



DEFRA PROJECT FO0108

**RESILIENCE OF THE FOOD SUPPLY TO
PORT DISRUPTION**

**FINAL ANNEX REPORT 9:
UK SUGAR IMPORTS
September 2012**

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1. EXECUTIVE SUMMARY

The UK is dependent on sugar imports, as domestic beet sugar production can only account for less than 50% of gross sugar demand of c.2 million tonnes. In addition, UK sugar cane refining capacity is effectively concentrated at a single location, i.e. Silvertown, London.

This Defra project 'Resilience of the Food Supply to Port Disruption' involved an assessment of possible port disruptions, their potential impact on UK food supply and the options for remedial action in the short to medium term. It followed publication in 2009 of the *UK Food Security Assessment* which had listed cane sugar (along with chemically pure sucrose) as a vulnerable food commodity.

The project was undertaken by Peter Baker (PRB Associates) and Andrew Morgan (Global 78). This Annex Report contains the principal findings, recommendations and conclusions arising from their research on sugar imports. Additional relevant information will be found in Annexes 3 to 6.

The work programme included use and further analysis of requested HMRC / Defra import tonnage data (for 2010); work with industry stakeholders to compile an accurate description of 'as-is' import scenarios (i.e. product origins, modal formats, volumes, services used and frequencies, etc.); and an attempt to understand the stakeholders' approach to ensuring consistent supply and review strategies already in place (or planned) to mitigate likely possible effects of port disruption. Findings include:

Code	Description	Non-EU tonnes k	EU tonnes k	Total tonnes k
#1701	Cane or beet sugar	1,004.8	418.0	1,422.8
#1702	Other sugars	4.0	453.0	457.0
#1703	Molasses	405.2	130.0	535.2
Total		1,414.0	1,001.0	2,415.0

- Raw cane sugar for UK refining at Silvertown, accounting for most #1701 non-EU sugar, arrives as dry bulk on the Thames. Although this is a concentrated flow and could be considered vulnerable, shipments are widely spaced and the refinery holds bulk stock of raw material. There are several possible alternative discharge ports in the South East, although the cost of trucking imported material from them would be high. Effects of interruption would be moderate
- Direct consumption cane sugar arriving in containers at ports such as Felixstowe constitutes the balance of #1701 non-EU sugar. Low volumes but customers include retailers with lean supply chains. Provided containers could be diverted to other ports, disruption could be mitigated
- Refined cane or beet sugar as #1701 arriving from the EU in containers or road trailers via the Dover corridor or ports such as Purfleet or Immingham (unaccompanied). Significant volumes for UK industrial customers with low raw material stocks. Mitigation as for direct consumption above
- Glucose syrup, etc. as #1702 arriving from the EU in tank containers or trailers with profile similar to preceding flow type. Significant volumes for UK industrial customers with low raw material stocks. Difficult to reconfigure or re-route, especially when taking into account tank availability.
- Molasses in liquid bulk as # 1703 arriving from EU and non-EU countries in sea-going tankers for UK storage and distribution, particularly for animal feeds. Shipments are at intervals and although there may be problems with vessel availability there is a range of ports served. Risk probably low
- Food and drink manufacturing takes c.80% of refined / processed supply; with grocery retail and foodservice taking c.20%. Serious interruption of supply would have a rapid and widespread impact on product availability and choice for the consumer.

The research demonstrated that it is feasible to gather reliable information from industry stakeholders about UK sugar import flows. Only by working at individual flow level is it possible to obtain the essential understanding to assess and mitigate supply risk. However, industry stakeholders will need to be persuaded about the merits of revealing information about their Business Continuity Planning.

2. INTRODUCTION

2.1 Overview

The Defra-funded research project FO0108 'Resilience of the Food Supply to Port Disruption' involved an assessment of possible port disruptions, their potential impact on UK food supply and the options for remedial action in the short to medium term.

The project was undertaken by Peter Baker (PRB Associates), a ports and shipping specialist, and Andrew Morgan (Global 78), an international food supply chain specialist.

The research was prompted in part by the outcomes of the *UK Food Security Assessment* (published in August 2009; updated in January 2010) which had listed cane sugar (and chemically pure sucrose) as a vulnerable food commodity and PRB Associates' follow-up report published in September 2009, *Background to Defra's Assessment of UK Food Security*.

The work included a series of food commodity Case Studies on imports of frozen meat and fish; citrus fruits; sugar; and palm oil. This Annex Report contains the principal findings, recommendations and conclusions arising from the research on sugar imports.

2.2 Background

Sugar cane and sugar beet have particularly high levels of sucrose which make them suitable for sugar production. Sugar cane is cultivated in tropical and sub-tropical regions while sugar beet grows exclusively in the temperate zone. After processing, the extracted sugar is used as a raw material in human food industries or fermented to produce ethanol, a low pollution fuel.

With less than 50% of the UK's annual sugar consumption of c.2 million tonnes being met from domestic production of beet sugar, the country is heavily dependent on imported supply of refined sugars (c.500 million tonnes); as well as on bulk imports of raw sugar for refining. UK sugar cane refining capacity is effectively concentrated at a single location, Silvertown, on the Thames.

Non-EU imports from tropical countries include raw cane sugar in bulk for UK refining; washed or refined cane sugars such as demerara; and imported molasses. EU imports include both beet and cane sugars from European refineries, and other sugars such as sucrose derived from corn starch, in a variety of modes of appearance.

Typical industrial applications for a wide range of sugars are:

- Granulated white sugar (from either sugar cane or sugar beet) in dry or liquid form is an essential raw material for much UK food and drink production, as well as for certain non-food applications
- Refined white sugar is also used to produce blended sugars and syrups required for many manufactured food products including confectionery, bakery items, sauces, and prepared foods
- Sugars and syrups are also supplied in a wide range of packaged formats to the foodservice sector via wholesale distributors, and to consumers via grocery retailers
- Other sugars such as sucrose or maltose (in liquid or dry formats) derived principally from cereals are used for both food and non-food manufacturing applications
- Molasses, which is an important by-product of sugar production, is used extensively in animal feed compounding, as well as for food manufacture, and non-food industrial uses.

