

# **Anticipated acquisition by Clariant of certain assets of Kilfrost**

## **Appendices and glossary**

Appendix A: Terms of reference and conduct of the inquiry

Appendix B: Kilfrost's group structure and financial background

Appendix C: The products

Appendix D: The economics of ADF supply

Appendix E: Barriers to entry and expansion

Glossary

## Terms of reference and conduct of the inquiry

### Terms of reference

1. On 17 February 2016 the CMA referred the anticipated acquisition by Clariant of the European aircraft de-icing fluid and rail de-icing fluid business of the Kilfrost Group.
  1. In exercise of its duty under section 33(1) of the Enterprise Act 2002 (the **Act**) the Competition and Markets Authority (**CMA**) believes that it is or may be the case that:
    - (a) arrangements are in progress or in contemplation which, if carried into effect, will result in the creation of a relevant merger situation, in that:
      - (i) enterprises carried on by, or under the control of, Clariant AG (**Clariant**) will cease to be distinct from enterprises carried on by, or under the control of, Kilfrost Group PLC (**Kilfrost**); and
      - (ii) the condition specified in section 23(2)(b) of the Act is satisfied with respect to the supply of aircraft de-/anti-icing fluid (**ADF**) to customers located in the UK; and
    - (b) the creation of that situation may be expected to result in a substantial lessening of competition within a market or markets in the United Kingdom for goods or services, including the manufacture and supply of ADF to customers located in the UK.
  2. Therefore, in exercise of its duty under section 33(1) of the Act, the CMA hereby makes a reference to its chair for the constitution of a group under Schedule 4 to the Enterprise and Regulatory Reform Act 2013 in order that the group may investigate and report, within a period ending on 3 August 2016, on the following questions in accordance with section 36(1) of the Act:
    - (a) whether arrangements are in progress or in contemplation which, if carried into effect, will result in the creation of a relevant merger situation; and

- (b) if so, whether the creation of that situation may be expected to result in a substantial lessening of competition within any market or markets in the United Kingdom for goods or services.

Andrea Coscelli  
Executive Director  
Markets and Mergers  
Competition and Markets Authority  
17 February 2016

### **Conduct of the inquiry**

2. We published [biographies on the members of the inquiry group](#) conducting the inquiry on 24 February 2016 and the [administrative timetable](#) for the inquiry was published on the CMA webpages on 8 March 2016.
3. We invited a wide range of interested parties to comment on the anticipated acquisition. These included competitors, customers, potential bidders and advisers to Clariant and Kilfrost. Evidence was also obtained from third parties through hearings, through telephone contact and through written requests. [Summaries of hearings](#) can be found on our webpage.
4. We received written evidence from Clariant and Kilfrost and non-confidential versions of their [main submissions](#) are on our webpage. We also held separate hearings with Clariant and Kilfrost on 19 April 2016.
5. On 11 March 2016 we published an [issues statement](#) on our webpage setting out the areas of concern on which the inquiry would focus.
6. On 16 March 2016 members of the inquiry group, accompanied by staff, attended a presentation and Q&A session with Clariant at the CMA office at Victoria House.
7. On 22 March 2016 members of the inquiry group accompanied by staff visited the offices of Kilfrost.
8. In order to prevent pre-emptive action, which is any action which might prejudice the reference or impede the taking of any action under this Part which may be justified by the CMA's decisions on the reference, we accepted [interim undertakings](#) from Clariant and Kilfrost and these can be found on the case webpage.
9. In the course of the inquiry, we sent to Clariant and Kilfrost and other parties some working papers and extracts from those papers for comment.

10. A non-confidential version of the provisional findings report has been placed on the [CMA's webpages](#).
11. We would like to thank all those who have assisted in our inquiry so far.

## Kilfrost group structure and financial background

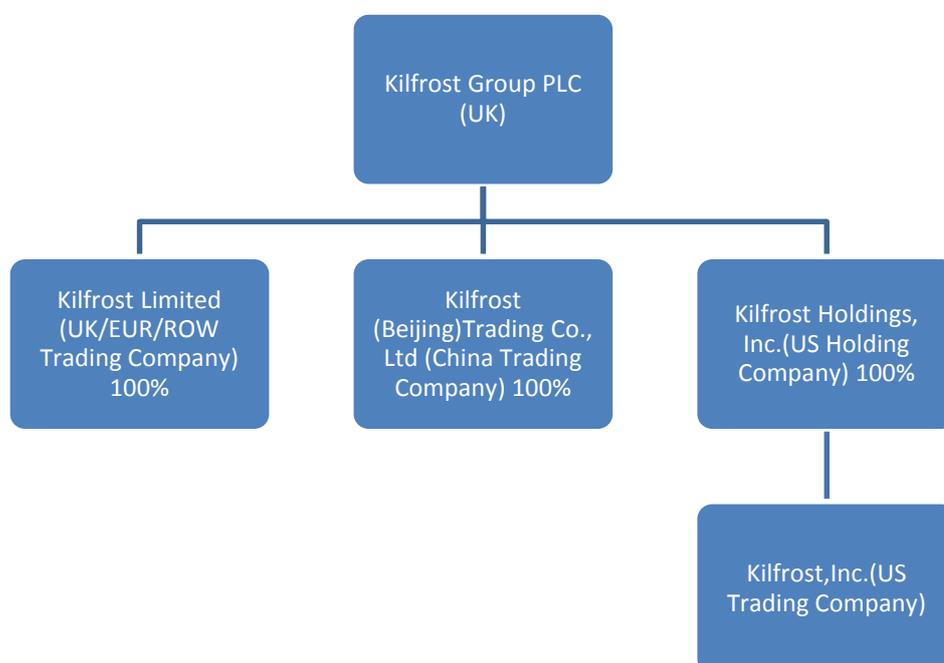
### Introduction

1. This appendix sets out the group structure and financial information in respect of Kilfrost. In this appendix unless where specifically stated Kilfrost financial information relates to Kilfrost Group PLC.

### Kilfrost's group structure

2. Kilfrost's group structure is set out in Figure 1 below.

Figure 1: Kilfrost's group structure



Source: CMA.

### Historical financial performance

3. Table 1 shows the summary financial performance of Kilfrost for the five periods ended 30 September 2012. It includes a 17-month period (period ended 30 September 2010) when Kilfrost changed its accounting year end. We note that Kilfrost was:
  - (a) profitable in each of the four periods ended 30 September 2011 and was loss making in the year ended 30 September 2012;

- (b) the year to September 2011 saw a significant increase in sales – £54.9 million compared with £30.8 million 2009 (comparing two 12-month periods) – as a result of a particular harsh winter; and
- (c) the year to September 2012 saw a ‘significant contraction’ in turnover compared to the prior year as a result of mild weather conditions in both North West Europe and North America.<sup>1</sup>

**Table 1: Kilfrost financial performance, 2008 to 2012**

	12 months to 30 April	12 months to 30 April	17 months to 30 Sept	12 months to 30 Sept	12 months to 30 Sept
	2008*	2009*	2010	2011	2012
Sales (£'000)	16,943	30,812	44,414	54,930	39,143
Gross profit (£'000)	2,868	5,785	9,372	10,426	6,715
Gross profit (%)	17%	19%	21%	19%	17%
Operating profit/(loss) (£'000)	364	2,109	1,330	3,273	(1,227)
Profit before tax (£'000)	324	2,033	1,199	2,948	(1,572)

Source: Statutory accounts.  
\*Kilfrost limited.

4. Key structural changes within Kilfrost during this period included:

- (a) North America: In mid-2008, a new wholly owned, US-based subsidiary was set up with a view to taking over the business being carried out by the subcontract manufacturer of Kilfrost ADF products in the Americas. In 2009, a decision was made to move from a subcontract manufacture model to direct sales into the North American market. A locally based management team was recruited and they worked closely with Cryotech, the incumbent subcontract manufacturer, during the 2009/10 season, to ensure a smooth transition of the US-based business to Kilfrost for the 2010/11 season. From 2010/11, season products were sold directly to customers, with the main customers being [REDACTED] and [REDACTED].
- (b) Asia – Japan, Korea, China: Kilfrost started exporting to China in 2007/08 through a local reseller arrangement. In November 2010 Kilfrost formed a local Chinese subsidiary to provide a more hands on/direct approach [REDACTED].

**2013 to 2018 plan**

5. In May 2013 Kilfrost put together a business plan for the period [REDACTED]. The main points from the business plan are:
- (a) [REDACTED]

<sup>1</sup> September 2012 report and group financial statements.

(b) [REDACTED]

(i) [REDACTED]

(ii) [REDACTED]

(c) [REDACTED]

6. Table 2 shows the projected sales growth for the respective divisions and regions.

**Table 2: Sales projections business plan 2013 to 2018**

£m

*12 months to 30 September*

	2013	2014	2015	2016	2017	2018
Winter						
UK/Europe	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
North America	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
China	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Sub-total	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
SFD	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
Total	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]

Source: Kilfrost.

### Financial performance 2013 to 2015

7. Table 3 shows the financial performance of Kilfrost for the three periods ended 31 March 2015 – Kilfrost extended its accounting period by six months from September 2014 to March 2015.
8. Kilfrost, in its September 2013 report and group financial statements, reported that turnover and profit showed a ‘strong recovery’ from 2012. It stated the:

Cold winter weather across Northern Europe lasted well into April, giving robust, late-season revenue. After a mild start to the winter in North America, cold weather commenced in mid-January and persisted until the end of March.’ In addition the ‘North American operation experienced 100% growth compared to 2012’. However, in order to achieve this ‘the Group had to forego margin in order to gain this increased market share.’<sup>2</sup>

This is in line with the business plan, which noted that the North American market is currently characterised by strong price competition that, with a range of competitors, is naturally driving down margins.

---

<sup>2</sup> September 2013 report and group financial statements.

9. In the 18 months ended 31 March 2015 Kilfrost reported an operating loss of £3.95 million. It reported that this was as a result of ‘two of the mildest winters in Europe for many years’.

**Table 3: Kilfrost financial performance for the three periods ended 31 March 2015**

	12 Months to 30 September	12 Months to 30 September	18 months to 31 March
	2012	2013	2015
Turnover (£'000)	39,143	62,614	75,211
Cost of sales (£'000)	(32,428)	(49,903)	(68,276)
Gross profit (£'000)	6,715	12,711	6,935
Gross margin (%)	[X]	[X]	[X]
Administrative expenses (£'000)	(8,056)	(8,485)	(11,170)
Other operating income (£'000)	114	137	286
Operating profit/(loss) (£'000)	(1,227)	4,363	(3,949)
Gross margin (£'000)	[X]	[X]	[X]
Operating margin (£'000)	[X]	[X]	[X]

Source: Statutory accounts.

10. Table 4 sets out the financial performance of Kilfrost for the period ended 31 March 2015, split into the 12-month period to 30 September 2014 and six months to 31 March 2015. In reviewing Kilfrost’s performance for the two periods it should be noted that: the 31 March period figures include the peak sale season (Winter 2014/15); but the period includes only six months of administrative costs.
11. The key point arising from the two periods is that gross margin [X] in the six months to 31 March 2015.

**Table 4: Kilfrost financial performance period ended 31 March 2015**

	12 months to 30 Sept 2014	6 months to 31 March 2015	18 months to 31 March 2015
Sales (£'000)	[X]	[X]	[X]
Cost of sales (£'000)	[X]	[X]	[X]
Gross profit* (£'000)	[X]	[X]	[X]
Gross margin (%)	[X]	[X]	[X]
Administrative expenses (£'000)	[X]	[X]	[X]
Other operating income (£'000)	[X]	[X]	[X]
Operating profit/(loss) (£'000)	[X]	[X]	[X]

Source: Kilfrost management accounts.

\*2014 gross profit taken as ‘Contribution before overheads’ in management accounts.

12. Further analysis of Kilfrost’s performance by region (Table 5) shows the volatility in trading between periods and regions resulting from variations in weather. The figures show a significant [X] in [X] in the 12 months to 30 September 2014 from 2013 with a [X] in the following months. In comparison the USA saw [X] in revenue in the 12 months to 30 September 2014 from 2013 with a similar magnitude [X] in the following six months. The [X] in revenue in [X] with an EBIT of £[X] million in 2013 [X] to a £[X] million EBIT loss in the 12 months to September 2014. However, over the full 30-month period the group made an EBIT [X] of £[X] million.

