Environment Agency

Evidence

Reasons for trends in English refuse derived fuel exports since 2010

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Miranda Kavanagh

Director of Evidence

Executive summary

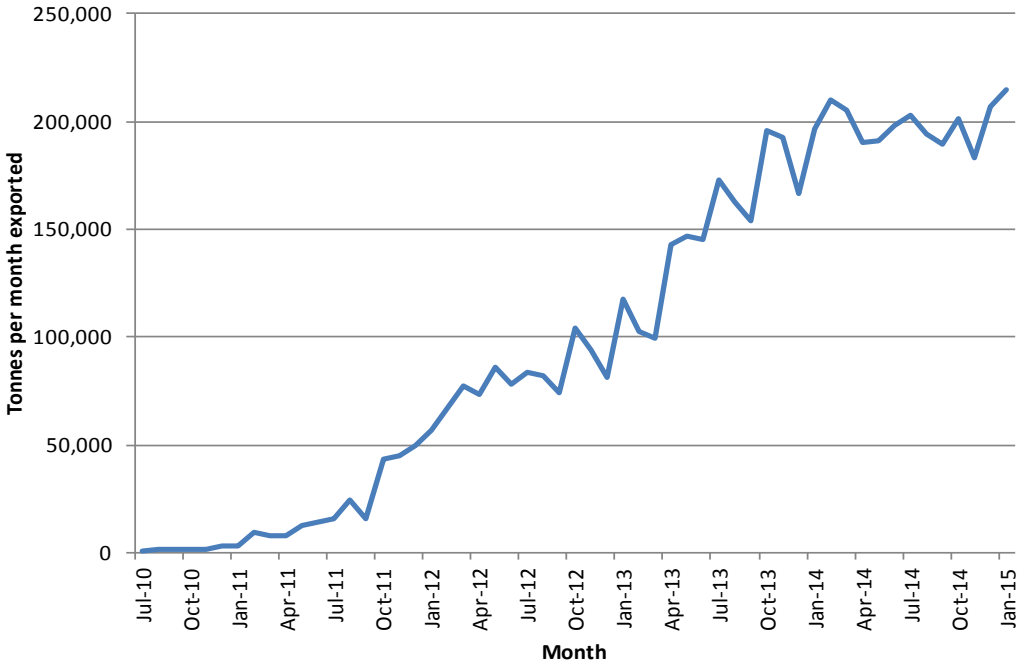
Background

Refuse derived fuel (RDF) can be defined as material that is produced from waste, has undergone some sort of treatment process, and is intended for use as a fuel. There is no single standard for RDF but end-users provide their own specifications based on calorific value, ash content and chlorine levels in the fuel.

Some of the available data cover the whole of the UK, while some cover only England. However, as around 80–85% of total UK RDF (if not more) comes from England, this report uses the simplifying assumption of treating all datasets as if they cover just England.

Exports of RDF from England went from zero in June 2010 to just over 215,000 tonnes in January 2015. The majority of these exports were to the Netherlands, with Germany and Sweden beginning to increase in importance from mid to late 2013.

Quantity of RDF exported from England, July 2010 to January 2015



Notes: Data for the months before November 2014 are for England and Wales. Data after that point are for England only.

Defra and the Environment Agency wanted to know what factors were behind the sudden emergence and growth of this market. By understanding why the RDF export market has developed in the way it has, it was hoped that an outline of where it might go in the future could be produced, which would inform both policy development and the allocation of regulatory resources.

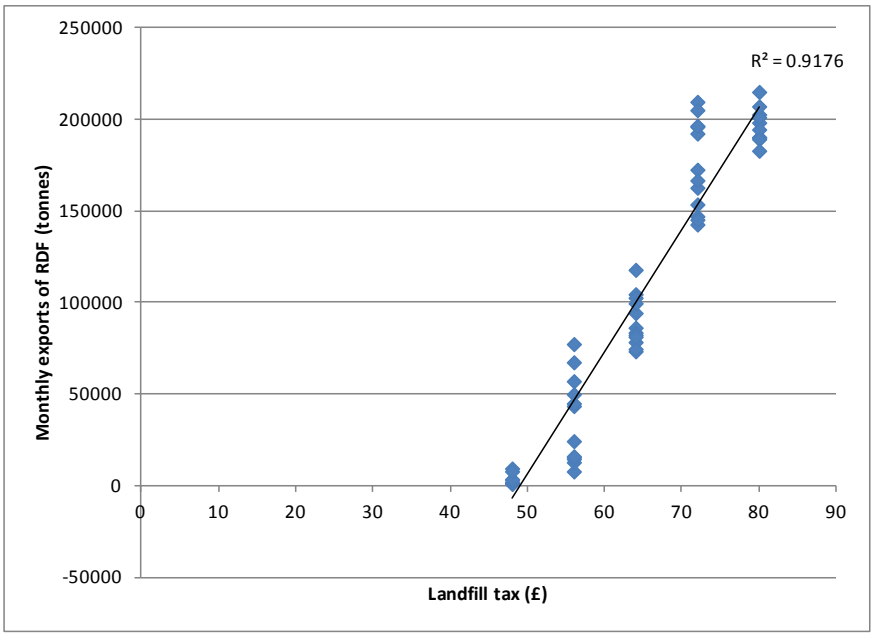
Results

Evidence from industry contacts, as well as a basic quantitative analysis of the English RDF export market produced as part of this project, provided an explanation for the trend in exports of RDF from England since 2010.

The market began in June 2010 after a regulatory decision by the Environment Agency based on the UK Plan for Shipments of Waste, which allowed the export of RDF. It has grown rapidly since due a greater demand for energy from waste (EfW) capacity than currently exists in England. This in turn was caused by material being shifted from landfill by the landfill tax and landfill diversion targets, and the lower cost of some continental European EfW facilities.

