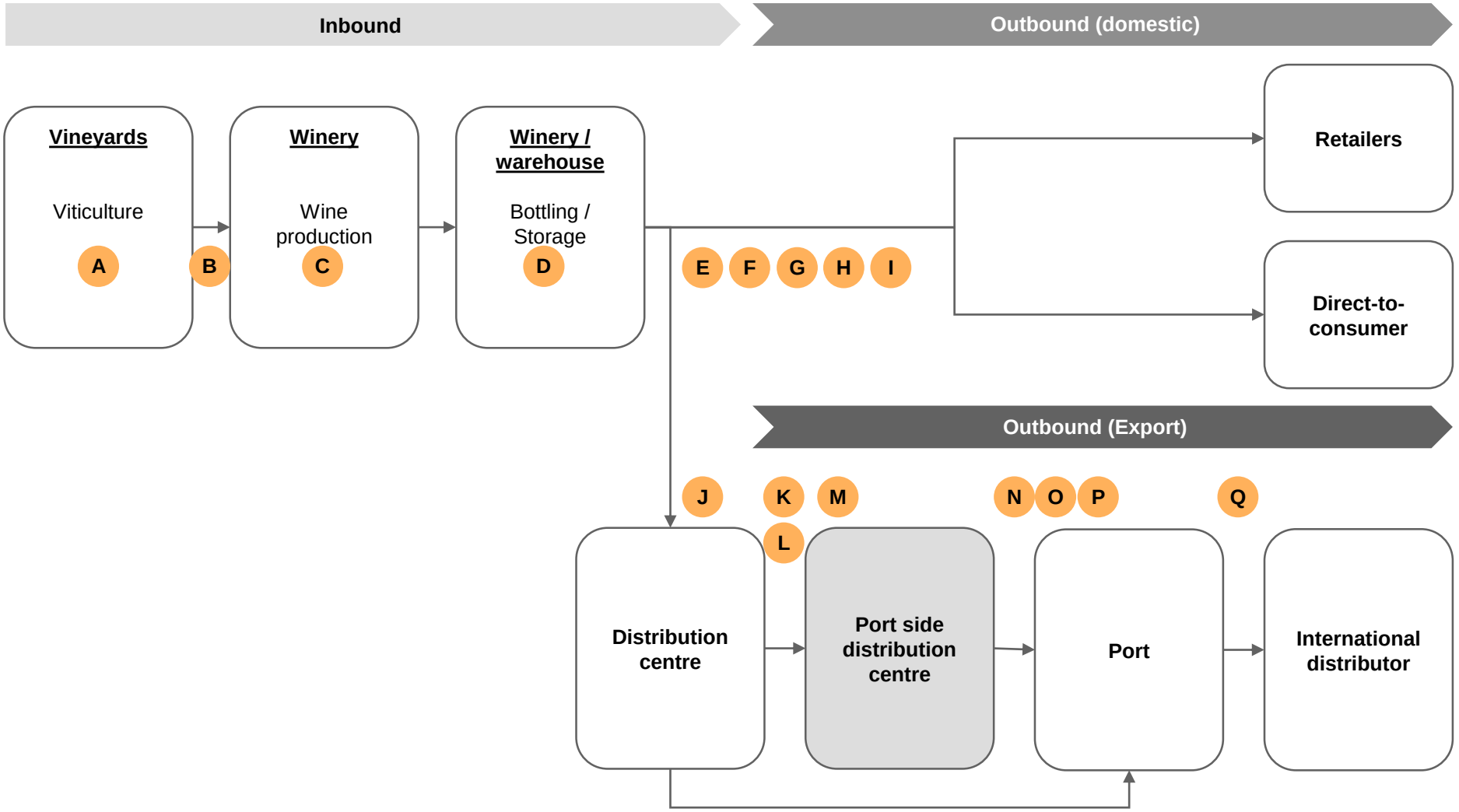
Metric Category	Metric Number	Metric Name	Units	Data availability			Data source
				SA	Napa Valley	Bordeaux	
Cost (inbound)	A	Grape volume	tonnes	●	●	◑	• Peak bodies
	B	Cost of grape freight	$ per tonne	◔	◔	◔	• Industry experts
	C	Wine volume	9LE*	●	●	●	• Peak bodies
	D	Holding cost	$ / month / 9LE*	●	◑	◑	• Peak bodies
Outbound (domestic)	E	Domestic %	% of wine volume and $	●	●	●	• Peak bodies
	F	Mode of domestic freight	Road / rail / sea	◔	◔	◔	• Peak bodies
	G	Average distance of domestic freight	Km	◑	◑	◑	• Secondary sources
	H	% of freight with temp. control	% of volume freighted	○	○	○	• Industry experts
	I	Cost of domestic freight	$ / km / 9LE*	●	◑	◑	• Peak bodies
Outbound (export)	J	Export %	% of wine volume and $	●	●	●	• Peak bodies
	K	Bulk vs. bottled %	% of wine volume	◑	◑	◑	• Industry experts
	L	Cost of container packing	$ / 9LE	◔	◔	◔	• Industry experts
	M	Holding cost at distribution centre(s)	$ / 9LE	◔	◔	◔	• Industry experts
	N	Average distance to port	Km by mode	◔	◔	◔	• Industry experts
	O	% of freight with temp. control	% of volume freighted	○	○	○	• Industry experts
	P	Cost of freight to port	$ / km / 9LE*	●	◑	◑	• Industry experts
	Q	Average cost of sea freight	Total $ / 9LE*	●	◑	◔	• Peak bodies • Industry experts
Quality	R	Waste factor	% of wine lost during freight	◔	◔	◔	• Peak bodies • Industry experts
	S	Customer complaints	# of complaints	○	○	○	• TBC
	T	Industry safety	# of fatalities / non-fatal accidents	○	○	○	• TBC
	U	DIFOT	% of deliveries achieved	○	○	○	• Industry experts • Peak bodies

Note: * 9 litres (standard metric within the wine industry; equivalent to twelve 750ml bottles)
Source: L.E.K. analysis

L.E.K.

Metrics were assessed across the supply chain

Simplified wine supply chain / location of cost benchmarking metrics:

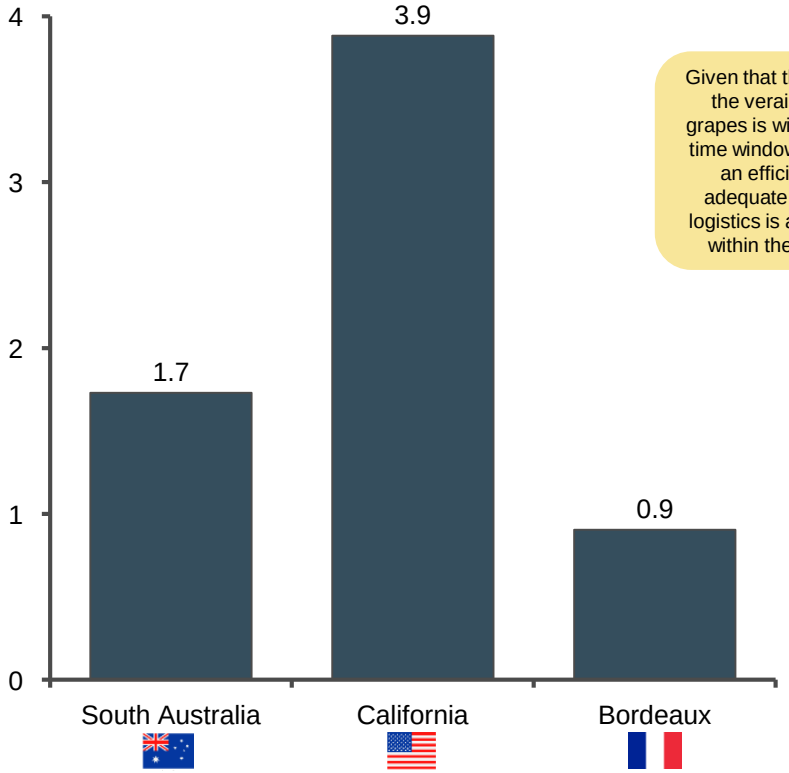


Source: L.E.K. analysis

California crushes a higher volume of grapes, whereas the cost of grape movements is lowest in South Australia

Inbound | Outbound (domestic) | Outbound (export) | Quality

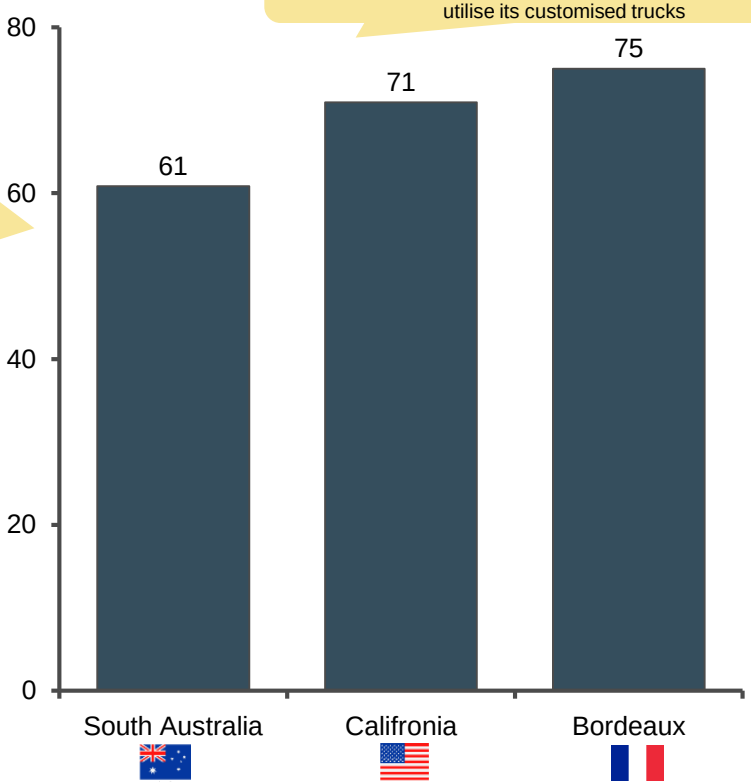
A **Wine grape crush volume**
(c.2018-19)
In millions of tonnes



Given that the timing of the veraison*** of grapes is within a short time window, ensuring an efficient and adequate supply of logistics is a challenge within the industry

B **Est. average cost of grape freight from vineyards to wineries**
(2018-19)
AUD* per tonne

Grapes grown adjacent to wineries will incur no transport cost. In addition, tractors are utilised for short-distance freight (i.e., 1-2km); For long haul freight, specialised logistics providers utilise its customised trucks



Est. cost** per 9LE	$0.10 AUD	$0.11 AUD	$0.12 AUD
Est. distance	~10-25km	~10-20km	~10-15km

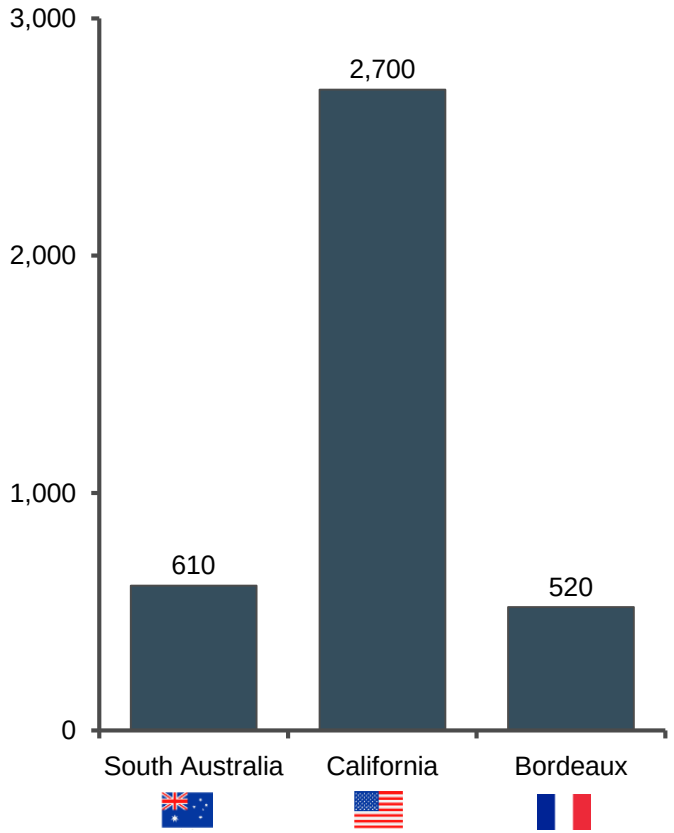
Note: * 2014-18 average exchange rate utilised (USD/AUD = 1.29); ** Average wine yield per a tonne of grapes assumed to be ~575 litres; *** Onset of ripening of grapes
Source: Wine Australia; California Department of Food and Agriculture; L.E.K. interviews and analysis

L.E.K.

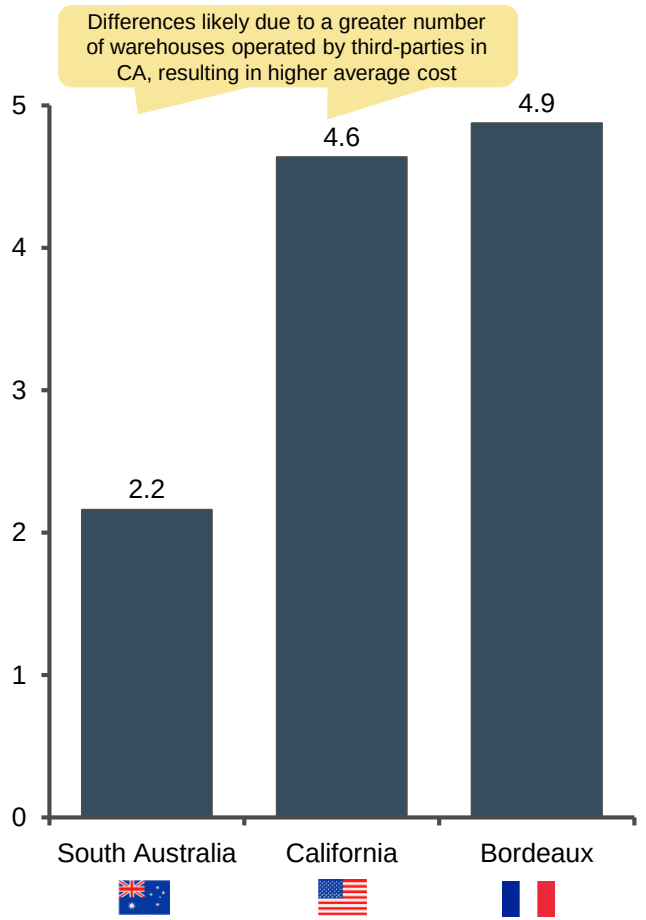
South Australia and Bordeaux produce c.1/5 of the volume produced in California; holding cost in South Australia is materially lower vs. California

Inbound | Outbound (domestic) | Outbound (export) | Quality

C **Wine production volume**
(c.2018)
In millions of litres



D **Est. average wine holding cost***
(c.2018)
AUD** per 9LE



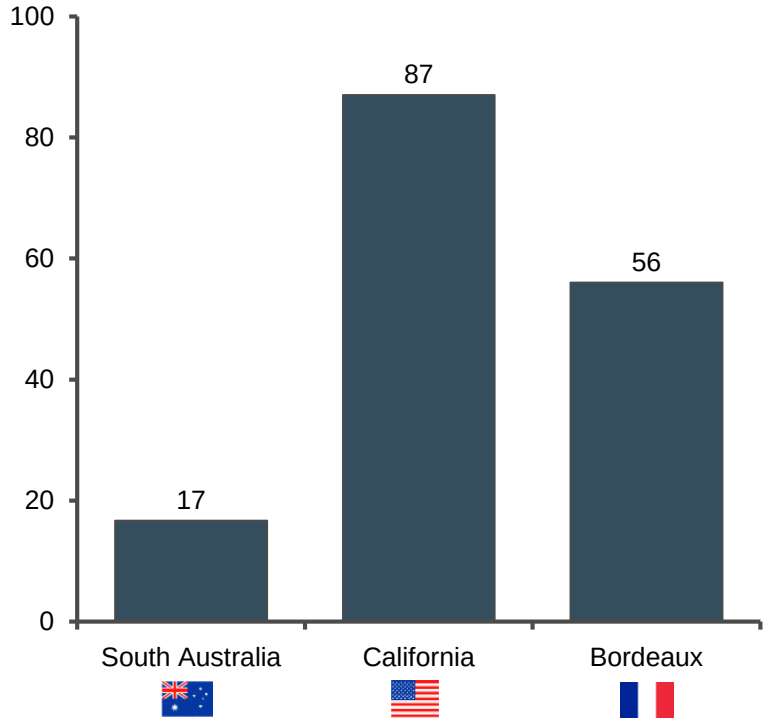
Note: * Assumes ~3 months of tank holding and ~12 months of bottle maturation; ** 2014-18 average exchange rate utilised (USD/AUD = 1.29)
Source: Wine Australia; California Department of Food and Agriculture; L.E.K. interviews and analysis

L.E.K.