**Table 5: Kilfroost financial performance by region 2013 to 2015**

	£'000	£'000	£'000	£'000	£'000
	12 months to 30 Sept 2013	12 months to 30 Sept 2014	6 months to 31 March 2015	18 months to 31 March 2015	30 months to 31 March 2015
<b>Turnover</b>					
UK/Europe	[X]	[X]	[X]	[X]	[X]
USA	[X]	[X]	[X]	[X]	[X]
China	[X]	[X]	[X]	[X]	[X]
Consolidation adjustments	[X]	[X]	[X]	[X]	[X]
<b>Total</b>	[X]	[X]	[X]	[X]	[X]
<b>EBIT</b>					
UK/Europe	[X]	[X]	[X]	[X]	[X]
USA	[X]	[X]	[X]	[X]	[X]
China	[X]	[X]	[X]	[X]	[X]
Consolidation adjustments	[X]	[X]	[X]	[X]	[X]
<b>Group total</b>	[X]	[X]	[X]	[X]	[X]
EBIT margin	[X]	[X]	[X]	[X]	[X]

Source: management accounts

13. Table 6 sets out Kilfroost's balance sheet as at 31 March 2015. The balance sheet shows a [X].

**Table 6: Kilfroost balance sheet 31 March 2015**

	£'000
Fixed assets	1,347
Current assets	23,537
Creditors due in less than 1 year	(18,521)
Net current assets	5,016
Creditors due in more than 1 year	(2,311)
Net assets	4,079
Stock	17,165
Trade debtors	5,639
Cash	379
Trade creditors	(5,074)
Invoice discounting	(11,644)

Source: Statutory accounts.

14. The Banking Facilities; [X] were due to expire on [X].
15. Kilfroost's board minutes of 24 June 2015 noted: [X].
16. The board minutes also noted that [X].

## Kilfroast's financial position post phase 1 transaction and current trading performance

17. The minutes of the board meeting of [X] noted that [X]. The board minutes of [X] set out that out of the sale £[X] million will be paid to [X] being used [X]. The minutes noted that [X].
18. The effect of the sale proceeds from phase 1 is shown in the respective balance sheets for Kilfroast. This is shown in Table 7 which has the balance sheets for the 30 March 2015 year end, July 2015 (the last month prior to the transaction) and August 2015 (the month of the transaction).

**Table 7: Kilfroast balance sheet March/July/August 2015**

	£'000		
	31 March	31 July	31 August
Fixed assets	[X]	[X]	[X]
Current assets	[X]	[X]	[X]
Creditors due in less than 1 year	[X]	[X]	[X]
Net current assets	[X]	[X]	[X]
Creditors due in more than 1 year	[X]	[X]	[X]
Net assets	[X]	[X]	[X]
Stock	[X]	[X]	[X]
Trade debtors	[X]	[X]	[X]
Cash	[X]	[X]	[X]
Trade creditors	[X]	[X]	[X]
Invoice discounting	[X]	[X]	[X]

Source: Management accounts.

19. The March 2015 statutory accounts that were signed on 15 January 2016 set out the options the board considered where available to the company depending on the outcome of regulatory review of phase 2 of the transaction. These were:
- (a) 'Divest all of our remaining ADF business then concentrate on our speciality Fluids markets and Toll manufacture ADF for Clariant
  - (b) Divest our ADF assets in Europe and retain the UK business plus grow Speciality Fluids
  - (c) Remain as we are now following our divestments of our ADF business outside of Europe.'
20. In respect of option (c) we note that Kilfroast Limited has made an operating profit [X] (see Table 8). Kilfroast has in addition been effectively [X] in terms of cash flow from operations (Table 9).

**Table 8: Kilfrost financial performance 11 months to February 2016**

	<i>Kilfrost ltd</i>	<i>Kilfrost Inc/ Kilfrost Beijing†</i>	<i>Group consolidated</i>
Sales (£'000)	[X]	[X]	[X]
Cost of sales* (£'000)	[X]	[X]	[X]
Gross profit (£'000)	[X]	[X]	[X]
Gross margin (%)	[X]	[X]	[X]
Overheads (£'000)	[X]	[X]	[X]
Licence income/other (£'000)	[X]	[X]	[X]
Operating profit (loss) (£'000)	[X]	[X]	[X]

Source: Kilfrost management accounts.

\*Material variances included in cost of sales as related to production costs.

†Calculated as balancing figure (any consolidation adjustments are included in this column).

**Table 9: Kilfrost quarterly cash flow 2015/16 (11 months)**

	<i>April - June</i>	<i>July - Sept</i>	<i>Oct - Dec</i>	<i>Jan - Feb</i>	<i>£'000 Total</i>
Sales	991	6,621	7,645	8,593	23,850
Operating profit	[X]	[X]	[X]	[X]	[X]
Cash flow from operations	[X]	[X]	[X]	[X]	[X]
Net cash flow before financing	[X]	[X]	[X]	[X]	[X]
Financing	[X]	[X]	[X]	[X]	[X]
Other	[X]	[X]	[X]	[X]	[X]
Net cash flow	[X]	[X]	[X]	[X]	[X]

Source: Management accounts.

21. The balance sheet of Kilfrost also shows an improved cash position, increase in trade debtors and a significant decrease in Bank [X] invoice creditor at 29 February 2016 over prior year (31 March 2015) as well as a significantly lower stock level.

**Table 10: Kilfrost balance sheet**

	<i>£'000</i>	
	<i>31 March 2015</i>	<i>29 February 2016</i>
Fixed assets	[X]	[X]
Current assets	[X]	[X]
Creditors due in less than 1 year	[X]	[X]
Net current assets	[X]	[X]
Creditors due in more than 1 year	[X]	[X]
Net assets	[X]	[X]
Stock	[X]	[X]
Trade debtors	[X]	[X]
Cash	[X]	[X]
Trade creditors	[X]	[X]
Invoice discounting	[X]	[X]

Source: Management accounts.

## The products

1. Both Kilfrost and Clariant (the Parties) supply fluids that are used for:
  - (a) the de-icing of aircraft: the removal of frost, ice, slush or snow from an aeroplane in order to provide clean surfaces; and
  - (b) the anti-icing of aircraft: the protection against the formation of frost or ice and accumulation of snow or slush on treated surfaces of the aeroplane for a limited period of time (holdover time).
2. De-icing and anti-icing fluids (ADF) fall within four different categories: Type I, II, III and IV. All types of ADF contain glycol mixed with various amounts of water and additives. The glycol compound used is either mono-propylene glycol (MPG) or mono-ethylene glycol (MEG).
3. The various types of ADF can be used in the following ways:<sup>1</sup>
  - (a) Type I, whether it is sold as a 'premix' by the manufacturer or as a concentrate to be diluted with water on site, is typically used for de-icing<sup>2</sup> the aircraft. It can however also be used for anti-icing purposes if heated at a minimum temperature of +60°C, with the same temperature being considered desirable for de-icing purposes. Type I fluids contain 80% glycol and 18 to 19% water, with some additives. They do not contain any thickeners and therefore will run off the wing surfaces after a certain time leaving only a marginal protective layer, which is seldom sufficient for prolonged protection. It is the heat of the mixture and spray pressure rather than any chemical reaction that makes the fluid suitable for de-icing. Type I fluids supplied as concentrates (ie 100% glycol content) for dilution with water prior to use shall not be used undiluted.
  - (b) Types II, III and IV contain thickeners to increase their viscosity and therefore holdover time. They are therefore particularly suited to anti-icing. They contain a minimum of 50% glycol and 48 to 49% water, with some additives. Thickened fluids are in general not heated when used as anti-icing fluids, as heat will diminish the viscosity of the products. For anti-icing, mixtures with a glycol content of 100%, 75% or 50% can be used. If diluted below these levels and heated, thickened fluids can be used for

---

<sup>1</sup> AEA (2015), *Recommendations for De-icing/Anti-icing Aeroplanes on the Ground* and *Training Recommendations and Background Information for De-icing/Anti-Icing of Aeroplane on the Ground*.

<sup>2</sup> Heated water can also be used for the de-icing of aircrafts.

de-icing, but the AEA recommends that de-icing should be performed with Type I fluid to avoid residue problems.

4. As the use of MEG in ADF is prohibited in the EEA for environmental reasons, Type III ADF is not supplied in the EEA. In the remainder of the appendix, the term ADF therefore refers to Type I, II and IV only and the terms thickened fluids to Type II and IV only.

### **Product specification**

5. Although the exact formulations of the four types of ADF are proprietary to the manufacturers, all ADF is manufactured to standards set by SAE International. There are two separate standards for Type I (AMS 1424) and Types II, III and IV (AMS 1428).
6. These standards include specifications for a fluid's aerodynamic acceptance test established jointly by the Aerospace Industries Association of America (AIA) and the European Association of Aerospace Industries (AECMA). The test specifies that an airplane ground ADF has acceptable aerodynamic flowoff characteristics if the fluid is tested in accordance with this standard and complies with its acceptance criteria.
7. It also specifies that if the test results are used to certify fluid compliance with the acceptance criteria, specific substantiation must be provided. This includes verifying that the test facility, associated staff, and resources satisfy the requirements of the test method. This information must be documented and submitted to an independent accrediting organisation, which will then qualify the technical suitability and competency of the test site or facility. The SAE International standards contain two requirements for anti-icing performance: a water spray endurance test (WSET) and a high humidity endurance test (HHET).<sup>3</sup>
8. Generally, once certified, the ADF products of different suppliers are perceived as equivalent to the extent they allow for similar holdover times and generally a certified ADF will be considered suitable. However, some airlines and airports may undertake some research and approve the use of particular ADF products on their aircraft and may set additional requirements. Customer comments that we have received on the use of different products include the following:
  - (a) [REDACTED] publishes a list of [REDACTED] approved fluids in its ADAM manual and the list is refreshed each winter season. Fluids must meet the relevant SAE

---

<sup>3</sup> Source: [www.boeing.com](http://www.boeing.com).

standard (AMS 1424 or 1428). [X] generally approves all conventional glycol based fluids produced by the major manufacturers unless there's a particular reason to withhold approval (known in-service issues, etc.). There is no commercial aspect, although [X] would call these 'trusted' companies – i.e. they know that they complete all the relevant AMS testing requirements. For lesser-known manufacturers, [X] generally only evaluates a fluid if they are advised that one of their ground handlers intends to use it. Since there is no recognised approval authority for ADF products, the [X] team has to do its own research, including obtaining test reports for the various SAE AMS testing requirements. So most 'unapproved' fluids can most likely still be approved, provided the [X] research is positive (and [X] has been asked about use of a particular fluid in the first place).

- (b) Some airports undertake their own testing of each ADF batch to ascertain the viscosity, percentage of glycol, etc.
- (c) Typically, [X] suggests a fluid to the airline and the airline accepts it. Ultimately, however, airlines must approve it for use on their aircraft, and sometimes airlines decide on a particular fluid. Normally only one ADF is approved, sometimes two from the same supplier are approved. Different fluids may be approved in different airports, depending on availability.
- (d) Airports and airlines do not specify any requirements on de-icing companies in terms of the specific ADF products to use on aircraft. [X] is simply required to inform the airlines/airports of the ADF they are using and the airlines have so far never opposed the ADF put forward by [X]. Airlines' primary concern, so long as the ADF is certified, is the cost.
- (e) [X] individually checks the various available ADF to see if they can be applied or not. Within [X] there is a specialist for ADF checking the market, observing the materials, and giving recommendations about what sort of suppliers can be used. [X] would generally stick to official requirements.

### **Holdover time tables**

- 9. The AEA publishes generic holdover tables that show the lowest holdover times, attained from the certified fluids, under a combination of weather conditions and temperatures.<sup>4</sup> The weather conditions are defined as freezing

---

<sup>4</sup> AEA (2014), [Guidelines for Holdover Times: Recommendations for De-icing/Anti-icing Aeroplanes on the Ground](#).

fog, snow/snow grains/snow pellets, freezing drizzle, light freezing rain and rain on cold soaked wing.

10. The holdover tables show that holdover times for Type II and Type IV differ significantly, particularly for the lower temperatures ( $-3^{\circ}\text{C}$  and below), with Type IV having longer holdover times than Type II. At higher temperatures, the holdover times of the two products are more similar.
11. In addition, manufacturers will develop holdover tables for their own products (as each product is based on a proprietary formulation). These may show longer holdover times than the generic holdover timetables published by the AEA but cannot be used for any of the fluids sold by other manufacturers.

### **The de-icing and anti-icing processes**

12. The AEA sets out the following two procedures for the de-icing and anti-icing of aircraft:

When aeroplane surfaces are contaminated by frozen moisture, they shall be de-iced prior to dispatch. When freezing precipitation exists and there is a risk of contamination of the surface at the time of dispatch, aeroplane surfaces shall be anti-iced. If both de-icing and anti-icing are required, the procedure may be performed in one or two steps. The selection of a one- or two-step process depends upon weather conditions, available equipment, available fluids and the holdover time to be achieved.

Some contamination, such as frost, can be removed and the surface protected from refreezing, all at the same time using the same fluid and same mixture. This is called a one-step procedure. One-step de-icing/anti-icing is generally performed with a heated unthickened fluid. Thickened fluid can and is in some cases used for this one-step process. Caution must be taken for the dry-out characteristics and gel residue problems of this particular scenario, the mixture to choose for this step is the mixture that gives a protective cover; in other words, the de-icing is performed with an anti-icing mixture, which protects the surface at the same time. The correct fluid concentration shall be chosen with regard to desired holdover time and is dictated by outside air temperature and weather conditions.