This demand has meant it is economic to produce RDF and export it to continental Europe, especially the Netherlands, Sweden and Germany, provided these routes cost less than disposal in English landfills. The landfill tax has therefore been a key driver in diverting waste from landfill and consequently for the RDF export market. This is shown by the high correlation between export levels and landfill tax rates, with continental EfW facilities setting their gate fees at a level designed to just undercut this disposal route.

Relationship between RDF exports from England and the level of landfill tax



The data also show that the market may be levelling off as RDF export routes become as expensive as English landfills.

To explore the future direction of the RDF export market, this analysis could be used as part of a scenario planning exercise by a group of experts in the area.

Acknowledgements

I would like to thank all those people who provided their expert advice and opinions as part of this work, in particular Ken Doran at Seneca Environmental Solutions Ltd. I would also like to thank the two peer reviewers of this report, Professor Amrita Dhillon and Professor David C. Wilson, who provided invaluable comments on an earlier draft of this paper. Any mistakes and omissions remain my own.

Contents

1 Introduction

This report is in response to a desire by the Department for Environment, Food and Rural Affairs (Defra) and the Environment Agency to know what factors were behind the sudden emergence and growth of the market for refuse derived fuel (RDF) from England since 2010. By understanding why the RDF export market has developed in the way it has, it was hoped that an outline of where it might go in the future could be produced, which would inform policy development and the allocation of regulatory resources.

Understanding what has caused the trend in exports of RDF from England since 2010 requires the collation and analysis of relevant data and the production of a basic quantitative analysis of the market.

In terms of defining the market, RDF can be defined as material that is produced from waste, has undergone some sort of treatment process and is intended for use as a fuel. Although different operators carry out different levels of treatment, broadly speaking there are the following processing stages. A proportion of the recyclates (for example, metals and plastics) is removed from the refuse. The residue is shredded and mixed with other residues to meet a particular specification, before the resulting material is baled. There is no single standard for RDF but end-users provide their own specifications based on the calorific value, ash content and chlorine levels in the fuel.

Although the RDF export market is not new it has many of the features associated with the market of, say, tablet computers after the launch of the iPad, notably:

- a high rate of growth
- multiple new entrants to the market
- a lack of clear ‘product’ standards
- a lack of standardisation of production methods, business models and supply chain relationships

More information on the structure of the RDF export market is given in Section 3.2.

The aim of this report is to try to understand what has caused the trend in exports of RDF from England since 2010 as is shown in Figure 1.1. Four aspects of this trend require explanation.

- Why did exports begin in July 2010 and not before?
- Why has the overall trend been one of rapid growth?
- Why do exports appear to be levelling off?
- What might be causing the short-term fluctuations in exports from month to month?

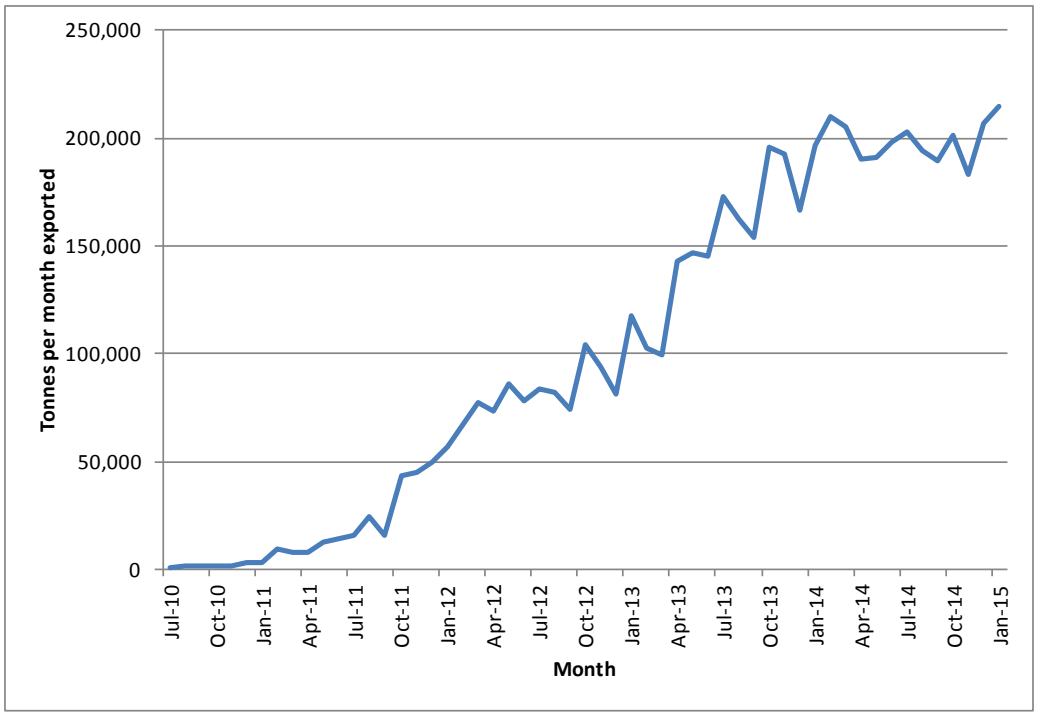


Figure 1.1 Quantity of RDF exported from England, July 2010 to January 2015

Notes: Data for the months before November 2014 are for England and Wales. Data after that point are for England only.

The source of these data is Environment Agency (2015) apart from the data points for January, February and August 2013, which come from a personal communication by N. Homer (Senior Technical Officer, Environment Agency).

2 Methodology

This report combines qualitative evidence from observers and participants in the market with quantitative evidence on aspects such as costs and treatment capacities.