3. WORK PROGRAMME

The work programme for this Case Study had these objectives:

- Determine the extent to which particular features of domestic and international transport infrastructure and food supply chains are likely to ameliorate / exacerbate the impact of UK port disruption on the supply of food imports into the UK
- Determine the extent to which UK food (import) security is contingent upon the resilience of overseas port infrastructure (both within and without EU waters, and now and in the future)
- Explore the behaviour, over the short to medium run (up to six months), of individual port operators, shipping companies and land-based logistics and food supply chain agents in the event of port disruption.

The programme therefore had the following principal steps:

- Desktop analysis and scoping discussions with industry specialists
- Review of HMRC / Defra imports tonnage data for 2010
- Identification of stakeholders willing to participate in the research
- Work with stakeholders to compile an accurate description of their 'as-is' import scenarios (in terms of product origins, modal formats, volumes, services used and frequencies, etc.)
- Understand stakeholders' approach to ensuring consistent supply and review strategies already in place (or planned) to mitigate likely possible effects of port disruption
- Report on findings to Defra and provide feedback to the stakeholders.

When the research started in September 2011, the most recent complete year for which statistics were available was 2010 so this was chosen as the preferred sample year. Also, in order to understand the physical dimensions of the flows, data about volumes (in tonnes) was chosen in preference to data about values.

Maintenance of commercial confidentiality was a key concern and in line with this the identity of participating stakeholders will not be published. However, this Annex Report does include information about key players in the industry from material already in the public domain.

The following **Table 3.1 Sugar Case Study Evidence Base** provides an overview:

	Number
Participating organisations – industry sector players	7
Participating organisations – logistics services providers	5
Total participating organisations	12
Web based evidence; hard and grey literature	31
Site visits / face-to-face interviews	6
Telephone interviews	6
Additional major inputs requested from participants	7
Total items in the evidence base	50

This activity summary excludes the considerable effort required to initiate communication, encourage participation, and also arrange conference calls and meetings. It should be noted that while some organisations responded quickly and favourably to the initial invitation to participate, others responded more slowly and needed encouragement, often over several months, to participate.

4. RESULTS

Research findings are summarised under these headings: Defra import statistics (2010); sugar production and supply; UK industry players; UK import flows; resilience of import flows; UK sugar demand by industry segment; food stocks and the attitude of the supply chain to replenishing stock; and behavioural aspects of the various players in the event of supply chain disruption.

4.1 Defra import statistics (2010)

The following **Table 4.1 Sugar Imports** shows the 'starting point' data for the research:

Code	Description	Felix.	Soton.	T/port	London	Imming.	L/pool	Belfast	Other ports	Non EU tonnes k	EU tonnes k	Total tonnes k
#1701	Cane or beet sugar	56.6		0.1	918.4	19.2	10.5			1,004.8	418.0	1,422.8
#1702	Other sugars	1.3	0.1	0.4	0.3		1.9			4.0	453.0	457.0
#1703	Molasses	0.2	0.1	0.2	19.2		189.2	28.1	168.2	405.2	130.0	535.2
Total tonnes k		58.1	0.2	0.7	937.9	19.2	201.6	28.1	168.2	1,414.0	1,001.0	2,415.0
Non EU tonnes % by port		4.1%	0.0%	0.0%	66.3%	1.4%	14.3%	2.0%	11.9%	100.0%		
Non EU vs EU tonnes %										58.6%	41.4%	100.0%
Ports												
1 Felixstowe												
2 Southampton												
3 Thamesport												
4 London including Tilbury and Thames Refinery												
5 Immingham												
6 Liverpool												
7 Belfast												
8 Other ports (molasses) = Avonmouth, Hull, and Sillith												

There are three high-level commodity codes (with abbreviated official descriptions) for sugar imports; ports of entry for non-EU imports only; and significant volumes from EU sources for all three codes.

4.2 Sugar production and supply (statistics from the International Sugar Organisation)

- **Sugar cane** which takes between 11 and 18 months from planting to first harvest, is grown in tropical or sub-tropical countries such as Australia, Brazil, Cuba, Fiji, India, Mauritius, and Zimbabwe. Cane is crushed to produce raw sugar, which might be refined in the country of origin to produce white granulated sugar, or exported for refining elsewhere (e.g. UK or the Continent).

Alternatively, raw cane sugar can be cleaned to produce a number of raw brown sugars such as demerara and muscovado in which the natural molasses remains in the crystals. These are generally packaged for export at source into bulk bags or retail packs.

Brazil is the world's largest producer (38.8 million tonnes in 2010-2011 crop year) and exporter (>40% of world supply), while India is the second largest grower. But because India is also the world's largest consumer, its output swings cause it to move between being an exporter and an importer. Some countries have preferential access to EU markets under such classifications as Africa, Caribbean and Pacific (ACP), Least Developed Countries (LDC) and especially, Most Favoured Nations (MFN).

Sugar mills will operate during the cane harvesting season but refineries will work throughout the year, including modern refineries in the Middle East, North Africa, Europe and the United States. Refineries in Europe include ones owned by AB Sugar (who also own British Sugar) in Spain and Portugal; and by Tate & Lyle Sugars (part of American Sugar Refining) in Portugal and the UK.

- **Sugar beet** is grown across Europe with France as the world's largest producer of beet sugar (4.3m tonnes in 2010-2011 crop year). Other growers include Czech Republic, Germany, Poland, Russia and the UK. The EU sugar reforms, which in 2006 opened up the European market to international competition, resulted in the closure of many sugar beet factories in Europe and production centred on larger, more efficient units.

In the UK, production is concentrated on four British Sugar factories in the East of England with growers located within a 28 mile / 50 km radius of each factory. The beet processing campaign runs for c.140 days each year from September to the following February / March. Factories can also store thick beet juice so that crystallised sugar production can continue throughout the year.

Similar scenarios for sugar production from sugar beet apply across the EU, with Sudzucker of Germany and Tereos of France as the market leaders, both with extensive European operations.

- The principal output from both cane and beet refining is **white granulated sugar**. As noted above, cane sugar might be refined in the country of origin or else in a destination country such as France or the UK. Beet sugar will, however, always be refined at source.

Refined white granulated sugar can then be supplied as dry or liquid bulk for the food and drink industries; moistened and compressed to produce sugar cubes; milled and sieved to produce fine sugars such as caster and icing sugars; or blended (with molasses) to produce a range of syrups and brown sugars. Outbound shipping formats might range from bulk tanker loads to pallet quantities of packaged products (e.g. tubs and pails, retail packs, foodservice sachets, etc.).