There are significant differences in the proportion of wine consumed domestically. Road freight remains the predominant domestic transport mode across all geographies

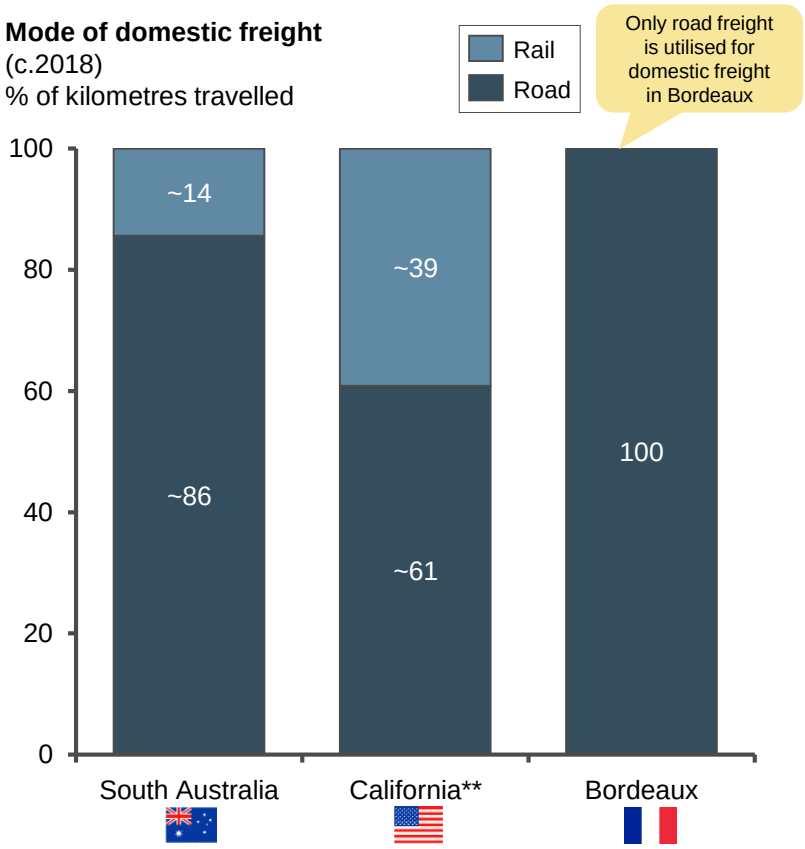
Inbound | **Outbound (domestic)** | Outbound (export) | Quality

E **Percentage of wine consumed domestically**
(c.2016-18)
% of volume



Vol.	~102m litres	~2,349m litres	~291m litres

F **Mode of domestic freight**
(c.2018)
% of kilometres travelled



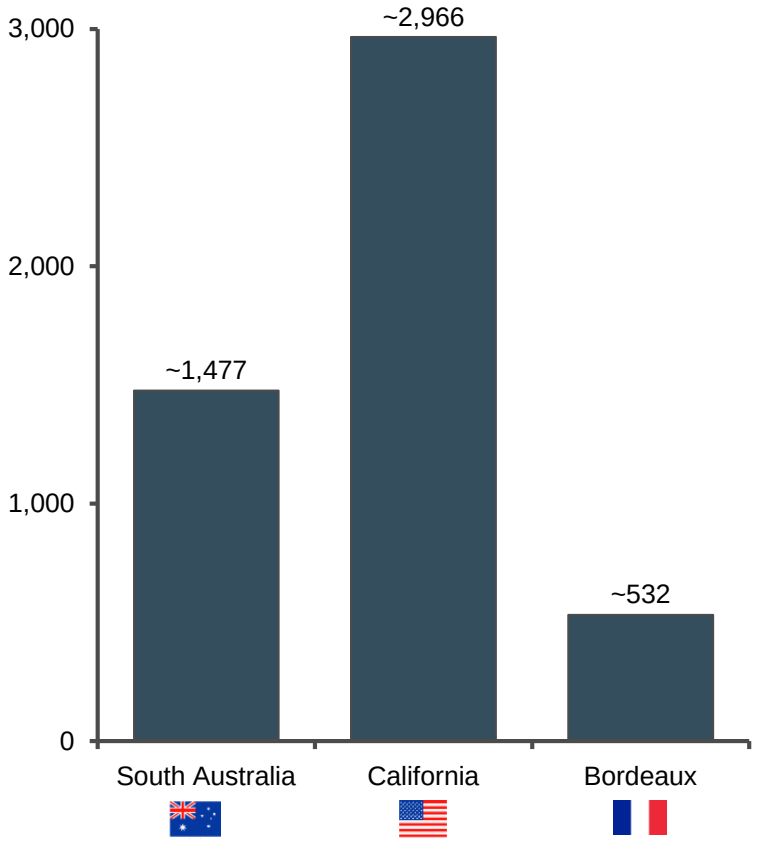
Note: * 2014-18 average exchange rate utilised (USD/AUD = 1.29); ** Estimated based upon population concentration among top ~20 U.S. cities. Cities east of Chicago assumed to utilise intermodal freight and ~20% of cross country freight assumed to utilise road freight; *** Estimated based on population concentration among key cities within each geography
Source: The Government of South Australia Wine ScoreCard; Wine Australia; L.E.K. analysis

L.E.K.

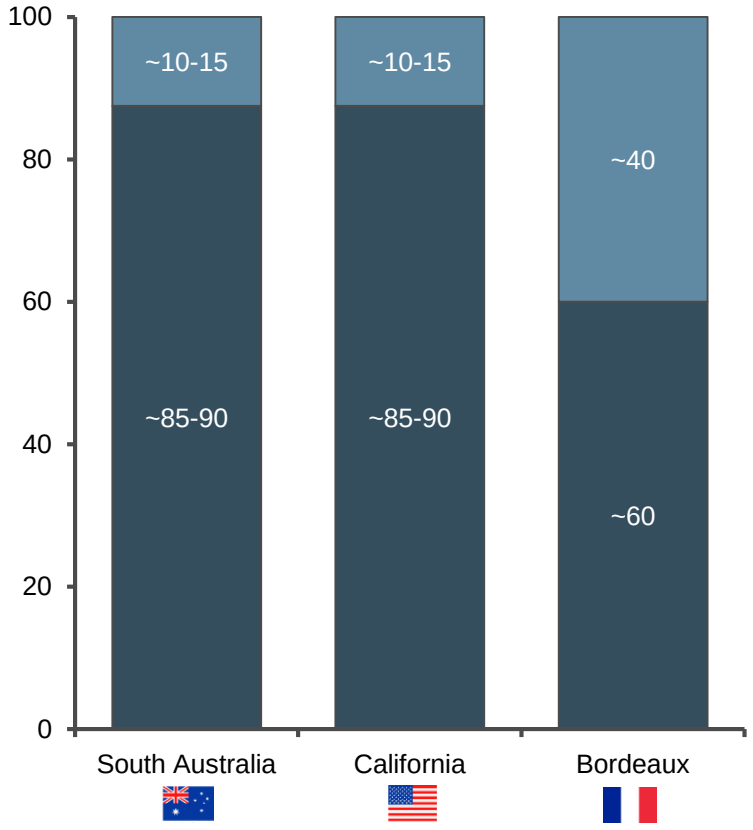
Domestic freight distances from CA are significantly longer than from SA. Temperature control is a much larger requirement in Bordeaux

Inbound | **Outbound (domestic)** | Outbound (export) | Quality

G **Average distance of domestic freight***
(c.2019)
Kilometres



H **Percentage of freight with temperature control**
(c.2019)
%



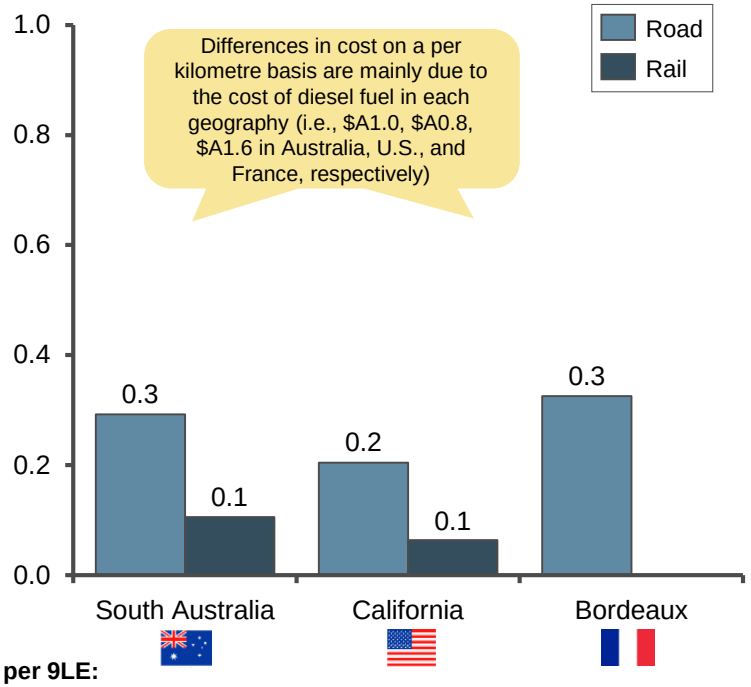
Source: Wine Australia; L.E.K. interviews and analysis

L.E.K.

The cost per kilometre of freight in SA is estimated to be higher with more road freight as well as sizable differences related to the cost of diesel fuel

Inbound | **Outbound (domestic)** | Outbound (export) | Quality

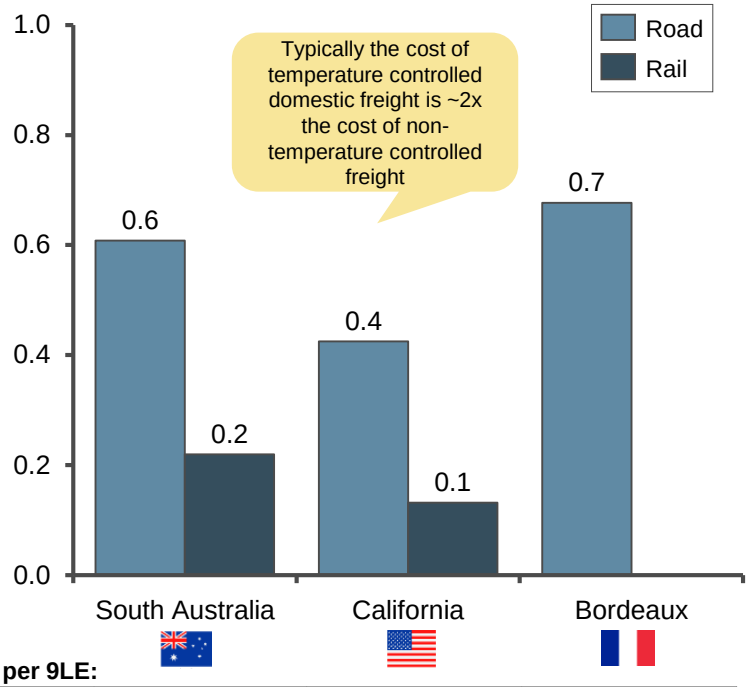
I **Cost of domestic freight per km (not temperature controlled)**
(c.2019)
AUD cent per 9LE



Total cost per 9LE:

Total cost (road)	$A4.3	$A6.0	$A1.7
Total cost (rail)	$A1.6	$A1.9	*Not applicable*
Weighted ave. total cost	$A3.9	$A4.4	$A1.7
Ave. distance	~1,477km	~2,966km	~532km

I **Cost of domestic freight per km (temperature controlled)**
(c.2019)
AUD cent per 9LE



Total cost per 9LE:

Total cost (road)	$A9.0	$A12.6	$A3.6
Total cost (rail)	$A3.2	$A3.9	*Not applicable*
Weighted ave. total cost	$A8.2	$A9.2	$A3.6
Ave. distance	~1,477km	~2,966km	~532km

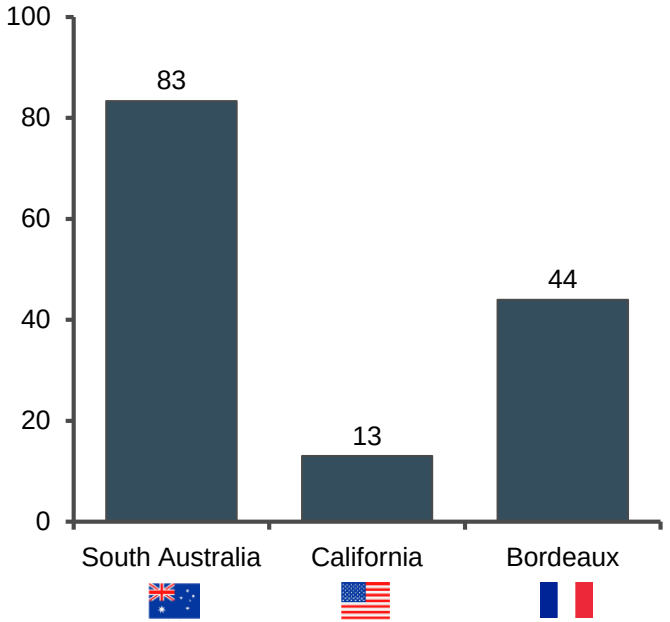
Source: World Freight Rates; Wine Australia; L.E.K. interviews and analysis

L.E.K.