Two-step de-icing/anti-icing (when the first step is performed with de-icing fluid) is a procedure performed whenever the contamination demands a de-icing process separately. The

correct fluid(s) shall be chosen with regard to ambient temperature. After de-icing, a separate over-spray of anti-icing fluid shall be applied to protect the relevant surfaces thus providing maximum possible anti-ice capability. The second step is performed with anti-icing fluid. The correct fluid concentration shall be chosen with regard to desired holdover time and is dictated by outside air temperature and weather conditions. A two-step procedure is common during freezing precipitation.

13. The AEA states that there is no single correct way of performing each and every de-icing/anti-icing. The operation must be suited for each airport, company and local setting. However only certified fluids and accepted procedures are to be used. As a general rule, the decision to use ADF rests with the ground crew or flight crew prior to dispatch. Subsequently, de- and anti-icing procedures are the responsibility of the pilot.<sup>5</sup>

---

<sup>5</sup> AEA (2015), *Recommendations for De-icing/Anti-icing Aeroplanes on the Ground*.

## The economics of ADF supply

### Introduction

1. This appendix sets out our preliminary views on the basic elements of the supply of ADF and some of the main features of the way firms compete in this market.
2. The appendix synthesises the evidence we have been able to obtain on the costs of the main suppliers of ADF. Although there are gaps in the evidence, the paper seeks to draw some high-level conclusions on the extent to which certain competitors derive a competitive advantage from their costs of production and supply.
3. The focus here is on variable costs. Other costs, in particular fixed costs and those associated with entry and expansion, are discussed in Appendix E.
4. We report first the quantitative information that was provided to us by the various players in the market in its original format (eg currency, volume/value) in order to avoid making additional assumptions (eg on exchange rates). When we then go on to compare these quantitative pieces of information, we make the necessary assumptions and convert numbers into the most commonly format used by the market participants (eg we use the Euro for values).

### The supply chain and associated costs

5. In order to be able to supply ADF to a customer, a manufacturer needs at least the following:
  - MPG, the main raw material.
  - Additives, the raw material in which lies the intellectual property of the manufacturer and where innovation is undertaken.
  - Blending facilities, in which the raw materials are mixed.
  - A security of supply proposition consisting of, among other things:
    - logistics and transport arrangements; and
    - storage;
  - Sales effort.

- Reputation, which is interlinked with the security of supply proposition.
6. We were also informed that innovative solutions (eg in-truck blending, glycol recycling) would technically be viable solutions.
  7. We have seen different approaches in how manufacturers supply to customers in the UK. That is, manufacturers have different ways in which they have set-up and how they are running their supply chain. See Figure 1 for the location of manufacturing plants and storage sites relevant for the UK supply of ADF.

**Figure 1: Current supply chain arrangements by suppliers for customers in the UK**

[X]

8. Differences between suppliers' costs to supply customers at a given location arise from several factors, including: the location of manufacturing plant(s); whether, where, and how long storage depots are used to supply these customers; and the logistical arrangements to transport and handle ADF. Each is discussed in turn below:

### **Raw materials**

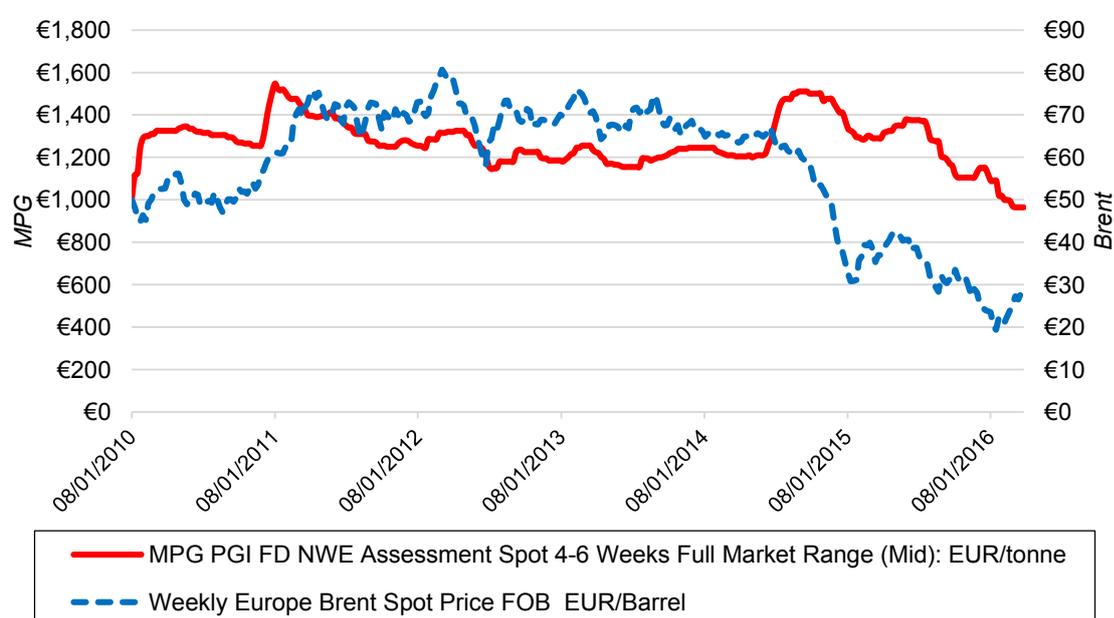
#### **MPG**

9. Monopropylene glycol (MPG) is a petroleum based product and used for various applications. There are two grades of MPG: 'technical' grade and 'food/pharmaceutical' grade. The main fields of application for technical grade MPG are unsaturated polyester resins, detergents, and antifreeze products. For food grade MPG, the main field of application is in cosmetics, where it is used as a moisture regulator. In 2012, European propylene glycol production capacity amounted to around 730 kilotonnes, approximately one-third is used for pharmaceutical grade, and two-thirds are used for industrial grade propylene glycol.
10. There are five suppliers of MPG in the EEA. Dow estimates that it is the [X] with around [X]% market share, [X] LyondellBasell ([X]%), and Ineos ([X]%). Ineos estimates confirm this [X] market share, but considers that LyondellBasell's market share is [X]% [X] and attributes [X]% market share to [X]. Shell informed us that it stopped supplying MPG in Europe in Q3 2014.
11. ADDCON told us that there were a few suppliers of MPG in Europe with Dow and LyondellBasell as dominant players, BASF and Ineos as smaller suppliers, and a handful of trading companies. However, it considered that

once it required large amounts of MPG (in a cold winter), it would automatically need to revert to the major players.

12. From the MPG manufacturers' revenue figures we can also see that [redacted] their customers that produce ADF account for [redacted]. [redacted] MPG purchases account for around [redacted]% of Dow's MPG revenue and it is [redacted]. Kilfrost, ABAX, and Proviron account for [redacted].
13. MPG represents the largest share of costs of ADF. Depending on the type of ADF, this may range between around [40–50]% and [80–90]%. This cost factor is also the factor with the greatest degree of variation as it is somewhat linked to the oil price (see price chart below in Figure 2).

**Figure 2: ICIS MPG and Brent oil price chart (2010 to 2015)**



Source: ICIS index as submitted by Clariant, Brent Spot price: Intercontinental Exchange

14. For its production in the UK, Kilfrost bought [redacted]. Clariant submits that it buys from [redacted] in [redacted] from where it is transported [redacted] to [redacted]. [redacted]. Clariant told us that it [redacted]. Responses from the MPG suppliers show that [redacted].
15. When we compared prices actually paid by Clariant and Kilfrost (see Figure 3), we observed that Clariant [redacted]. On average, this [redacted]. [redacted] Clariant's assumption of a cost reduction [redacted].

**Figure 3: Average monthly MPG price paid per kilogramme (kg)**

[REDACTED]

Source: CMA based on information from the Parties, ADDCON and ABAX, and the ICIS MPG index.

16. We have also received information on the prices paid for MPG by ABAX and ADDCON in December 2015 (see Figure 3). ABAX paid [REDACTED]. [REDACTED]. ADDCON pays [REDACTED]. ABAX, ADDCON, and Kilfrost's prices paid are [REDACTED]. It therefore appears that Clariant pays [REDACTED].
17. We also obtained data from three MPG suppliers on the prices paid by the different ADF manufacturers. This data also showed that [REDACTED]. Clariant pays [REDACTED]. However, this data suggested that ABAX [REDACTED]. The responses from Dow, LyondellBasell, and Ineos indicate that [REDACTED]. This data also indicated that Proviron [REDACTED].
18. Depending on the trading terms (in particular whether transport costs are included), [REDACTED] price differences may be explained by long-term relationships between ADF manufacturers and MPG manufacturers, volume discounts, and/or the distance between the MPG plant and the ADF manufacturing plant.
19. The plants of MPG manufacturers in the EEA are at the following locations: Ineos: Cologne (Germany),<sup>1</sup> LyondellBasell: Fos-sur-Mer (France), Rotterdam (Netherlands),<sup>2</sup> Dow: Stade (Germany),<sup>3</sup> BASF: Ludwigshafen (Germany),<sup>4</sup> Repsol: Tarragona (Spain).
20. Kilfrost has storage capacity for MPG of [REDACTED] that can be supplemented [REDACTED]. In addition, Kilfrost has bulk storage capacity of [REDACTED].
21. Through [REDACTED], based in Antwerp (Belgium), which provides blending services to Kilfrost for [REDACTED], Kilfrost also has access to bulk storage of MPG which [REDACTED] provides for [REDACTED]. Kilfrost's [REDACTED] storage vessel is linked to the [REDACTED] vessel by way of a [REDACTED] with deliveries being made directly between the storage vessels and the [REDACTED] taking place in the Kilfrost container.
22. Clariant has storage capacity for MPG of [REDACTED]; further MPG may be stored in [REDACTED].
23. The suppliers also informed us about their arrangements with MPG purchasers:

---

<sup>1</sup> [www.ineos.com](http://www.ineos.com) (retrieved 15/04/2016).

<sup>2</sup> Safety Data Sheet Ver. 1.3 Propylene Glycol Industrial (revision date: 08/10/2015) (retrieved from [www.lyondellbasell.com](http://www.lyondellbasell.com) 15/04/2016).

<sup>3</sup> [www.dow.com](http://www.dow.com) (retrieved 15/04/2016).

<sup>4</sup> [www.propylene-glycol.com](http://www.propylene-glycol.com).

- Dow told us that supply contracts for MPG could be long term (up to [X] years) with a pricing formula based on cost/market index or they could be freely negotiated. Pricing was updated on a [X] basis. A pricing formula was used for large customers (above [X] usually). For smaller customers, Dow negotiated prices on a monthly basis.
- LyondellBasell told us that both contract and spot sales were available depending on the customer. The contract length spanned over [X] and was typically [X]. The price could be linked to [X]. There was a [X] per month. Spot pricing was dependent upon current market rates and availability.
- Ineos told us that contracts for MPG were done on an ad-hoc basis. During the last three to five years, ADF manufacturers had in general issued tenders for their demand. The tender volumes were dictated by several factors including time of the year, forecasted winter conditions and stocks of finished ADF and MPG. In Ineos' experience of the tendering processes the main driver was price given that MPG was seen as a commodity in the market place. [X]. The majority of sales were either based on monthly negotiated or order by order negotiated spot basis. It also had contracts based on cost plus or market minus mechanisms though typically for one- to three-year time periods.

24. The evidence received on the MPG purchases of ADF suppliers shows that there are [X]. Our current view is therefore, that, if these [X].

#### *Other raw materials*

25. Other raw materials for the production of ADF comprise mainly the additives and water.
26. Water accounts for between [10 - 20]% and [50 - 60]% by volume in ADF concentrate, depending on the type. Additional water can be added for dilution to reduce the use of ADF, for instance at higher temperatures (see Appendix C).
27. The additives consist of a mixture of liquid and solid substances and represent around [0 - 5]% to [20 - 30]% by volume in ADF concentrate, depending on the type. These provide for the required chemical and physical characteristics of the different ADF types, including: viscosity, surface tension, wetting ability, anti-foam capacity, corrosion inhibition, and colouring for identification. The additives are usually [X] (sometimes called 'add pack') [X].

28. Additives play a major role in Types II and IV to achieve the necessary properties in these ADF products. Manufacturers' research and development is focused on the composition of additives (see Appendix E). The exact ingredients and formulations of the additives are commercial secrets kept by the manufacturers.
29. Clariant's production cost figures show that other raw materials (ie mainly additives) account for a (internal) cost of €[REDACTED] (representing around [REDACTED]% of total variable cost) per tonne of ADF Type I and €[REDACTED] ([REDACTED]%) per tonne of ADF Type IV.<sup>5</sup>
30. ABAX submitted that other raw materials accounted for [REDACTED]. ABAX's cost for additives therefore appears to be [REDACTED].
31. LNT Solutions told us that it [REDACTED]. This would correspond to [REDACTED].
32. ADDCON told us that additives and other raw material accounted for €[REDACTED] per tonne of ADF Type I.
33. We do not have information on the cost of additives [REDACTED].
34. It is conceivable that the ingredients in the additives are [REDACTED]. However, due to the small proportion of cost that additives represent, our current view is that [REDACTED].

