

Australian Government

Department of Infrastructure and Regional Development

Bureau of Infrastructure, Transport and Regional Economics



Freightline 3 – Australian sugar freight transport

At a Glance

The Freightline series is intended to provide information about where freight moves in Australia. This issue focusses on the bulk transport of sugar cane, raw and refined sugar, as well as molasses in Australia, in financial year 2011–12. The Bureau of Infrastructure, Transport and Regional Economics (BITRE) notes that 2011–12 was a slightly atypical year for the sugar industry, with the after effects of Cyclone Yasi (February 2011) affecting production and transport arrangements, most particularly through the temporary closure of the Port of Lucinda's sugar export facilities for repairs. BITRE will, in due course, update these estimates to cover financial years since 2011-12.

- Australian raw sugar production totalled 3683 kilotonnes in 2011–12, milled from 27 950 kilotonnes of sugarcane. Approximately 66 per cent of total raw sugar production was exported in bulk in 2011-12, with the remainder supplying the domestic market. Australia also imported a small volume (approximately 115 kilotonnes) of sugar in 2011–12.
- Australia typically accounts for between 2 and 3 per cent of total world sugar production in any one • year, but is the fourth largest exporter of cane sugar, with most of our exports going to Asia (principally South Korea, Indonesia and Japan).
- Queensland accounted for about 94 per cent of Australian sugarcane production in 2011–12, with the • remainder grown in northern New South Wales.
- Bulk raw and refined sugar exports were estimated to total 2419 kilotonnes in 2011–12, comprising • 2307 kilotonnes of raw sugar and 112 kilotonnes of refined sugar. Approximately 57 per cent of total bulk sugar exports in 2011–12 went through the Port of Townsville.
- The inland sugar cane freight transport task is predominately handled by mill-owned cane rail systems, which accounted for about 85 per cent of cane movements to mills (by mass), with road transport accounting for the remaining 15 per cent in 2011–12.
- The movement of raw sugar from mills to refineries or ports, and refined sugar from refineries to ports, • involves a mix of road, conveyor, rail and sea transport. Raw and refined sugar destined for export, for example, is transported by a mix of rail (53 per cent by mass – of these the majority is by publicly-owned rail between Burdekin and Townsville with a significant minority by mill-owned railways) and road (47 per cent by mass) to one of the six sugar exporting ports in Queensland. The bulk terminals in Queensland handle only raw sugar for export or to Yarraville, Victoria. Refined sugar is exported in containers through Sydney, Melbourne and Brisbane, and in bulk through the Port of Mackay.
- BITRE estimates that the sugar cane freight task totalled 632.9 million tonne kilometres in 2011-12, comprising 462.9 million tonne kilometres by rail and 170.1 million tonne kilometres by road.
- The raw and refined sugar freight task in the same period was approximately 1346 million tonne kilometres, comprising 119.8 million tonne kilometres by road, 90.3 million tonne kilometres by rail and 1136 million tonne kilometres by coastal shipping.
- The sugar milling and refining processes also produce several by-products, such as molasses, bagasse and mill mud. Bagasse and mill mud are principally re-used by industry; molasses is marketed separately.

- Australian molasses production totalled approximately 898 kilotonnes in 2011–12. Approximately 60 per cent of total molasses production was exported in 2011–12, with the remainder directed to the domestic market for use in biofuels, stockfeed and rum production. Approximately 75 per cent of all molasses exports went through the Port of Townsville in 2011–12.
- BITRE estimates that the total molasses freight task measured 215 million tonne kilometres in 2011–12, with 77.7 million tonne kilometres by rail, 1.7 million tonne kilometres by road and 136 million tonne kilometres by coastal shipping.
- Combining cane sugar, raw and refined sugar and sugar by-products, BITRE estimates total sugar and related product freight was approximately 2.25 billion tonnes kilometres in 2011–12—631 million tonne kilometres by rail, 349 million tonne kilometres by road and 1272 million tonne kilometres by coastal shipping—which was equivalent to around 0.4 per cent of total domestic freight movements in that year.

Introduction

Increased policy focus on freight, and the adequacy of infrastructure to support Australia's growing freight task, is increasing the demand for more detailed information on where and how freight moves. Detailed data on freight movements, however, is either expensive to collect, owing to the breadth and diversity of the task, or, where it involves private companies (e.g. rail), availability is restricted by commercial confidentiality concerns. As a consequence, there is generally little current data available.

Information on the size and scope of rural and agricultural commodity transport tasks is particularly lacking. This limits the information base for infrastructure planning, both in terms of understanding current transport flows and in assessing infrastructure bottlenecks, and inhibits governments' ability to develop appropriate policy responses and assess competing infrastructure needs (RIRDC 2011).

This issue of *Freightline* focuses on where and how Australia's sugar cane, and related products, are transported, covering movements of cane sugar from farms to mills, transport of raw sugar to export ports and refineries, and the movement of milling by-products, principally molasses. Estimates of sugar cane and related product freight movements for 2011–12 are presented, based on modelling of regional supply and use. BITRE acknowledges that 2011–12 was a slightly atypical year for the sugar industry and sugar supply chain arrangements, with the after effects of Cyclone Yasi in February 2011 affecting production and transport arrangements, most particularly due the temporary closure of the Port of Lucinda's sugar export facilities for repairs.

The movement of refined sugar products, from domestic refineries to domestic consumers, is not examined in this paper. The main reason for this is that approximately 80 per cent of refined sugar destined for the domestic market is consumed by food manufacturers, and this information is often commercial-in-confidence. Retail sales account for the remaining 20 per cent of refined sugar sold in Australia, marketed predominantly through Sugar Australia's brands (Sugar Australia 2011).

Sugar and the Australian sugar industry

Sugar cane is an annual tropical crop which requires strong sunlight, fertile soil and plenty of water—at least 1.5 metres of rain each year or access to irrigation (Canegrowers 2010). Sugar cane plants are typically regrown 3 to 4 times after the first harvest, before they need to be re-sown. A crop of cane takes between 9 and 16 months to grow in Queensland and 18–24 months in northern New South Wales; when ripe, the cane is usually about 2–4 metres tall. Australia's sugarcane is typically harvested during the drier months of the year, which is typically between June and December, depending on the weather (Canegrowers 2010).

Once harvested, sugar cane (in the form of short pieces of cane stalk called billets) need to be transported to sugar mills within 16 hours to preserve the sugar cane juice. The billets are loaded into trucks for road transport and into mill bins at local sidings for train transport. At sugar mills, billets are weighed, chopped and shredded, then crushed to extract the sugar cane juice. The leftover fibrous material, called bagasse, is typically used as fuel to run the mill's boiler furnace. The cane juice is cleaned and thickened, by boiling off excess water. It is then seeded with tiny sugar crystals in a vacuum pan and boiled until sugar crystals have formed and grown. These crystals are separated from the surrounding molasses (a thick black sweet sticky liquid) around them in centrifuges. The crystals are then tumble-dried and stored in large bins as raw sugar (Canegrowers 2010). This process is repeated several times, until no further sugar can be extracted from the molasses.

Australian sugar production

Over the decade 2001–02 to 2011–12, Australia produced approximately 33 million tonnes of sugar cane per annum, and around 4.7 million tonnes of raw sugar (ABARES 2014a). Total cane production has varied from year to year, depending on prevailing climatic conditions such as rainfall and temperature. Between 2002–03 and 2006–07, sugar cane production averaged around 37 million tonnes per annum and raw sugar production averaged 5.1 million tonnes, but since 2007–08, total sugar cane production has averaged around 30 million tonnes per annum and raw sugar production around 4.2 million tonnes per annum (ABARES 2014a, ABS 2012 and earlier issues).¹ In 2011–12, sugar cane production was 27 950 kilotonnes and total raw and refined sugar output 3.68 million tonnes (Canegrowers 2012).