Over 80% of wine produced in South Australia is exported; given the high export volume of low-cost wine, bulk freight is most utilised in SA vs. comparators

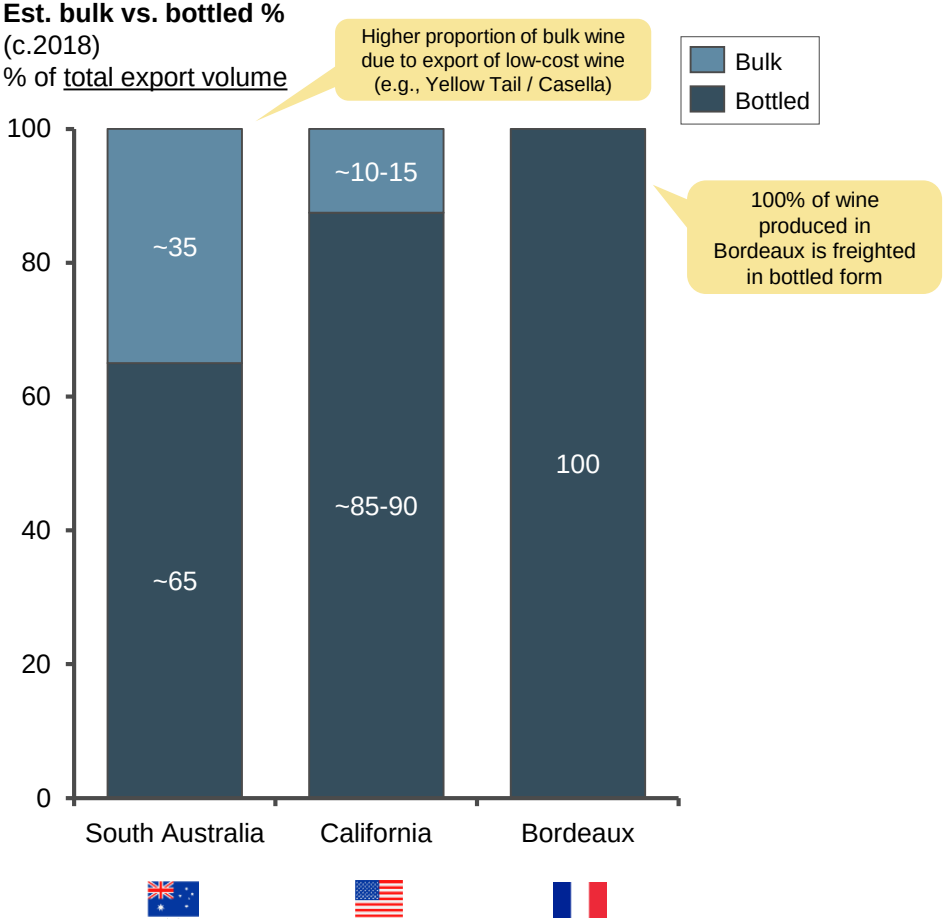
Inbound | Outbound (domestic) | **Outbound (export)** | Quality

J **Percentage of wine exported**
(c.2018)
% of volume



	South Australia	California	Bordeaux
Export volume	~508m litres	~351m litres	~229m litres
Export value	~$A1.79b	~$A1.79b^	~$A3.14b
Implied value per litre	~$A3.5	~$A5.1	~$A13.7

K **Est. bulk vs. bottled %**
(c.2018)
% of total export volume



Note: * Distance from Barossa Valley to the Port Adelaide; ** Distance from Barossa Valley to Port Melbourne; *** Average distance between Madera, Fresno, Merced, and Stanislaus counties to the Port of Oakland; ^ 2014-18 average exchange rate utilised (USD/AUD = 1.29)

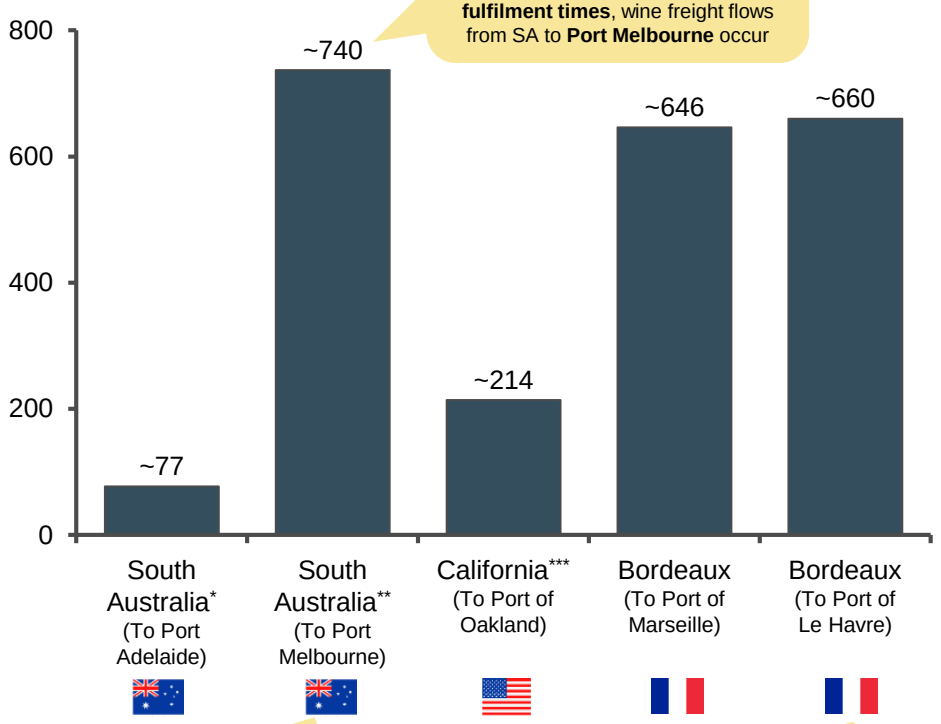
Source: The Government of South Australia Wine ScoreCard; Wine Australia; California Department of Food and Agriculture; The Wine Institute; L.E.K. analysis

L.E.K.

The port of Melbourne is often used for international freight to meet customers' time requirements, resulting in longer distance of road movements to port

Inbound | Outbound (domestic) | **Outbound (export)** | Quality

N **Average distance to port**
(c.2019)
Kilometre

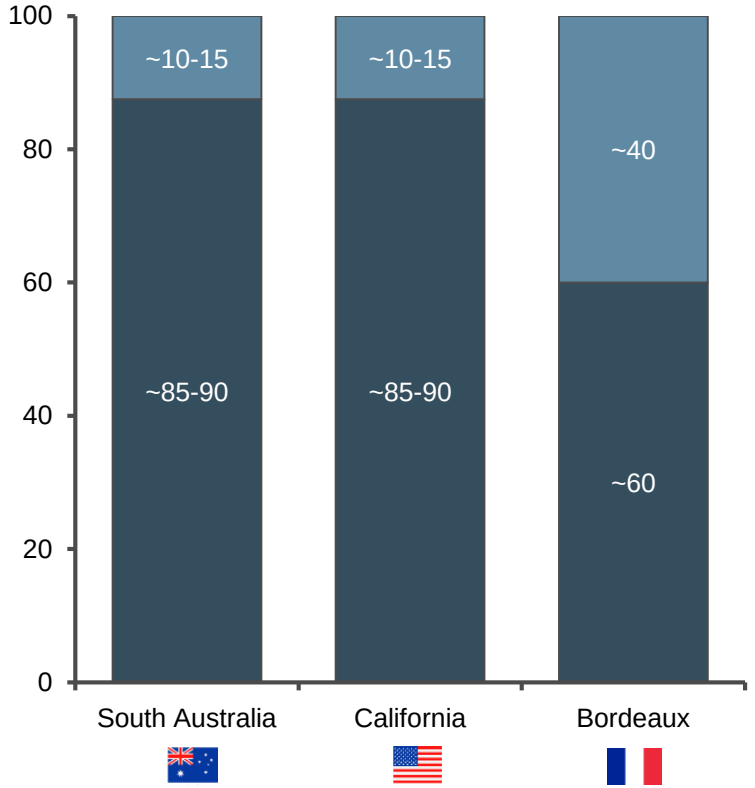


Limitations regarding the **frequency of container vessels servicing Port Adelaide** exist. In order to **meet customers' required fulfilment times**, wine freight flows from SA to **Port Melbourne** occur

Est. **~15-20%** of wine produced in South Australia for export is freighted to Port Melbourne; the weighted average distance between SA and the two ports is ~209km

Given geographical locations of the two key ports, shipment to **Asia** (e.g., China) is typically freighted to the **Port of Marseille**, while shipment to **North America** is freighted to the **Port of Le Havre**

O **Percentage of sea freight with temperature control**
(c.2019)
%



Note: * Distance from Barossa Valley to the Port Adelaide; ** Distance from Barossa Valley to Port Melbourne; *** Average distance between Madera, Fresno, Merced, and Stanislaus counties to the Port of Oakland

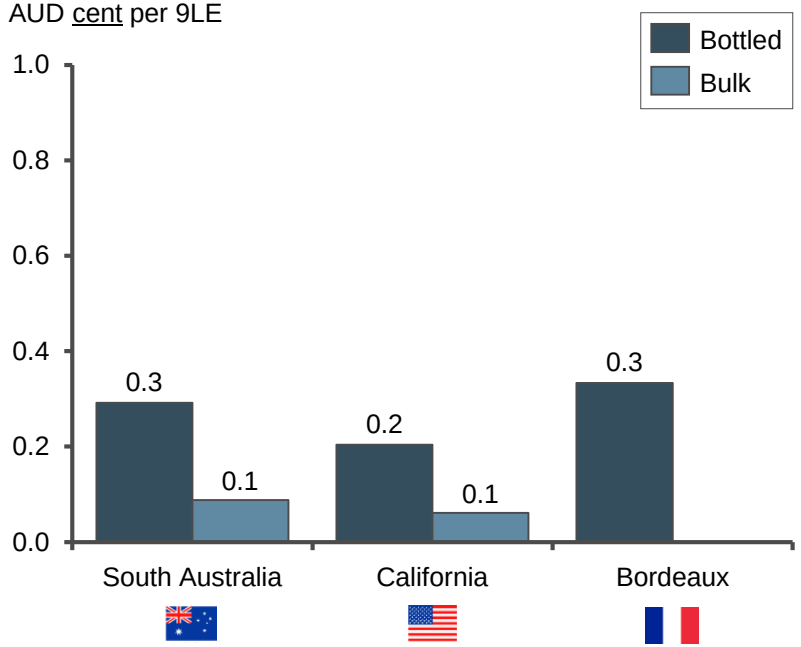
Source: The Government of South Australia Wine ScoreCard; Wine Australia; California Department of Food and Agriculture; The Wine Institute; L.E.K. analysis

L.E.K.

The cost of road freight to port from SA is higher vs. comparators, with temp. controlled freight being ~2x vs. non-temp. controlled freight

Inbound | Outbound (domestic) | **Outbound (export)** | Quality

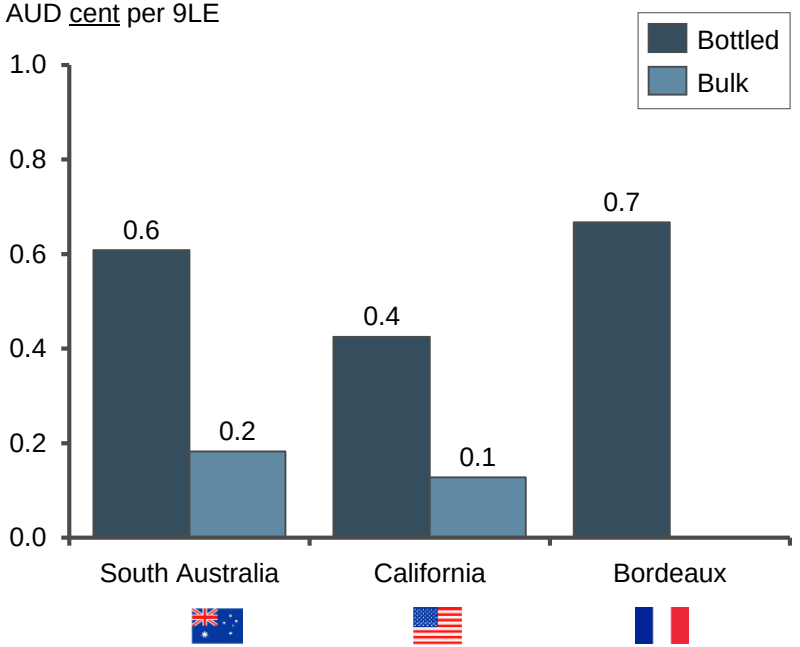
P **Cost of freight to port per kilometre (not temperature controlled)**
(c.2019)
AUD cent per 9LE



Total cost per 9LE:

Total cost (bottled)	$A0.6	$A0.4	$A2.2
Total cost (bulk)	$A0.2	$A0.2	-
Ave. distance	~209km	~214km	~653km

P **Cost of freight to port per kilometre (temperature controlled)**
(c.2019)
AUD cent per 9LE



Total cost per 9LE:

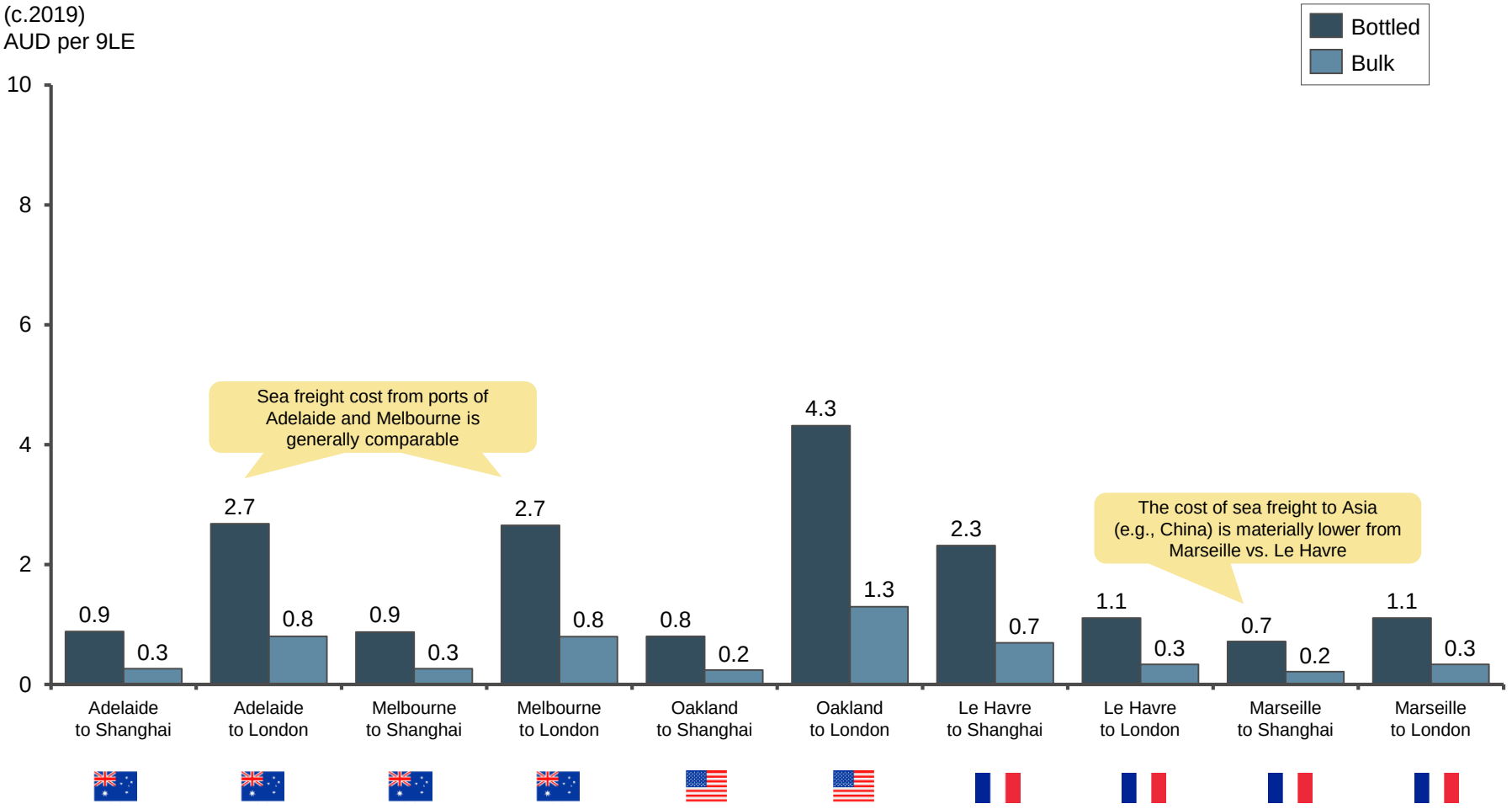
Total cost (bottled)	$A1.3	$A0.9	$A4.4
Total cost (bulk)	$A0.4	$A0.2	-
Ave. distance	~209km	~214km	~653km

Source: L.E.K. interviews and analysis

The cost of sea freight from Australian ports to Asia is generally competitive vs. California

Inbound | Outbound (domestic) | **Outbound (export)** | Quality

Q **Average total cost of sea freight* (agnostic of taxes and levies)**
(c.2019)
AUD per 9LE



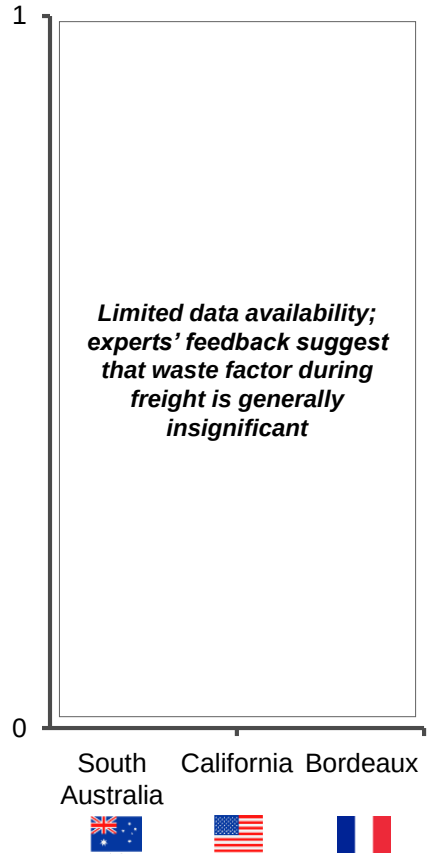
Note: * Assumes unrefrigerated 20ft containers with ~800 9LE cases and ~24,000 litres capacity for bottled and bulk wine, respectively
Source: Wine Australia; California Department of Food and Agriculture; L.E.K. analysis

L.E.K.