The qualitative evidence was obtained from personal communications in 2014 from:

- J. Collis, Economic Adviser, Defra
- J. de Swart, Director, AEB Amsterdam, Netherlands
- K. Doran, General Manager, Seneca Environmental Solutions Ltd
- N. Homer, Senior Technical Officer, Environment Agency
- A. Krajewski, Sales Manager Europe, ARN Nijmegen, Netherlands
- D. Owens, Residual Waste Team Leader, Defra
- B. van Bolhuis, Director International Affairs, Ministry of Infrastructure and the Environment, Netherlands
- W. van der Mei, Head of Resource Efficiency Division, Ministry of Infrastructure and the Environment, Netherlands

Quantitative data were obtained through a literature review and attendance at the Exploratory Anglo-Dutch Round Table on Waste Management Synergies held in London on 15 September 2014. To allow comparison and analysis, these data were combined in a Microsoft® Excel spreadsheet using appropriate exchange rates and the UK gross domestic product (GDP) deflator to express all prices in 2013 pounds sterling.

A series of measures of the structures of the English and Welsh RDF export market and the foreign RDF import market were produced. Based on these measures, a conceptual framework to allow analysis of the market was proposed. A diagrammatic representation of a variety of treatment and disposal supply chains for the residual waste used to produce RDF was created and a range of costs assigned to each link in the chain.

All the information was combined to allow the four questions listed in Section 1 to be answered and conclusions drawn.

3 Quantitative data

Some of the available data cover the whole of the UK, while some cover only England. However, as around 80–85% of total UK RDF – if not more – comes from England (AMEC 2013), this report uses the simplifying assumption of treating all datasets as if they cover just England.

3.1 Export levels

Figure 1.1 charts publicly available data on total RDF exports from England. It shows that the rate of increase in exports of RDF since July 2010 has been significant.

However it is also useful to understand where RDF is being exported to. Figure 3.1 shows that the market is dominated by the Netherlands, though a closer look at the time series data in Figure 3.2 reveals a more subtle picture. While the Netherlands has provided the vast majority of the growth in exports up to late 2013, after that point export levels appear to be stabilising with growth occurring in the German and Swedish markets.