Compared to the world's largest sugar producers—Brazil, India and China—Australia is a relatively small producer, typically accounting for between 2 and 3 per cent of total world sugar production.² In comparison, Brazil, India and China accounted for 19.8 per cent (34.6 Mt), 16.2 per cent (28.6 Mt) and 7.1 per cent (12.5 Mt), respectively, in 2011–12. However, Australia is the fourth largest exporter of cane sugar, behind Brazil, Thailand and India (ABARES 2012). South Korea, Indonesia and Japan are the largest importers of Australian sugar, purchasing approximately 63 per cent of Australian sugar exports (ABARES 2012, ABS 2012).

The majority of Australia's sugar cane is grown in Queensland and New South Wales (see Figures 1 to 3).³ In Queensland, most sugar cane is grown along the coast, in the Cairns, Townsville, Mackay, Wide Bay and Gold Coast regions. The remainder is grown in the Atherton Tableland, to the west of Cairns. In New South Wales, sugar cane production stretches around the Richmond, Tweed and Clarence Rivers.

Table 1 shows sugar cane production by state between 2002–03 and 2011–12. Queensland accounted for approximately 94 per cent of Australia's sugar cane, with New South Wales producing the remaining 6 per cent in 2011–12.

	2002–03	2003–04	2004–05	2005–06	2006–07	2007–08	2008–09	2009-10	2010-11	2011-12
Queensland										
Total area planted ('000 ha)	423	414	411	375	383	355	376	370	293	326
Sugar cane production (kt)	34 23 1	33 553	35 290	34 385	33 058	29 788	29 842	29 330	23 615	24 443
Yield (t/ha)	81	81	86	92	86	84	79	79	80	75
New South Wales										
Total area planted ('000 ha)	21	30	20	18	22	24	16	19	15	13
Sugar cane production (kt)	2 362	2 988	2 33	2 283	2 977	2 587	1614	I 905	I 567	5 4
Yield (t/ha)	111	100	108	127	133	109	104	100	107	121
Western Australia										
Total area planted ('000 ha)	3	4	3	4	3	2	0	0	0	0
Sugar cane production (kt)	401	453	399	461	361	247	0	0	0	0
Yield (t/ha)	116	112	119	115	112	110				
Australia ^b										
Total area planted ('000 ha)	448	448	434	398	409	381	391	389	308	339
Sugar cane production (kt)	36 995	36 993	37 822	37 128	36 397	32 621	31 457	31 235	25 182	25 957
Yield (t/ha)	83	83	87	93	89	86	80	80	82	77

Table I: Australian sugar cane production, by state, 2002–03 to 2011–12^a

.. not applicable

a. Sugar cane crop time is approximately between June and December. b. Includes data from Western Australia.

Sources: ABS (2012 and earlier issues).

^{1.} Note that CANEGROWERS—the peak body for Australian sugarcane growers—and ABARES estimates (ABARES 2014a) of the sugar cane harvest differs slightly from the ABS estimates for 2010–11 and 2011–12. CANEGROWERS reported 27.9 million tonnes of sugar cane harvest for 2011, which relates to sugar cane harvested between May/June and November/December of 2011, and approximates the 2011–12 financial year, while ABS estimates only 26.0 million tonnes in 2011–12. The freight movement estimates reported here are based on CANEGROWERS' reported cane harvest, as well as data from sugar mill operators, and the ABS figures are used purely for comparative historical discussion.

Australian average sugar cane yields are relatively high; in 2011–12 average Australian yields were about 10 per cent higher than the average sugar cane yield in Brazil (ABARES 2012; Velasco 2013).

^{3.} Small volumes of sugar cane were also produced in Western Australia within this period (around the Ord River), but typically comprised less than one per cent of total national output (ABS 2012 and earlier issues). Western Australian sugar supply chains are not examined in this paper.





Sources: ABARES (2014a, 2014b) and BITRE estimate.⁵

Figures 4 to 7 show the location of sugar mills, refineries and sugar export ports across Queensland and New South Wales. Only Sugar Australia's Yarraville Refinery, in Melbourne, does not appear in these figures.

Milling and refining operations

Milling

There are currently eight milling companies operating 24 separate sugar mills in Australia (see Table 2). The milling companies are:

- Wilmar Sugar Australia Limited
- Mackay Sugar Limited
- MSF Sugar Limited
- Tully Sugar Limited
- Isis Central Sugar Mill Limited
- Bundaberg Sugar
- Heck Group and
- NSW Sugar Milling Cooperative.

As of 2012, Australian sugar mills had a total milling capacity of approximately 40 million tonnes of sugar cane per annum.

^{4.} ABARES Land Use of Australia, Interim Version 5, 2010–11 (ABARES 2014b) - Agricultural land uses – detail has been combined with ABS agricultural production statistics (ABS 2012 and earlier issues) to estimate farm locations and sugar cane output. Note that BITRE has adjusted the ABS (2012) sugar cane production estimates to reconcile with ABARES (ABARES 2014a) and CANEGROWERS (Canegrowers 2012) sugar cane production estimates (refer to Footnote I for details).

Some land areas that were classified by ABARES (2014b) as used in sugar cane production but were a significant distance from the nearest mill were omitted on verbal advice from CSIRO (pers. comm. A. Higgins)—sugar cane farms tend to be located within a reasonable distance of the mill.

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Figure 2: Sugar cane growing areas, Central Queensland, 2011–12

Source:





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There are six bulk sugar export terminals, all owned by Sugar Terminals Limited and managed under a leasing arrangement by Queensland Sugar Limited (QSL).⁶ These are located at:

- Cairns
- Mourilyan (Innisfail)
- Lucinda
- Townsville
- Mackay

Sources: See Footnote 7.

Bundaberg.

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Figure 4: Location of sugar mills, refineries and ports around Cairns, Mourilyan and Lucinda

^{6.} Wilmar recently served notice to QSL, on 21 May 2014, that it will break away from the Queensland export sugar industry's collaborative approach through QSL from July 2017 (QSL 2011).

ABARES (2014a, 2014b); ABS (2012); ASMC (2013a); Bundaberg Canegrowers (2013); Bundaberg Sugar (2012b); Canegrowers (2012); Chen and Chou (1993); Finasucre (2012); GA (2006); Gladstone Ports (2012); IMETT Group (2012); Lonergan Edwards & Associates (2011); Mackay Sugar (2012a, 2012b, 2013); MSF Sugar (2012); NQBP (2013); Port of Townsville (2013a); Ports North (2012a); DTMR (2002); Rocky Point Sugar Mill (2012); Sucrogen (2011); Sugar Australia (2004b, 2013b); Sunshine Sugar (2014, 2007 and earlier); Wilmar International (2011, 2012, 2013), and BITRE estimates.



Figure 5: Location of sugar mills, refineries and ports near Townsville and Mackay

Sources: See Footnote 6.





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Figure 7: Location of sugar mills and refineries, Southern Queensland and Northern New South Wales

Refining

There are currently four sugar refineries in Australia, owned and operated by three separate companies. Table 3 lists the four refineries and 2012 output levels.