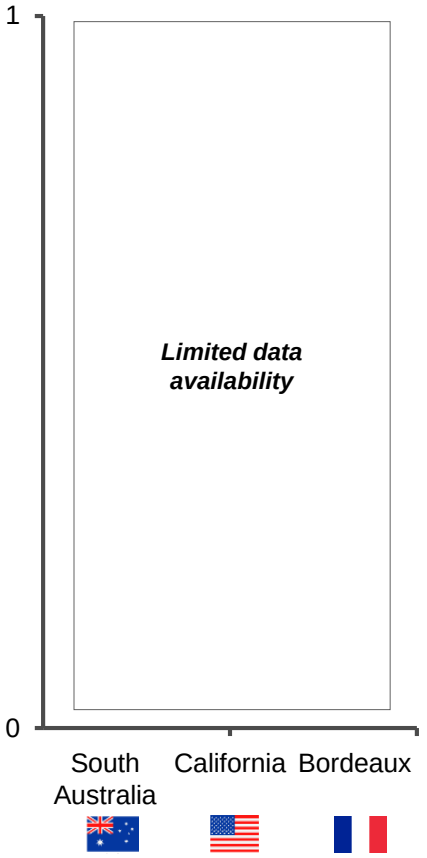
With the exception of DIFOT, there are limitations related to data availability for quality related metrics

Inbound | Outbound (domestic) | Outbound (export) | **Quality**

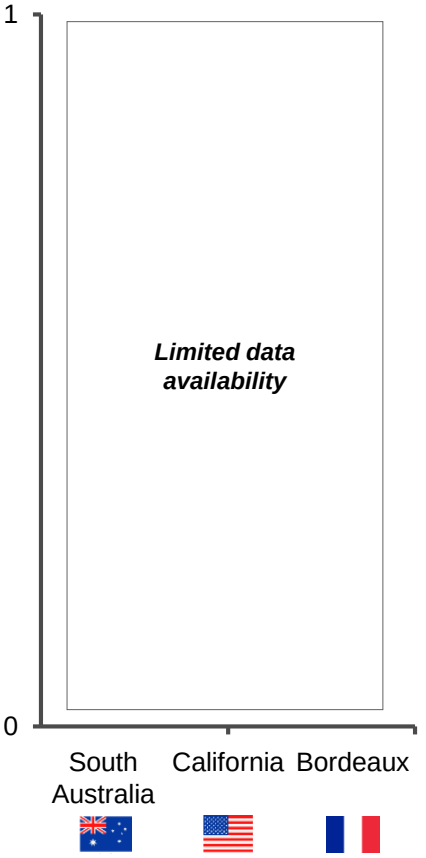
R **Waste factor during freight**
(c.2019)
% of volume



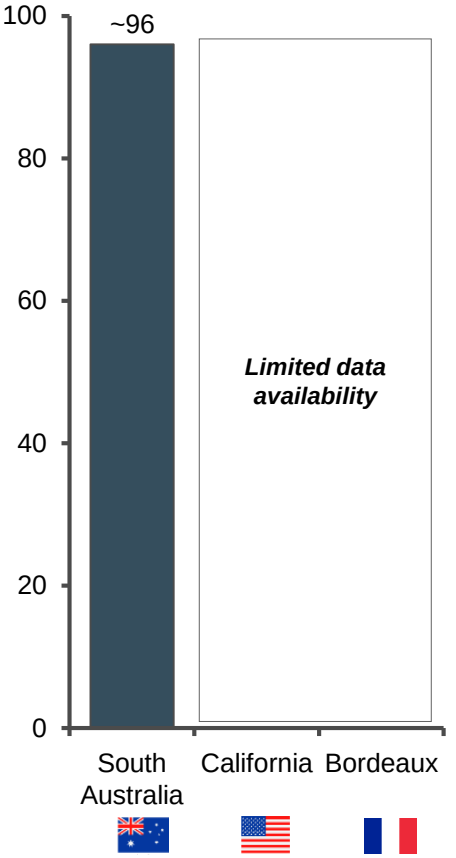
S **Customer complaints**
(c.2019)
Number of complaints



T **Industry safety**
(c.2019)



U **DIFOT**
(c.2019)
% of deliveries



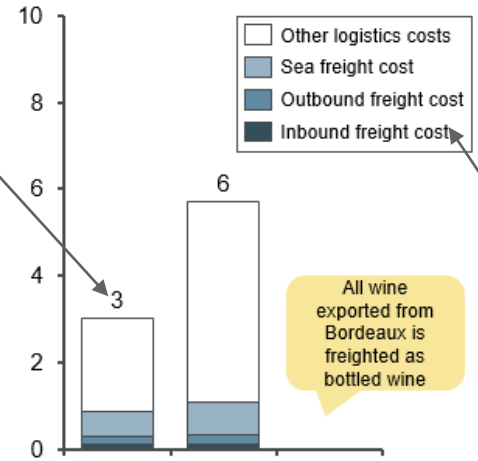
Source: Wine Australia; California Department of Food and Agriculture; L.E.K. analysis

As a means to assess the supply chain holistically, a rolled-up benchmark has been generated. Some interpretative considerations are important

Total costs indicate the costs related to freight and other associated logistics costs of wine

A number of important considerations to the physical differences exist that may impact the efficiency of the supply chain

Freight / holding cost structure (bulk export)
(c.2019)
In AUD per 9LE



Does not include distance travelled during sea freight

	South Australia	California	Bordeaux
Ave. total distance	209km	214km	653km
Total vol. freighted	178m litres	44m litres	0 litre

Other logistics costs include non-transport costs such as:

- Holding cost of wine prior to outbound freight
- (*Export*) Cost of container packing
- (*Export*) Holding cost at distribution centre(s)

Sea freight cost include:

- (*Export*) Cost of sea freight

Outbound freight cost include:

- Cost of domestic freight
- (*Export*) Cost of freight to port

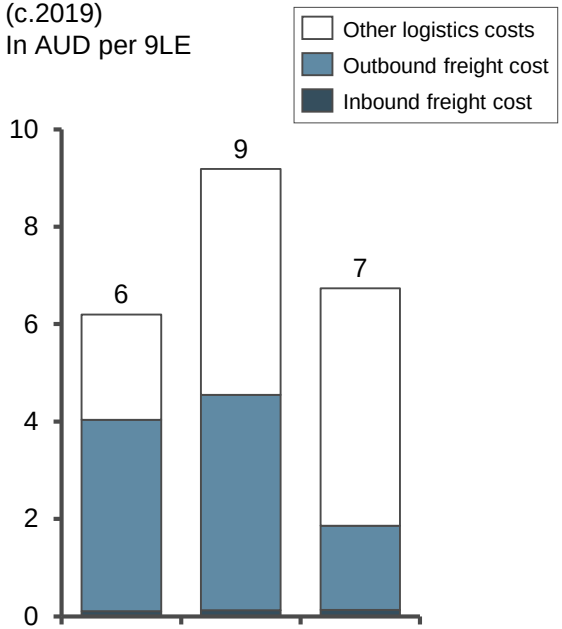
Inbound freight cost include:

- Cost of grape freight from vineyards to wineries

Source: L.E.K. analysis

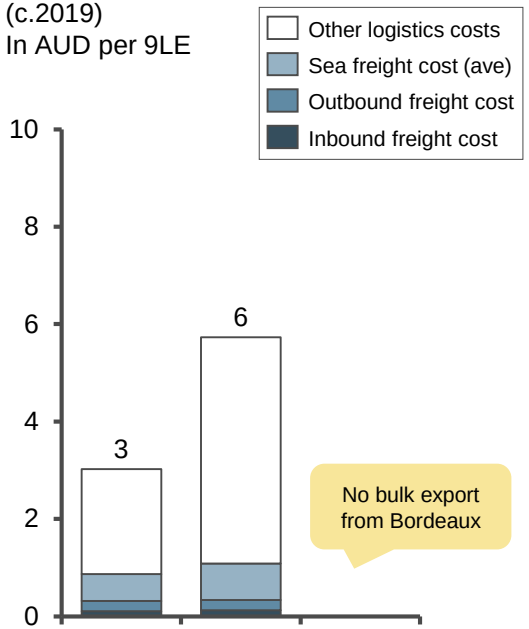
The Australian wine supply chain appears to be reasonably efficient against the geographies reviewed from a cost perspective

Freight & holding costs (domestic)
(c.2019)
In AUD per 9LE



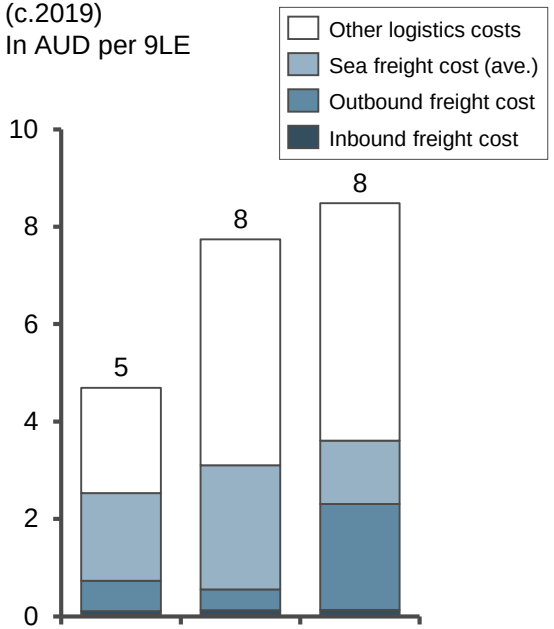
	South Australia	California	Bordeaux
Ave. total distance*	1,477km	2,966km	532km
Total vol. freighted	102m litres	2,349m litres	291m litres

Freight & holding costs (bulk export)
(c.2019)
In AUD per 9LE



	South Australia	California	Bordeaux
Ave. total distance*	209km	214km	653km
Total vol. freighted	178m litres	44m litres	0 litre

Freight & holding costs (bottled export)
(c.2019)
In AUD per 9LE



Does not include distance travelled during sea freight

	South Australia	California	Bordeaux
Ave. total distance*	209km	214km	653km
Total vol. freighted	330m litres	307m litres	229m litres

Note: * Estimated average distance transported from wineries to market
Source: L.E.K. analysis

Benchmark summary

Summary of wine benchmarks:

	A Grape volume	B Cost of grape freight (Per tonne)	C Wine volume	D Holding cost (Per 9LE)	E Domestic %	F Mode of domestic freight	G Ave. distance of domestic freight	H % of freight with temp. control	I Cost of domestic freight (Per 9LE)
South Australia	1.7m tonnes	61 AUD	610m litres	2.2 AUD	17%	14% rail / 86% road	1,477	10-15%	3.9 AUD
California	3.9m tonnes	71 AUD	2,700m litres	4.6 AUD	87%	39% rail / 61% road	2,966	10-15%	4.4 AUD
Bordeaux	0.9m tonnes	75 AUD	520 litres	4.9 AUD	56%	0% rail / 100% road	532	40%	1.7 AUD

	J Export %	K Bulk vs. bottled %	L Cost of container packing	M Holding cost at dist. centres	N Average distance to port*	O % of freight with temp. control	P Cost of freight to port	Q Ave. cost of sea freight	R Waste factor	S Customer Complaints	S Industry safety	U DIFOT
South Australia	83%	35% / 65%	*n/a*	*n/a*	209	10-15%	0.6 AUD	1.8 AUD	*n/a*	*n/a*	*n/a*	96%
California	13%	10-15% / 85-90%	*n/a*	*n/a*	214	10-15%	0.4 AUD	2.6 AUD	*n/a*	*n/a*	*n/a*	*n/a*
Bordeaux	44%	0% / 100%	*n/a*	*n/a*	653	40%	2.2 AUD	1.3 AUD	*n/a*	*n/a*	*n/a*	*n/a*

Relative performance vs. South Australia:

Less superior — *More superior*

Note: * Weighted average where applicable
Source: L.E.K. analysis

L.E.K.

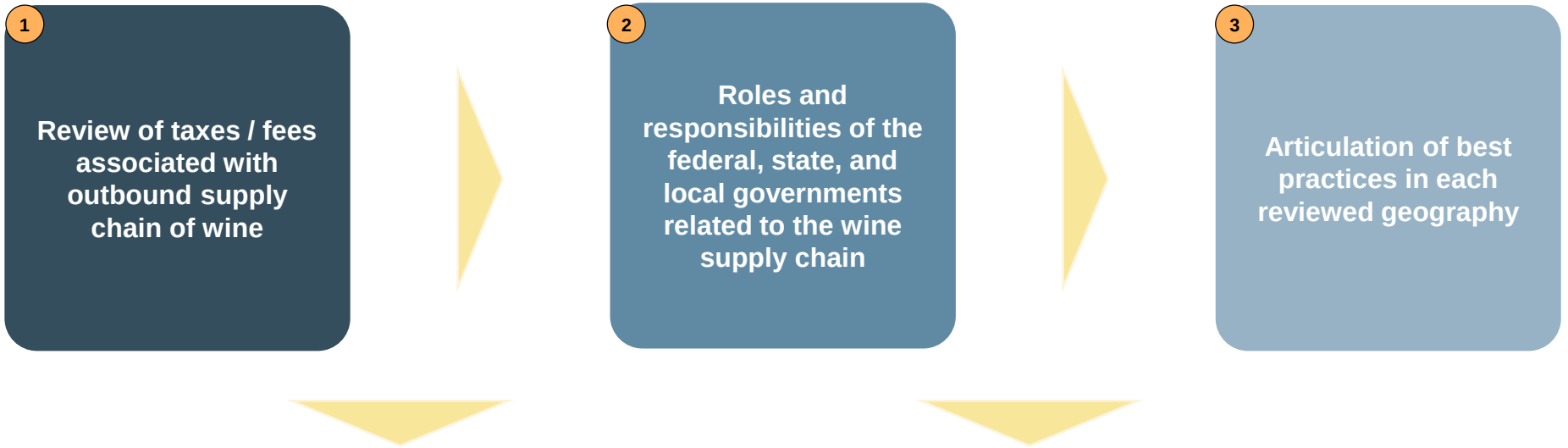
Wine benchmarking findings

- South Australia's wine supply chain appears generally efficient relative to comparators in the U.S. and France
- ***(Inbound metrics)*** Despite California crushing a higher volume of grapes, the unit costs of transporting grapes to wineries appears to be relatively consistent across regions, if not marginally cheaper in Australia
  - The industry is of significantly larger scale in California than in Bordeaux or South Australia in terms of finished goods production
  - The nature of the supply chain (location of warehousing, market structure) is also inherently different. For example, holding costs at in the USA are higher than in other regions in part due to the increased market power held by US distributors
- ***(Outbound metrics)*** While there is a propensity to utilise the 'general freight' supply chain in Australia vs. utilisation of a more dedicated wine distribution channels in the U.S., the difference in cost on a per km basis (i.e., higher per/km cost in South Australia vs. California) is offset by the lower average distance travelled in Australia relative to the U.S.
  - In addition, the competitiveness of the domestic 'general' freight supply chain and concentration of major customers (e.g., Sydney, Melbourne, Brisbane etc.) supports cost effective intra country movement of wine
  - For domestic transport, trucks remain the predominant mode, except for longer haul distances in Australia and the U.S., where intermodal facilities and the general rail freight flow is used
  - Supply restricted, super premium wine that require customers to subscribe to multi year waiting lists, is generally air freighted from Bordeaux, but this represents a relatively small (volume) share
  - Bulk wine (bottled in the market of consumption rather than production) is transported in containers fitted with an internal bladder
  - Temperature controlled freight is reserved for only the highest quality wines, with the cost of temperature control ~2-3x the price of 'dry' (i.e., not temperature controlled) transport. Temperature control for wine is only necessary over years to preserve quality, and the relative impact of the supply chain transport duration is unlikely to have any noticeable quality impact
- ***(Export metrics)*** Similarly to domestic freight, export of wine from South Australia appears also efficient vs. California, due to (a) relative proximity to Port Adelaide resulting in a lower cost of freight to port, and (b) competitiveness of the cost of sea freight
  - However, Bordeaux appears to outperform South Australia regarding the cost of sea freight to both China and the UK, given the geographical locations of the ports of Le Havre and Marseille