### **Manufacture**

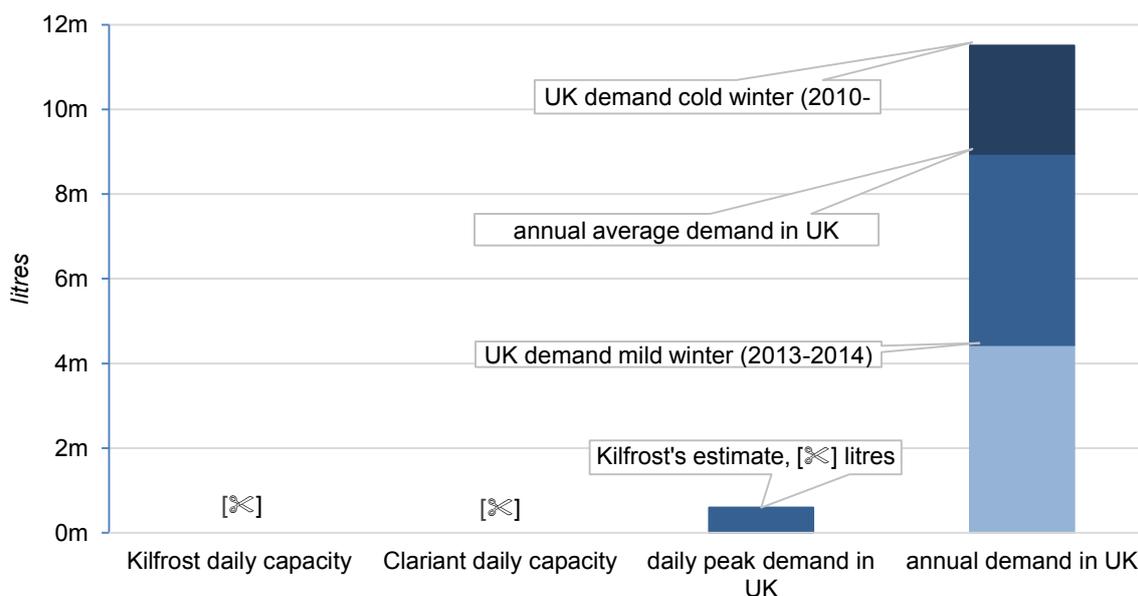
35. The main production stage appears to be the mixing and blending. The product is then filled into bulk storage tanks, road tankers, or ISO tank containers (commonly around 23,000 litres) and IBCs (commonly around 1,000 litres) for transport. Production and decanting happens at ambient temperatures under atmospheric pressure and there are no complex chemical reactions or special safety precautions to be taken as the products do not become more hazardous than their ingredients.
36. The Parties and some third parties also mentioned that blending could be and was sometimes undertaken by toll-manufacturers. Some third parties, and LNT Solutions in particular, have informed us that there are also innovative solutions where customers blend ADF themselves (ie the 'add pack', glycol, and water) or where mixing is undertaken in the spraying rig or lorry.

---

<sup>5</sup> Based on the information provided [REDACTED].

37. However, we also understand that the fluid produced at each site needs to be certified (and not the equipment or the facility at the site).
38. Clariant told us that it used [redacted] vessels at its manufacturing plant in Gendorf. [redacted]. These would not be used for other products, [redacted]. [redacted] additional [redacted] vessel ([redacted] the production capacity of [redacted]), which was normally used for other products, could be used for the production of ADF.
39. Clariant also stated that it had [redacted] for the production of ADF.

**Figure 4: Comparison of production capacities and UK demand**



Source: Parties.

40. Kilfrost told us that its ADF production capacity was around [redacted] litres per day with the existing staff and a [redacted]-hour operation. It could produce up to [redacted] litres per day operating [redacted] hours (with additional staff if for more than [redacted]).
41. Kilfrost told us that it had [redacted].
42. Clariant assumed a reduction in personnel cost of [redacted]% in its valuation of the acquisition.
43. We have received the following information about variable production costs (excluding raw material costs):
  - The Parties initially submitted that production costs per kg of ADF [redacted] for Kilfrost.
  - Kilfrost later submitted that production costs would be around £[redacted] per litre of ADF (this corresponded to [redacted]).

- The Parties initially submitted that production costs per kg of ADF (Types I and IV) would be €[REDACTED] for Clariant.
  - Clariant later submitted that production costs would be €[REDACTED] per kg ADF Type I, €[REDACTED] per kg ADF Type II, and €[REDACTED] per kg ADF Type IV. [REDACTED].
  - ABAX submitted that the production costs for 1 tonne of ADF Type I would be €[REDACTED] (ie €[REDACTED] per kg).
  - ADDCON submitted that the production (manufacturing) costs for 1 tonne of ADF Type I would be €[REDACTED] (ie €[REDACTED] per kg).
44. We could therefore rank the manufacturers by the cost they incur to manufacture ADF: [REDACTED].
45. Given the information we have received from the suppliers our current view is that production costs [REDACTED].
46. However, due to the [REDACTED].

## **Logistics**

### *Transport*

47. Differences in transport cost a supplier incurs when serving a customer partly arise from where the manufacturing or blending facilities of the supplier are located. For instance, Clariant supplies customers in the UK with ADF manufactured in [REDACTED]. Kilfrost manufactures in Northumberland, and Proviron manufactures in Belgium. This means that the distance [REDACTED]. Proviron's manufacturing plant is located relatively close to the South East of England.
48. The Parties and third party manufacturers informed us that they used logistics providers to transport ADF. [REDACTED]. Kilfrost used [REDACTED]. Clariant [REDACTED]. Other suppliers also named [REDACTED] as a possible haulier.
49. We have received the following information about transport costs:
- Kilfrost submitted that the average transport cost of ADF for supply in the EEA would be €[REDACTED] per kg of ADF Type I and €[REDACTED] per kg Type II (representing around [REDACTED]% to [REDACTED]% of total variable cost).
  - Kilfrost submitted a list of destinations in the UK with associated transport costs from Haltwhistle. As example, the direct delivery of one tank container ADF from Haltwhistle to Luton airport (LTN) costs Kilfrost £[REDACTED] (€[REDACTED]). Longer distances are associated with lower costs per kilometre.

We estimate that the average transport cost per kilometre in the UK over these destinations is around £[redacted] (€[redacted]).<sup>6</sup>

- Clariant submitted that the average transport cost of ADF for the supply in the EEA would be €[redacted] per kg of ADF Types I and II (representing around [redacted]% to [redacted]% of total variable cost depending on the type).
- Clariant submitted a list of destinations in the UK with associated transport costs from [redacted]. As example, the direct delivery of one tank container ADF [redacted] costs Clariant [redacted]. We estimate that the average transport cost per kilometre over these UK destinations is around €[redacted].<sup>7</sup>
- We have also reviewed the average transport costs per kg of ADF submitted by Clariant, which is reported to be around €[redacted]. This figure does however not include transport from [redacted] and from [redacted]. Based on the number of tank containers transported between the different storage locations and the aforementioned transport costs, we estimate that the average cost per kg is then around €[redacted] (depending on the price for the transport [redacted]).<sup>8</sup>
- LNT Solutions told us that it [redacted].
- ABAX submitted that on average transport costs to the UK would be around €[redacted] per tonne ADF (ie €[redacted] per tank container).
- ADDCON estimated that it would incur transport costs to the UK of €[redacted] per tonne ADF (ie €[redacted] per 23,000 litres tank container).

50. As examples, below are provided the transport costs per tank container for [redacted] and [redacted] airports (Table 1).

**Table 1: Example transport costs for Kilfrost and Clariant**

	<i>Kilfrost</i>		<i>Clariant</i>	
	<i>From Haltwhistle</i>		<i>From [redacted]</i>	
	[redacted]	[redacted]	[redacted]	[redacted]
To [redacted]	£[redacted]	[redacted]	€[redacted]	[redacted]
To [redacted]	£[redacted]	[redacted]	€[redacted]	[redacted]

Source: Parties.

<sup>6</sup> We chose the [redacted] for each destination. Includes [redacted]. These are not actual average cost incurred.

<sup>7</sup> We chose the [redacted] for each destination. Includes [redacted]. These are not actual average costs incurred.

<sup>8</sup> Clariant submitted that the correct figure for average transport costs was €[redacted] as provided in [redacted]. However this figure is lower as it only includes transport cost rates from [redacted] to [redacted]. Our estimate is the average across all transport costs incurred to supply customers in the UK (ie it includes costs incurred for actual deliveries from [redacted] to all of Clariant's customers in the UK on the routes that were actually used to supply them).

51. Kilfrost's business plan mentions that its partner facilities in Antwerp (Belgium) saves it 'significant costs previously incurred in respect of transport to and from Haltwhistle and additional storage in Europe in ISO containers' when serving customers in Continental Europe. [REDACTED].
52. ABAX submitted that transport costs formed part of [REDACTED].
53. Clariant also submitted that the transport cost of MPG [REDACTED].
54. Our current view is therefore that transport costs are [REDACTED].

### *Storage*

55. The manufacturers have one or more storage sites where they keep ADF in tank containers for later delivery and use by their customers.<sup>9</sup> We understand that manufacturers would usually not own the tank containers but rather rent these at a certain cost per day from the logistics contractors mentioned above. Similarly, they would rent storage space for such a tank container at a certain cost per day as well as a certain cost for handling a tank container. In some circumstances the rental of a trailer may also be necessary at a certain cost per day.
56. These costs are additional to the working capital cost of holding ADF stocks in these tank containers. This has implications on the cost for manufacturers: a higher number of storage sites used, a higher number of tank containers, and a longer storage time will increase that cost. On the other hand, more storage sites and more storage capacity may enable manufacturers to even out peaks of demand across regions, respond to orders more quickly, or increase resilience of the supply chain in adverse weather conditions.
57. Similarly, there are implications of the weather on these costs. In periods with low demand, storage periods are typically longer whilst at the same time revenues will be lower. There is also a trade-off to be made at the end of each season: suppliers can either leave the tank containers with unsold ADF at one of the storage sites or repatriate these (at the costs discussed in the section above) at their production facilities where incremental storage costs are (we assume) zero and where (own) bulk storage facilities can be used.
58. Kilfrost's internal documents indicate that it has a number of storage sites for ADF in the UK from which it can supply customers, but it can also supply directly to customers in the UK without the use of a storage facility (see also

---

<sup>9</sup> We understand that this is the most common way of operation. A tank container would usually contain 23,000 litres of fluid. Storage in bulk storage tanks or IBCs (containing around 1,000 litres fluid) are alternative containers for storing ADF.

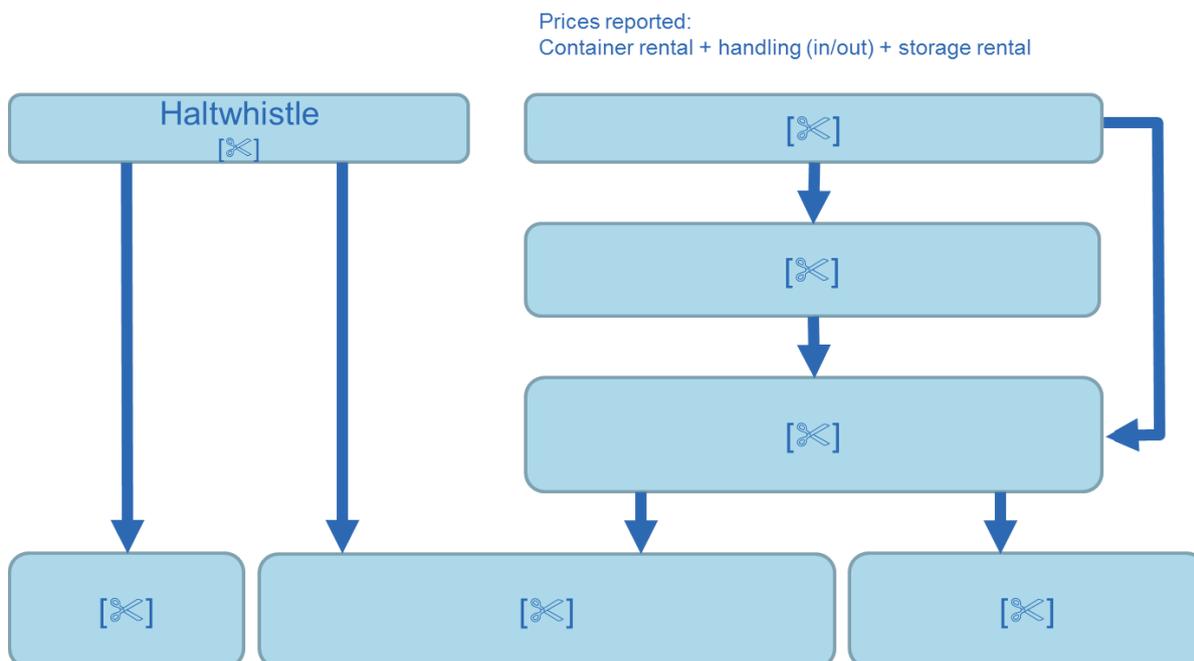
Figure 5). We have not received information on when, which, and how long storage sites are used to supply customers in the UK but Kilfrost submitted later that in the UK less ADF stock was required for UK customers as it could supply straight from its manufacturing plant.