Sugar Australia operates the largest two refineries—Racecourse (Mackay) and Yarraville (Melbourne), while Bundaberg Sugar (Bundaberg) and New South Wales Sugar Milling Cooperative (Harwood) operate the other two refineries. Sugar Australia's two refineries produced 599 kilotonnes of refined sugar (approximately 62 per cent of Australian refined sugar production) in 2011–12. The remaining refined sugar production was more or less evenly split between Bundaberg Sugar's Bundaberg Refinery, in Queensland, and Manildra's Harwood Refinery, in New South Wales. Total refined sugar production across all four refineries was approximately 966 kilotonnes in 2011–12 (Canegrowers 2012; CSR Sugar 2009; Finasucre 2012; Manildra Harwood Sugars 2012; and Sugar Australia 2011, 2013a).

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Operator	Mill	State	Mill capacity	Mill input	Mill output	CCS ^a ratio	
			(tonnes – su	igar cane)	(tonnes — raw sugar)	(per cent)	
Mackay Sugar	Mossman	Queensland	1 100 000	411012	57 269	13.9	
	Farleigh	Queensland	I 700 000	1 253 617	168 110	13.4	
	Marian	Queensland	2 600 000	758 23	235 779	13.4	
	Racecourse	Queensland	I 700 000	1 150 612	154 297	13.4	
MSF Sugar Limited	Tableland	Queensland	700 000	679 000	89 085	13.1	
	Mulgrave	Queensland	I 500 000	741 000	97 219	13.1	
	South Johnstone	Queensland	1 550 000	708 198	92 716	3.	
	Maryborough	Queensland	I 000 000	667 000	87 510	13.1	
Tully Sugar	Tully	Queensland	2 500 000	1 225 358	143 845	11.7	
Wilmar Sugar ^b	Macknade	Queensland	I 820 000	804 498	108 310	13.3	
	Victoria	Queensland	3 740 000	1 984 312	263 814	13.3	
	Invicta	Queensland	3 670 000	3 578 523	475 765	13.3	
	Pioneer	Queensland	2 160 000	2 106 161	280 014	13.3	
	Kalamia	Queensland	1 800 000	833 40	243 716	13.3	
	Inkerman	Queensland	2 070 000	2 018 404	268 347	13.3	
	Proserpine	Queensland	2 130 000	I 465 424	194 828	13.3	
	Plane Creek	Queensland	I 760 000	I 066 270	141 761	13.3	
Bundaberg Sugar	Bingera	Queensland	I 407 000	717 161	99 183	13.8	
	Millaquin	Queensland	I 330 000	677 823	93 743	13.8	
Isis Sugar	lsis	Queensland	I 505 000	223 35	171 762	14.0	
Heck Group	Rocky Point	Queensland	624 000	267 669	34 877	13.0	
Sunshine Sugar	Condong	New South Wales	650 000	312 852	35 287	11.3	
	Broadwater	New South Wales	I 020 000	714 956	79 484	11.1	
	Harwood	New South Wales	780 000	585 659	65 938	11.3	
Total			40 816 000	27 950 015	3 682 659	13.2	

Table 2: Australia's sugar mills in 2012

a. CCS – Commercial Cane Sugar

b. Wilmar reported 13.5 Mt of sugar cane was processed by December 2011 (Wilmar International 2011). In reconciling reported total sugar cane from CANEGROWERS and ABARES, as well as reported volumes by other milling companies, BITRE has assumed Wilmar processed approximately 15 Mt of sugar cane in 2011–12.

Sources: See Footnote 6.

Table 3: Australia's sugar refineries in 2012

Operator	Refinery	State	Refinery capacity	Refinery input	Refinery output	Conversion factor ^a
			(tonnes – ra	w sugar)	(tonnes – refined sugar)	(per cent)
Sugar Australia	Yarraville	Victoria	320 000	290 000	271 440	94
Sugar Australia	Racecourse	Queensland	420 000	350 258	327 841	94
Bundaberg Sugar	Bundaberg	Queensland	220 000	175 532	165 000	94
NSW Sugar Milling Cooperative	Harwood	New South Wales	250 000	215 586	201 788	94
Total			1 210 000	03 376	966 069	94

a. Ratio of refined sugar output to raw sugar input.

Sources: See Footnote 6.

Sugar exports

Bulk raw and refined sugar exports totalled approximately 2419 kilotonnes in 2011–12 (BITRE estimates) and accounted for 4.8 per cent of the value of total farm exports, \$1.73 billion, in that financial year (ABARES 2012). The main Australian sugar export ports are Townsville, Mackay, Lucinda,⁸ Mourilyan (Innisfail), Bundaberg and Cairns. The main port for Australian refined bulk sugar exports is Mackay. The Port of Townsville is the largest sugar export port, with approximately 1490 kilotonnes in 2011–12. Table 4 shows sugar exports by port in 2011–12.

Table 4: Raw and	d refined bulk	sugar exports	by port,	2011–12 ^{a,b}
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Port	Bulk sugar exports					
	Raw	Refined	Total			
		(kilotonnes)				
Bundaberg	252.9		252.9			
Cairns	157.2		157.2			
Innisfail	322.4		322.4			
Mackay	383.0	298.9	681.9			
Townsville	I 490.5		I 490.5			
Total	2 606.0	298.9	2 905.0			

a. Estimates include raw sugar shipments from Bundaberg, Mackay and Townsville

to the Yarraville Refinery, as well as refined sugar shipment to Sydney Port from Mackay.
Ports Australia also reported 49 683 tonnes of containerised refined sugar exports from Melbourne Port, 42 589 tonnes from Brisbane Port and 17 308 tonnes from Sydney Port. Containerised export volumes are not included in table estimates.

Sources: Gladstone Ports (2012); NQBP (2013); Port of Townsville (2013a); Ports North (2012a); DTMR (2002).

Domestic sugar consumption

Approximately 745 kilotonnes (77 per cent) of refined sugar was supplied to the domestic market with the remaining 221 kilotonnes exported⁹ (ABS 2013; Bundaberg Canegrowers 2013; Mackay Sugar 2012a; Manildra Harwood Sugars 2012; Sugar Australia 2013a). Based on information from Sugar Australia (Sugar Australia 2011, 2013a), MSF Sugar Limited (MSF Sugar 2013a), and Mackay Sugar (Mackay Sugar 2012a), approximately 164 kilotonnes, of the 745 kilotonnes of refined sugar for domestic consumption, was packaged for retail consumption, while the remaining 581 kilotonnes (78 per cent of refined sugar for domestic consumption) was used by the food and beverage manufacturing industry.

There was also about 115 kilotonnes of sugar imported into Australia in 2011–12¹⁰ (ABS 2013)—this does not include the sugar content of imported sugar confectionary and cocoa powder containing added sugar or other sweeteners.

Sugar transport arrangements

The sugar transport task is integral to the sugar production process, transporting sugar cane from farms to mills, raw sugar to refineries and/or ports for export, and refined sugar to domestic users and for export. The discussion here is focused on transport of sugar cane in bulk forms from sugar cane farms to mills, and then raw sugar to ports for export, as well as raw sugar from mills to refineries and refined sugar from refineries to ports for export. Transport of refined sugar from refineries to domestic users is not covered—principally because the task is more diffuse and there is less information available about it. Figure 8 provides a simplified diagram of the Australian sugar industry supply chain.

9. This estimate includes about 110 kilotonnes of refined sugar exported from Melbourne, Brisbane and Sydney ports in containers.

Imported sugar product classifications includes raw cane and beet sugar, non-raw cane and beet sugar, molasses from cane and beet sugar, maple sugar and syrup, as well as other sugars not elsewhere specified (Commodity codes: 6111, 6112, 6121, 6129, 6151, 6159, 6192, 6199, and 51692).