Agenda

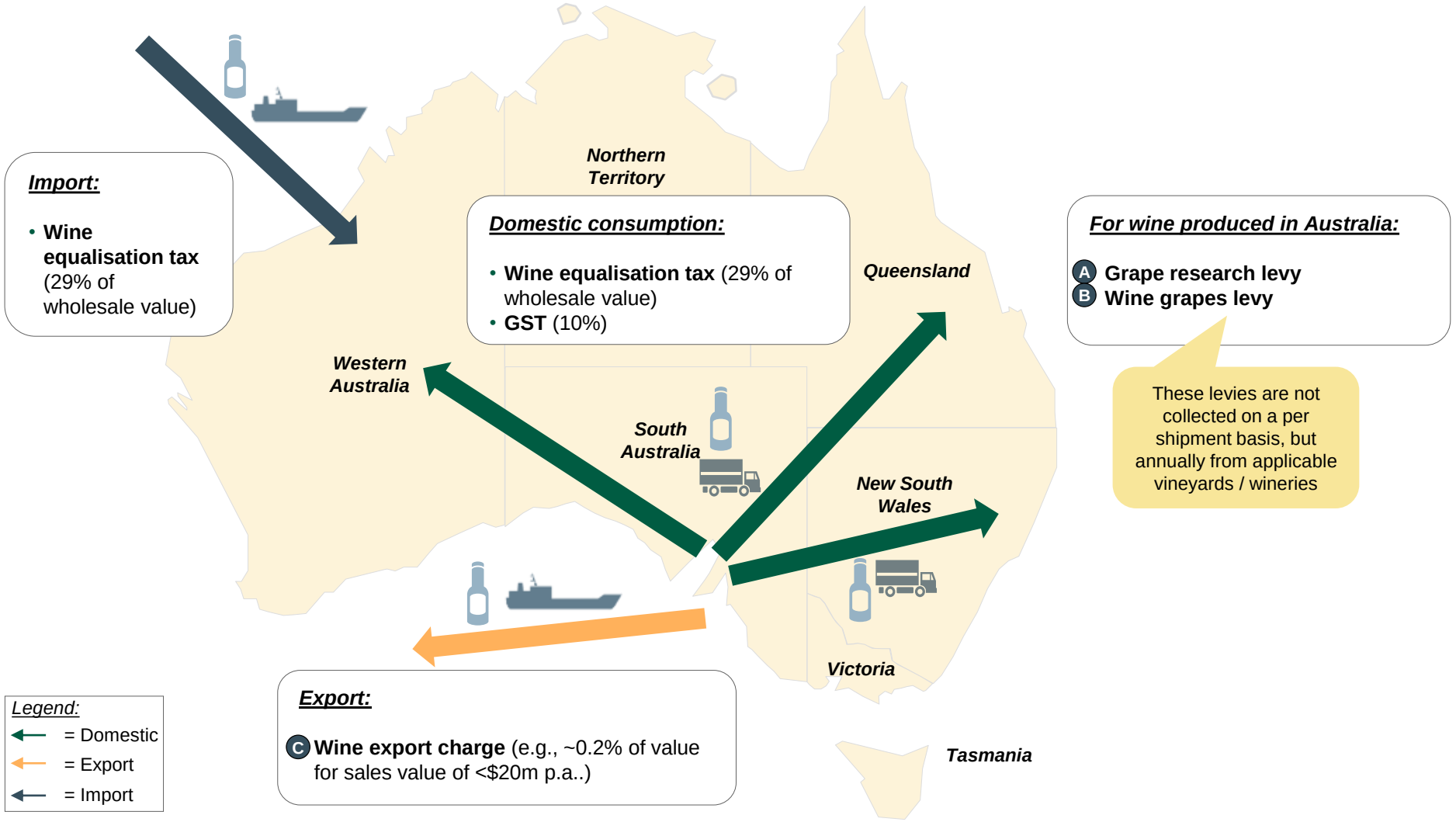
- Executive summary
- Scope and rationale for the study
- Waste supply chain
- **Wine supply chain**
  - Australia
  - Global comparators
  - Freight network and supply chain metric performance comparison
  - **Freight network and supply chain planning, governance and investment comparison**
  - Identification of areas of improvement within the Australian supply chain
- Benchmarking supply chain – An approach for further supply chains
- Approach for further work

Similar to waste, this review was conducted in four stages to identify opportunities for improvement



There are several types of taxes / levies imposed related to the movement of wine to / and from Australia

1



Source: Wine Australia; Department of Agriculture; L.E.K. analysis

Levies collected from wine producers in Australia are mainly utilised to fund Wine Australia's operations

1

A Grape research levy in Australia: Paid to Wine Australia (~99% of total levies) and Plant Health Australia (~1%). **~$4m AUD collected in 2018**

- The grape research levy is payable on fresh grapes, dried grapes, and grape juice delivered to a processing establishment in Australia
- The levy rate is $2.00 AUD per tonne of grapes

B Wine grapes levy in Australia: Paid to Wine Australia (~99.5% of total levies) and Plant Health Australia (~0.5%). **~$14m AUD collected** in 2018

Quantity (in tonnes)	Stepped amount of levy payable per tonne		Levy base
More than 0 to not more than 10	$5.00 per tonne	+	$200
More than 10 to not more than 3K	$9.20 per tonne (including first 10 tonnes)	+	$180
More than 3K to not more than 6K	$8.80 for each tonne over 3,000 tonnes	+	$27,780
More than 6K to not more than 9K	$7.00 for each tonne over 6,000 tonnes	+	$54,180
More than 9K to not more than 12K	$6.30 for each tonne over 9,000 tonnes	+	$75,180
More than 12K to not more than 20K	$5.60 for each tonne over 12,000 tonnes	+	$94,080
More than 20K to not more than 40K	$5.50 for each tonne over 20,000 tonnes	+	$138,880
More than 40K	$5.40 for each tonne over 40,000 tonnes	+	$248,880

C Wine export charge (WEC) in Australia: Paid to Wine Australia. **~$3m AUD collected in 2018**

Wine FOB (free on board) sales value for the levy year	Levy base amount		Amount of levy payable
$0 to $20 million AUD	0		0.20% of value
$20 million to $70 million AUD	$40,000 AUD	+	0.10% of value between $20 million and $70 million AUD
>$70 million AUD	$90,000 AUD	+	0.05% of value over $70 million AUD

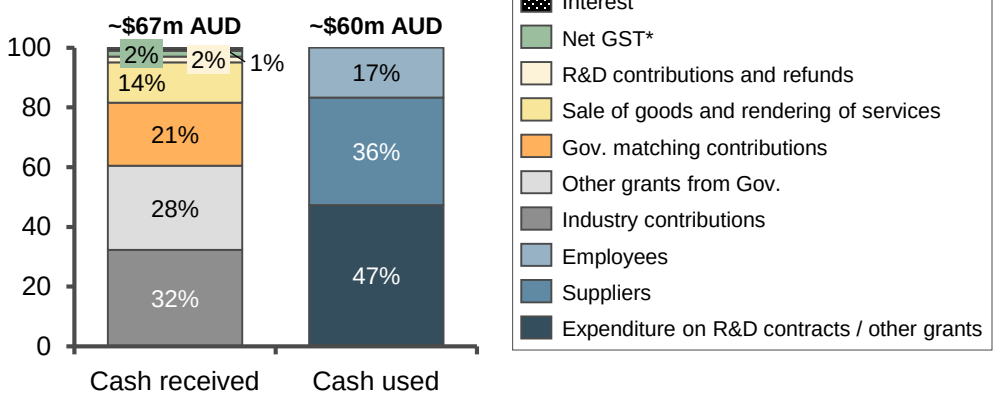
Source: Wine Australia; Department of Agriculture; L.E.K. analysis

L.E.K.

Funded by a number of levies, Wine Australia provides a number of critical initiatives and guidance for Australian winemakers to enable wine export

2

Wine Australia: Breakdown of cash received / used
(FY2017*)
Percentage of total



- **Wine Australia** (part of the Australian Government) is key regulatory body for the wine industry in Australia
  - Coordination and funding of grape and wine R&D, and the publication of its outcomes
  - Surveillance and support related to export of Australian wine
  - Promotion of Australian wine among both domestic and overseas markets
- Wine Australia's primary funding sources are primarily the following:
  - Income from industry through levies (i.e., grape research levy, wine grapes levy, and the wine export charge)
  - Regulatory services and activities
  - Contributions related to marketing activities
  - Other grants (e.g., Government etc.)
- Almost half of Wine Australia's expenditures are related to R&D

Key roles of Wine Australia:

Regulatory monitoring of wine exports

- Funded by the wine export charge (WEC), Wine Australia ensures appropriate labelling of wine among wine producers exporting >100 litres annually
  - A certificate confirming adherence to the labelling requirements in destination countries is required among some export countries (e.g., China)

Research, development, and extension within the wine industry

- With ~$28m AUD invested towards research, development, and extension (RD&E) initiatives annually, Wine Australia is undertaking numerous research projects including:
  - Bio security, pest / disease management, climate adaptability
  - Efficiency related to vineyard management, production etc.
  - Improvements in yeast / bacterial and grapevine / rootstock performance
  - Market access
  - KPI tracking (e.g., measures of quality)

Promotion of Australian wine both within Australia and internationally

- Wine Australia also implements marketing programs both within Australia as well as internationally
  - For example, Wine Australia established its flagship online store on Alibaba's Tmall in 2016 with an aim to participate in the increasing popularity of e-commerce among Chinese consumers

Feedback from industry players suggests that Wine Australia is a critical enabler of their ability to efficiently export wine produced in Australia

Note: * From operating activities
Source: Wine Australia; L.E.K. analysis

The government of South Australia has a number of responsibilities to support the stakeholders within the South Australian wine industry

2 **Key roles of the government of South Australia:**

Government of South Australia
Primary Industries and Regions SA
PIRSA

Preparation and dissemination of the PIRSA wine ScoreCards

- The Primary Industries and Regions South Australia (PIRSA), a key economic development agency within the government of South Australia, provides “Wine ScoreCards”, which publishes industry statistics related to:
  - Volume and value of wine grape and wine produced in South Australia
  - Value of domestic consumption by type (e.g., interstate sales, retail / hospitality consumption)
  - Value and volume of wine exported overseas etc.

Management of 7 wine industry funds within South Australia

- The PIRSA currently operates 7 wine industry funds, including the South Australian Grape Growers Industry Fund, as well as 6 other regional funds*
- While the rules differ slightly by each fund, contributions are required by (a) wine grape growers, (b) winemakers purchasing grapes from a grape grower, and (c) winemakers growing their own wine grapes
- Contribution received are used to fund a number of local associations (e.g., Barossa Grape and Wine Association etc.) within South Australia

Note: * Adelaide Hills, Barossa, Clare Valley, Langhorne Creek, McLaren Vale, and Riverland regional founds
Source: The Government of South Australia; L.E.K. interviews and analysis

L.E.K.

There is limited legislative policy or planning involvement in the wine supply chain (1/2)

2

	Viticulture		Vinification and storage			Outbound freight (*domestic and export*)		
	Vineyard license / accreditation	Wine grape collection and freight	Wine production	Warehouse storage	Labelling	Truck registration (domestic freight)	Road design / maintenance (domestic freight)	Freight route / mode
Federal government			Wine production is regulated by federal laws	Wine Australia requires prudent record keeping of wine stored under the Australian Grape and Wine Authority Act, Section 39F	Wine Australia regulates labelling guidelines / requirements under the Wine Australia Act 2013**	State transport authorities manage truck registrations	Federal departments manage major network	
State government	The SA state government requires an application for a license within 3 months of planting*		Wine production is regulated by state laws				State Transport department manage networks within each state	
LGAs							LGAs manage 70% of roads	
Relative impact on supply chain cost	○	◑	○	◔	○	○	○	●
Relative impact on supply chain quality	○	◑	○	◔	○	○	○	●

Although freight route and mode impact both the cost and quality of the wine supply chain, there is limited government involvement / influence specific to wine

○ Low relative cost

● High relative cost

Note: * A fee of $9.5 AUD / hectare is required for registration; ** Accompanying regulations include he Food Standards Code, the National Measurement Act, and the Competition and Consumer Act 2010

Source: The Government of South Australia; Wine Australia; Department of Agriculture; L.E.K. interviews and analysis

L.E.K.

There is limited legislative policy or planning involvement in the wine supply chain (2/2)

2

	Outbound freight (*export*)			
	Licence to Export	Product Registration	Export Permit	Distribution centre
Federal government	Wine Australia regulates the approval process	Wine Australia regulates the approval process	Wine Australia regulates the approval process	
State government				
LGAs				
Relative impact on supply chain cost	○	○	○	◑
Relative impact on supply chain quality	○	○	○	◑

○ Low relative cost

● High relative cost

Source: The Government of South Australia; Wine Australia; Department of Agriculture; L.E.K. interviews and analysis

L.E.K.

There are a number of wine supply chain "best practices" observed within both Australia and comparators

3

Type	Description	CA	BDX	SA	Examples	Impact on freight efficiency	Impact on competitive-ness
Type of supply chain utilised	• The degree of which the wine supply chain is commodity specific vs. general	✓		✓	• The degree of utilisation of wine specific supply chain vs. the general supply chain differs materially across geographies • Wine freighted from **California** is typically freighted via wine specific supply chain, resulting in efficiency on a per km basis • In Australia, much of the freight of wine is through the general supply chain	◑	◑
Standardisation of labelling	• Regulatory programmes with the purpose to ensure the authenticity of wine produced	✓	✓	✓	• Labelling requirements for **Californian** wine is mainly regulated by the Alcohol and Tobacco Tax and Trade Bureau (TTB) • **Bordeaux** wine labels are governed by both national and regional laws; there is no obligation to state the ranking of the Château under various classifications • In **Australia**, Wine Australia offers the Label Integrity Program (LIP) with the purpose of ensuring the authenticity of wine produced in Australia	○	◕
Regulatory guidance for wine exports	• Dissemination of information / enforcement of export regulations	✓		✓	• In **California**, the USDA Foreign Agricultural Service offers "Exporter Guides" tailored for each destination country • **Wine Australia** oversees all regulatory requirements related to export of Australian wine	◑	◕
Overseas marketing programmes	• Programs among gov. bodies to drive overseas consumption			✓	• Under Wine Australia, Australia is the only country assessed with an existing government-led programme with the purpose of providing market development activities (e.g., establishment of an E-commerce store in China etc.)	○	●
Temperature control of the supply chain	• Utilisation of temperature control during freight	✓	✓	✓	• While the utilisation of temperature controlled freight is relatively limited generally, there is a utilisation of temperature controlled freight for **Bordeaux** wine is more frequent due to the premium nature of its appellation	◑	◕

Source: The Government of South Australia; Wine Australia; Department of Agriculture; L.E.K. interviews and analysis

L.E.K.

Industry stakeholders are generally satisfied regarding the role of Wine Australia

Feedback from industry stakeholders:

The role of Wine Australia is highly regarded among industry stakeholders

- Feedback regarding the role of Wine Australia is generally positive among industry stakeholders, particularly as it relates to the export of Australian wine through labelling standardisation, regulatory guidance

"… Wine Australia plays a pivotal role in enabling Australian winemakers to export wine in a smooth and efficient manner …"
Executive, Australian Wine Peak Body, October 2019

Wine Australia also provides market development initiatives

- Industry stakeholders also noted Wine Australia's unique market development initiatives (e.g., establishment of a proprietary e-commerce shop in China)
  - Wine Australia is the only government body across the geographies assessed providing market development initiatives, both domestically and internationally

"… They (Wine Australia) have dedicated staffs overseas, and they even operate a e-commerce store in China dedicated to selling wine produced in Australia, for example. This is quite unique …"
Senior Executive, Major Australian wine company, October 2019

Source: L.E.K. interviews and analysis

Industry participants indicate that they see the materials movement elements of the supply chain as efficient, with appropriate Government support

Wine

Australian industry participants indicate that the supply chain is efficient…..