- **Other sugars** include glucose, dextrose, fructose, lactose and maple, which are derived from a variety of producers. Glucose, produced from cereals and distributed in liquid or dry form, is particularly important for a range of food manufacturing sectors including brewing. Cargill and Syral (a subsidiary of Tereos) are two leading suppliers to the UK glucose market.
- **Molasses**, which is a by-product of sugar refining, has different taste characteristics according to whether it was derived from sugar cane or sugar beet. Its primary use is as an ingredient for the manufacture of compound **animal feeds**.

In the food industry it is used as a microbiological energy source in a wide range of fermentation processes to grow yeasts, moulds and bacteria. It is also blended with white granulated sugar to produce syrups and treacles, as well as brown sugars (different from raw brown sugars).

While both British Sugar and Tate & Lyle produce molasses from their refining operations, ED & F Man and United Molasses Group are the leading molasses importers and suppliers in the UK.

- When attempting **comparative analysis of refinery inputs and outputs**, it should be noted that there will not be an exact correspondence between inbound tonnages of raw sugar and outbound tonnages (e.g. of sugars or syrups). Much will depend on the product mix and formulation of finished products (e.g. liquid granulated white sugar includes significant quantities of water).

4.3 UK industry players

UK industry players are relatively few in number; most import sugar but not all manufacture. The two leading manufacturers are British Sugar and Tate & Lye Sugars; with Ragus Sugars as a specialist manufacturer of blended sugars and syrups with a strong presence in the bakery sector. These three companies produce both branded and own label products. Other industry players work as merchants or traders, sometimes with associated storage facilities and / or packing operations.

The key players (in alphabetical order) are as follows:

- **British Sugar, Peterborough.** Part of AB Sugars, which has interests in Iberia, Africa and China. Retail and foodservice brands are Silver Spoon and Billington's. It is the sole processor of the UK sugar beet crop. Factories at Bury St. Edmunds (also with milling and packing facilities), Cantley, Newark, and Wissington, have a reported total annual production capacity of c.1 million tonnes.

British Sugar imports modest quantities of cane sugar in containerised bulk or bagged formats, either for processing out of season at Newark, or as direct consumption sugar for its Billington's brand. The company has also evaluated the option to refine raw cane at Cantley.

- **Cargill, Trafford Park.** Cargill is the world's largest privately-owned commodities trader with extensive agri-business interests. Its Trafford Park plant is part of the starches and sweeteners

business which produces sweeteners and wheat proteins from the UK wheat crop for both the food and non-food industries. Although it does not import, its particular relevance is that it competes with companies like Syral (Tereos) which supply glucose syrups to the UK market.

- **ED & F Man, London.** A privately-owned company involved in global sourcing, delivery, distribution of commodities such as sugar, cocoa, and coffee. Its Liquid Products business is a leading supplier of molasses and liquid blends for animal feed, fermentation, and other applications. Sourced from around the world, bulk molasses is stored at five strategic port locations: Avonmouth, Dagenham, Liverpool (also Head Office), Grangemouth, and Hull.
- **Napier Brown, Normanton.** Now part of the Real Good Food Group, Napier Brown started as a sugar merchant in 1924. It sources sugar from the UK, continental Europe, and around the world. It also owns the Whitworth's brand. With a packing operation at Normanton for own label and branded sugars and a new import facility announced at Immingham, it is an important supplier of bulk and packed sugars to the UK food manufacturing, foodservice and retail sectors.
- **Ragus Sugars, Slough.** A privately-owned company and owners of the Eastick's brand. Ragus is a niche manufacture specialising in custom formulations of crystalline sugars; liquid sugars; partial invert and fully inverted syrups; and treacles and molasses, for its industrial customers.

While it does not have the scale of companies like British Sugar or Tate & Lyle, Ragus has established itself as an important player in the UK market and it imports significant amounts of its raw materials directly from source countries across the globe.

- **Tate & Lyle Sugars, London.** Part of American Sugar Refining since late 2010. Its iconic retail and foodservice brands are Tate & Lyle and Lyle's Golden Syrup. It is the leading importer of sugar in the UK by far, bringing in bulk raw cane sugar to its Thames Refinery at Silvertown. In turn this refinery supports the nearby syrups production plant at Plaistow.

The Thames Refinery has a production capacity of over 1.1 million tonnes but over the last few years bulk raw sugar imports have varied between 1.2 and 0.7 million tonnes, as a result of market forces, legislation and business options. Direct consumption bagged sugars in container loads are also imported.

- **United Molasses Group, London** is the parent company of a group of businesses focused on the global trading and marketing of molasses and related products. The storage business has over 400,000m³ of storage assets at Liverpool (including Birkenhead), Hull, Dagenham and Portbury including the heated food-grade tanks required for molasses storage.
- Other (non-UK) players to watch include **Sudzucker** (Germany), with a reported stake in ED&F Man, and **Tereos** (France) with significant interests also in Brazil, Czech Republic and Reunion. Interestingly in 2007 **Syral**, the starch subsidiary of Tereos, acquired the former Tate & Lyle facility at Greenwich, which it then closed after moving production to the Continent.

4.4 UK import flows

UK sugar imports can be split into distinct flow types, each with its individual characteristics. The way they align with the Defra import classification that was described earlier is shown below:

Code	Description	Import flow types (and source)
#1701	Cane or beet sugar	<ul style="list-style-type: none"> • Raw cane sugar in dry bulk for UK refining (non-EU) • Direct consumption cane sugar in containers (non-EU) • Refined cane or beet sugar in containers or road trailers (EU)
#1702	Other sugars	<ul style="list-style-type: none"> • Glucose syrup in tank containers or trailers (EU)
#1703	Molasses	<ul style="list-style-type: none"> • Molasses in liquid bulk for UK storage and distribution (EU and non-EU)

It should be noted that: for code 1701, once the c.918k tonnes of raw sugar arriving at London are taken out of the equation, more sugar is sourced from the EU than from non-EU countries; for code 1702 nearly all imports are from the EU; but for code 1703 most imports come from non-EU countries. However, some imports reported as EU traffic may just have been cleared at a continental EU port.

Some sugar arrival types are illustrated in **Annex 9: Appendices I and II**. Also, as regards container types, International Standards Organisation (ISO) containers used in main-line, long-haul shipping worldwide will be 20', 30', or 40' long. In Europe 45' (13.6 metre) length containers are also used. Therefore European short sea, road and rail services could be carrying containers of either regime.