Sugar terminal facilities at the Port of Lucinda experienced extensive damage due to Cyclone Yasi and were not operational for the 2011– 12 harvest period.



Figure 8: Simplified schematic diagram of the Australian sugar industry supply chain

Source: BITRE analysis.

Sugar cane transport

In Queensland, harvested sugar cane is transported from farms to nearby sugar mills primarily by narrow gauge rail (610 mm), which are all owned, operated and maintained by the milling companies (ASMC 2012b), with a smaller amount transported directly by truck. Conversely, all sugar cane produced in New South Wales, where there is no dedicated cane rail network, is transported from farms to nearby sugar mills by truck.

There are approximately 3980 kilometres of sugar railway network track in Queensland across 20 cane train networks, all use 610 mm gauge, except Pioneer Mill, which uses 1067 mm (narrow) gauge (ASMC 2012b; Browning 2007; Pernase & Pekol 2012). Current rolling stock comprises around 250 diesel hydraulic locomotives and about 52 000 cane *bins* (the common term for cane rail wagons) of between 4 and 15 tonnes capacity, both four-wheel and bogie. Cane rail operations run from about June to December transporting chopped cane during the crushing season (Browning 2007; Geraghty 2005). Locomotives of up to 520 kilowatts power are also in use, with numbers of them converted to 610 mm. Browning (2007) reports that the furthest run to a mill is approximately 119 km and the average distance hauled is around 35 kilometres. Trains can run at up to 40 km/h and can be up to 2000 tonnes in weight and one kilometre in length (Browning 2007).

Maryborough, Atherton Tableland and Rocky Point Mills are not serviced by cane railway infrastructure, and road transport is used to transport all sugar cane from farms to these mills (IMETT Group 2012; Lonergan Edwards & Associates 2011; Rocky Point Sugar Mill 2012). Road haulage of the cane harvest is either undertaken directly by the individual mills or contracted out to private hauliers. The principal heavy vehicles used to transport the cane harvest are 6-axle articulated trucks (14 to 24 tonnes capacity), multi-lift vehicles with a 21 to 24 tonnes capacity, and B-doubles (36 to 39 tonnes capacity) (Pernase & Pekol 2012).

Raw sugar transport

Transport of raw sugar, from sugar mills to sugar refineries and ports, is currently primarily handled by a mix of road, rail, and coastal shipping.¹¹ Conveyors feed raw sugar to Racecourse, Bundaberg and Harwood Refineries from their nearby mills.

Movement of raw sugar from mills to ports for export is handled by rail and road transport. In Queensland, raw sugar is transported from mills to one of six Queensland Sugar Limited (QSL)-managed bulk sugar

^{11.} Coastal shipping is used to transport raw sugar from the Port of Mackay in North Queensland to Sugar Australia's Yarraville refinery in Melbourne.

terminals for loading onto ships. However, the Australian Sugar Milling Council (2013) has recently noted that escalating rail transport costs has resulted in decreasing use of rail to transport sugar from mills to bulk sugar terminals. For example, trucks are now used to transport sugar from the Mackay sugar mills to the Mackay Port (ASMC 2013a). In 2014, approximately 1.4 million tonnes of raw sugar was transported from mills to port via public rail, 0.5 million tonnes went by mill-owned railway system and 2 million tonnes by road transport (ASMC 2015, private correspondence).

Raw sugar is transported to refineries by a combination of rail and road from nearby mills (except Yarraville refinery), by conveyor for refineries located with mills (Racecourse, Bundaberg and Harwood) and by coastal shipping to Yarraville (sourced from Mackay Port) (Sugar Australia 2008).

Refined sugar transport

The majority of Australia's refined sugar exports are sourced from the Racecourse refinery, and transported by rail to Mackay Port for export. Most of Australia's exports first overseas destination is the Port of Singapore, presumably for further distribution (Sugar Australia 2008). Some refined sugar is also transported in bulk via coastal shipping from Mackay to Glebe Island Terminal at Sydney Port (Sugar Australia 2009). Refined sugar produced at Yarraville is exported via its bulk tanker and container loading facility which is located in the Melbourne Port complex (CSR Sugar 2009).

As previously noted, approximately 80 per cent of refined sugar consumed domestically is used by food manufacturers (such as beverages, confectionery and bakery production), and the remaining 20 per cent sold directly as sugar (MSF Sugar 2013a). The demands of refined sugar by food manufacturers, and consequently the freight task involved in transporting refined sugar from refineries to food manufacturers, is not publicly available. Additionally, the type of refined sugar transported to the food manufacturers are not exclusively in the form of pure solid refined sugar. Consequently, the sugar freight task between refineries and food manufacturers or retail shops was not considered for this publication.

Infrastructure for sugar and sugar cane transport

Bulk sugar port export facilities

As previously noted, there are six bulk sugar export ports in Australia, five operating in 2011–12. This section provides a brief overview of existing bulk sugar export facilities and capacity.

Port of Townsville

The Port of Townsville currently has a total bulk export capacity (including, but not limited to, sugar) of 23 million tonnes per annum (Mtpa) (Port of Townsville 2013a, 2013b). In 2011–12, the total bulk throughput at the port was 12.9 Mt (Port of Townsville 2014). While the Port of Townsville has well-developed plans to expand capacity and facilities at the port—including a new deep-water outer harbour, providing 6 additional berths and bulk cargo storage space, and deepening and widening of existing approach channels—the project does not appear to involve expansion of sugar export facilities (Port of Townsville 2011, 2013b), which currently accounts for 12 per cent of total port throughput (Port of Townsville 2014). Townsville bulk sugar terminal has two sheds with a total capacity of 755 000 tonnes.¹²

Port of Mackay

The Port of Mackay has separate berths handling bulk raw sugar (No. 3 Berth, operated by QSL) and refined sugar (No. 4 Berth, operated by Sugar Australia). QSL's bulk sugar ship loader has a maximum loading capacity of 2400 tonnes per hour (tph), and average loading capacity of 2000 tph, and Sugar Australia's facility has a design loading capacity of 500 tph. The Mackay terminal has a storage capacity of around 760 000 tonnes of raw sugar and 45 000 tonnes refined sugar capacity (NQBP 2012). Total exports of raw and refined sugar through the port was 682 000 tonnes in 2011–12, equivalent to 25 per cent of total port throughput, by mass, and the second largest export commodity through the port after petroleum. However, sugar exports have comprised as much as 36 per cent of total port throughput in some years. There are currently no published plans to expand the Port of Mackay. Mackay bulk sugar terminal has four sheds with a total capacity of 737 000 tonnes (See Footnote 12).

^{12.} Refer to http://www.sugarterminals.com.au/locations/.

Port of Mourilyan

The Port of Mourilyan has a single berth exporting sugar and molasses, and since 1995 has also been used to export live cattle. The port is operated by Mourilyan Bulk Sugar Terminal, a subsidiary of QSL. The bulk sugar ship loader has a maximum loading capacity of 2300 tph and average loading capacity of 1800 tph. The terminal has storage capacity of 186 000 tonnes of raw sugar. Sugar is the predominant export commodity through the port, with the 453 219 tonnes through the port in 2011–12 accounting for 71 per cent of total throughput (Ports North 2012b). There are no published plans to expand sugar handling capacity at the Port of Mourilyan. Mourilyan bulk sugar terminal has only one shed with a capacity of 175 000 tonnes (See Footnote 12).