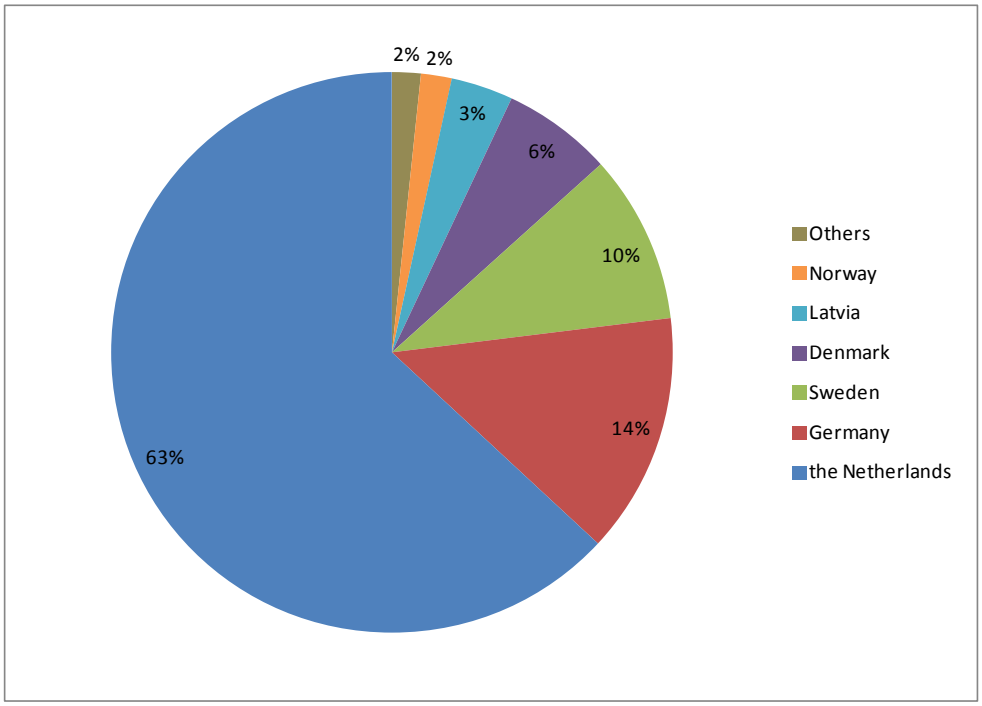


Figure 3.1 Destination of RDF exports from England, July 2010 to January 2015

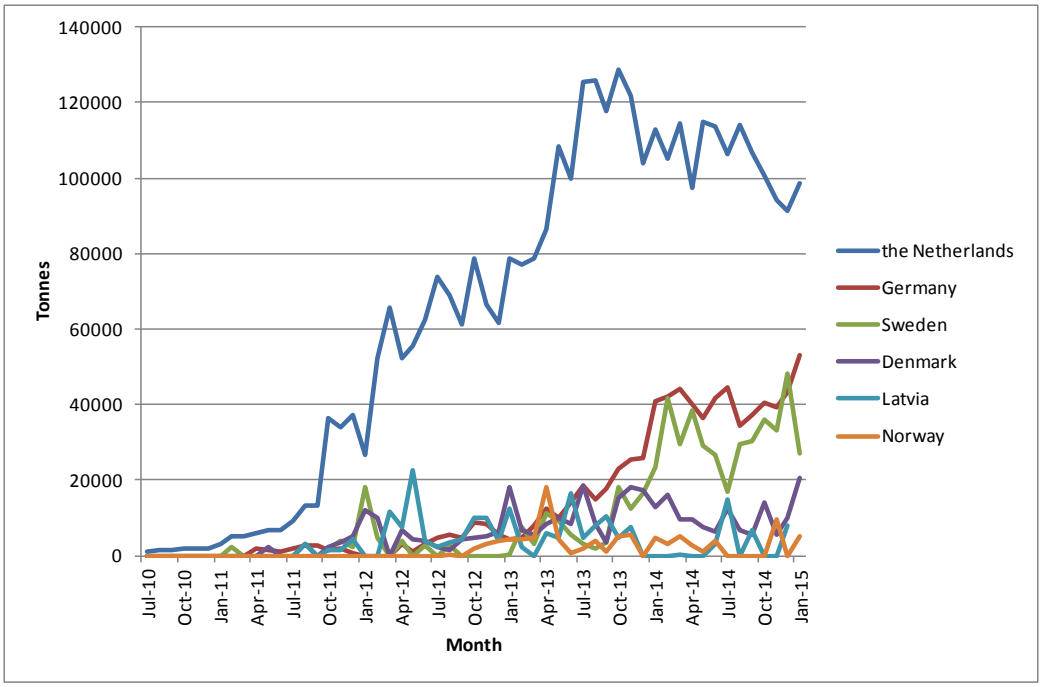


Figure 3.2 Time series of destination of RDF exports from England, July 2010 to January 2015

3.2 Market structure

Figure 3.3 shows that the number of companies active in the market each month fluctuates, but has basically followed the same trend as total exports. By January 2015 there were nearly 40 companies exporting RDF from England, a figure that had stayed relatively stable since April 2014.

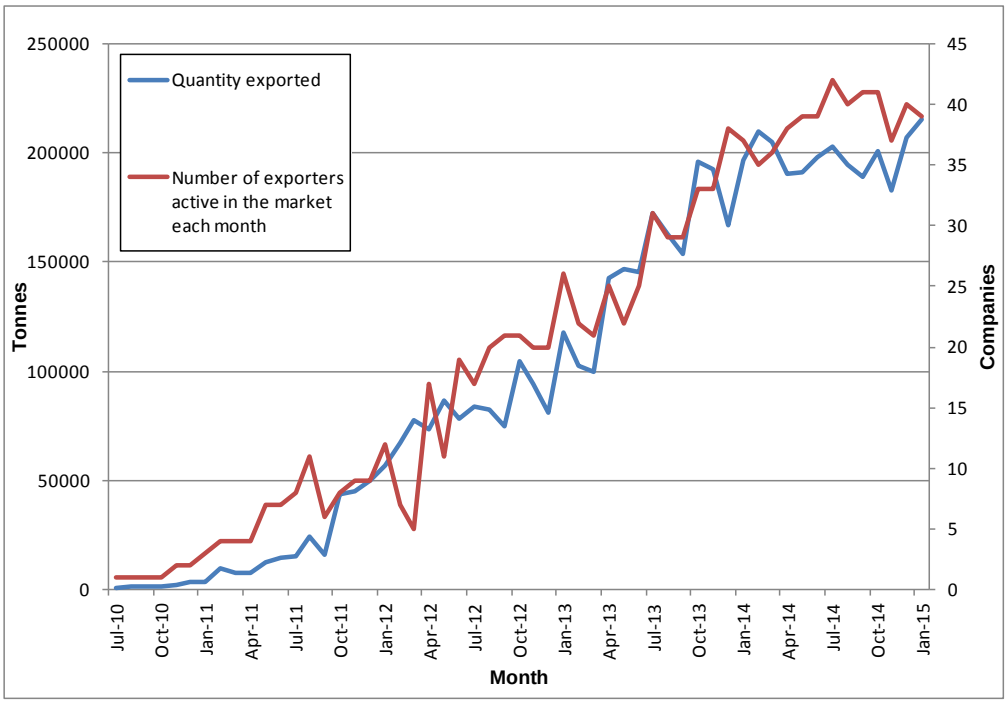


Figure 3.3 Number of companies active in export of RDF from England, July 2010 to January 2015

In terms of the total amount of RDF exported over the period from July 2010 to January 2015, Figure 3.4 shows that the market is reasonably consolidated. For example, five companies account for 50% of total exports and 12 account for around 80%.