- **Raw cane sugar:** in dry bulk for UK refining (non-EU)

Raw cane sugar can come from a wide variety of tropical countries, subject to sourcing contracts and market conditions. Imports arrive on the **Thames** as dry bulk shipments to Tate & Lyle Sugars' Thames Refinery jetty at Silvertown. In 2010, vessel calls averaged c.5 per month and shipments ranged from c.5,000 to c.30,000 tonnes, accounting for all c.918k tonnes non-EU imports reported for London. Sugar is discharged by shore-based cranes into hoppers and then moved by conveyors into a bulk storage shed.

Other raw cane imports (e.g. small volumes for British Sugar's 30k capacity refining at Newark) will arrive as a dry bulk shipment to a port such as **Immingham**, or in containers that are single 'bag-in-a-box' units or loaded with bulk bags (c.1 tonne) to a container port such as **Felixstowe**. Port selection depends on country of origin and the deep sea service used. Connection between port and refinery will be made by road, using bulk trailers or skeletal trailers as appropriate.

- **Direct consumption cane sugar:** in ISO containers (non-EU)

Cane sugar from tropical countries, such as Mauritius or Malawi, arrives in ambient 20 tonne ISO containers which can be loaded in a variety of formats: bulk bags (c.1 tonne), in 50kg / 25kg sacks, or in retail packs on pallets. The 20 tonne load limit per container takes into account road transport limitations in the country of origin.

The total non-EU (i.e. cane sugar) volume reported for 2010 was 1,005k tonnes. Deducting raw cane supplies of c.918k tonnes for Tate & Lyle and c.15k tonnes for British Sugar would suggest a balance of 72k tonnes for **direct consumption cane sugar**. At 20 tonnes per container this would equal c.3,600 containers per annum, or 72 container loads per week over 50 weeks, not allowing for seasonality

In 2010 most arrivals were at **Felixstowe** (a few at **Thamesport**) with the balance at **Immingham** or **Liverpool**. Arrivals at these two final ports would suggest supply via container feeder services from Rotterdam. **Tilbury** was also cited in interviews as a port of entry.

- **Refined cane or beet sugar:** in ISO containers or in road trailers (EU)

The EU volume of 418k tonnes would logically comprise traffic in the following four flow types:

	Import flow and source	Most likely route(s)
1	ISO container with 20 tonne load of non-EU origin but cleared at an EU port	Feeder services to UK container ports
2	ISO container with 26 tonnes of white granulated sugar from EU refineries	Through train services via the Channel Tunnel
3	ISO tank container with 26 tonne load of liquid white granulated sugar from EU refineries	Unaccompanied RoRo traffic from Rotterdam or Zeebrugge to ports such as Purfleet or Immingham
4	Dry freight road trailer (loaded with 28 x 1 tonne bags) or tank road trailer loaded with 25 tonnes of liquid sugar	Accompanied RoRo services via the Dover corridor (i.e. ferry or Eurotunnel shuttle)

The route description in the above table is based on preliminary interview evidence. It should also be noted that the quoted load sizes may be less than a vehicle's actual payload capacity.

Although information about **refined cane or beet sugar** flows is incomplete, it would be reasonable to assume an average load 25 tonnes. Dividing the 418k total tonnes by 25 tonnes would give a result of 16,720 vehicle loads per annum. This would equal c.334 unit loads per week over 50 weeks, not allowing for seasonality.

- **Glucose syrup:** in ISO tank containers or in road tank trailers (EU)

The EU volume of 453k tonnes would logically comprise traffic in the following flow types:

Table 4.4: Glucose Syrup Flows		
	Import flow (and source)	Most likely route(s)
1	ISO tank container with 22 tonne load of liquid glucose (EU)	Unaccompanied RoRo traffic from Rotterdam or Zeebrugge to ports such as Purfleet or Immingham
2	Road tank trailer with 25 tonne load of liquid glucose (EU)	Accompanied RoRo traffic from Dunkerque or Calais to Dover (or via Eurotunnel shuttle)

These loads would come from EU plants such as those belonging to Syral at Aalst (Belgium) and Marckolsheim (France) and could be destined for the UK brewing industry. Other customers will be in the soft drinks and ice cream manufacturing segments, etc.

Although information about **other sugars** flows is incomplete, it would be reasonable to assume an average load of 24 tonnes. Dividing the 453k total tonnes by 24 tonnes would give a result of 18,875 vehicle loads per annum. This would equal c.378 loads per week over 50 weeks, not allowing for seasonality.

- **Molasses:** in liquid bulk for UK storage and distribution (EU and non-EU)

Arrivals are by tanker and comprise imports from EU sources (e.g. beet molasses from Poland) and non-EU sources. Non-EU molasses may arrive in bulk at Amsterdam, where it is cleared, followed by onward shipment of part of the cargo (now reported as EU traffic) to the UK.

Ships will vary in size range from 3,000 tonnes to 40,000 tonnes capacity. When the larger ones are used they will often do a 'milk-round' of calls to several UK terminals, discharging say, 11,500 tonnes (10,000 m³) into bulk storage tanks at each call. UK ports of call can include **Avonmouth, Liverpool, Greenock, Grangemouth, Hull and Dagenham**.

To transport molasses, vessels must be capable of heating cargo up to 40°C or more before discharging at the rates required by the receiving terminal, where product is then pumped into heated food grade bulk storage tanks.

Another factor is competition for tankers not only from within the molasses industry but also from the hydrocarbon and vegetable oil industries, including strong demand from shippers of crude palm oil, which also has to be heated before discharge.

Further research and analysis would be required to verify or amend all the above conclusions.

4.5 Resilience of import flows

The resilience of import flows to port disruption can be summarised as follows:

- As noted above, raw cane sugar for UK refining at Silvertown, accounting for most #1701 non-EU sugar, arrives as dry bulk on the Thames. Although this is a concentrated flow and could be considered vulnerable, shipments are widely spaced and the refinery holds bulk stock of raw material. Overall the effects of any interruption could be contained, although if another port was used the cost of moving imported material by road would be high.

An alternative discharge port would require grab cranes and hoppers, and (preferably) access to a dry bulk shed for temporary storage of the cargo, until it could be moved to Silvertown by road in bulk tippers. This was last done some 25 years ago after a conveyor fire at the Thames Refinery, with discharge taking place at Tilbury's No. 1 berth. It is envisaged that similar arrangements could apply at Tilbury or at another port in the South East in the event of disruption either at the Silvertown itself or on the Thames further downstream.