59. We have received the following quantitative information about storage costs:

- Kilfrost submitted that the average cost of tank container rentals for the supply in the EEA would be €[redacted] per kg of ADF Types I and II (representing around [redacted]% to [redacted]% of total variable cost depending on the type).
- Further, Kilfrost submitted that its overall average cost per tank container to cover rental and storage based on 67 days rental period was around £[redacted] (€[redacted]) over the 'last few years'. The average daily rental and storage rate of its three contractors would be around £[redacted]. Again on average over the 'last few years', the depot and handling costs per tank container were around £[redacted] (€[redacted]) (comprising all relevant depot and handling costs incurred). It also submitted that the vast majority of tanker rentals were in Continental Europe. We infer that these costs are lower when customers in the UK are supplied.
- For example, Kilfrost pays at [redacted]: £[redacted] per day for the rental of a tank container, £[redacted] per day for the storage itself, handling (per lift) of £[redacted], and £[redacted] per day for the rental of a chassis.
- Clariant submitted that the average cost of tank container rentals for the supply in the EEA would be [redacted].
- We also note that Clariant's storage and depot costs for the supply of ADF to customers in the UK that were provided to us do not include the [redacted]. In addition, Clariant accounted for a cost of capital of around [redacted].
- As example, Clariant pays at [redacted] per day [redacted], and [redacted].

60. Clariant operates a supply chain with [redacted] that can be used before ADF is delivered to a customer in the UK (see also Figure 5). Tank containers are usually transported [redacted], sometimes also [redacted].[redacted] for UK customers. The site in [redacted]. From [redacted]. Clariant also submitted that it could transport through [redacted], if required. Tank containers are then transported [redacted]. Customers in [redacted]. Customers in [redacted]. Clariant has provided the number of tank containers transported between these sites and the storage and handling costs.

**Figure 5: Overview of depot options of Kilfrost and Clariant**



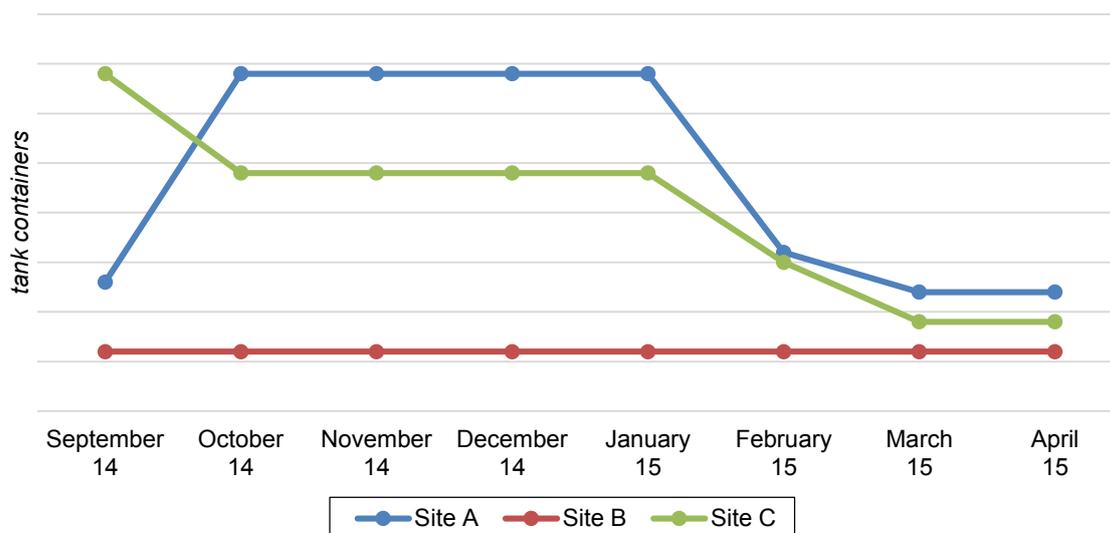
Source: CMA based on information from the Parties.

61. According to the statements of Kilfrost and the information we have received from Clariant, it is likely that [REDACTED].
62. Due to the absence of [REDACTED] and the [REDACTED], we do not consider that [REDACTED].

*ADF stock*

63. We have received [REDACTED]. We understand that the Parties [REDACTED].
64. Kilfrost told us that during the season 2015/2016 it had £[REDACTED] million worth of ADF stocked in Europe and its accounts show that it had [REDACTED] litres ADF in stock (including [REDACTED]).
65. Kilfrost clarified that it had £[REDACTED] million in stock at peak during the season 2015/2016 which corresponds to around [REDACTED] tank containers. It considered that less ADF stock was required for UK customers as it could supply straight from its manufacturing plant.
66. Clariant told us that it had on average [REDACTED] in stock for each customer.

**Figure 6: Number of tank containers Clariant had during the season 2014/2015 at storage sites for UK supply**



Source: Clariant.

67. Proviron stored ADF for its UK customers [in container terminals in the UK]. It told us that it could set up storage for individual customers at a location close to the point of use.
68. However, we consider that a number of elements leads to there being a 'network effect' of existing storage and logistics:
  - Greater storage capacities implies greater ADF reserves in high demand periods since more liquid is stored in depots, production can be evened out, and lead times for scaling up production and raw material supplies can be longer.
  - This may lead to economies of scale as it may allow producers to reduce the amount of ADF stock per customer and make suppliers less dependent on long-term weather forecasts.
  - A greater number of storage sites close to a customer signals lower risks of supply disruptions in adverse weather conditions as ADF can be supplied from more than one depot in case of transport disruptions.
  - A greater number of storage sites between a manufacturing site and a customer may compensate for more remote suppliers (eg [✂]).
  - A greater number of storage sites allows suppliers to even out demand peaks due to local weather events in winter, as cold spells may not always affect large areas and ADF can then be transferred between storage sites;

in addition, the ability to transfer ADF between storage sites may allow continuous supply even in case of failure of parts of the supply chain.

### ***Two comparisons of the different cost factors between suppliers***

69. Based on the information we have summarised above, we have analysed what costs the different suppliers would incur in two scenarios: (i) supplying one tank container of ADF Type I to a (average) customer in the UK during the season 2015/2016; and (ii) supplying one tank container of ADF Type [X] to [X] at [X] airport during the season 2014/2015.

#### *Supply of ADF Type I to customers in the UK (season 2015/2016)*

70. We have received [X] information about the costs to supply ADF Type I to customers in the UK. We report these costs for one tank container (around 23,000 litres). We have therefore estimated the costs for the suppliers from which we have received information with a view to make these costs comparable (see Table 2).
71. For MPG: We used for Kilfrost and Clariant the price they paid in December 2015 for MPG (€[X], €[X]) and the quantity of MPG that is used for a tank container of their Type I products. We revised the figure for Clariant as MPG is [X]). We use for ABAX and ADDCON the MPG cost mentioned above.
72. For other raw material: [X]. We used for Clariant the cost of other raw materials (ie excluding MPG) per tonne of ADF as provided. We use for ABAX and ADDCON the cost mentioned in the relevant section above.
73. For production costs: We use the average of Kilfrost's production costs for one tank container [X]. For Clariant we use the cost provided [X]. We use for ABAX and ADDCON the cost mentioned in the relevant section above.
74. For transport costs: We use average transport costs of Kilfrost's haulage rates for direct mainland GB destinations. For Clariant, we use the weighted (by number of tank containers transported) average cost incurred to transport tank containers to the UK (including the transport cost from [X], as discussed above). We assume therefore that each of the Parties supplies an average customer out of their existing customer base.
75. For storage costs: We use the rental and handling costs provided by Kilfrost and Clariant [X]. We also note that additional storage costs for Clariant occur whenever it uses [X]. [X].

**Table 2: Cost comparison for one tank container of ADF Type I at December 2015 prices to supply a customer in the UK**

Per tank container	Storage				
	MPG	Other raw material	Production	Transport	[X]
Kilfrost	€[X]	€[X]	€[X]	€[X]	[X]
Clariant	€[X]	€[X]	€[X]	€[X]	[X]
ABAX	€[X]	€[X]	€[X]	€[X]	[X]
ADDCON	€[X]	€[X]	€[X]	€[X]	[X]

Source: Parties' responses to CMA enquiries.

76. We have not included other costs (eg packing) as we assume that these do not materially differ between suppliers. [X].

77. We note that Clariant appears to be [X] but Kilfrost has a [X].

*Supply of ADF Type [X] to [X] airport (season 2014/2015) ([X])*

78. We repeat the above exercise by using the cost information available to estimate the cost for Kilfrost and Clariant information that they [X] in supplying ADF Type [X] to [X] during the season 2014/2015. We report these costs for one tank container (around 23,000 litres) (see Table 3).

79. For MPG: We used for Kilfrost and Clariant the price they paid in April 2014 for MPG (€[X], €[X]) and the quantity of MPG that is used for a tank container of their Type [X] products. We note that Clariant used [X]. We use LNT Solutions' [X].

80. For other raw material: [X]. We use for Clariant the cost of other raw materials (ie excluding MPG) per tonne of ADF as provided. We use LNT Solutions' [X].

81. For production costs: We use the average of Kilfrost's production costs provided for [X]).<sup>10</sup> For Clariant we use the cost as provided by Clariant.

82. For transport costs: We use Kilfrost's [X] haulage rate for direct delivery to [X] and convert into euros. For Clariant, we use the actual cost incurred for the [X] tank containers delivered to [X] and include the omitted transport cost [X], as discussed above. This figure takes account of a number of tank containers that were transported to [X] via [X] (at higher cost). We also report LNT Solutions' [X].

---

<sup>10</sup> Applying Bank of England £/€ spot exchange rate for December 2015.

83. For storage costs: We do not have information about [X]. If we assume that all tank containers would have been delivered directly from Haltwhistle, there would have been no costs for storage (apart from cost of ADF stock, if any). We can therefore conclude that the assumptions on Kilfrost's cost can be considered as providing [X]. For Clariant, we use the [X] tank containers [X] and allocate proportionally storage and handling costs at [X] as well as for [X]. This figure takes account of a number of tank containers that were stored [X]. We also report LNT Solutions' [X].
84. For revenues we use the retail price of €[X] per litre and extrapolate to obtain the revenue for a tank container.
85. We do not include other costs such as packing costs, stock working capital, cost of capital [X] or other cost factors that suppliers may consider relevant in this comparison. We have also not included the cost of [X] that Clariant [X].

**Table 3: Cost comparison for one tank container of ADF Type [X] at April 2014 prices to supply [X] ([X])**

<i>Per tank container</i>	<i>MPG</i>	<i>Other raw material</i>	<i>Production</i>	<i>Transport</i>	<i>Storage</i>	<i>Total cost</i>	<i>Revenues (€[X]/l)</i>	<i>Gross margin</i>
Kilfrost	€[X]	€[X]	€[X]	€[X]	€[X]	€[X]	€[X]	€[X]
Clariant	€[X]	€[X]	€[X]	€[X]	€[X]	€[X]		€[X]
LNT Solutions' [X]	€[X]	€[X]		€[X]	€[X]	€[X]		€[X]

Source: Parties' responses to CMA enquiries.

86. We can now compare the margins that the suppliers would earn under the assumptions made above. As can be seen, Clariant [X]. As our cost estimates Kilfrost's constitute a lower bound, it is likely [X]. This is corroborated by [X].
87. LNT Solutions [X] per tank container. [X].
88. Although there is a degree of uncertainty around the cost estimates, our current view is [X].

## Barriers to entry and expansion

### Introduction

1. This appendix lays out and assesses each of the barriers to entry or expansion in the supply of ADF to UK customers.<sup>1</sup> Each section focuses on an individual barrier and sets out the views of the Parties and relevant third parties before our preliminary assessment.

### *Barriers to entry and expansion*

2. Our guidelines<sup>2</sup> note four categories of barriers to entry or expansion, which involve the following aspects in the context of ADF supply:
  - (a) **Structural and strategic barriers:** In the supply of ADF, structural barriers for suppliers include set-up costs of a manufacturing unit (incurred by suppliers), ensuring a reliable supply of MPG<sup>3</sup> and the process to establish a logistics network that is able to fulfil the lead times. Strategic barriers concern the security of supply<sup>4</sup> and stock working capital management. We also consider the switching costs faced by customers. We note that the factors noted above are inter-related, especially in the case of suppliers being able to meet peak demand.
  - (b) **Economies of scale:** In the supply of ADF, the purchase costs of MPG by suppliers of ADF and manufacturing costs could give rise to economies of scale. Likewise, there could possibly be economies of scope if the manufacturing and logistics facilities could be used for non-ADF products.
  - (c) **Technical barriers:** In the supply of ADF, factors such as proprietary formulae and recipes of ADF required by suppliers is a key consideration.
  - (d) **Legal barriers:** In the supply of ADF, the certifications required by suppliers are a key consideration.