- Wine industry participants (peak bodies, vineyard operators, wine producers and supply chain services providers) expressed a consistent level of satisfaction with the supply chain efficiency
  - the competitiveness of the domestic 'general' freight supply chain and concentration of major customers supports cost effective intra country movement of wine
- Industry bottlenecks typically exist only during vintage, as surge capacity of trucks in wine regions are required to transport grapes to production facilities
- As finished goods enter the 'general' freight supply chain any inefficiencies are shared across several other domestic and export 'dry' freight categories
  - efficiency of delivering and loading export containers through container ports
  - frequency of container vessel arrivals at Port Adelaide
  - efficiency of the empty container circular supply chain
  - the ease of country of destination import facilities

…and that the policy, planning and infrastructure landscape supports efficiency

- There are several types of taxes / levies imposed related to the movement of wine to / and from Australia. These fees appear to have limited impact on the supply chain operations or efficiency
  - The wine equalisation tax (WET) is a 29% imposed on all wine sold in Australia
  - Levies collected from wine producers in Australia are mainly utilised to fund Wine Australia's operations
  - Wine Australia provides a number of critical initiatives and guidance for Australian winemakers to enable wine export
- The government of South Australia has a number of additional responsibilities to support the stakeholders within the South Australian wine industry, predominantly focussed on supporting tourism and export
- Overall, there is limited legislative policy or planning involvement in the wine supply chain

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Wine Opportunity Summary

Approach to determining suggestions / opportunities

- During the course of the study, interviews with a diverse set of industry stakeholders were conducted
- Given the "pilot" nature of the effort, and the subjections of the supply chain (and geographies), suggestions / improvements have been focused on this scope and are by nature, not exhaustive
- Key to the suggestion set is the need to consistently trade-off supply chain efficiency, cost, and the competitiveness of Australian wine

Suggestions / opportunities for improvement

Initiative	Initiative	Impact on freight efficiency
A	**Consideration of temperature controlled freight**	
B	**Capacity of logistics providers at vintage**	
C	**Continued efforts on improving container throughput**	
D	**Continued support of wine as an export product**	
E	**Cost of freight for smaller lots**	
F	**Data collection: Volume of grapes and finished goods**	
G	**Data collection: Export vs. Domestic**	
H	**Data collection: Collection of cost data**	
I	**Data collection: Collaboration with int. markets**	
J	**Efficiency of wine supply chain vs. other consumer goods exports**	

Type of impact:
= Wine specific
= General Freight

Source: L.E.K. interviews and analysis

L.E.K.

Observations related to freight efficiency and global competitiveness (1/3)

4

Type of impact:
= Wine specific
= General Freight

	Issue	Examples / impact	Opportunity	Impact on freight efficiency
A **Consideration of temperature controlled freight**	• Given the temperature sensitive nature of wine, temperature controlled freight is sometimes preferable • The majority of wine is freighted without temperature control. This is not an issue for all but the super premium products of the market	• In Bordeaux, a sizable volume of premium wine is freighted in a temperature controlled environment, resulting in (at minimum) a higher perceived quality product delivered to customer	• Increasing the utilisation of temperature controlled wine freight could be considered, as the demand for quality control across the supply chain increases	
B **Capacity of logistics providers at vintage**	• Given the short window of time to transport wine grapes during vintage, capacity limitations amongst local providers exist, related to movement of the grapes from vineyards to wineries	• Late deliveries of grapes cause delays in wine production and inefficient production • The cost of freight during vintage can increase based on supply/demand factors	• Optimisation of logistics providers' capacity during peak periods could positively impact the efficiency of 'inbound' freight efficiency • Consider the use of vehicles with an opposite seasonality trend	
C **Continued efforts on improving container throughput**	• Continued effort to ensure efficiency in throughput via container ports	• There are limited bottlenecks in the export chain, however the efficiency of port throughput either via disruption or efficiency was noted	• Continue to improve the efficiency of container ports (particularly Port Adelaide and Port Melbourne) that are most utilized by the South Australian wine industry	

Note: Source: L.E.K. interviews and analysis

L.E.K.

Observations related to freight efficiency and global competitiveness (2/3)

4

= Wine specific
= General Freight

	Issue	Examples / impact	Opportunity	Impact on freight efficiency
D **Continued support of wine as an export product**	• Wine Australia performs a valuable, appreciated and well regarded role in approving Australian wines for international markets	• Wine Australia facilitates the trade of Australian wines into international markets • Wine Australia appears to be best practice in a global context	• Continue to review the role of Wine Australia versus international agencies	
E **Cost of freight for smaller lots**	• The cost of wine freight smaller quantities (i.e., direct to customers, out of cellar doors) is typically materially higher vs. shipments in larger quantities	• The ability for a wine region 'tourist' to purchase a case of wine and then freight the product home can be prohibitively expense	• Consider alternative distribution paths for small lot direct to consumer products • Noting that by volume and value this remains a small share of the Australian market	
F **<u>Data collection</u>:** ***Volume of grapes and finished goods***	• While grape volume data is currently collected at a relatively granular level within Australia, an improvement of wine volume data collection may be needed	• There is relatively limited publically available data related to the volume of wine produced by state / region • This lack of data makes it difficult to estimate the total freight task	• Consider development of data standards and consistent reporting to track the freight flows	

Source: L.E.K. interviews and analysis

L.E.K.

Observations related to freight efficiency and global competitiveness (3/3)

4

	Issue	Examples / impact	Opportunity	Impact on freight efficiency
G **Data collection: *Export vs. Domestic***	• Given differences in the methodologies around data collection, there is limited alignment around export vs. domestic data	• In South Australia, the local government provides estimates based upon wines produced in South Australia. However, Wine Australia collects data based on exports from industry players with head offices within South Australia	• Align data collection methodologies across Government Agencies	
H **Data collection: *Collection of cost data***	• There is limited initiatives around collection of cost data, particularly as it relates to freight	• Absence of adequate cost data could result in limited decision making ability among industry stakeholders	• Develop data sharing arrangements across peak bodies and private entities to allow comparison of supply chain costs	
I **Data collection: *Collaboration with int. markets***	• Units of data reported and the methodologies utilised across geographies can differ materially	• Given the absence of collaborative efforts internationally, an 'apples for apples' can be challenging	• Develop international data sharing arrangements with peak bodies and international government agencies to allow periodic benchmarking	
J **Efficiency of wine supply chain vs. other consumer goods exports**	• There is limited understanding on the efficiency of the wine supply chain relative to other consumer goods / FMGC exports	• A comparison of the wine export supply chain against a set of comparable consumer goods export supply chain could be beneficial	• When further benchmarking studies are undertaken, perform in a consistent manner to allow comparison back to the wine industry	

Source: L.E.K. interviews and analysis

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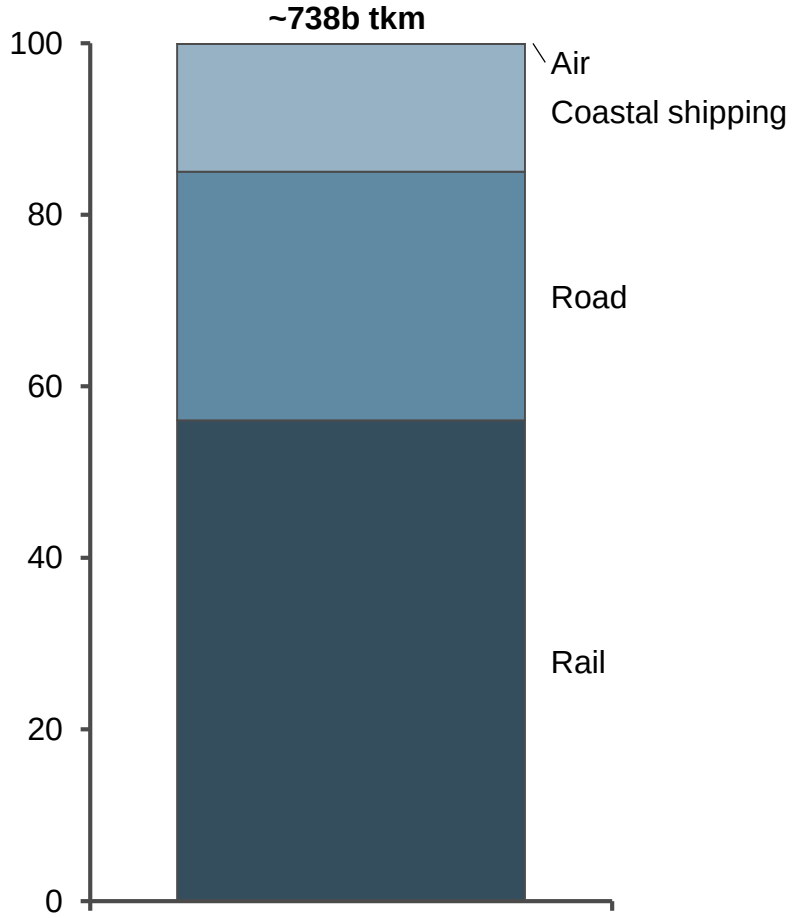
- Next steps
- Appendix

There are good statistics on Australia's freight task by mode, but not by either product / commodity or supply chain archetype

- The measurement of Australia's freight task is well understood at the macro level in terms of domestic flows and export/import movements
- As identified by the National Freight and Supply Chain Strategy, additional data is a critical enabler to improve the nation's productivity
- It is the view of this study that establishing a data set that includes a perspective on:
  - How the total freight task breaks down by product/commodity group
  - The archetypes of supply chains such that parallels and common lessons learnt can be transferred
  - The breakdown (by industry) of 'trucks on the road'
- A first step towards this is an agreed taxonomy of the landscape of both product/commodity supply chains and supply chain archetypes

Domestic goods moved by mode
(FY2015-16)
Percentage



Source: Australian Bureau of Statistics; L.E.K. analysis

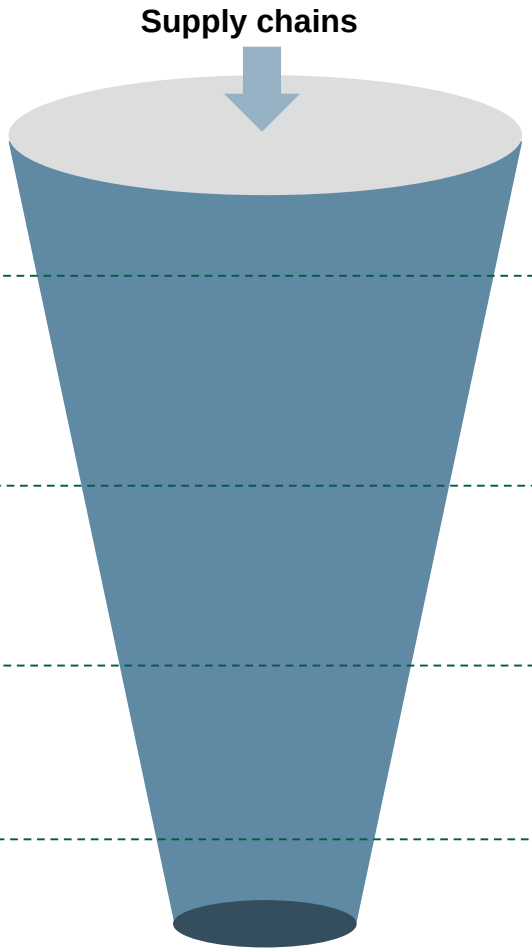
The proposed methodology has seven major steps

Key action steps	Description
1 **Identification of relevant supply chains**	• A framework has been developed to **prioritise supply chains across five critical dimensions** that consider both the scale and nature of supply chains, as well as the likely impact of further study • It is expected that **consultation with both Government and Industry** will be necessary in order to further refine this list
2 **Preliminary research on the supply chain**	• A preliminary investigation of the supply chain should be conducted in order **to determine it's suitability for benchmarking**. This includes tactical considerations of **data availability** and a **preliminary scan of international comparators**
3 **Formulation of a value driver tree to determine essential metrics**	• **Value driver tree decomposition** of the supply chain into **key metrics** that drive the supply chain as a whole • The value driver tree allows a **simplified perspective** of a given supply chain, thereby allowing to better understand metrics of high importance
4 **Development of a framework for selection of international comparators**	• **Identifying the most relevant comparators** will be critical when assessing Australia's relative performance vs. international comparators • Comparators should be selected on the basis that they are **aspirational targets** from a supply chain perspective, particularly regarding the cost of freight • In addition, the geographic basis for comparison should be considered; given **geographical differences** among comparators; it may be most impactful to choose regions / cities rather than countries in some cases
5 **Accumulation of publically available data**	• Considerations related to **data availability** and an "**apples to apples**" comparisons should be carefully considered when analysing and comparing supply chains • When accumulating data from publically available sources, (a) **the reliability of sources** (e.g. official vs. non-official) and (b) **frequency of data collection** (e.g. most recent data whenever possible) should be taken into account
6 **Methods for filling data gaps**	• Given the absence of an internationally harmonised data collection protocol among most supply chains, **data gaps** around both qualitative (e.g. policies, planning etc.) and quantitative (e.g. data availability) is likely • **Leveraging other techniques such as bottom up development, expert interviews and surveys** is pivotal throughout the process
7 **Synthesis of findings and implications**	• Leverage findings from the study, and implications thereof, to build a cohesive understanding and potential action plans

The longer list of supply chains can be prioritised using this selection criteria, and also through consultation with Government and industry

1

	Considerations	Rationale
Size and growth	• What is the total volume moved? • What is the total value of the goods moved? • Is the industry a significant employer? • Is the industry on a significant growth trajectory	• The supply chain/industry needs to be large enough to warrant investment or reform • Supply chains that support rapidly growing industries are likely to need research through the growth phase to ensure development
Freight importance	• What is the cost of freight as a percentage of product value?	• Where freight cost is a more significant proportion of a product's value, efficiency improvements will have more impact • Will an improvement in the 'speed' of the supply chain allow Australian product to reach new markets (i.e. fresh horticulture)
Export Importance	• What is the split of import / export versus domestic? • How competitive is Australia in the international market?	• Industries where the cost of the supply chain are a significant contributor to Australia's competitiveness provide more robust investment cases
Geographic scope	• How does the activity split metro vs regional? • Is the supply chain relevant in multiple geographies?	• The quantum of community impact may vary based on the metro / Regional split • Supply chains that effect more end markets are of higher priority
Known efficiency / public interest	• Is it 'well known' that the supply chain is inefficient? • Is this supply chain receiving political / industry / media attention? • Is there sufficient fragmentation of the supply chain to indicate that intervention will generate value?	• Supply chains with known inefficiencies are of higher interest • Without being reactive, higher priority will naturally fall to attention generating industries (i.e. waste)



Source: L.E.K. analysis

L.E.K.