A perspective on UK domestic production capacity is that while there are four British Sugar beet processing plants across the East of England (supported by sugar beet growers within a radius of c.29 miles / 50 kilometres of each factory) an equivalent total output capacity is provided by the single cane sugar refinery operated by Tate & Lyle Sugars at Silvertown.

- Direct consumption cane sugar arriving in containers at ports such as Felixstowe constitutes the balance of #1701 non-EU sugar imports. Import volumes are low but customers include retailers with lean supply chains that need on-time delivery. Provided containers could be diverted to other ports, disruption could be mitigated although diversion could cause delivery delays.
- Refined cane or beet sugar (as #1701) arriving from the EU in containers or road trailers via the Dover corridor or ports such as Purfleet or Immingham (unaccompanied). Significant volumes are for UK industrial customers with low raw material stocks. Mitigation arrangements would be as for direct consumption cane sugars, with diversion of containers to other ports. However, because many customers would require the sugar as inbound raw material for production processes the delivery delay could cause significant problems.
- Glucose syrup, etc. (as #1702) arriving from the EU in tank containers or trailers with profile similar to preceding flow type. Significant volumes for UK industrial customers with low raw material stocks, and a dependence on the inbound deliveries for their production processes. These flows could be difficult to reconfigure or re-route, especially when taking into account tank availability and the fact that some (container) traffic is normally routed as unaccompanied traffic.
- Molasses in liquid bulk (as #1703) arriving from EU and non-EU countries in sea-going tankers for UK storage and distribution, particularly for animal feeds. Shipments are at intervals and although there may be problems with vessel availability there is a range of ports served. Risk probably low.

4.6 UK sugar demand by industrial sector

In order to meet the project's objectives, the consultants wished to assess the potential downstream impact of port disruption on sugar supply. This required gaining an understanding of demand by industrial sector, which was not easy in view of the constraints of commercial confidentiality. Also, in view of Data Protection Act considerations, trade associations felt unable to assist.

Therefore, high-level information about demand was compiled mainly from interviews along with cross-checks to literature in the public domain. As such the results are provisional and should be considered as a starting point for more detailed research.

However, the key findings are as follows:

- The annual total UK market requirement is in the order of 1.9 to 2.0 million tonnes of sugar. Most of this is white granulated sugar produced from either sugar cane or sugar beet. This requirement does not include 'Other sugars' or 'Molasses'
- White granulated sugar is supplied in liquid format where the process requires liquid sugar but the delivery site does not have a sugar dissolver – particularly relevant for the soft drinks industry
- The most important market segments, with c.80% in terms of volume, are those in the food and drink manufacturing industries. Retail and foodservice combined demand is c.20%
- Less than 50% of supply comes from UK domestic sugar beet processing, so there is obviously a high dependency on imports, whether as raw material for UK refining, or as finished product imports from both EU and non-EU sources.

In view of commercial sensitivities, the major sugar suppliers to the UK market were not in a position to share information at customer level about downstream demand. However, from careful comparison of available data and background information, an estimated profile of annual demand in volume terms by segment was compiled, as shown below:

	Segment	% split
1	Soft drinks	27%
2	Confectionery	24%
3	Bakery	15%
4	Dairy inc. ice cream	4%
5	Prepared foods	3%
6	Preserves	3%
7	Snack foods	3%
8	Other	2%
9	Brewing	1%
	Sub-total	82%
10	Retail	12%
11	Foodservice	6%
	Total	100%

Although the soft drinks, confectionery, and bakery segments are reported as the major users, it should be noted that sugar, even in small quantities, is a critical ingredient for many products. It is also widely used in products such as low price sausages, which are bulked with husk and sugar. So the impact of supply disruption could be far-reaching, especially as most manufacturers have very limited raw material storage capacity on-site and depend on continuous stock replenishment.

Interview comments included:

- “*There are probably 100 industrial users requiring more than 10,000 tonnes of sugar each year*”. Supporting this view and indicating that in fact many companies source far greater quantities, Premier Foods – one of the leading manufacturers and processors – reported on its website that it bought 85,000 tonnes of sugar in 2010
- “*80% of the demand comes from 20% of the names*”. This comment suggests a long tail of companies with small delivery requirements – a conclusion supported by interview evidence.

A summary schematic of code #1701 imports but excluding #1702 ‘Other sugars’ and #1703 ‘Molasses’ imports appears as **Annex 9: Appendix III**.

4.7 Food stocks and the attitude of the supply chain to replenishing stock

- Little hard evidence about raw material stock levels could be uncovered within the time constraints of the research. Also the annual Defra *Food Stocks Survey* is understood to report data about stock levels of finished goods rather than of raw materials
- However, based on the levels of stakeholder co-operation already enjoyed by the consultants, it would probably be feasible to undertake a detailed fact-finding exercise that could produce reliable evidence about inbound sugar stock levels in UK food and drink manufacturing
- In the meantime anecdotal evidence (and past experience) suggests that most food and drink manufacturers keep raw material stock levels to a minimum in order to contain stockholding costs; because their inbound storage facilities are restricted; and because they have grown accustomed to frequent deliveries from UK suppliers, or their European counterparts.

4.8 Behavioural aspects of the various players in the event of supply chain disruption

- Little evidence about behavioural aspects could be uncovered. This was due in part to the time constraints of the research but also because most stakeholders regard Business Continuity Planning as commercially sensitive and are therefore reluctant to share this information.

- Nonetheless, from this Case Study examination of the UK sugar market, the following behaviours would be expected on the part of manufacturers, traders, and importers:
 - Disruption of raw sugar supply to Tate & Lyle Sugars at Silvertown could be ameliorated by use of the company's bulk sugar stocks or use of an alternative port for bulk discharge with ongoing movement by road to the refinery
 - British Sugar's four UK plants have an annual output capacity of c.1 million tonnes of white granulated sugar, with a combined bulk storage capacity of c.280,000 tonnes. Depending on the timing of the disruption and the current stock position, this company might also be in a position to supply other customers in an emergency
 - The UK market is already accustomed to overseas supply of refined beet sugars from the Continent. So depending on the nature and location of port disruption, importers would no doubt seek alternative routes via RoRo ferries. It should also be noted that import patterns are changing as glucose syrups are being used in food and drink recipes as cheaper alternatives to refined sugars
 - A similar approach would no doubt apply to imported flows of (un)refined cane sugars arriving by deep sea services, although this could involve re-routing container flows normally arriving at ports such as Felixstowe to Continental ports.