Port of Bundaberg

The Port of Bundaberg has one sugar export berth and a bulk liquids berth that also services the molasses export terminal. The sugar handling infrastructure includes a ship loading conveyor with an average loading capacity of 1400 tph and bulk storage capacity of 300 000 tonnes of raw sugar. The molasses ship loading facilities have an average loading rate of 285 tph and landside storage capacity of approximately 36 600 tonnes. Sugar and molasses exports were the only commodity exports in 2011–12, totalling 260 000 tonnes. The Port of Bundaberg is not accessible by rail, and all freight must be delivered to the port by truck (DTMR 2002). Sugar and Molasses are the only commodities currently being exported through the port (Port of Bundaberg 2010). There are no published plans to expand sugar handling facilities at the Port of Bundaberg bulk sugar terminal has two sheds with a total capacity of 316 000 tonnes (See Footnote 12).

Port of Cairns

The Port of Cairns has one berth (wharf) devoted to sugar and molasses exports, which is owned and operated by Sugar Terminals Limited. The ship loader has an average raw sugar loading capacity of 1600 tph (Maritime Safety Queensland 2014) and bulk storage capacity of around 250 000 tonnes of raw sugar. Sugar and molasses exports totalled approximately 180 000 tonnes in 2011–12. Raw sugar exports were approximately 39 per cent of the port's 398 617 tonnes total exports in 2011–12 (Ports North 2012a). There are no published plans to expand sugar export capacity at the Port of Cairns. Cairns bulk sugar terminal has two sheds with a total capacity of 234 000 tonnes (See Footnote 12).

Port of Lucinda

The Port of Lucinda bulk sugar export facilities comprises a single offshore berth connected by a 5.7 kilometre jetty to shore. Port facilities include 230 000 tonnes raw sugar storage capacity and raw sugar ship loading capacity of just over 1000 tph. Sugar is the main export commodity through the port—the port also serves as the supply port for Palm Island nearby. Due to damage to the sugar export terminal caused by Cyclone Yasi in February 2011, there were no sugar exports from Lucinda in 2011–12. Repairs to the facility included structural, mechanical, hydraulic and electrical systems along the jetty, conveyor system, wharf and ship loader. In 2012–13 it exported approximately 424 000 tonnes of raw sugar. There are no published plans to expand sugar export capacity at Lucinda. Lucinda bulk sugar terminal has three sheds with a total capacity of 231 000 tonnes (See Footnote 12).

Sugar cane rail system

As previously noted, the dedicated cane rail system comprises nearly 4000 kilometres of track, which is integral to the cane milling supply chain. The cane rail system is owned and maintained by the sugar mill operators, and it is the most efficient method of moving sugar cane to mills where high volumes of sugar cane needs to be transported to mills within 12 to 24 hours of harvest. The Queensland cane railway system has handled as much as 32 million tonnes of sugar cane in a year. The Queensland sugar mills have a combined sugar cane processing capacity of about 38.4 million tonnes per annum.

The typical transport distance for sugar cane by cane railway is between 13 and 35 kilometres, average trains speeds are up to 40 km per hour, and average train combinations are up to 2000 tonnes in weight and one kilometre in length (Pernase & Pekol 2012).

The Australian Sugar Milling Council (ASMC) has highlighted the value of the cane rail network to the industry and estimated that the replacement cost of the network would be between \$1.5 and \$2.0 billion (assuming and average cost of between \$300 000 and \$500 000 per kilometre of track (ASMC 2012b).

BITRE estimates of the cane rail freight task (presented below) imply the cane-related road freight task would be ten times larger in tonne kilometres term, absent the cane rail network.

Bulk sugar export rail and road infrastructure

Two of the six bulk sugar port terminals are serviced by rail infrastructure—Townsville and Mackay (Queensland Rail 2007a).¹³ All six bulk sugar ports also lie on Queensland Rail's North Coast Line, which consists mostly of single track, except for a short section between Stuart and Townsville (Queensland Rail 2007a, 2007b). Maximum allowable speeds on the line are mostly 80 km per hour and the maximum allowable axle load is 20 tonnes. The North Coast Line is used to transport passengers, containerised freight and bulk freight (grain and sugar), and so bulk sugar trains have to compete with other traffic for access. The Australian Sugar Industry Alliance (ASA) notes that while bulk sugar transport by rail is a more efficient method (i.e. delivers higher volume throughput), more sugar is currently transported by road from sugar mills to ports for export (ASA 2013; ASMC 2013a).

All six bulk ports have good road transport infrastructure connections to sugar mills. The road network provides B-double access between most sugar mills and bulk sugar port terminals, and Higher Mass Limit vehicle access to the Port of Townsville. Queensland Transport and Main Roads also permit B-double access to parts of the network during the cane planting and crushing season. Industry has also called for less restricted operation of "over-size over-mass" vehicle permits for the sugar cane industry (ASA 2013).

Sugar-related freight movements

As outlined in the introduction, the primary purpose of the *Freightline* series is to illustrate where and how freight moves. This section provides estimates of sugar-related (i.e. sugar cane, raw and refined sugar) freight movements in 2011–12.

Sugar cane movements

Figure 9 provides an illustration of the size and scope of sugar cane freight movements across Australia in 2011–12. It has been derived by modelling movements of harvested cane from farms to mills, by transport mode, for subsequent crushing.

Industry estimates that sugar cane railways carry the majority of sugar cane from sugar cane farms to nearby sugar mills (ASMC 2012b) and BITRE's modelled estimates concur. Overall, BITRE estimates total rail movements of sugar cane from farms to mills were approximately 462.9 million tonne kilometres (73 per cent of sugar cane volume movements) in 2011–12 and total road freight movements involved in transporting sugar cane were approximately 170.1 million tonne kilometres (27 per cent of total sugar cane volume movements) in the same period (see Table 5).

Note that road transport is used entirely for sugar cane movements from farms to nearby mills in New South Wales (Condong, Broadwater and Harwood sugar mills) and for a small number of cane mills in Queensland that do not have dedicated cane tramway networks—Atherton Tableland, Maryborough and Rocky Point mills (MSF Sugar 2013b, 2015; Rocky Point Sugar Mill 2012). Across the rest of the industry, road transport is used to transport sugar cane from farms to nearby rail sidings, for subsequent rail transport to mills. (Figures 11 to 15 illustrate cane movements from farms to mills across the different growing regions.)

¹³ Lucinda Port is served by cane railways only (Port of Townsville 2013c), while the Ports of Bundaberg, Cairns and Mourilyan are not served by rail access, although rail access exists in the towns of Bundaberg, Cairns and Innisfail (Queensland Rail 2007a).









	0			*		
Jurisdiction	Road	Rail	Total	Road	Rail	Total
	(million tkm)		(^a (kilotonnes)	
New South Wales	43.6		43.6	1 613.5		6 3.5
Queensland	126.5	462.9	589.4	34 374.2	73 303.8	107 678.0
Total	170.1	462.9	632.9	35 987.7	73 303.8	109 291.5

Table	5:	Estimated	sugar	cane	transport	flows,	by	jurisdiction	and	transport	mode,	20)	_	2
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.. not applicable

a. Total tonnage presented on loading basis

Source: BITRE estimates.

BITRE's sugar cane rail transport task estimate of 24.1 million tonnes in 2011–12 broadly approximates ASMC's estimate of 25.5 million tonnes (ASMC 2012b)—with the slight discrepancy potentially due to modal assignment in the BITRE model.

Figure 11: Sugar cane freight task, Mackay region, 2011–12



Source: BITRE estimates.