---

<sup>1</sup> We consider that the effects of the Merger should be analysed both on an EEA-wide basis and on a narrower UK-wide basis. With regards to barriers to entry and expansion, we are focusing the analysis on the barriers to entry and/or expansion faced by a supplier with existing operations in continental Europe.

<sup>2</sup> *Merger Assessment Guidelines* (CC2/OFT1254), paragraph 5.8.5.

<sup>3</sup> MPG is the key raw material for the production of ADF.

<sup>4</sup> Relates to the reputation of suppliers coupled with risk aversion of customers.

## ***The Parties' position on the extent of barriers to entry***

### *Clariant*

3. Clariant submitted that barriers to entry or expansion in the UK were low. It added that the key to supplying UK customers was to set up adequate logistics capabilities, which could be done by subcontracting and/or renting from third parties with relative ease and little expense.<sup>5</sup>
4. Clariant told us that low barriers to entry in the UK ADF market was demonstrated by Clariant's entry in 2012, when it approached UK customers and offered its ADF, and with Proviron recently doing the same. Clariant also said that the UK ADF market could be served satisfactorily from producers based in Europe, through a well-established supply chain, and no local manufacturing service was required.
5. Clariant considered that the most likely new entrants could be existing ADF suppliers from elsewhere in Europe and/or the world and existing suppliers of adjacent products, such as runway de-icers or MPG, and in light of this, did not consider that know-how and Intellectual Property (IP) or certifications or approvals or other aspects of the supply chain would create a barrier to entry.<sup>6</sup>

### *Kilfrost*

6. Kilfrost submitted that barriers to the manufacture of ADF were not insignificant, to the extent that the formula required to manufacture ADF was a trade secret (and sometimes patent protected).<sup>7</sup>
7. However, Kilfrost also submitted the following:
  - (a) Barriers to distribution of ADF were low.
  - (b) It was not necessary to possess a local manufacturing facility to be able to guarantee supply of ADF either in the UK or the rest of Europe/the world. Specifically, it was sufficient to hold sufficiently large storage facilities and to stockpile enough ADF to be able to ensure supply to the relevant customer(s) as and when they needed it.
  - (c) There were reputational barriers to entry relating to customers' concerns regarding security of supply which made them risk averse. But Kilfrost

---

<sup>5</sup> [Clariant initial submission, paragraph 6.1.](#)

<sup>6</sup> [Clariant initial submission, paragraph 6.1.](#)

<sup>7</sup> [Kilfrost initial submission, section 6.](#)

was of the opinion that any supplier that committed to stockpile sufficient ADF to provide security of supply was able to succeed in this industry.<sup>8</sup>

8. This is consistent with Kilfrost's internal documents. [REDACTED]:

(a) [REDACTED];

(b) [REDACTED];

(c) [REDACTED];

(d) [REDACTED]; and

(e) [REDACTED].

### **Structural and strategic barriers**

9. In the following section we look at:

(a) Structural barriers, which comprise:

(i) the set-up costs of a manufacturing unit(s) to produce ADF,

(ii) ensuring adequate supply of MPG, and

(iii) the logistics of transporting ADF to the customer.

(b) Strategic barriers, which relate to:

(i) Security of supply and the reputation of an ADF supplier,

(ii) Stock working capital management, and

(iii) Switching costs.

### **Structural barriers**

#### *Set-up costs (manufacturing)*

10. Clariant told us that it did not believe that the set-up costs of a manufacturing unit and logistics facilities represented a barrier to entry.<sup>9</sup> Clariant said that a new entrant could avoid the costs associated with setting up a production facility by:

---

<sup>8</sup> Kilfrost initial submission, section 6.

<sup>9</sup> Clariant initial submission, paragraph 9.6.

(a) entering into an agreement with a toll manufacturer;<sup>10</sup> or

(b) importing the ADF into the UK from their overseas production facilities ie by using existing capacity in an overseas manufacturing unit. Clariant said that a number of suppliers followed this model. It also noted that MPG (the key raw material for ADF) was not produced in the UK and needed to be imported.<sup>11</sup>

11. Kilfrost uses a blender located in Antwerp from which it supplies continental Europe.
12. ADDCON told us that the equipment (including tanks for raw materials and finished goods and manufacturing equipment plus loading) used to manufacture Type I ADF would cost around [REDACTED]. Its current facility was capable [REDACTED]. It said that an additional investment of approximately €[REDACTED] would be needed for it to be able to produce all the three types of finished products. ADDCON also added that a new supplier could start the business in the UK with a couple of containers (at a cost of €25 to €30 per day per container or €30,000 per season per container) and if it then established itself after two or three seasons as a supplier with a good reputation, then a second step would be to find an established provider doing the blending. ADDCON noted that a third party blending service provider would typically be prepared to invest, but there would be an expectation that a long-term agreement for the service would be in place. The fixed costs for a blending facility were approximately €120,000 per year.
13. ABAX told us that it had considered supplying ADF using a toll-manufacturing agreement with a local partner, Esseco, but had not taken this project forward. Esseco (which distributed ABAX's products for a period of approximately ten years) told us that Clariant had asked if Esseco would be interested in blending ADF. Esseco added that there had also been similar conversations with ABAX although the interest in this instance came mainly from itself. However Esseco had not been prepared to take this forward because of the investment and cost of accreditations required to start blending, which were prohibitive given the margins it could achieve.

---

<sup>10</sup> Clariant initial submission, paragraph 9.25.

<sup>11</sup> Clariant initial submission, paragraph 9.4.

## *Logistics/supply chain*

### *Clariant*

14. Clariant considered that the key requirement for a company that sought to enter the UK for the manufacturing and distribution of ADF was to establish the necessary logistics facilities, ie depots for storage of ADF and transport.<sup>12</sup> However, it did not consider that there was any inherent complexity in the logistics system.<sup>13</sup> It added that ADF products did not have any specialist transport requirements, and it was not necessary for a supplier to own the logistics capabilities. It said that logistics could be subcontracted to third-party hauliers and storage facilities could be rented.<sup>14</sup>
15. Clariant told us that the lead times required by customers in Europe were very similar. It added they varied between [REDACTED] and [REDACTED] hours, maybe up to [REDACTED] and maybe even [REDACTED] hours, but that it was always compressed into a small time period.

### *Kilfrost*

16. Kilfrost considered that barriers to the distribution of ADF were not high. It noted that pan-European supply was made possible by the fact that the national rules or requirements regarding the quality/purity of ADF in Europe were the same.<sup>15</sup>
17. Kilfrost also said that the transportation of ADF was straightforward. Specifically, ADF was non-hazardous and could be easily transported by road or rail, with no special equipment necessary to transport or store the ADF.<sup>16</sup> It added that stockpiling was made simpler because ADF did not perish. As a result it was possible to store ADF for many years, (although it was necessary to have ADF tested every three years to ensure the product still met relevant standards).<sup>17</sup>
18. Kilfrost did not consider it necessary for a supplier to possess a local manufacturing facility to be able to guarantee supply of ADF either in the UK or the rest of Europe/the world. It said that it would be sufficient to hold sufficiently large storage facilities and to stockpile adequate ADF to be able to ensure supply to the relevant customer(s) as and when they needed it. It

---

<sup>12</sup> [Clariant initial submission](#), paragraph 9.2.

<sup>13</sup> [Clariant initial submission](#), paragraph 9.3.

<sup>14</sup> [Clariant initial submission](#), paragraph 9.3.

<sup>15</sup> [Kilfrost initial submission](#), paragraph 6.3.

<sup>16</sup> [Kilfrost initial submission](#), paragraph 6.4.

<sup>17</sup> [Kilfrost initial submission](#), paragraph 6.6.

noted that a number of suppliers such as Clariant, Proviron, and LNT Solutions had adopted variations of this 'import' model across Europe.<sup>18</sup>

### *Proviron*

19. Proviron did not consider finding local logistics partners in the UK to be a barrier. Proviron also told us that the logistics and customer requirements on delivery dictated whether it was economically viable to supply a customer. It gave the example of a customer in Eastern Europe that was happy with a seven-day delivery time so that Proviron did not have to store the product locally in Eastern Europe and was able to be competitive in that region as transfer costs were low. It also added that another customer closer (than Eastern Europe) to its manufacturing hub wanted a 12-hour delivery time. It said that the logistics costs were a lot higher for this customer.
20. Proviron also told us that it did not offer premix ADF due to logistical and environmental reasons and highlighted that with 75:25 premix ADF, it would have had to ship 25% extra water. It therefore considered that the 75:25 dilution was better done at the airport by the customers.

### *ABAX*

21. ABAX explained that [REDACTED] cost base was better than its own in terms of logistics, transport and storage close to airports and ABAX consequently struggled to compete given these lower costs for [REDACTED]. But ABAX said it was still competitive in France and could work with optimal logistics there. It added that operating less than [REDACTED] km from customers made things easier. ABAX also explained that customers in Eastern Europe had lower volume requirements. In addition, smaller customers sometimes had more flexible lead times at [REDACTED] to [REDACTED] hours, compared to [REDACTED] to [REDACTED] hours for larger customers.

### *Esseco*

22. Esseco transported ADF from ABAX's plant near Paris in 25 metric tonne ISO containers to its Wakefield facility where it decanted the product into IBCs, which were then shipped directly to airports. It told us that the transport costs of Type II ADF were very high because it was not only importing MPG and additives, but also water which accounted for 60% of the product content.

---

<sup>18</sup> [Kilfrost initial submission](#), paragraph 6.5.

## *ADDCON*

23. ADDCON noted that ADF manufacturers required logistics capabilities and infrastructure in any geographic market before being able to compete there. It told us that the cost of setting up a network to supply customers around Europe was very high. It said that this was a significant barrier for new players. It noted that in Germany at least, a supplier would be expected to have the infrastructure in place prior to bidding – meaning that it would be possible to make the investment without subsequently winning any business.
24. With regard to transport, it said that there were not many specialist companies. It knew of three: Hoyer, Interbulk and Vitten, the first two being the largest. These companies would provide their services to anyone.

## *LNT Solutions*

25. LNT Solutions did not consider finding local logistics partners in the UK to be a barrier.

## *Customers*

26. [REDACTED] told us that during the tendering process, suppliers were required to demonstrate that they had a reliable logistics chain (as a pre-requisite) and, once that was fulfilled, [REDACTED] looked at price. It also said that suppliers could buy in such logistic services from a number of shipping companies. It added that the ADF market was not only driven by price, but also by reliable supply of de-icing fluid.

## *Securing a reliable source for MPG purchases*

### *Clariant*

27. Clariant highlighted that upstream, access to MPG was straightforward. There were a range of chemical producers (of MPG), which a new entrant could contract with. It did not believe that a small supplier would have any difficulty in obtaining supplies from MPG providers.<sup>19</sup>
28. Clariant told us that MPG could be purchased from a range of chemical producers, including Dow, BASF, Ineos and Repsol. It said that its MPG was supplied [REDACTED] where there was a shortfall of supply such as in cases of repeated exceptional demand. Such suppliers of MPG included [REDACTED].

---

<sup>19</sup> [Clariant initial submission](#), paragraph 9.9.

29. Clariant told us that whilst there was a problem in the winter of 2010/11 with the supply of MPG to all ADF manufacturers, this was not a UK-specific problem as there was variable demand for ADF given the variable weather conditions across Europe at that time. [REDACTED], now had extra production capacity.

*Kilfrost*

30. Kilfrost told us that because most customers of MPG bought large quantities, purchases were generally made directly from manufacturers. Historically Kilfrost purchased MPG [REDACTED] from [REDACTED] until [REDACTED] ran out of stock in Europe [REDACTED] and Kilfrost [REDACTED].
31. Kilfrost told us that there was a finite supply of MPG in Europe. Therefore, customers wanted to know that the ADF suppliers had access to adequate supply of MPG.

*ABAX*

32. ABAX told us that Clariant operated worldwide and had agreements with MPG suppliers for high volumes, giving it a better price. ABAX, by contrast, bought on a [REDACTED]. It was not able to provide a range for the amount of MPG it bought but it estimated that it would produce [REDACTED] tonnes of ADF in total per year.
33. ABAX told us that it was concerned that post-merger it would be unable to buy raw materials at a price that allowed it to be competitive. It believed that it had around [REDACTED]% of the European market, compared to [REDACTED] which would have [REDACTED]% and, as such would benefit from better raw material prices. It observed that the prices it had been offered for MPG by [REDACTED] than the prices that had been offered to [REDACTED]. It noted that in addition to Dow, there were other MPG suppliers. It said that there might be three, four or five suppliers and that ABAX would work with the supplier that offered the best price. However, prices were very similar among suppliers. [REDACTED].