Important factors to take into account include: the fact that these players have contractual obligations to supply UK food and drink manufacturers, which they would have to fulfil; existing Continental suppliers are already involved in the UK market. The combined result is that all players would be actively seeking alternative import routes.

5. DISCUSSION

5.1 Overall assessment of the results

The pattern of UK import flows is complex and driven by a range of macro-economic factors including aspects of the EU sugar regime; world supply and demand; the impact of weather conditions on cane and beet harvests; the need to buy sugar in order to fill customer contract orders; and price movements and trading activity. Other issues surround the UK import flows themselves. The following highlights emerged:

Relevant factors

- **The EU sugar regime** (in Common Agricultural Policy) changed dramatically in 2006 when the European market was opened up to international competition. Certain groups of countries (e.g. those in the Africa, Caribbean and Pacific, 'ACP' classification) now had unrestricted access to this market, so that they could either sell to EU refineries or could refine themselves and then sell into Europe. Other sources still faced quota restrictions and tariffs of various types.

One result of this new competition was rationalisation of sugar production with far fewer factories across Europe (British Sugar for example went from 17 factories to 4, although net capacity increased because of improved efficiency). European companies also embarked on or continued international expansion: e.g. AB Sugars in eastern and southern Africa; Tereos in Brazil; etc.

Proposals for EU regime reforms are now being considered for 2015. Concerned about adequate availability of quality sugar, in February 2012 the UK Industrial Sugar Users Group (UKISG) which represents the manufacturers of soft drinks, biscuits, chocolate, confectionery, breakfast cereals, ice cream, yoghurts and chilled deserts, called on the European Commission to:

- Abolish beet production quotas on 30th September 2015
- Reduce import tariffs in advance in advance of 2015
- Guarantee adequate imports of duty free cane sugar after 2015

These EU-related developments can be expected to have a continued impact on world sugar trade flows and on the sources of UK sugar imports. It should be noted that the 'sugar season' starts on 1st October each year.

- **World supply and demand profiles** keep changing. Europe has moved from surplus to deficit. Although in surplus, over the past five years Brazil (the world's leading supplier) has been unable to continue its production growth for technical reasons. Neither has it been able to maintain an advantageous exchange rate as the Real (R\$) has appreciated, although the rate against the US\$ has now eased. India (the world's second supplier) moves between surplus and deficit, depending on in-country demand.

Overall supply is also stretched to keep up with burgeoning world demand growing at a compound rate of 2% per annum, equivalent to an extra 30 million tonnes every 10 years. This demand is driven by both increased world population and by increasing wealth (measured in GDP growth) in countries such as India and China where eating habits are moving towards a 'Western' diet. Demand for biofuels can also contribute to accelerated demand, subject to world oil prices.

The UK therefore has to compete with the demands from other markets to secure supply. Some traditional supply markets such as Mauritius have been lost, at least in part, to industry players from other countries such as Sudzucker from Germany. So imports can now come from a wide variety of countries, with different standards of port infrastructure and export shipping services.

- **Adverse weather conditions** can affect both cane and beet sugar supply. For example, the Australian sugar cane harvest (June to December) was severely hampered by excessive rainfall in late 2010. This rain also affected sugar content. Subsequent flooding then hit both production and transportation to the port. In the UK, frost damage to the beet crop in early 2011 adversely affected beet quality. This had serious implications for production times, volumes, and reserve stock levels. Extreme weather conditions can affect supply markets and UK import flows.

- **Unexpected shortages** such as the one caused by the poor 2010-2011 beet harvest can trigger additional imports. The need to buy sugar to fill customer contract orders was cited in Associated British Foods *Annual Report for 2011* as follows: “the decision was taken to meet all customer requirements, despite the very tight market, using a combination of de-stocking, additional in-house refining and supplementary supplies secured from third parties at high cost”.
- **Sugar prices** increased threefold over the five years to January 2011, although with significant annualised volatility. Now, as a result of record harvests in several big producers, including Thailand, raw sugar prices collapsed in May 2012. The New York price fell below 20 cents per lb, down from its high of over 36 cents per lb in early 2011. And traders are currently predicting that the current surplus will continue on into the 2012-2013 season.

In addition to volatility, there is also trading complexity. One long-standing feature of the sugar market is that commodities traders, instead of trying just to protect themselves against the inherent uncertainties of trading, are often trying to use the markets to make a return on price movements. More recently hedge funds and pension funds have also entered the market.

5.2 Difficulties and risks associated with current systems

- Macro-economic conditions and events of the sort described above, including those that are weather-related and / or unexpected. These will affect where and how much sugar of all types and qualities the UK can source, whether from non-EU or EU suppliers
- Against this uncertainty is the fact that the UK has significant domestic sugar production along with substantial storage for white granulated sugar (British Sugar report a total finished product silo capacity at its four factories of 278k tonnes)
- However, while it may be true that sugar consumption in the home (and retail demand as a consequence) has reduced in recent years, industrial demand is extensive and strong. Sugar and cheaper substitutes such as high fructose corn syrups are important across many segments
- Also because even small quantities of sugar can be critical for many recipes in industrial food manufacturing, a broad spectrum of UK food supply could be compromised by a shortage
- The most likely pinch points, which vary by import flow, can be summarised as follows:

	Import flow (and source)	Appearance	Port group(s)	Pinch points
1	Raw cane sugar for UK refining (non-EU)	Dry bulk vessel	Thames (Immingham)	River Thames channel and jetty
2	Direct consumption cane sugar (non-EU)	ISO container	Tilbury Felixstowe Immingham Liverpool	Port entry channel Terminal Landside connection
3a	Refined cane or beet sugar – dry or liquid format (EU)	ISO container or ISO tank container	Purfleet Immingham Eurotunnel	
3b		Trailer or ISO tank container	Dover corridor Eurotunnel	
4a	Glucose syrup (EU)	ISO tank container	Purfleet Immingham Eurotunnel	
4b		Tank trailer	Dover corridor Eurotunnel	
5a	Molasses (EU or non-EU)	Liquid bulk tanker	Avonmouth Liverpool Grangemouth Hull	

6. CONCLUSIONS

The research showed the dependence, not only on non-EU supply of raw cane sugar, but also the dependence on EU supply of refined sugars of various types for food and drink manufacturing. It also segmented the high-level import categories, first into individual import flow types, and then into more detailed information about routes. At this level it was possible to show how the flows depended on transport equipment and services of different types.