 \mathbf{c}

Freightline



Figure 12: Sugar cane freight task, Southern Queensland and Northern New South Wales, 2011–12

Domestic bulk sugar freight task

Figure 13 illustrates the size and scope of raw and refined bulk sugar freight movements across Australia in 2011-12. It has been derived by modelling flows from sugar mills to ports and sugar refineries by transport mode.

Figure 13: Estimated Australian bulk sugar freight task, 2011–12



Note: The raw and refined sugar movements depicted here only considers bulk transport and excludes containerised transport. The sugar freight movements were estimated using the least transport cost while also considering actual and practical conditions of sugar transport where possible (for example, sugar juice was transported from Tableland Mill to South Johnstone and Mulgrave Mills before being sent to nearby sugar exporting ports).

Approximately 51 per cent of the 3502 kilotonnes of raw sugar produced from across the 20 sugar mills in Queensland in 2011–12 was transported by rail to five bulk sugar terminal located at Cairns, Townsville, Mourilyan (Innisfail), Mackay and Bundaberg ports—note that the Port of Lucinda was not operational during this period, and its designated raw sugar exports were diverted to Townsville in 2011–12. The remainder of Queensland-produced raw sugar was sent to sugar refineries in Mackay and Bundaberg. Raw sugar from Rocky Point Mill was transported to Harwood Refinery (IMETT Group 2012; Rocky Point Sugar Mill 2012). All of the New South Wales' Harwood mill raw sugar is input to the Harwood refinery (Sunshine Sugar 2014). Smaller volumes of raw sugar were transported by road and conveyor from nearby sugar mills to sugar refineries at Mackay, Bundaberg and Harwood. Raw sugar input for the Yarraville refinery was transported by coastal shipping from the Port of Mackay.

Table 6 provides estimates of the bulk raw sugar freight task, from mills to refineries and ports. BITRE estimates the total freight task was more than 1.3 billion tonne kilometres in 2011–12. Due to the much longer freight distances involved, coastal shipping accounts for approximately 1.1 billion tonne kilometres (or 84 per cent of the domestic bulk sugar freight task), while rail and road transport account for 144 million tonne kilometres (9 per cent) and 94 million tonne kilometres (7 per cent), respectively. On a tonnage movement basis, however, rail accounted for 1.5 million tonnes, road 1.8 million tonnes, coastal shipping 0.5 million tonnes and conveyors 0.3 million tonnes in 2011–12.¹⁴ These estimates imply an average road haulage distance of 34 kilometres per tonne for raw sugar movements, an average rail haulage distance of 78 kilometres per tonne, and an average domestic shipping haulage distance of 2380 kilometres per tonne.

Jurisdiction	Road	Rail	Coastal shipping ^a	Total	Road ^a	Rail	Coastal shipping ^a	Conveyor ^b	Total
_	(million tkm) ^c						(kilotonnes) ^d		
New South Wales	15.7			15.7	180.7			65.9	246.6
Queensland	104.1	90.3	35.9	1 330.3	2 287.7	1 267.8	477.2	248.0	4 280.7
Total	119.8	90.3	35.9	I 346.0	2 468.4	I 267.8	477.2	314.0	4 527.5

Table 6: Estimated sugar transport flow	s, by jurisdiction and	l transport mode, 2011–12
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a. Based on originating port.

b. Mass-distance (tonne kilometre) freight task by conveyor is excluded from the analysis because conveyors generally run on-site, only hundreds of metres at most, and so contribute less than 0.01 per cent to the total raw sugar freight task.

c. Excludes conveyor transport of bulk sugar from Racecourse Mill to Racecourse Refinery, from Millaquin Mill to Bundaberg Refinery and from Harwood Mill to Harwood Refinery.

d. Total loaded tonnage of raw sugar transported from mills to ports and refineries, as well as from refinery to port; also includes raw sugar transported from Rocky Point Mill (Queensland) to Harwood Refinery (New South Wales).

¹⁴ ASMC estimated that in 2010, a ratio of 62.5 per cent to 37.5 per cent of sugar was transported by rail to Queensland bulk sugar terminals (ASMC 2012b). BITRE's modelling and analysis implies that in 2011–12 (the 2011 sugar cane season) only about 51 per cent of sugar was transported by rail to Queensland bulk sugar terminals. The discrepancy could be attributed to a more recent changes by Mackay sugar to use road transport rather than rail transport for sugar delivery to Mackay Port (ASMC 2013a), which was applied in the modelling for the 2011–12 period.





Source: BITRE estimates.



Figure 15: Estimated bulk sugar freight task, Mackay port region, 2011–12



Source: BITRE estimates.

Figure 17: Estimated bulk sugar freight task, South East Queensland and Northern New South Wales regions, 2011–12



Sugar by-product related freight movements

The sugar milling and refining process produces several other by-products, which are either marketed separately, used within the mill or returned back to farms. These by-products include molasses, bagasse, boiler ash and filter mud (mill mud).

Molasses is the syrup left over from the final centrifuging in the sugar milling process to produce raw sugar (Sugar Australia 2004a), in which the remaining sugar content is too low to make further extraction economical (Sucrogen 2011). In 2011–12, total molasses production was approximately 898 kilotonnes,¹⁵ up from 800 kilotonnes in 2010–11 (ASMC 2013a; Bundaberg Canegrowers 2013; Bundaberg Sugar 2012b; Canegrowers 2012; IMETT Group 2012; Lonergan Edwards & Associates 2011; Mackay Sugar 2012a, 2013; Rocky Point Sugar Mill 2012; Sunshine Sugar (2007 or earlier); Wilmar International 2011, 2012, 2013). In Australia, molasses output is typically between 2.8 to 4.1 per cent of the mass of the original milled sugar cane (Lonergan Edwards & Associates 2011).

Bagasse is the fibre from the crushed sugar cane stalks, and is primarily used by sugar mills to generate electricity to power mill operations (ASMC 2012a, 2013c; Commodity Intelligence & Australian Sugar Milling Council 2012) with any excess sold back to the electricity grid. In 2011–12, the sugar industry generated 908 GWh of electricity, of which 488 GWh was exported to the national electricity grid. Smaller volumes of bagasse are also marketed as garden mulch. In 2011–12, approximately 7.5 million tonnes of bagasse was produced by Australian sugar mills from almost 28 million tonnes of sugar cane harvested (Canegrowers 2012; Sugarcane.org 2015). ASMC reported that on average 9 million tonnes of bagasse was burnt to generate electricity each year (ASMC 2014).

Mill mud is a nutrient rich by-product which consists of soil and impurities contained in the harvest, mixed with ash from the boilers in the sugar milling process (Mossman Sugar Mill and Farm Tours 2010). Approximately 9 per cent from the amount of sugar cane processed in the mill becomes mill mud, which is sold back to farmers as an alternative form of fertiliser (Mossman Sugar Mill and Farm Tours 2010). This amounted to about 2.5 million tonnes of mill mud produced by sugar mills in 2011–12.

The transport of molasses, mill mud and, to a lesser extent, marketed bagasse products add to the sugarrelated freight task. This section provides estimates of the molasses freight transport task and of the likely size of the mill mud freight task.

Molasses transport

Molasses production and exports

The Australian sugar industry typically produces between 800 and 1000 kilotonnes of molasses each year. Table 7 shows molasses production and export volumes between 2006–07 and 2011–12 and Table 8 shows estimated molasses production by companies which operated sugar mills in 2011–12.