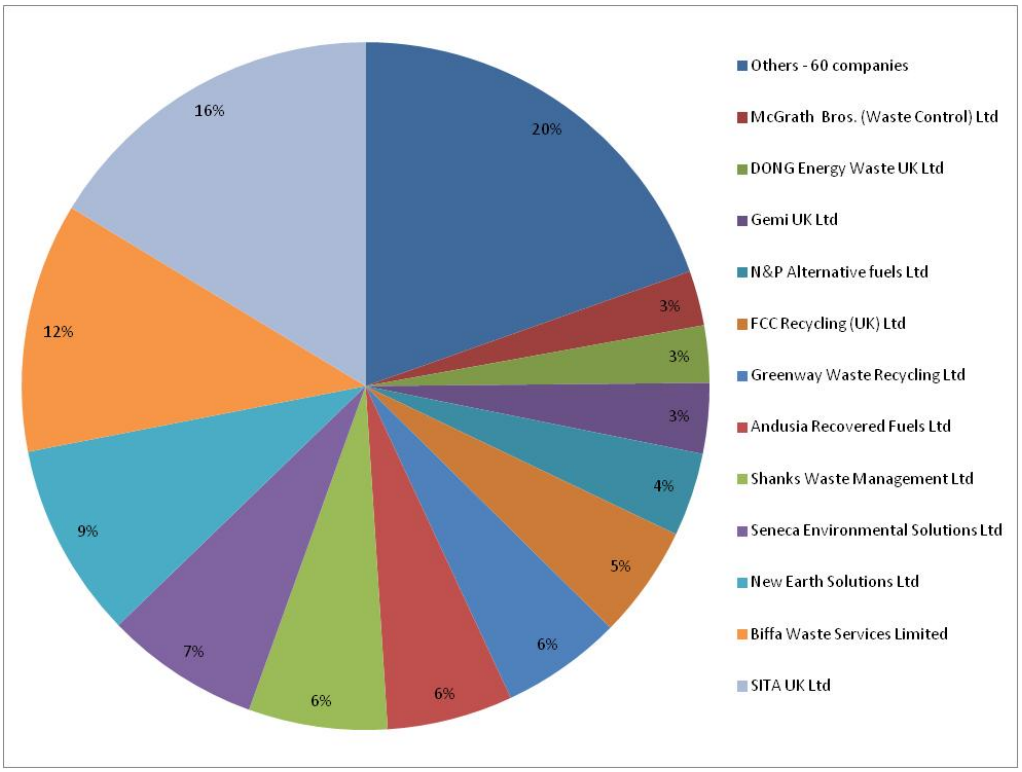


Figure 3.4 Structure of English RDF export market by total tonnage exported, July 2010 to January 2015

At the other end of the export chain, Figure 3.5 shows that nine companies import two-thirds of England's RDF – and four companies account for just over half of English RDF imports. Again this indicates a reasonably well consolidated market.

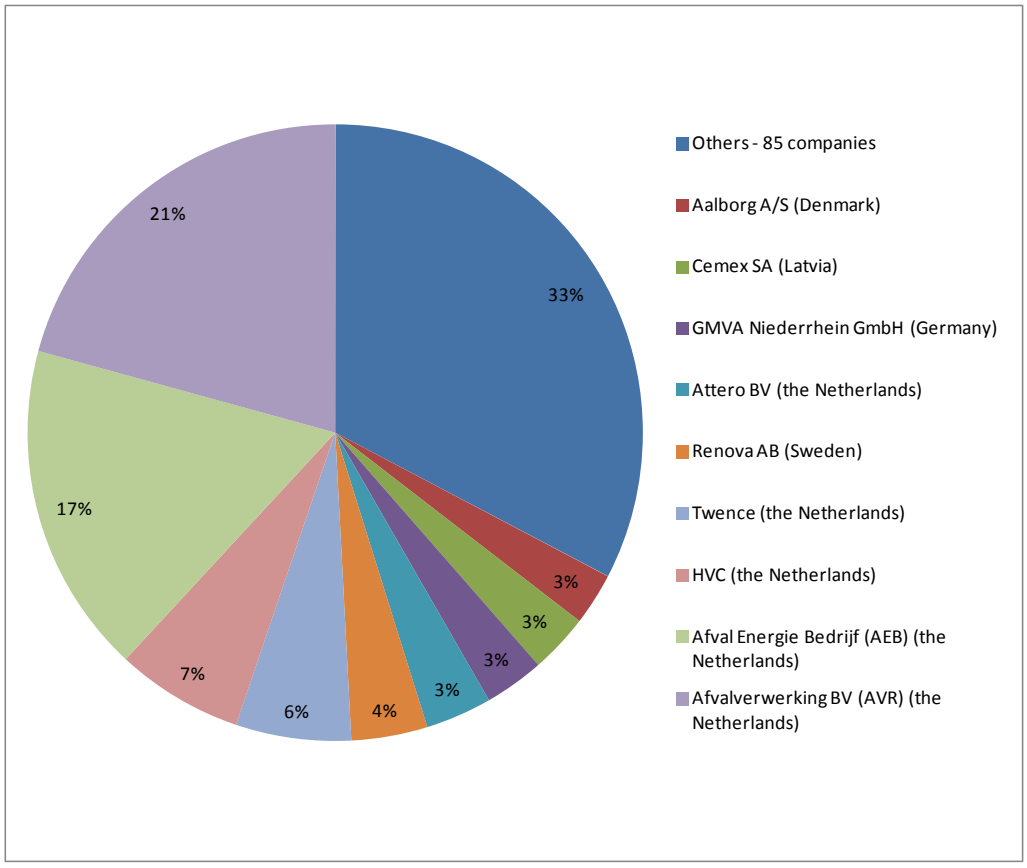


Figure 3.5 Structure of continental European RDF import market by total tonnage imported, July 2010 to January 2015

3.3 Energy from waste (EfW) treatment capacity

Figure 3.6 shows that the Netherlands has consistently had more EfW capacity than residual waste to burn, though this does not necessarily mean that the country has 'over-capacity' in its EfW sector.

This is because, from the point of view of the Dutch EfW system as a whole, the gap between capacity and supply of residual waste in the early 2000s looks more like a reasonable operating margin that allows for unplanned outages. Certainly in the late 2000s that gap starts to widen, but the market responds with the closure of AVR's Rotterdam plant in 2010. Without RDF imports, it is conceivable that more plants would have closed.

However, from a game theory standpoint, individual EfW plant operators would presumably prefer there to be no spare capacity at their plant and for that system-wide operating margin to come at the expense of one of their competitors. It is noticeable, for example, that once the RDF import market really gets going in 2012, the operating margin all but disappears. For this reason it seems reasonable to label the gap between Dutch residual waste generation and EfW capacity as over-capacity, which stood at around 0.6 million tonnes (Mt) in 2010 according to de Baedts (2014). Without imports this might have grown to approximately 1 Mt by 2012, although as stated above, it is conceivable that the market would have responded by 'shaking out' the least profitable EfW site or sites.