Many of the routes use specific equipment with high levels of utilisation and schedules are tightly timed. Although road transport has inherent flexibility advantages over modes such as rail, it would be a mistake to assume that these flows from the EU could be switched easily to use alternative equipment or be deployed on other routes in the event of serious disruption.

A fair appraisal of the Sugar Imports Case Study would therefore be:

	Objective	Result
1	Determine the extent to which particular features of domestic and international transport infrastructure and food supply chains are likely to ameliorate / exacerbate the impact of UK port disruption on the supply of food imports into the UK	A substantial base of meaningful evidence has been compiled. Importantly this is by individual flow type, which has in turn enabled a preliminary assessment of risk. More work needs now to be done on specific upstream and downstream aspects
2	Determine the extent to which UK food (import) security is contingent upon the resilience of overseas port infrastructure (both within and without EU waters, and now and in the future)	Evidence indicates a significant dependency on EU port infrastructure for sugar flows. Because there is such a wide spread of non-EU ports of origin it is difficult to make a realistic judgement
3	Explore the behaviour, over the short to medium run (up to six months), of individual port operators, shipping companies and land-based logistics and food supply chain agents in the event of port disruption	This was limited by stakeholder reluctance to provide information about their Business Continuity Planning. However a number of reasonable assumptions have been made

The work programme demonstrated that it is feasible to gather reliable information from industry stakeholders about UK sugar import flows. Although compilation of evidence was time-consuming and encountered setbacks, such as when stakeholders were cautious about whether to participate, the overall result was positive. Data quality (i.e. definition, completeness, accuracy, etc.) caused some concerns at times during the research but overall the evidence gathered is believed to be reliable.

This leads to the conclusion that research of this type – as opposed to data analysis in isolation – has significant value. In fact it is probably the only way to acquire adequate understanding of what is happening and why in the supply chain. It is also recognised that the macro-economic environment is continually changing and that it will be important to stay up to date and regularly refresh knowledge and understanding.

The research confirmed the importance of consistent and reliable sugar supply to manufacturers and processors in the food and drink industries. Based both on anecdotal evidence and past experience, it is known that many companies have honed their inbound raw material supply chains so that they have only enough raw material stock for a short period – sometimes for as little as a day or a week – and time-based supplier performance is therefore critical.

It is tempting, when considering how to maintain product availability and choice for the consumer, to focus for example on an issue such as on-shelf availability of packaged sugars in the retail store. But looking at the wider picture, first foodservice supply comes into view, and then a whole range of manufactured and processed foods and drinks where sugar, or a substitute derived from cereals, are essential ingredients.

7. MESSAGES AND FINDINGS

The recommendations arising from the research are as follows:

1. A scenario planning exercise combined with detailed modelling is required to evaluate business risk. The complexity of supply chain networks argues for scenario planning based on adequate information and understanding. Only by working at individual flow level is it possible to obtain this.
2. A suitable framework and forum must be devised in which industry stakeholders can be persuaded to share information about their Business Continuity Planning processes and conclusions.
3. There are also serious evidence gaps about both upstream supply (e.g. how much sugar is in fact coming from EU production or is it just being cleared at a continental port?) and about downstream ordering and stock holding. These gaps need to be filled through continuing investigation using the approach and methodology employed for this research.

It should be noted that these evidence gaps are similar to those concerning palm oil research that were identified in **Annex 10**. Parallels between the commodities exist as regards bulk modal appearance (although sugar is dry bulk, while palm oil is liquid bulk); the fact that there are only a few players responsible for UK refining and manufacture; and also the fact that supplies of manufactured product are going to a very wide industrial customer base. However, the authors of this report recommend that Defra should commission further investigation to fill these gaps.

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Appendix I: Raw Cane Sugar Arrival at Thames Refinery

Import flow classification		
A	Food commodity	<i>Raw cane sugar</i>
B	Source region / country	<i>Tropical and sub-tropical countries</i>
C	Temperature / atmosphere regime	<i>Ambient</i>
D	Transport mode(s)	<i>Sea</i>
E	Flow type	<i>Dry bulk</i>
Logistics information		
1	Commodity format	<i>Loose</i>
2	Shipping unit	<i>Bulk</i>
3	Vessel / vehicle type	<i>Dry bulk carrier</i>
4	Terminal handling	<i>Jetty with crane</i>
5	Storage on arrival	<i>Bulk store</i>



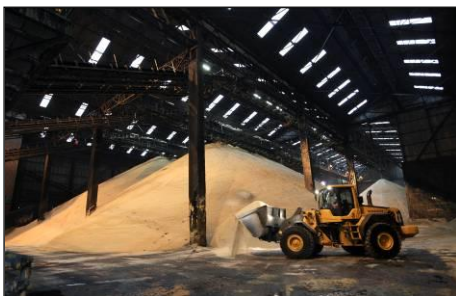
Genco Charger (28,398 DWT) swinging to berth at Thames Refinery



Monterey (15,078 DWT) on berth (Raw Sugar Jetty) at Thames Refinery



Jetty crane unloading at Thames Refinery



Bulk sugar store at Thames Refinery

Pictures © 2012 Tate & Lyle Sugars Ltd.

Appendix II: Other Sugar Arrival Types

Import flow classification		
A	Food commodity	<i>Sugar (dry and liquid)</i>
B	Source region / country	<i>European production</i>
C	Temperature / atmosphere regime	<i>Ambient</i>
D	Transport mode(s)	<i>Short sea or Eurotunnel shuttle</i>
E	Flow type	<i>Unit load</i>
Logistics information		
1	Commodity format	<i>Bulk</i>
2	Shipping unit	<i>Container or road trailer</i>
3	Vessel / vehicle type	<i>LoLo or RoRo ferry / Eurotunnel shuttle</i>
4	Terminal handling	<i>Ferry terminal or Eurotunnel terminal</i>
5	Storage on arrival	<i>Silo or bulk store</i>