	Table 7: Australian molasses	production and	export volume,	2006–07 to	2011–12
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	2006-07	2007–08	2008–09	2009-10	2010-11	2011-12		
	(kilotonnes)							
Molasses production	1 050.0	1 000.0	950.0	900.0	800.0	898.0		
Export volume	330.0	260,0	290.0	250.0	320.0	506.5		
C ANAT (2010) C	(2014)		: (2012)		•			

Sources: AMT (2010), Canegrowers (2014), Russell & Frymier (2012) and BITRE estimates.

^{15.} It is estimated that about 49 kilotonnes extra molasses supply was available in 2011–12 period to fulfil the export requirement and bulk domestic demand. This may have come from sugar mills' stores as well as extra supply from Tully Sugar Mill (information from their website indicates a higher amount of supply but suggest an unusual sugar cane–molasses conversion rate). While total molasses production in 2011–12 exceeded bulk domestic demand and export volumes, it was unclear if molasses from New South Wales' sugar mills was used other than to supply the retail molasses market.

Table 8: Australian molasses production by sugar milling company, 2011–12

Company	Number of sugar mills	Molasses production ^a
		(tonnes)
Wilmar International	8	498 000
Mackay Sugar	4	142 631
MSF	4	70 040
Tully	I	36 364
NSW Milling Cooperative	3	50 663
Bundaberg Sugar	2	48 915
lsis	I	42 893
Heck Group	I	8 405
Total	24	897 912

a. BITRE estimates Australian molasses production totalled approximately 898 kilotonnes in 2011–12. There are, however, no official estimates of total molasses production in Australia in 2011–12. The estimates presented here are based on a mix of reported mill molasses output and estimated mill output, derived using sugar cane input and the average molasses–cane sugar ratio. The production estimates also accord with total estimated molasses production was around 892 kt in 2012, 942 kt in 2013 and 1091 kt in 2014 (ASMC pers. comm., October 2015).

Sources: AMT (2010), Canegrowers (2014), Russell & Frymier (2012), ASMC (pers. comm.) and BITRE estimates.

Wilmar International is the largest single molasses producer in Australia, producing 459 kilotonnes across its eight high-capacity sugar mills in 2011–12, which amounted to just over half of all molasses produced in Australia in 2011–12.

Australia exported approximately 507 kilotonnes of molasses in 2011–12 (excluding the approximately 40 kilotonnes shipped from Townsville and Bundaberg to Melbourne), or just on 60 per cent of total molasses production in that year. Molasses export destinations included the United States, New Zealand, China, Korea, Taiwan, Philippines, Indonesia, Vietnam and the European Union (AMT 2010). Over 76 per cent of all molasses exports in 2011–12, went through the Port of Townsville, with smaller amounts exported through Mourilyan (Innisfail), Cairns and Mackay. Table 9 shows the volume of Australian molasses exports by port in 2011–12.

Table 9: Australian molasses exports by port, 2011–12^a

Port	Molasses exports
	(tonnes)
Brisbane	I 096
Bundaberg	7 226
Cairns	36 410
Innisfail	79 656
Mackay	40 001
Townsville	381 782
Total	546 171

 a. Includes domestic shipping, where 33 547 tonnes was shipped from Townsville to Melbourne and a further 7226 tonnes from Bundaberg to Melbourne. Part of this shipment (6 111 tonnes) was then further shipped to Devonport (Tasmania) and Fremantle (Western Australia).
 Sources: BITRE estimates based on Mackay Sugar (2012a), NQBP (2013), Port of Townsville (2013a), Ports North (2012a), DTMR (2012).

Domestic use

Molasses is primarily used domestically as raw material to produce ethanol, stockfeed, rum and industrial ethanol, with small volumes retailed directly as molasses.

The Sarina distillery, co-located at Wilmar International's Plane Creek sugar mill, consumed approximately 155 kilotonnes of molasses and produced 39 million litres of ethanol in 2011–12 (Wilmar International 2014).¹⁶ Mackay Sugar supplied approximately 100 kilotonnes of molasses in the same period to Wilmar International (Mackay Sugar 2012a). Around 117 kilotonnes of molasses was used as stockfeed material by

^{16.} Based on a typical molasses-to-ethanol conversion rate of 4 kg of molasses per litre of ethanol (Russell & Frymier 2012).

GrainCorp Liquid Feeds¹⁷ (which operates two plants at Marian and Childers, both in Queensland) and by Bundaberg Molasses (one plant in Oakey, Queensland). A further 20 kilotonnes was estimated to be used by domestic rum producers—Bundaberg Distilling Company and Vok Beverages (Beenleigh Rum).¹⁸ Table 10 shows the estimated domestic usage of Australian molasses.

Table	10:	Australian	molasses	usage,	201	_	12
1 4010		/ (a) o o i a i a i a	1110100000	abage,			

Usage	Location	Molasses usage
		(tonnes)
Biodiesel (Sarina Distillery)	Sarina, Queensland	154 500
Stockfeed (GrainCorp Liquid Feeds, Marian)	Marian, Queensland	27 100
Stockfeed (GrainCorp Liquid Feeds, Isis)	lsis, Queensland	36 000
Rum (Bundaberg Rum)	Bundaberg, Queensland	20 000
Molasses (Bundaberg Molasses)	Bundaberg, Queensland	54 000
Industrial Ethanol (Rocky Point)	Gold Coast, Queensland	8 405
Other uses (Feedlots and retail sales, including shipment to Melbourne)	Various	91 436
Total		391 441

Sources: BITRE estimates based on Australian Cane Farmers (2015); ASMC (2013a); Beef Central (2014); Bundaberg Distilling Co ; Bundaberg Sugar (2012a); Canegrowers (2012); IMETT Group (2012); Leah Kidd (2013); Mackay Sugar (2012a, 2013); Mossman Sugar Mill and Farm Tours (2010); Bloesch, Rayment, & Pulsford (1997); Wilmar International (2011, 2012).

Molasses transport arrangements

Figure 18 provides a simplified flow chart of the Australian molasses supply chain. The transport task estimates, presented below, consider only transport of molasses in bulk from sugar mills to ports, for export, and from mills to large domestic users. Transport of molasses for retail sale (estimated to be about 23 per cent of total molasses sales, including molasses supplied direct to feedlots) is not covered.

Figure 18: Simplified molasses supply chain





^{17.} GrainCorp also has another plant in Braybrook, Victoria, which receives molasses supply as part of molasses domestic shipping from Townsville to Melbourne Port. (Braybrook is located just 3 km from Melbourne Port.)

Note that Beenleigh Rum molasses demand is relatively small (approximately 500 tonnes per annum), and it is excluded from the analysis (Bloesch, Rayment, & Pulsford 1997).

Molasses transport patterns and freight volumes

Table 11 provides estimates of the size of the domestic molasses freight transport task, including the transport to port of molasses destined for export. BITRE estimates the total molasses freight task was 215 million tonne kilometres in 2011–12. Coastal shipping is estimated to have accounted for over 63 per cent of the task (136 million tkm), rail approximately 36 per cent (78 million tkm) and road 1 per cent (1.7 million tkm). By mass, BITRE estimates rail accounted for the majority of molasses movements, with the majority of molasses destined for export transported to ports by rail in 2011–12, while road accounted for approximately 23 per cent of molasses movements. Approximately 47 kilotonnes of molasses was shipped around the coast in 2011–12, but the average travel distance was nearly 3000 kilometres per tonne, contributing to the size of the overall task. Figures 23 to 25 illustrate the molasses transport volumes in 2011–12.