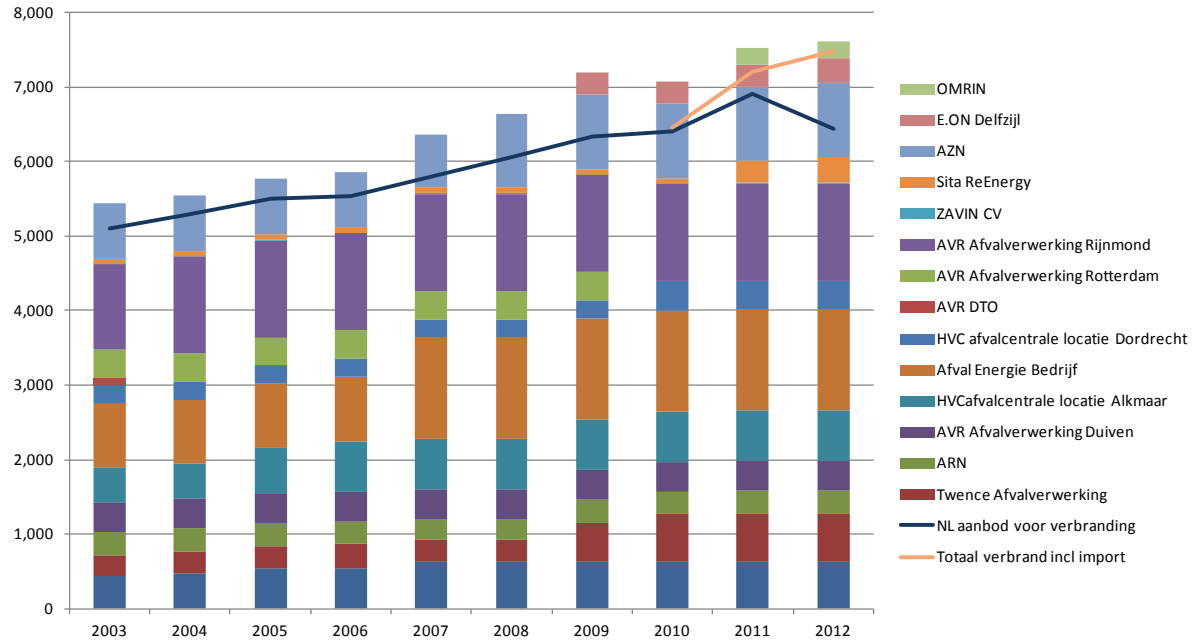


Figure 3.6 Capacity of Dutch EfW plants and amount of residual waste requiring disposal

Notes: The units on the y-axis are thousand tonnes of waste.

The blue line refers to waste generated within the Netherlands that required treatment or disposal using an EfW plant and the orange line shows the total waste requiring treatment or disposal including imports.

Source: de Baedts (2014)

A report by Tolvik Consulting gives estimates of 'over-capacity' in 2010 in the key export markets of the Netherlands, Germany and Sweden of 1.1 Mt, 4.2 Mt and 0.6 Mt respectively (Tolvik Consulting 2011), though these figures may be out-of-date. Although data on German and Swedish plants were not available within the timeframe of this report, two new plants have been built in the Netherlands since the report by Tolvik Consulting was compiled (Figure 3.6).

In 2012 to 2013, 5.5 Mt of municipal waste went to EfW facilities in England at a time when total residual waste from English local authorities was around 14 Mt (Defra 2014a). There is therefore currently less EfW capacity in England than residual waste potentially available for treatment, particularly once residual commercial and industrial waste is also taken into account. Additional capacity is expected to come on line domestically over the next few years, but most independent forecasts show levels of residual waste exceeding annual domestic treatment capacity by between 4 and 15 Mt in 2020 (Defra 2014b).

3.4 Exports from other EU Member States

Figure 3.7 suggests that, for the moment, it is not unreasonable to work with the simplifying assumption that England is the only exporter of RDF to the key continental European countries. The red segment in Figure 3.7, which becomes visible in August 2010, shows English RDF imports to the Netherlands (the main destination of English RDF exports) growing until they vastly outweigh imports from all other countries by the end of 2011.

Discussions with industry contacts suggest that England's dominance in terms of the countries exporting to the Netherlands has continued since then. Similar charts are sadly not available for Germany and Sweden, but as the Netherlands accounts for the lion's share of English RDF exports, the simplifying assumption has been retained for these countries as well. More specifically, this assumption has been retained for those plants in Germany and Sweden that import English RDF. Conversations with industry contacts suggest that German plants closer to the east of the country are dominated by imports from Poland and other eastern EU Member States.