Two tactical considerations must be included when identifying further supply chains

1

Appropriate international comparators exist

- Selection of supply chains with appropriate international comparators should be prioritised to best compare the efficiency and efficacy of the supply chain
- Furthermore, establishing a robust understanding related to the key differences among those geographies (e.g., structure of the industry, geographical differences etc.) is pivotal. For example:
  - while both Canada and the United States are relevant comparators for the grain supply chain, the degree of vertical integration and the size of the geographies differ materially relative to Australia

The sub-regions of California (U.S.) and the Bordeaux region (France) were selected as comparators

	South Australia	California	Bordeaux region
Number of key winery regions	1	2*	1
Production volume (Millions of litres)	610	2,700	520
Export volume (Millions of litres)	508	351	229
Domestic consumption vs. export ratio	*17% / 83%*	*87% / 13%*	*56% / 44%*
Bulk vs. bottled ratio	*29% / 71%*	*10-15% / 85-90%*	*0% / 100%*
Average price per bottle (AUD)	$5-25	$20	$5-$25
Number of wineries	700	3,900	7,400
Urbanisation of population (% of population)	*80%*	95%	*80%*
National price of diesel fuel* (USD per litre)	$1.00	$0.79	$1.61

Macro factors, geographical differences etc. should be taken into careful consideration

There is a baseline level of local data availability to enable comparison

- Sufficient data availability both among Australian supply chain and international comparators is critical to ensure the reliability of the benchmark study
  - While improvements in the collection of data across Australia can be encouraged within industries, influencing comparator countries to do the same is more challenging
- Cohesive collaboration among the Government (federal, state, and local), industry stakeholders, and peak body (*if applicable*) is likely to result in the most favourable outcome
  - Furthermore, where data sharing (and consistency) arrangements with international counterparties can be facilitated, this would drive the most robust comparison

Given that availability of data is pivotal for a successful benchmark study, the degree of data availability should be systematically tracked and assessed

Eight specific metrics have been investigated for waste

		Metric type	What it is	Importance / relevance
Quality	A	*Environmental outcomes*	The proportion of waste diverted from landfill by type of waste (e.g. Garbage, Recyclables, and Organics)	A successful circular economy can be measured by the proportion of waste that is recycled, incinerated rather than sent to landfill
	B	*Safety*	Number of fatal and non-fatal injuries on a standardised basis (e.g., per 100k hours worked)	Critical focus in all supply chains
	C	*Reliability*	Number of collections missed on a standardised basis (e.g., per 100k collections)	Indicator of the efficiency related to collection of waste
Cost	D	*Total waste servicing cost*	Total cost related to collection, sorting, processing, and disposal of waste	Measure of total cost to the community
	E	*Cost of freight*	Average cost of freight per ton / kilometre travelled	Measure of unit efficiency
	F	*Location of nodes*	The freight distance from collection to consolidation and consolidation to disposal / diversion	The location of critical assets drives the average distance travelled by freight modes; this becomes a key indicator at network shape & size
	G	*Number of nodes*	The number of times the waste is handled along the collection to disposal chain	Indicator of supply chain efficiency (i.e. less is better)
	H	*Modes of freight*	The mix of freight mode by trucks, trains, and ships	Each mode will have a different base efficiency, with the mix contributing to the efficiency of the entire chain

Source: L.E.K. analysis

L.E.K.

Once selected as a priority, a brief investigation should be undertaken to develop a preliminary assessment of the scope of the review

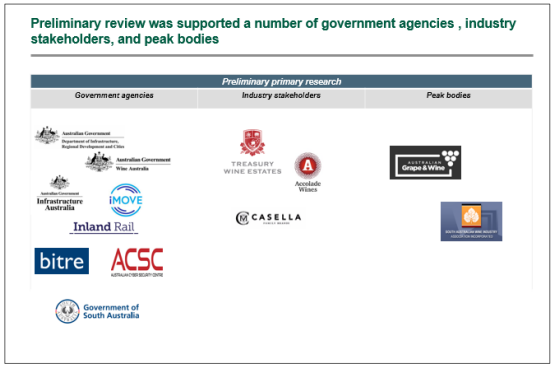
2

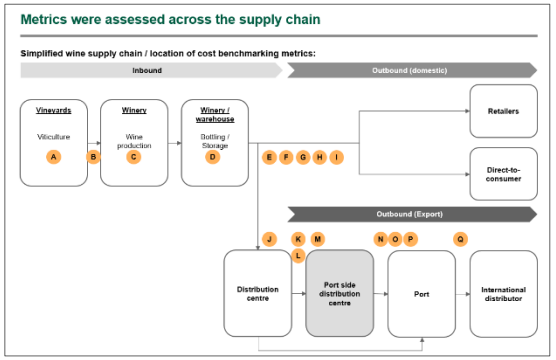
The preliminary review should consist of three steps

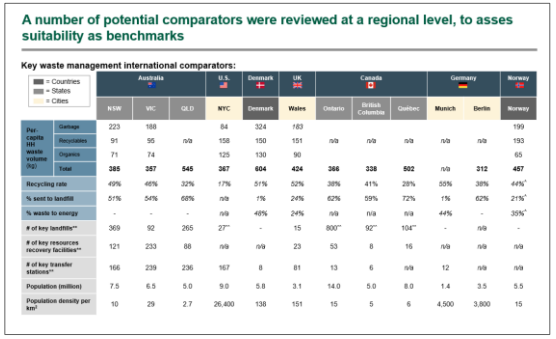
1. Conduct preliminary interviews with industry stakeholders to develop a baseline understanding of the industry

2. Develop an end to end map of the supply chain and the physical flow of goods including volumes, key routes and modes of transport

3. Assemble the initial data set that facilitates comparison of international comparators







L.E.K.

3 Decomposition of a supply chain using a value driver tree allows the identification of the important metrics for benchmarking

A value driver tree is a decomposition of the drivers along a supply chain

- A value driver tree is a simple, mathematically consistent representation of the costs, and operational metrics associated with a supply chain
- Development of a value driver tree is intended to be a logically complete representation of the major activities that take place within a supply chain
- For a macro level examination of a supply chain, it is important that appropriate simplifications take place as solving for every permutation and combination within a supply chain is not feasible (or readily comparable from a benchmarking perspective)

It is expected that value driver trees will align to supply chain archetypes

- The two value driver tree's developed for this study were created to be fit for purpose for the waste and wine supply chains. It is important to consider that
  - these supply chains are inherently different and the supply chains are different, with different metrics associated
  - if another domestic distribution / export consumer product was reviewed, the value driver tree developed for the wine supply chain should be repurposed

Consistent use of value driver trees should generate a cross supply chain consistency of review

- By consistently using value driver trees across a number of supply chains, this will generate a number of positive outcomes for the consistency of freight data:
  - lower overhead for reviewing new supply chains
  - Increased consistency of metrics allowing both international comparison, but also domestic comparison (i.e. is the wine industry more efficient at moving finished goods to port than other packaged goods)
  - Allow 'higher level' reviews where product groups are too granular for review (i.e. a review of all container based exports)

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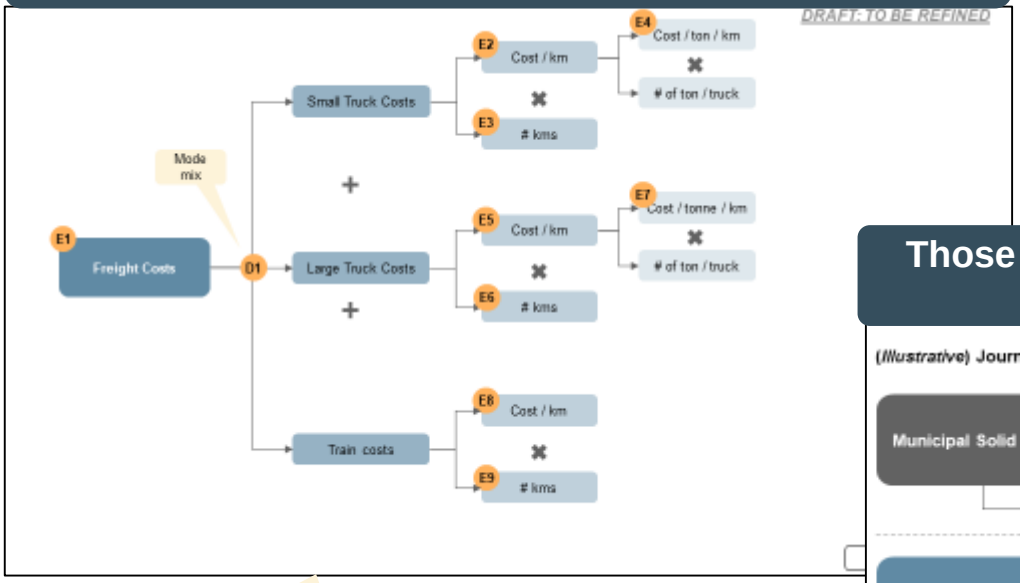
Example: Metrics for the waste supply chain were prioritised using a value driver tree

3

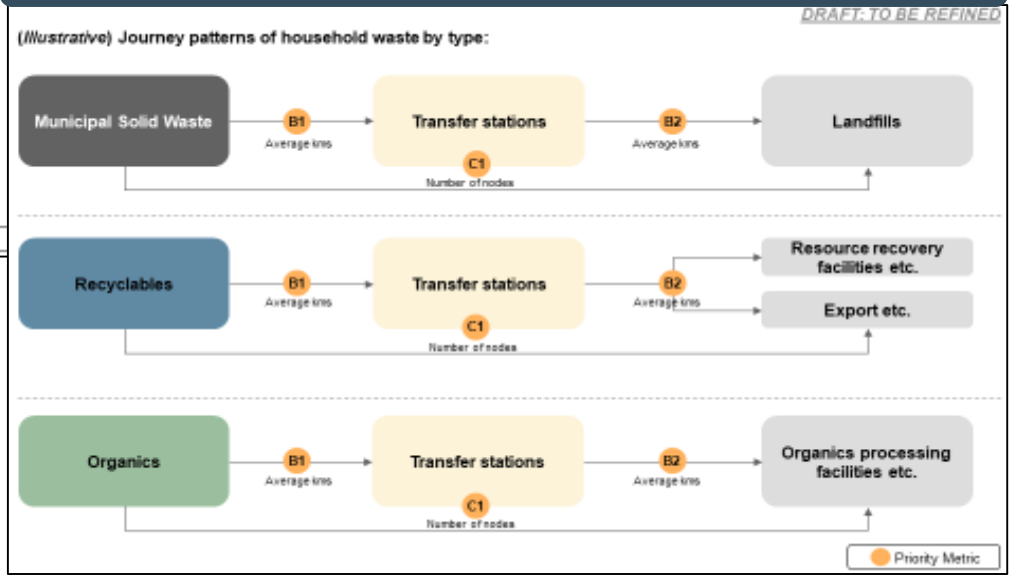
A value driver tree was developed for freight costs to move waste



When developing value driver trees and reviewing with industry stakeholders, priority metrics can be identified based on overall impact to the supply chain

Most supply chains will have sub-types or sub routes. Like-for like metrics should be applied across these branches

Those value drivers were applied to each sub-chain within waste



In addition to ‘hard’ cost benchmarking, identification of ‘time’ and ‘quality’ benchmarks is also important for comparison

3

Cost

Cost metrics can be assessed entirely within the value driver tree. If costs of known importance are not included, it is likely further depth or branches are required on the value driver tree

Speed / time

Speed/time metrics are typically partially addressed by a value driver tree. Some consideration needs to be given to perishable commodities that can access new markets, if the total time in the supply chain is reduced

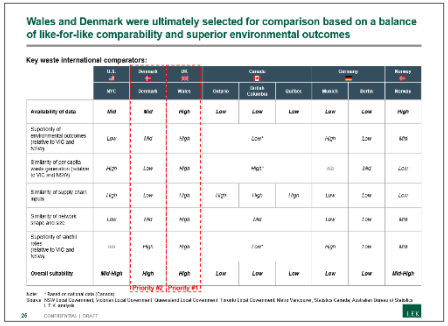
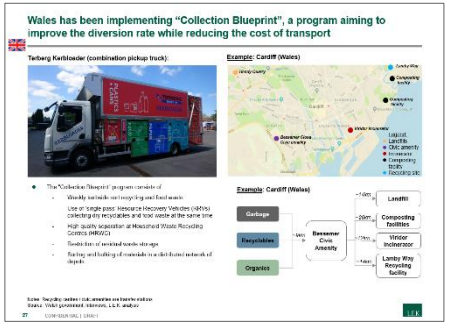
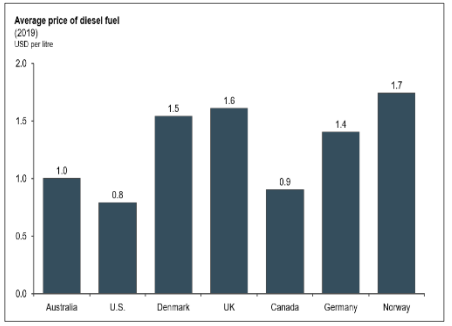
Quality

Speed/time metrics are typically partially addressed by a value driver tree. Some consideration needs to be given to a range of supply chain specific factors. Examples of this include:

- Industry Safety
- Customer Satisfaction
- Sustainability Outcomes
- Environmental Outcomes
- Spoilage rates
- Rework rates

There are a number of key considerations related to the selection and analysis of international comparators

4

	Identification of relevant geographies	*Aspirational targets*	*Macro: demographic / economic differences*
Description	• Given **macro differences** (e.g., population, urbanisation of population etc.) among geographies, **a country-to-country comparison may not be always appropriate**	• **Aspirational targets** (e.g., superiority relative to Australian benchmarks in terms of efficiency, safety etc.) should always be prioritised for further consideration	• Consideration of international comparisons should always be implemented in a "apples-to-apples" manner, taking into account both demographic (e.g., population etc.) and economic (e.g., cost of diesel fuel etc.) differences
Considerations	• International comparators should be **selected based upon comparability**; as such, a "country-to-city" comparison **may be appropriate** in some cases	• A number of critical performance metrics should be pre-defined / analysed in order to identify aspirational target(s)	• In the event that country-specific data is limited, normalisation of existing data based upon the relative demographic / economic differences should be implemented to best understand the suitability of a given comparator
Examples			

Source: L.E.K. analysis

L.E.K.

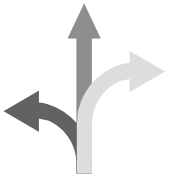
5 In addition, the quality of available data is also a key consideration; as such, normalisation of existing data and use of assumptions may be required

Data collection

- Whenever possible, data should be collected from official sources (e.g. government bodies, peak bodies etc.)
- Both primary (i.e., stakeholder interviews) and secondary (e.g., government statistics, market reports etc.) should be selected and leveraged depending on its' specific objectives

Data audit / normalisation

- An "apples-to-apples" methodology is critical to ensure the credibility of the underlying comparison
- In some cases, official data require careful audit and normalisation
  - Given potential inconsistencies in the methodology / collection protocol of the underlying data, further adjustment may be required



Assumptions

- After audit of the data, assumptions are often formulated prior to the implementation of the analysis / comparison

Analysis

- A further analysis of available data and assumptions will generate insights related to the relative performance of the supply chain
- Continuous refinements should be made to ensure the most robust outcome possible

Source: L.E.K. analysis

5 6 The collection of data may be streamlined via establishment of data sharing arrangements. This could enable the collection of data sets not publically available

Recommended data sharing methods / arrangements with stakeholders:

Stakeholder type	Recommended method	Description of the method	Potential <u>benefits</u> of the arrangement	Potential <u>challenges</u> of the arrangement
Industry participants	• Systematic data collection agreements with industry participants (for data uncollected by peak bodies)	• Data sharing agreement (e.g., pre-formulated surveys) with leading industry participants as well as SMEs on an annual basis	• Accuracy of the outcome given its bottom up approach based upon actual underlying data	• Concerns related to sharing of commercially sensitive information
Freight providers	• Systematic data collection agreements with key freight providers	• Data sharing agreement related to the volume, value, and destination of materials / goods freighted on an annual basis • An equal emphasis on achieving collaboration with small to mid-sized freight providers can be important	• Ability to aggregate data received from various freight providers • Ability to segment data across regions of origin, location of destinations, mode of freight etc.	• Concerns related to sharing of commercially sensitive information
Peak bodies	• Data download arrangement	• Arrangements to receive all relevant data (including data not publically published) in a continuous manner	• Ability to receive aggregated data, throughout both upstream and downstream end of the supply chain	• Harmonisation of data categories across relevant peak bodies • Incremental resources required to accumulate and synthesise data

Source: L.E.K. analysis

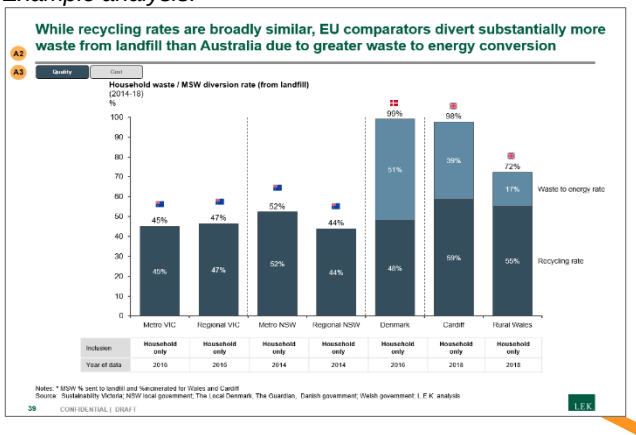
6 In the unlikely event that the stated methods do not yield the required categories of data, a number of options remain for generating a benchmarking outcome