Table 11: Estimated molasses transport volumes, b	y jurisdiction and transport mode, 2011–12 [;]
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Jurisdiction	Road	Rail	Coastal shipping	Total	Road	Rail	Coastal shipping	Total
		(million	tkm)			(kilotor	nnes)	
Victoria			8.3	8.3	••		6.I	6.1
Queensland	1.7	77.7	127.7	207. I	126.4	719.8	40.8	886.9
Total	1.7	77.7	136.0	215.4	126.4	719.8	46.9	893.0

.. not applicable

a. Jurisdictional allocation of freight volumes (tonnes) is based on state/territory of origin.

Source: BITRE estimates.

Figure 19: Estimated molasses freight movements, 2011–12







Figure 20: Estimated molasses freight task, Northern and Central Queensland regions, 2011–12

Source: BITRE estimates.

Figure 21: Estimated molasses freight task: South East Queensland and Northern New South Wales regions, 2011–12





Combined across the separate sugar-related freight tasks, BITRE estimates the transport of cane sugar, raw and refined sugar and molasses products totalled approximately 2.5 billion tonnes kilometres in 2011–12— approximately 859 million tonne kilometres by rail, 388 million tonne kilometres by road and 1272 million tonne kilometres by coastal shipping (see Table 12). This is equivalent to around 0.4 per cent of the total domestic freight task (although the coastal shipping task comprises about 1.3 per cent of total coastal shipping freight in 2011–12).

Table 12: Estimated total	sugar related transp	ort volumes, by ju	risdiction and t	transport mode,
2011-12		, · ·		

Product	Road	Rail	Coastal shipping	Total		Road	Rail	Coastal shipping	Conveyor	Total
(million tkm) ^b								(kilotonnes)		
Sugar cane	170.1	462.9		632.9		35 987.7	73 303.8			109 291.5
Raw & refined bulk sugar	119.8	90.3	35.9	1 346.0		2 468.4	1 267.8	477.2	314.0	4 527.5
Molasses	1.7	77.7	136.0	215.4		126.4	719.8	46.9		893.0
Other ^a	57.0			57.0		2 516.0				2 516.0
Total	348.5	630.8	I 272.0	2 251.3		41 098.5	75 291.4	524. I	314.0	117 228.0

.. not applicable

a. Other sugar-related freight covers only transport of mill mud from mills back to farms.

b. Excludes conveyor transport of bulk sugar from Racecourse Mill to Racecourse Refinery, from Millaquin Mill to Bundaberg Refinery and from Harwood Mill to Harwood Refinery.

Appendix Tables A.I to A.3 provide a more detailed breakdown of estimated sugar-related freight movements in 2011–12, by Statistical Area Level 3.

Final remarks

This Freightline issue has outlined the size, scope and location of sugar-related freight movements in Australia, and provided estimates of domestic sugar-related freight volumes for 2011–12. The estimates presented here are based on modelled movements of cane sugar, bulk raw and refined sugar and bulk molasses from points of supply to points of domestic demand and ports for export. The information used to model these movements are based almost entirely on publicly available data on production and use of sugar and related products, or where this is not available, informed assumptions, as well as assumptions about transport costs and infrastructure availability. Consequently, the reported flows are indicative of the actual pattern and volume of movements in 2011–12. Despite these limitations, the information reported herein fills an acknowledged gap in information about freight movements in Australia.

Table A.1: Estimated movements of sugar cane, by origin-destination pair and transport mode, in 2011-12^{a,b}



a. Estimates include multiple handling.

b. Origin destination pair was based on ASGS 2011 SA3-level regions(Australian Bureau of Statistics 2010).

 \mathbf{c}

Table A.2: Estimated movements of raw and refined sugar, by origin-destination pair and transport mode, 2011-12^{a,b}

					Destin	ation			
					Destin	ucioni			
Origin	Воtапу	Bundaberg	Cairns - South	Clarence Valley	Innisfail - Cassowary Coast	Mackay	Maribyrnong	Townsville	Grand Total
	Road (kiloto	onnes)							
Bundaberg	365								365
Cairns - South			100		57				157
Charters Towers - Ayr - Ingham								223	223
Clarence Valley				66					66
Far North			60		29				89
Innisfail - Cassowary Coast					266				266
Mackay						999			999
Maryborough	65								65
Ormeau - Oxenford				35					35
Port Douglas - Daintree			57						57
Richmond Valley - Coastal				79					79
Tweed Valley				35					35
Whitsunday						33			33
	Rail (kiloto	nnes)							
Charters Towers - Ayr - Ingham								1 268	1 268
Dome	stic Shipping	g (kiloton	nes)						
Bundaberg							150		150
Mackay	187						71		259
Townsville							69		69
AI	I Modes (kil	otonnes)							
Bundaberg		365					150		514
Cairns - South			100		57				157
Charters Towers - Ayr - Ingham								1 491	1 491
Clarence Valley				66					66
Far North			60		29				89
Innisfail - Cassowary Coast					266				266
Mackay	187					999	71		1 257
Maryborough		65							65
Ormeau - Oxenford				35					35
Port Douglas - Daintree			57						57
Richmond Valley - Coastal				79					79
Townsville							69		69
Tweed Valley				35					35
Whitsunday						33			33

a. Estimates include raw sugar transport from sugar mills to ports and sugar refineries, as well as from sugar refineries to ports.
b. Origin destination pair was based on ASGS 2011 SA3-level regions (Australian Bureau of Statistics 2010).
Source: BITRE estimates.

 \mathbf{c}

Table A.3: Estimated movements of molasses, by origin–destination pair and transport mode, 2011–12^{a,b}

						Desti	nation					
-												
Origin	Bundaberg	Cairns - South	Darling Downs - East	Devonport	Fremantle	Innisfail - Cassowary Coast	Mackay	Maribyrnong	Ormeau - Oxenford	Townsville	Wynnum - Manly	Grand Total
			Road (k	ilotonnes)								
Bundaberg	41											41
Mackay							65					65
Ormeau - Oxenford									8			8
Port Douglas - Daintree		13										13
			Rail (kil	otonnes)								
Bundaberg	23		26								I.	50
Cairns - South		24				I.						24
Charters Towers - Ayr - Ingham						24	4			382		411
Innisfail - Cassowary Coast						54						54
Mackay							103					103
Maryborough			28									28
Whitsunday							50					50
		Dome	estic Ship	ping (kild	otonnes)							
Bundaberg								7				7
Maribyrnong				4	2							6
Townsville								34				34
		A	II Modes	(kilotonn	es)							
Bundaberg	63		26					7			I.	98
Cairns - South		24				Т						24
Charters Towers - Ayr - Ingham						24	4			382		411
Innisfail - Cassowary Coast						54						54
Mackay							167					167
Maribyrnong				4	2							6
Maryborough			28									28
Ormeau - Oxenford									8			8
Port Douglas - Daintree		13										13
Townsville								34				34
Whitsunday							50					50

a. Estimates include molasses transport from sugar mills to ports and to large domestic usage.

b. Origin destination pair was based on ASGS 2011 SA3-level regions (Australian Bureau of Statistics 2010). Source: BITRE estimates.

Abbreviations

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
AMT	Australian Molasses Trading Pty Ltd
ASA	Australian Sugar Industry Alliance
ASMC	Australian Sugar Milling Council
CCS	Commercial Cane Sugar
CSR	Colonial Sugar Refining Company (CSR Sugar)
DTMR	Department of Transport and Main Roads (Queensland Government)
IMETT	Integrated Motorsport Education Tourism and Technology
MSF	Maryborough Sugar Factory Limited
NQBP	North Queensland Bulk Ports Corporation
QSL	Queensland Sugar Limited
RIRDC	Rural Industries Research and Development Corporation
tkm	tonne kilometres (equivalent to one tonne moved one kilometre)

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