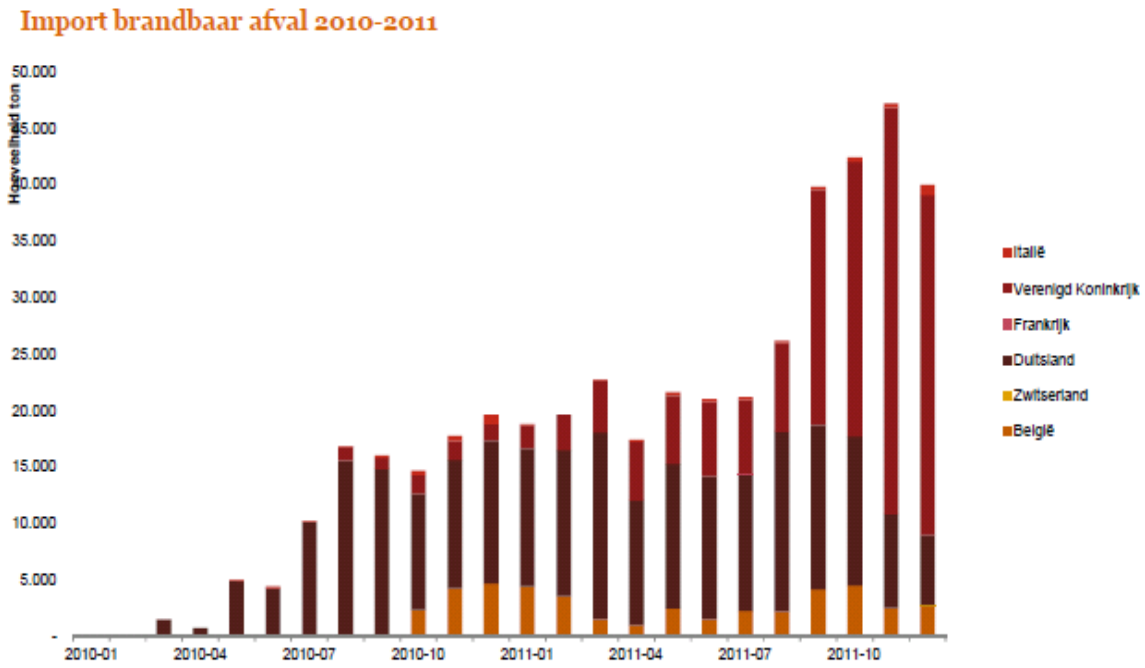


Figure 3.7 Imports of combustible waste to the Netherlands, 2010 to 2011

Note The units on they-axis are in tons.

The key reads from top to bottom: Italy; United Kingdom; France; Germany; Switzerland; and Belgium.

Source: de Baedts (2014)

3.5 Costs

Figure 3.8 summarises the different disposal and recovery routes available for residual municipal, commercial and industrial waste in England. Use of the term 'residual' suggests that all the recyclates that can be economically removed from the waste have been. Although this is unlikely to be the case in practice, this description is acknowledges that the waste that goes into producing RDF has undergone some level of treatment in terms of recyclate removal.

Figure 3.8 provides a framework for assessing the price of a range of English recovery and disposal options. As set out in Section 5, much of the data used to build up the prices of these different options are given as costs. However, discussion with industry contacts suggests that it is not unreasonable to assume that cost and price are equivalent in this context.

There are three important assumptions in Figure 3.8.

- Illegal waste sites have not been included as a disposal or recovery route because of the difficulty of getting hold of gate fee data.
- Only export routes from England to the Netherlands, Germany and Sweden have been included.
- There are no competing disposal or recovery export routes from other countries into those plants handling English RDF in the Netherlands, Germany and Sweden.