*ADDCON*

34. ADDCON told us that it [REDACTED]. It said that [REDACTED] told it that it could not enter into a contract, but that ADDCON could choose to buy on the spot market.

*Proviron*

35. Proviron told us that it sourced MPG from multiple European suppliers. Because its plant was located in Belgium [REDACTED].

## ***Strategic barriers***

### *Security of supply and reputation of a supplier*

#### *Clariant*

36. Clariant told us that security of supply was the number one priority in the business of supplying ADF. Clariant added that incumbent suppliers in Europe (including the UK) tended to have the benefit of having demonstrated to their customers that they could be reliable suppliers.<sup>20</sup> It added that an existing customer would also be familiar with the ordering system, fluid handling, performance, and quality control of its current supplier(s) of ADF.<sup>21</sup>
37. However, Clariant believed that these incumbency advantages were not insurmountable.<sup>22</sup> It cited evidence of switching by customers. In addition, it said that customers ran tender processes on a regular basis, and were often keen to switch suppliers where a new supplier could offer a lower price and/or a more secure supply of products. It added that the standardised nature of ADF products meant that this was a straightforward and inexpensive process.<sup>23</sup> Clariant provided examples of ADF suppliers able to supply UK customers when there was limited awareness of their ADF activities.<sup>24</sup>
38. Furthermore, Clariant said that there were variable weather conditions and winters in all jurisdictions and in particular across Europe. Therefore, Clariant did not consider peak demand requirements during severe winters to be a distinctive feature of the UK.<sup>25</sup>

#### *Kilfrost*

39. Kilfrost considered that there were reputational barriers to entry. It said that these were due to customers' concerns regarding security of supply which made them risk averse. It added that customers preferred to remain with tried and tested suppliers, which could guarantee supply of a high quality product and provide good customer service.<sup>26</sup> Kilfrost was of the opinion that any competitor committed to stockpiling sufficient quantities of ADF to provide security of supply was able to succeed in this industry.<sup>27</sup>

---

<sup>20</sup> [Clariant initial submission](#), paragraph 9.28.

<sup>21</sup> [Clariant initial submission](#), paragraph 9.28.

<sup>22</sup> [Clariant initial submission](#), paragraph 9.29.

<sup>23</sup> [Clariant initial submission](#), paragraph 9.29.

<sup>24</sup> [Clariant initial submission](#), paragraph 9.32.

<sup>25</sup> [Clariant initial submission](#), paragraph 9.27.

<sup>26</sup> [Kilfrost initial submission](#), paragraph 6.7.

<sup>27</sup> [Kilfrost initial submission](#), paragraph 6.7.

40. Kilfrost added that if a supplier did not have a good reputation, then it would not be able to compete. In its opinion, it would take a supplier over a decade to gain a reputation with the larger customers. It noted that the airline industry was exceptionally conservative
41. Kilfrost considered that UK customers of ADF had a preference for suppliers with a manufacturing presence and local storage facilities in the UK. This was because such companies were perceived by some customers as being better able to guarantee security of supply. However, it noted that customers were price sensitive and if a supplier were to offer sufficient storage to ensure security of supply, it said that customers could consider using them.<sup>28</sup>
42. Kilfrost said that logistics was an important part of security of supply because, it would not be possible to offer security of supply without a good logistics network.

#### *Proviron*

43. Proviron told us that in order to win contracts, suppliers would have to demonstrate that they could meet peak demand and handle worst case scenarios. It added that within the UK, there was a difference in prices charged to customers because of the difference in guaranteed lead time that customers requested. It said that a customer who wanted a delivery in one hour would pay a higher price than a customer who wanted a delivery in three days.
44. Proviron said that it only held stocks in container terminals in the UK at [X].
45. Proviron told us that a large geographic spread of ADF business all over Europe and even beyond was critical to success in the ADF business. It noted that if Proviron only had UK customers, then it would have been extremely vulnerable during periods of mild winters experienced recently.

#### *ADDCON*

46. ADDCON told us that it believed a proven track record as a reliable supplier could be established in two to three winter seasons.

#### *LNT Solutions*

47. LNT Solutions told us that incumbent suppliers maintained an advantage within the bidding process for contracts, which was borne from the risk-averse

---

<sup>28</sup> [Kilfrost initial submission](#), paragraph 3.9.

nature of customers. It said that this inhibited customers' willingness to change supplier and the nature of the bidding processes. It outlined the need for a supplier to demonstrate its ability to maintain security of supply during volatile weather conditions and that this was judged through past performance (by way of references).<sup>29</sup>

### *Customers*

48. [X] currently purchases Type IV ADF from [X] and Type I ADF from [X]. [X]. [X] told us that [X] supplied it ADF for around 20 years prior. [X], Clariant won a tender in [X] for the supply of Type IV ADF. [X] were the only two bidders in the tender. [X] gave the following reasons for choosing [X]:
- (a) [X] ADF was more innovative, which had better holdover times as well as colour coding properties.<sup>30</sup>
  - (b) [X] offered a significantly better price [X].
  - (c) The route from [X] (closer) storage facilities in [X] was less likely to be affected by adverse weather than supply from [X]. [X] relied predominantly on road transport, but [X] could transport ADF on rail and road.
49. [X] also told us that other suppliers had not been able to meet its needs because their fluids did not meet its specifications and/or they could not supply the volumes required.<sup>31</sup> It also said it only considered [X] because of their trusted reputations.
50. [X] told us that it did not consider other suppliers such as ABAX, LNT Solutions and ADDCON because it was not familiar with them.

### *Stock working capital*

#### *Kilfrost*

51. Kilfrost told us that it stored ADF in [X] locations in the UK. It also held [X] stocks of MPG at its Haltwhistle site.

---

<sup>29</sup> [LNT Solutions hearing summary](#), paragraph 23.

<sup>30</sup> Colour coding properties allow one to see which parts of the aircraft had de-iced.

<sup>31</sup> [X] requires around [X] of ADF as would be required in an extraordinary winter such that the one experienced in 2011.

52. In its assessment of the Kilfrost acquisition, Clariant valued the stock held by Kilfrost at £[redacted] million, of which £[redacted] million was in the UK.
53. [redacted] records that [redacted] stocks, mainly in [redacted] containers, each holding [redacted] litres, are held at [redacted] sites [redacted], close to key customers. Strategic raw material stocks are [redacted] held in [redacted] and also in the [redacted] (Antwerp) toll blending facility.
54. The chart below shows Kilfrost's historic stock levels. The chart shows [redacted] the effects of the milder winters (than expected) of 2013/14 and 2014/15. Kilfrost also told us that it managed its stock in a way that it [redacted].

**Figure 1: Kilfrost UK stock levels**

[redacted]

Source: [redacted].

55. Kilfrost told us that if a customer wanted to have stock located near it in a particular location, then [redacted].

#### *Clariant*

56. [redacted].
57. Clariant told us that it managed its stock levels [redacted]. For example, it started with [redacted] stock levels just before the winter, it then [redacted] stock levels until [redacted]. Then it decided whether to [redacted] ADF ([redacted]) depending on the weather forecast. Then by [redacted] it tried to [redacted]. [redacted]. It added that it also [redacted] always amounting to [redacted] to offer security of supply.
58. Clariant also said that it managed its [redacted] level. This included the financing of any working capital via debt or equity. It added that [redacted].
59. Clariant told us that despite [redacted] holding about [redacted] of ADF in stock, it still required delivery within [redacted] hours. It pointed to this example to highlight that Clariant did not see huge variations in customer expectations regarding lead times.

#### *LNT Solutions*

60. LNT Solutions told us that it had considered a model where the risks of security of supply and stock were shared between the supplier and customer. This was because other suppliers already took on all of the risk, and hence there was little incentive for customers to take on the risk. It however noted that through innovative solutions it had developed some degree of risk sharing at certain locations in North America.

### *Customers*

61. [X] told us that its storage capacity was [X] litres held across [X] airports.
62. [X] said it always kept at least [X] of supply in storage at the airport in case of a prolonged storm. It also had two [X] litre tanks at [X] and two tanks with about [X] litres that it used to transport some fluid from [X]. It said that its storage capacity could cover around two month's usage in the UK.
63. [X] also said that it held contingency stock in [X] and that it had storage of approximately [X] litres. It added that assuming a mild winter with a steady usage (ie no peak weeks), the [X] litres would last for approximately [X].
64. [X] told us that it had nearly [X] litres of storage across its network of tanks, plus what it could hold in the rigs.
65. [X] said that it had [X] litres of local airside storage capacity.
66. [X] told us that it only kept around [X] litres in stock due to low usage.
67. [X] told us that it held enough stock on site and that it had storage of approximately [X] litres, which could last for a [X] depending on the weather.
68. [X] told us that it stocked ADF, the quantities of which it considered adequate.

### *Switching costs*

69. Clariant told us that the customer did not have to change its infrastructure in order to change supplier. It added that all fluids were interchangeable in existing equipment.
70. [X] told us that that it sourced its ADF primarily from Kilfrost [X]. It told us that switching suppliers involved approving the other fluid manufacturer, a process that could take several months. It added that approval would need to be sought from all affected airlines. [X].
71. [X] told us that switching suppliers would be onerous for it for a number of reasons. First, the current tanks and rigs would need to be emptied, washed out by an external company at a great cost and time. Second, the tanks and rigs would need to be relabelled with new details. Third, staff would have to retrain to operate the new fluid in use. It estimated the costs to wash tanks was £1,000 with disposal costs.
72. [X] told us that a significant concern in changing supplier (of ADF) was that the current tanks would need to be drained and cleaned, prior to them being

used by a competitor's fluid. It considered that this process was disruptive to its operation and that it would incur costs.

73. [X] told us that switching suppliers would entail the removal and/or use of old stock and cost up to £5,000 plus costs of removal. [X].
74. [X] told us that it bought ADF from Kilfrost only because of Kilfrost's service record and that it was unaware of other credible supply options in the UK. Hence, it had not considered switching. It added that in order to switch to an alternative supplier a full tender process including due diligence would have to be undertaken. It added that this task could take between one and three months to complete, subject to urgency.
75. [X] told us that it had not considered switching in the last five years. In order to switch, the [X] would have to give notice of termination and re-tender the requirement. It said that this would probably take in the region of six to nine months to get a new supplier in post assuming its products met the [X] specifications.
76. [X] told us that switching suppliers would be very simple and not costly – it involved cleaning the storage tanks.

### **Economies of scale and scope**

77. In this section we look at whether there are economies of scale in relation specifically to the purchase costs of MPG (the most significant cost category) and manufacturing costs. In addition, we also consider whether there are any economies of scope in terms of the manufacture (and transport) of ADF and related products such as rail de-/anti-icing fluid which may act as a barrier to entry.

### ***Economies of scale***

#### ***ABAX***

78. ABAX told us that it found the UK market difficult in light of competition from [X], which could procure MPG cheaply.

#### ***Clariant***

79. Clariant told us that economies of scale in the supply of ADF could potentially come from the [X].
80. Clariant told us that a supplier of ADF did not need a critical mass of customers to be able to operate successfully. It added that to begin supplying

in the UK, it was sufficient for a potential entrant to win one customer contract of sufficient substance to set up the logistical capabilities to service that customer. It said that the straightforward nature of the supply chain meant that capacity could be quickly run up and involved limited investment. It considered production to be flexible and could be easily subcontracted to tolling companies.<sup>32</sup> Clariant did not consider that the need for rapid increases of capacity in times of high demand would act as a barrier to entry in the UK.<sup>33</sup>

#### *Kilfrost*

81. Kilfrost told us that the [REDACTED] was the main source of economies of scale in ADF business. It said there were some cost advantages in logistics [REDACTED].

#### *Proviron*

82. Proviron told us that turnover and volumes were not good indicators of the viability of an ADF business: a supplier could achieve a high turnover and high volumes, but make significant losses. It also told us that it bought MPG from multiple sources both on the spot market and contract market.
83. Proviron considered that Kilfrost's geographical advantage of being based in the UK was such that it could influence the profitability of its competitors and thus the profitability of entry and exit in the UK.

#### *ADDCON*

84. ADDCON noted that it would be commercially more advantageous as an overseas manufacturer to focus on winning contracts at specific airports rather than on a UK-wide basis. It added that there could be a trade-off between gaining sufficient scale and profitably producing (and supplying) ADF in the UK. Therefore, it considered that the costs to market ADF UK-wide and diseconomies of scale hindered its ability to compete in the UK. [REDACTED].

[REDACTED]

85. [REDACTED] told us that Clariant was its [REDACTED] customer of MPG in the EEA in 2015 accounting for approximately €[REDACTED] million of sales revenue with Clariant (and Kilfrost) accounting for [REDACTED] of the MPG sales for ADF.

---

<sup>32</sup> Clariant initial submission, paragraph 9.27.

<sup>33</sup> Clariant initial submission, paragraph 9.27.