	What it is	How to do it	Potential challenges
Bottom up estimation	• Build-up estimation based on the lowest possible degree of detail • Individual estimates are aggregated as total estimates	• De-composition of each relevant data points into functions of distance freighted, cost of freight on a per kilometre basis etc. • Estimation of each de-composed data points based on available data sources and subsequent aggregation	• Requires a relatively accommodative timeline to execute • Challenges may arise given the non-linear nature of some supply chains. As such, adjustments utilising assumptions may be required
Expert consultation	• In-depth primary research via export consultations	• Formulation of a comprehensive consultation guide, encompassing all relevant quantitative and qualitative inputs required • Identification of relevant stakeholders across governments, industry, and peak bodies; consultations should be considerate of any potential commercially sensitive information	• Challenges may arise related to achieving high sample size given the nature of the research method
Industry surveys	• A questionnaire-based primary research • Often utilised to receive quantitative feedback with a high sample size	• Formulation of a list of survey questions both quantitative and qualitative inputs • Obtain consensus from relevant stakeholders to complete the survey within the required timeline • Quantitative analysis of the survey to extract relevant insights / findings	• Limited ability to capture rationales (i.e., the 'whys') for respondents' answers given the nature of the research method • Challenges may arise related to obtaining ad hoc qualitative feedback, given the 'fixed' nature of the research method

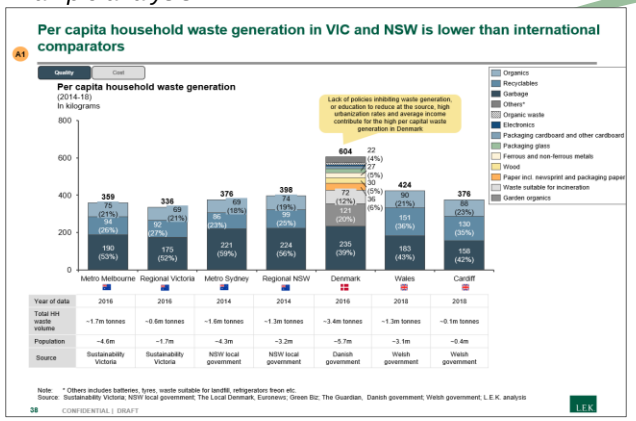
Source: L.E.K. analysis

7 Synthesis of findings and implications is the final step, following the data collection activity

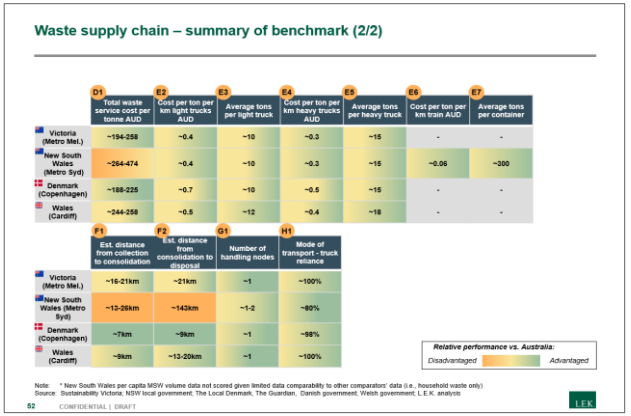
Example analysis:



Example analysis:



Example synthesis:



Example action plans:

Potential action plans	*Importance*
#1: Improve…	***High***
#2: Consider…	***Mid***
#3: Engage...	***High***
#4: Assess…	***Mid***
#5: Regulate…	***Mid***
#6: Collaborate…	***Low***

Source: L.E.K. analysis

The synthesis and roll up of data is the critical final step that needs to consider data collected, data gaps, and overall materiality

7

- The collection of data throughout any given supply chain will typically lead to a range of granular metrics. These metrics will consider:
  - the mode of transport (road/rail/air/sea) and potentially sub mode (i.e. type of truck)
  - form of the freight (e.g. loose item / pallet / container / stillage)
  - the specific leg of a chain (i.e. between a region and port; or cross city)
- Merit exists in collecting the granular metrics and forming like for like comparisons. However, consolidating to a headline level, to develop a single view to demonstrate the overall efficiency of a supply chain is important.
  - in most cases, this will be a 'total cost of freight movement' along the chain (i.e. as per the wine benchmarks in the pilot study)
  - depending on the chain it may be beneficial to have this as a proportion of the end to end cost that includes processing costs that may be unrelated to freight (i.e. as per the wine benchmarks in this pilot study)
- In the event of remaining data gaps, making judgements as to the materiality of the gaps, and any necessary adjustments to ensure that the comparison is as 'like for like' as possible is important

A number of suggestions for future study should be considered

	Issue	Examples / impact	Opportunity
A **Industry involvement**	• Up-front engagement with industry (particularly peak bodies and large producers) in order to select the supply chain, may increase the likelihood of participation	• Data sharing, particularly cost data is potentially commercially sensitive • Understanding these limitations early is important	• Engage industry players when selecting supply chains, and agree on data sharing protocols to reduce data collection barriers
B **International Comparator data flows**	• Similarly to Australian industry involvement, extracting like for like data from international entities is inherently difficult	• It is difficult to establish the availability of detailed data in a rapid assessment of an international market	• Consider agreements with international comparators up front, and agreeing data sharing (and consistency) protocols
C **Time period for investigations**	• The nature of studying each supply chain is that there are numerous interviews and consultation to take place	• It can be time consuming, and drawn out to collect data from sources that are not otherwise compelled to assist	• Consider the length of each investigation and bias towards a 'long and thin' approach to collecting information

Source: L.E.K. interviews and analysis

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- Appendix

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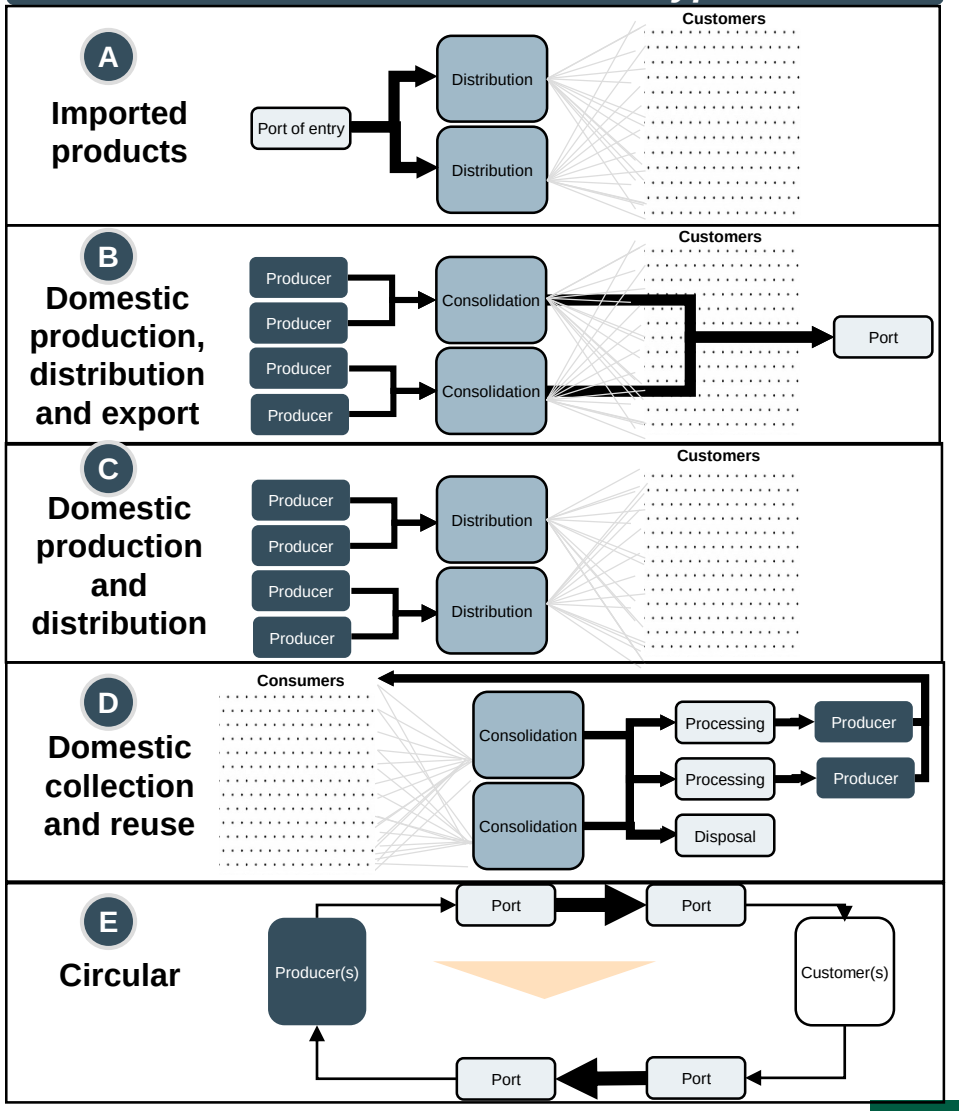
Using material movement 'archetypes' could be an additional lens to consider for supply chain selection

Major product types and example sub types

Major product types	Example sub-types (not exhaustive)
Animal products	• Beef, poultry, leather, dairy
Building products	• Bricks, concrete, cement, pre-fab frames
Consumer goods	• Electronics, cars, clothing
Extractives	• Iron ore, coal, LNG, lithium
Forestry	• Logs, woodchips, paper products
Grains	• Wheat, oats, soy beans, sorghum
Horticulture	• Rice, bananas, mangoes, apples
Liquids / Chemicals	• Petrol, diesel, ammonia

Selecting a cross-section of product types and supply chain types will continue to test and refine the method for increasing ease of repeatability

Material movement archetype

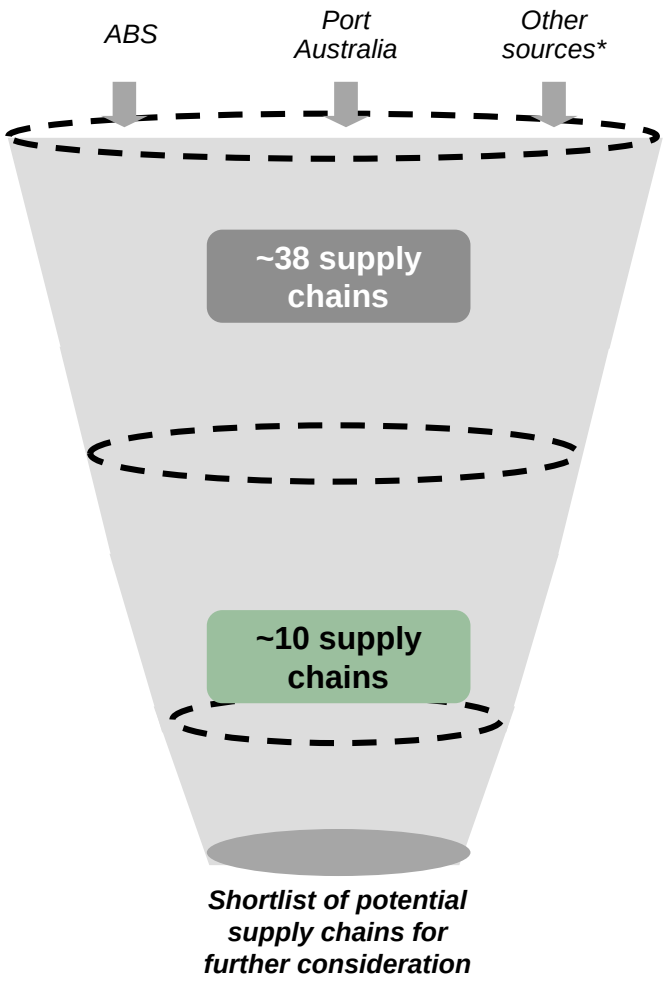


Source: Australian Bureau of Statistics; L.E.K. analysis

L.E.K.

A starting point of further supply chains were consolidated then subsequently assessed for further consideration

Supply chain screening process



Screening criteria

Universe development — **1**

- Generate the full set of relevant supply chains
- Examples include:
  - Beef
  - Aircrafts
  - Crude oil

Prioritise supply chains — **2**

- Prioritise supply chains based upon (a) overall impact to the Australian economy, (b) margin of freight cost relative to the value of the commodity / item, and (c) degree of import dependence

High priority supply chains — **3**

Note: * Other government statistics (e.g., BITRE), market reports etc.
Source: L.E.K. analysis

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A range of relevant supply chains were initially evaluated

Potential supply chains:

Aircrafts	*Coffee*	*Petrol*
Ammonia	*Concrete*	*Pre-fab frames*
Apparel	*Crude oil*	*Plasterboard products*
Apples	*Diesel*	*Pork*
Aquaculture	*Electronics*	*Potatoes*
Bananas	*Footwear*	*Poultry*
Barley	*Furniture*	*Rice*
Beef	*Glass*	*Soy beans*
Beer	*Woodchips*	*Sodium Cyanide*
Bricks	*Lamb*	*Soft drinks*
Canola	*Leather*	*Sorghum*
Cars	*Legumes*	*Spirits*
Carrots	*Lithium*	*Steel*
Cement	*LNG*	*Timber*
Ceramic	*Logs*	*Tobacco*
Cereals	*Mangoes*	*Tomatoes*
Cheese	*Milk*	*Wool*
Chemicals	*Milk powder*	*Wheat*
Chestnuts	*Minerals*	
Chlor-Alkali products	*Oats*	
Clothing	*Oilseeds*	
Coarse grains	*Oranges*	
Clothing	*Paper products*	

Overall suitability:*

Least suitable — *Most suitable*

Note: * Overall assessment of the size of the domestic market and the margin of freight cost relative to the value of goods, and degree of import dependence. Coal and Iron Ore not included in the list; ** Milk is moved nationally and finalized good are also exported

Source: L.E.K. analysis

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Based upon economic importance, proportion of freight cost and import dependence, we have suggested 10 potential supply chains for consideration

Short-listed supply chains	Archetype		Economic impact	Freight component	Bulk	Containerised	Liquid	General	Comments
Cement	A	C	◔	◑	✓				
Dairy products ** *(e.g., milk)*	B		◔	◑	✓		✓	✓	Refrigerated
Grains *(e.g., wheat, oats, coarse grains, etc.)*	B		●	◑	✓	✓			
Horticulture *(e.g., apples, bananas, oranges, tomatoes)*	A	B	◔	◕		✓		✓	Refrigerated
Lithium	B		◔	◔		✓		✓	
Meat *(i.e., beef, lamb, pork, poultry)*	B		●	◑		✓		✓	Refrigerated
Petrol	A		●	◑			✓		Hazardous
Steel	A	B	◔	◑		✓		✓	
Timber	B		◔	◑	✓	✓		✓	Bulk = wood chips
Wool	B		◑	◑		✓		✓	

Note: * Overall assessment of the size of the domestic market and the margin of freight cost relative to the value of goods, and degree of import dependence. Coal and Iron Ore not included in the list; ** Milk is moved nationally and finalized good are also exported

Source: L.E.K. analysis

L.E.K.

Key statistics on 10 potential supply chains

Supply chain	GVP (millions of AUD)	Total Volume Produced / Imported	Unit price	Potential freight impact
Cement	15,000	30m m^3	$0.5 / L	
Dairy products*	4,000	9,102m L	$0.4 / L	
Grains**	5,700	25m t	$0.2 / kg	
Horticulture	10,000	4m t	$2.4 / kg	
Lithium	1,000	21k t	$47.0 / kg	
Meat***	12,000	2m t	$5.7 / kg	
Petrol^	46,000	36,060 m L	~$1.30 / L	
Steel	11,000	3m t	$4.2 / kg	
Timber	2,220	17m m^3	$0.1 / m^3	
Wool	2,600	325k t	$8.0 / kg	

Notes: * Milk; ** Wheat; *** Cattle & calves; ^Imported refined petroleum products
Source: ABS; APH; Australian Petroleum Statistics; Australian Horticulture Statistics; CCAA; NFF; Wool producers; L.E.K. research and analysis

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A special thanks to the contributors for contributing to the study

Key contributors

Federal government

State governments

Waste peak bodies

Wine peak bodies