'Bag-in-a-box' container discharging granulated sugar



Road trailer with bulk bags of white granulated sugar



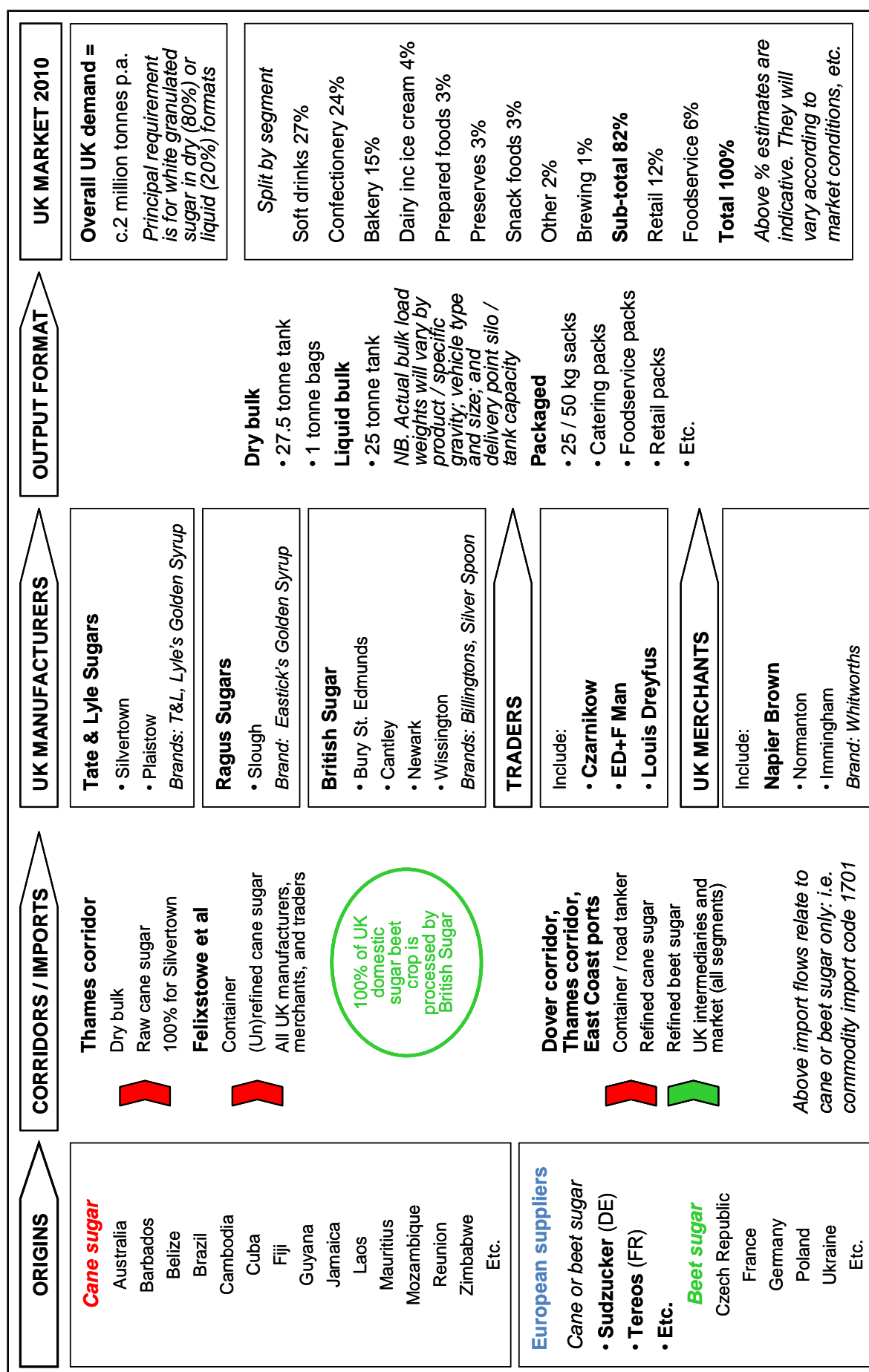
ISO food tank used to import liquid sucrose from EU



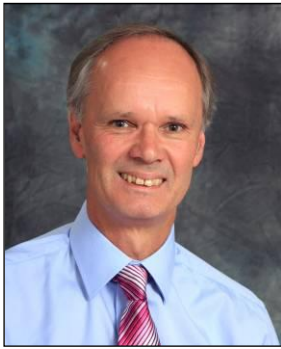
Road tank trailer used to import sugars from EU

Pictures © 2012 Napier Brown Ltd, Ragus Sugars (Mfg) Ltd., Hoyer (UK) Ltd., Atchison Topeka Ltd.

Appendix III: Sugar Imports Schematic (excluding 'Other sugars' and 'Molasses')



ABOUT THE AUTHORS



Peter Baker, the founder and owner of PRB Associates, specialises in operational, financial and market analysis in the ports and shipping sectors; with working experience in the ports sector and in RoRo ferry operations.

In addition to a range of project commissions in the UK and internationally, Peter has researched and produced the '*UK Short Sea Freight RoRo and LoLo Capacity Analysis and Report*' every year since 2000 and for the first time in 2009 produced an Irish equivalent. The report and database information provide a detailed analysis and assessment of the capacity provision and spread in the market, with comprehensive route, service, vessel and port information contained in detailed appendices.

PRB Associates Limited specialises in providing shipping and transport consultancy and analysis services for private and public sector organisations. Founded in 1998, PRB Associates has successfully completed commissions for freight generators, freight transport service providers (shipping lines and road transport operators), port operators and various public sector organisations. Assignments have ranged from service analyses, feasibility studies, financial modelling and economic impact studies, to market research and appraisal and national transport strategy formulation.



Andrew Morgan, the founder of Global 78, has extensive international business and logistics experience gained in projects across many industrial sectors, including food supply projects in Europe, Brazil and India. These advisory and implementation projects have ranged in scope from agri-business, through manufacturing and processing, to wholesale and retail distribution in final consumer markets.

A Chartered Member of the Chartered Institute of Logistics and Transport (UK), Andrew is the author of '*Making the Brazil Connection – managing risk in the international food supply chain*' and also co-author of the UKIBC Report '*India Agri-Food Supply Chains: Overview and Opportunities*'.

Global 78 Limited is focused on helping commercial clients discover new perspectives for success in local and international markets and for delivery of real bottom-line improvements. It also undertakes research for public sector policy-making. Food supply chains are complex. Innovation, resilience and sustainability are all vital elements for successful policy, strategy, and operations. The Global 78 team therefore provides clients with quality research, specialist advice, and support for implementation.

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