### ***Economies of scope***

86. Clariant said that there was some scope to switch production lines between different types of ADF. However, it would involve cleaning the tanks. It also told us that the vast majority of MPG that it purchased was for ADF. However, it also purchased some MPG for use in solar panels and shampoo.
87. Kilfrost said that even though it was technically possible to switch production between different types of ADF in a short period of time, [X]. This was because the decision to produce the different types of ADF and dedicate the production lines [X].
88. Proviron also said that Types I, II and IV were produced on dedicated production lines. Hence, it did not run any other product on those dedicated production lines.

### **Technical barriers**

89. In this section we look at the key technical barriers relating to proprietary formulae and recipes of ADF that are required by suppliers. Existing producers of ADF would already have overcome these technical barriers.
90. Therefore, an important consideration is whether manufacturers of products related to ADF or those not related to ADF would face significant technical barriers, or whether they could circumvent these barriers by entering into licensing arrangements with approved manufacturers.

### ***Clariant***

91. Clariant told us that suppliers of products related to ADF, such as runway de-icing products, or MPG had the necessary technology and expertise to easily develop ADF products and enter the market. It gave the examples of LNT Solutions and ADDCON, which it said were leading providers of runway de-icing products. It also said that a supplier could enter into a licence arrangement with an approved ADF manufacturer to provide that manufacturer's product to UK customers, as an alternative to developing its own formula.<sup>34</sup>

### ***Kilfrost***

92. Kilfrost noted that technical barriers existed in relation to formulae required to manufacture ADF, which was a trade secret (and sometimes patent

---

<sup>34</sup> [Clariant initial submission](#), paragraph 9.8.

protected). It also noted the following to highlight that technical barriers to enter the UK ADF market were not high:

- (a) there were a number of suppliers of ADF that already had the necessary know-how to produce ADF to be sold in the UK;
- (b) other companies (such as chemical companies) had the necessary expertise to develop formulae for ADF; both of these groups could switch to supplying ADF in the UK; and
- (c) a number of manufacturers of ADF worldwide could, and did, license their formula to other suppliers, thus negating the need for a supplier to have to devise its own formula to enter the market.<sup>35,36</sup>

### *ADDCON*

- 93. ADDCON told us that it took one and a half years to develop a Type I ADF and obtain approval. It explained that developing and manufacturing Type I ADF was easier than developing Type II and IV ADF because the formulation for Type I ADF was less complex. Types II and IV ADF required more experience, mainly due to the viscosity of the product. ADDCON expected that it would take two to two and a half years to develop Type II and IV ADF. [REDACTED]. It would cost €[REDACTED] for the development and accreditation of the new two types of de-icer, with full European-wide approval.<sup>37</sup>
- 94. ADDCON noted that developing a formula and processes to manufacture ADF was one of the main barriers to entry into this market as this was proprietary information of each manufacturer. It also noted that in order to be a credible supplier of ADF, a manufacturer had to offer the full range of ADF (Types I – IV) because most contracts with customers were for the full range (excluding Type III ADF in Europe) of ADF. It added that single product suppliers could only be considered as minor players.

### *LNT Solutions*

- 95. LNT Solutions told us that it took about three years to develop and test a Type II or Type IV ADF from scratch.<sup>38</sup>

---

<sup>35</sup> [Kilfrost initial submission](#), paragraph 6.1.

<sup>36</sup> [Kilfrost initial submission](#), paragraph 6.2.

<sup>37</sup> [ADDCON hearing summary](#), paragraph 2.

<sup>38</sup> [LNT Solutions hearing summary](#), paragraph 12.

## *Proviron*

96. Proviron told us that highly qualified technical, operational and commercial people who had long-term background/experience in the ADF business were critical to success in this business.

## **Legal barriers**

97. The main legal barrier relates to the certification of ADF products.

## *Clariant*

98. Clariant did not consider that the certifications and approvals required for the development of new ADF products were a significant barrier to entry and did not consider this testing to be complex or costly.<sup>39</sup> It also told us that it was relatively easy for new suppliers to obtain certifications, operate under licences or arrange tolling arrangements with existing suppliers.<sup>40</sup> It also submitted that it would not be possible for a large supplier to influence standard setting to its advantage.<sup>41</sup> It said that the qualification/certification process usually took up to six months.
99. In terms of the costs of accreditation, Clariant gave the following estimates:
- (a) Type I ADF: SMI testing was between £[redacted] and £[redacted]; AMIL testing was between £[redacted] and £[redacted]; and snow testing was not required.
  - (b) Type II and IV ADF: SMI testing was between £[redacted] and £[redacted]; AMIL testing was between £[redacted] and £[redacted]; and snow testing costs were between £[redacted] and £[redacted].
100. Clariant highlighted that there were a number of potential suppliers that operated outside the UK and that these suppliers already had approved products. Therefore, Clariant said that these suppliers could enter the UK quickly and easily.<sup>42</sup>

## *Kilfrost*

101. Kilfrost did not highlight any legal or regulatory requirements that gave rise to significant barriers for suppliers to enter the UK ADF market. It added that suppliers could enter the UK market from other geographic regions. Suppliers

---

<sup>39</sup> [Clariant initial submission](#), paragraph 9.19.

<sup>40</sup> [Clariant initial submission](#), paragraph 9.8.

<sup>41</sup> [Clariant initial submission](#), paragraph 9.20.

<sup>42</sup> [Clariant initial submission](#), paragraph 9.18.2.

could also enter through licensing (from other suppliers), which would entail minimal legal or regulatory requirements.<sup>43</sup>

### *ADDCON*

102. ADDCON told us that certification and approval of ADF was undertaken for each production site. If a production site was changed, the manufacturer would need to seek re-certification. ADDCON also noted that the Merger (between Kilfrost and Clariant) could raise the barriers to entry and expansion. It said that larger manufacturers could influence standard setting bodies by pushing the improvements of their own innovations (through their research and development) to become standard requirements for the whole industry. It added that this could increase the (sunk) research and development costs for suppliers and therefore disadvantage smaller suppliers.

### *LNT Solutions*

103. LNT Solutions told us that once the ADF formulation had been finalised, there was additional pre-approval testing. This costs about £[redacted] per fluid type. It added that testing took place in climatic chambers and there was material testing. Also, approval was required from three test houses: AMIL in Canada, APS in Canada and SMI in the USA. It also said that the results applied near-globally, although in some countries (not the UK) there may be extra environmental testing required. LNT Solutions added that there could also be additional client and regional specific tests required to enable entry into that particular market. It clarified that in the UK, if the ADF passed the specifications, there was no additional government approvals required. However, some retesting had to be done every two years.

### *Esseco*

104. Esseco considered the time and costs to get accredited to become a blender were significant and prohibitive, as discussed in more detail in relation to the ability of ADF suppliers to identify blenders in the UK.

---

<sup>43</sup> [Kilfrost initial submission](#), section 6.

## Glossary

<b>ABAX</b>	ABAX Industries SPCA, a French producer of hygiene and industrial cleaning products, as well as <b>ADF</b> .
<b>ADDCON</b>	ADDCON Europe GmbH, a manufacturer of <b>ADF</b> , as well as runway de-icer, food products, feed additives and oil-drilling fluids.
<b>ADF</b>	<p>Anti- and de-icing fluid for use on aircraft. De-icing covers the removal of frost, ice slush and snow from aircraft in order to provide clean surfaces, Anti-icing is protection against the formation of frost or ice and the accumulation of slush or snow on treated surfaces of the aircraft for a given period of time.</p> <p>ADF falls into four categories. Except where stated, we use the term ADF to refer to Types I, II and IV only.</p> <p>We use ADF in both a singular and a plural form.</p>
<b>AEA</b>	Association of European Airlines, a trade association.
<b>AllClear</b>	AllClear Systems LLC, a Pennsylvania-based provider of aviation de-icing products.
<b>AMIL</b>	The Anti-icing Materials International Laboratory, an engineering research laboratory associated with the University of Quebec at Chicoutimi.
<b>AMS</b>	Aerospace Material Specifications, standards produced by SAE International. AMS 1424 relates to <b>Type I ADF</b> and AMS 1428 relates to <b>Types II, III and IV ADF</b> .
<b>APA</b>	Asset Purchase Agreement
<b>BASF</b>	BASF SE is a chemicals manufacturer headquartered in Germany.
<b>Blending/blender</b>	The process of combining glycol, additives and water to create a concentrated <b>ADF</b> product.
<b>Boryszew</b>	Boryszew SA, a Polish chemicals company.

<b>Clariant</b>	Clariant AG, a Swiss-based global specialty chemicals company.
<b>Concentrate</b>	A form of <b>ADF</b> containing glycol, additives and water. Concentrated ADF may be diluted by the customer in a specified proportion.
<b>Deicing Solutions</b>	Deicing Solutions LLC is a manufacturer and distributor of <b>ADF</b> , based in New Hampshire.
<b>Dow</b>	Dow Europe GmbH, part of The Dow Chemical Company, a US multinational chemicals company. Dow Chemicals, where used, refers to the US parent.
<b>EEA</b>	European Economic Area.
<b>Esseco</b>	Esseco UK, a Wakefield-based manufacturer of chemicals. Esseco UK is a wholly owned subsidiary of Esseco Group based in Italy.
<b>Glycol</b>	See <b>MEG</b> and <b>MPG</b> .
<b>Ground handler</b>	Ground handlers provide a number of services to airlines. These may include cabin cleaning, passenger services, luggage handling, towing, refuelling and de-icing.
<b>Holdover time</b>	The estimated time for which an anti-icing fluid will prevent the formation of frost or ice and the accumulation of snow on the protected surfaces of an aeroplane, under specified weather conditions.
<b>IBC</b>	Intermediate bulk container, a stackable container mounted on a pallet designed to be moved using a forklift or a pallet jack. IBCs have a volume range that is situated between drums and tanks, hence the term 'intermediate'.
<b>IDS</b>	Integrated Deicing Services LLC, a de-icing services supplier based in the USA.
<b>Ineos</b>	Ineos Manufacturing Deutschland GmbH, part of Ineos Group Limited, a multinational chemicals company headquartered in Switzerland.
<b>IP</b>	Intellectual property.

<b>ISO container</b>	ISO or intermodal containers are used for the intermodal transport of freight. They are manufactured according to specifications from the International Organization for Standardization (ISO) and are suitable for multiple transportation methods such as truck, rail, or ship. Liquids are carried in the ‘tank container’ type ISO container.
<b>Kilfrost</b>	Kilfrost Group Public Limited Company, a family owned UK-based manufacturer and distributor of anti/de-icing products to the civil aviation and transportation industries.
<b>LNT Solutions</b>	LNT Solutions Limited, a division of LNT Group. LNT Solutions primarily supplies <b>ADF</b> , runway de-icing fluid and rail track adhesion products. It also supplies related retail products for facility management.
<b>LyondellBasell</b>	LyondellBasell Industries NV, a chemical company headquartered in the Netherlands.
<b>MEG</b>	Mono-ethylene glycol, a chemical commonly used for antifreezes and coolants. MEG is used in <b>Type III ADF</b> . However, the use of MEG in ADF is prohibited in the <b>EEA</b> for environmental reasons.
<b>Merger</b>	The anticipated acquisition by <b>Clariant</b> of the <b>Target Business</b> from <b>Kilfrost</b> .
<b>MPG</b>	Mono-propylene glycol, a chemical used in a wide range of industries and products including food production, paints, detergents, antifreeze and cosmetics.
<b>Pre-mixed</b>	A form of <b>ADF</b> in which the manufacturer has diluted the ‘concentrated’ product in advance on the customers’ behalf. Pre-mixed may be used where the customer is unwilling or unable to use the water available at its own location.
<b>Proviron</b>	Proviron Functional Chemicals NV, a Belgian chemicals manufacturer and supplier of <b>ADF</b> .
<b>Repsol</b>	Repsol Quimica SA, part of Repsol SA, a multinational energy company based in Spain.
<b>SAE</b>	SAE International (formerly the Society of Automotive Engineers), a US-based professional association and standard-setting body.

<b>SMI</b>	Scientific Material International, an independent laboratory that conducts <b>AMS</b> specification tests.
<b>Target Business</b>	<b>Kilfrost's</b> European <b>ADF</b> business, the rail de-/anti-icing fluid business and associated assets.
<b>Type I ADF</b>	Type I ADF is used only for de-icing aircraft (the removal of frost, ice, slush or snow), while Types II and IV can be used for both de-icing and anti-icing (the protection against the formation of frost or ice and accumulation of slush or snow), as they contain thickeners to increase their viscosity.
<b>Type II ADF</b>	Type II ADF is used for both de-icing and anti-icing (the protection against the formation of frost or ice and accumulation of slush or snow) as it contains thickeners to increase its viscosity.
<b>Type III ADF</b>	Type III ADF generally contains <b>MEG</b> and is not supplied in the <b>EEA</b> . Except where stated, we use the term ADF to refer to Types I, II and IV only.
<b>Type IV ADF</b>	Type IV ADF is similar to Type II, with a longer <b>holdover time</b> when used in concentrated form.