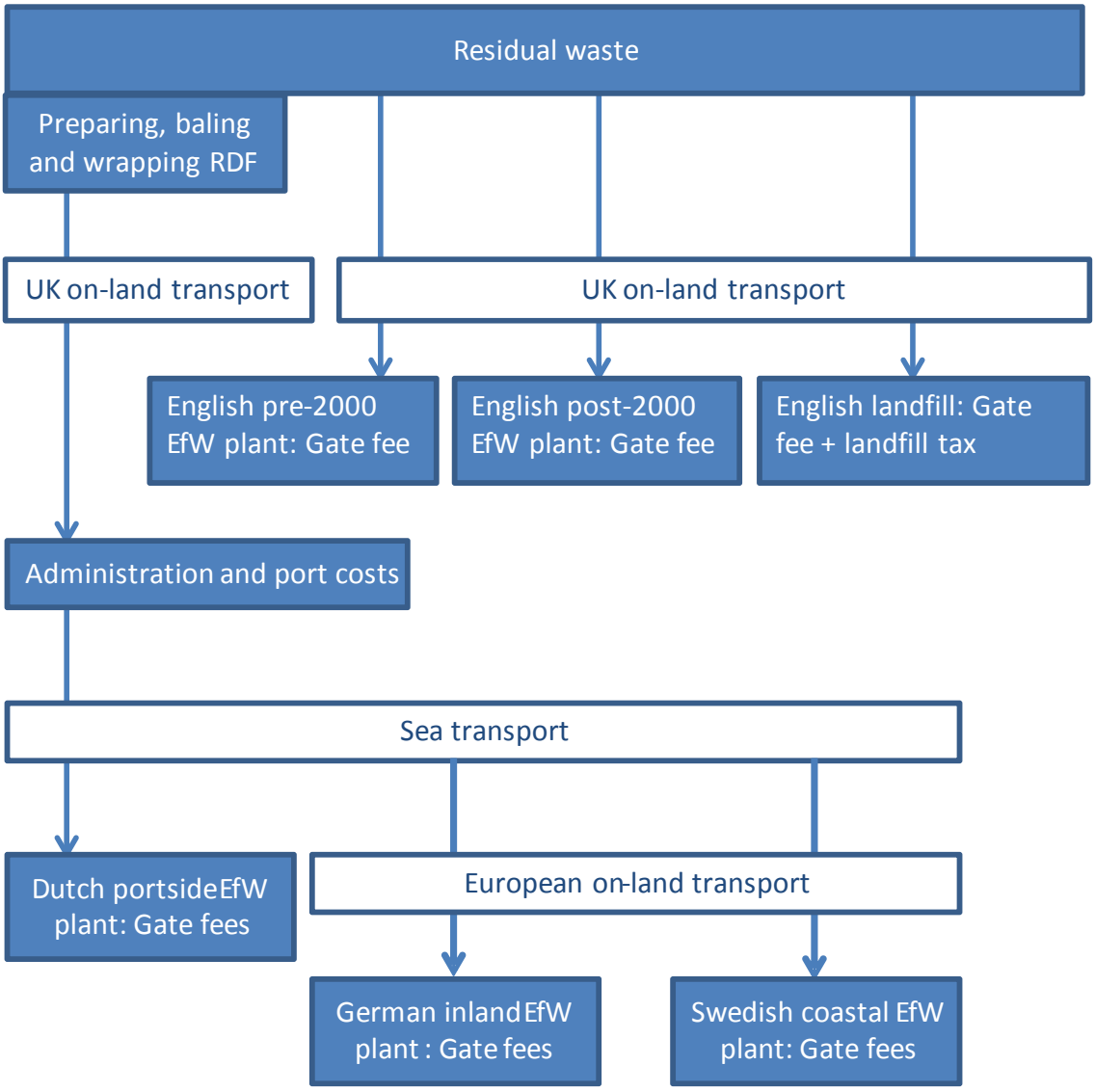


Figure 3.8 Disposal and treatment supply chains for residual waste

Note The split between pre-2000 and post-2000 English EfW plants comes from data supplied by WRAP.

Table 3.1 shows the range of values used to estimate the costs of each disposal or recovery route. All prices have been converted from euros to pounds sterling using average annual historical exchange rates (OANDA 2014).

The sea transport costs in Table 3.1 were calculated using data from Freightlink for a return journey for a single articulated lorry with an assumed payload of 40 tonnes. Given the volumes of RDF being exported, it is unlikely that this is the logistical option of choice for larger consignments. Nevertheless, it is in line with the values quoted by AMEC (2013) and so has have used as a data source, albeit with some caution.

Table 3.1 Values used to estimate costs of different disposal or recovery routes, 2014 to 2015

	Preparing, baling and wrapping RDF[1]	English on-land transport[2]	Landfill tax[3]	Port costs[4]	Sea transport[5]	European on-land transport[6]	Gate fees[7]	Total
Pre-2000 English EfW	£0	£5–10	n/a	n/a	n/a	n/a	£35.36–101.02	£40.36–111.02
Post-2000 English EfW	£0	£5–10	n/a	n/a	n/a	n/a	£62.63–113.14	£67.63–123.14
English landfill	£0	£5–10	£80	n/a	n/a	n/a	£9.09–44.45	£94.09–134.45
Dutch EfW	£16.93–24.59	£5–10	n/a	£4.10–8.20	£0–10	£0	£32.79–49.18	£58.28–101.97
German EfW	£16.93–24.59	£5–10	n/a	£4.10–8.20	£0–20	£15	£43.84–61.38	£84.34–139.17
Swedish EfW	£16.93–24.59	£5–10	n/a	£4.10–8.20	£0–35	£10	£35–50	£70.49–137.79

Notes: Prices in £/tonne

£0 sea transport costs may be available for 'smaller baled consignments ... where the transport has already been paid for by the company importing material ... to the UK ... so it is essentially empty and free on the return leg' (AMEC 2013).

[1] AMEC (2013) using €-£ exchange rate of £1.15 to the € to match rate used by Tolvik (2011) and Owens (2014).

[2] AMEC (2013) and GIB (2014)

[3] HMRC (2013) using April 2013 rate.

[4] AMEC (2013)

[5] CIWM (2013) and calculations using the return price for articulated lorries – assuming each lorry can carry 40 tonnes of material – available from Freightlink (2014)

[6] Green Investment Bank (2014)

[7] UK data from WRAP (2014a), foreign data from Tolvik Consulting (2011) and Green Investment Bank (2014), except for Swedish gate fees (K. Doran, General Manager, Seneca Environmental Solutions Ltd, personal communication, 2014).

Sweden's EfW plants have very low gate fees compared with other countries in this analysis. The explanation given by Tolvik Consulting (2011) for this is 'the heavy reliance on CHP [combined heat and power] and the revenue from the sale of heat' of these plants.

If EfW plants have long-term contracts to supply heat and electricity but find that they are not receiving enough waste, they would be forced to lower their gate fees or even to buy fuel to burn to meet their contractual obligations. Presumably such reliance on heat and power revenues is relatively higher for plants in Sweden than it is for plants in countries such as the Netherlands and Germany, where CHP is also much more common than in England.

4 Theory

The hypotheses above need to be tested by the evidence, but to use that evidence effectively it needs to be slotted into a coherent and relevant theoretical framework.

Economic theory states that there are a number of factors that can affect demand in a particular market (Dawson et al. 2006). These are set out below and expanded upon in the rest of this section.

1. The price of a good
2. The price of other, related goods
3. The expected future price of all the goods above
4. Incomes of consumers
5. Socio-economic influences
6. Political and regulatory influences (which I have added as a separate category)

In this case the 'good' in question is the service provided by foreign EfW plants in accepting English RDF. However, as Figure 3.8 shows, the gate fee charged by such plants is only a part of the overall cost of disposing of the municipal, commercial and industrial waste used to produce RDF. It is the disposal of this waste which is the ultimate good that is being bought and therefore it is the price of the entire route from waste to disposal (or recovery if energy is generated from the incineration of the waste) that needs to be examined.

The 'other goods' that need to be examined are the disposal or recovery routes for England's waste that compete with export of RDF to a foreign EfW plant. Competition for that capacity from foreign sources of waste also needs to be considered. Each country will have a similar range of disposal and recovery routes available to it as England does. Depending on the prices of the different routes, a country may send waste (either untreated or in the form of RDF) to its own EfW facilities, or send RDF to facilities in another country. Either way, these waste streams will compete with exported English RDF for limited space in EfW facilities.

The key factors therefore seem to be numbers 1, 2, 3 and 6 above, but there is still no conceptual framework within which to place them.

4.1 Choice of conceptual framework

There are a number of alternatives to consider.

The neoclassical model of perfect competition makes a number of very stringent assumptions, as follows:

1. All market participants are price-takers, that is, they are too small for the amount that they buy or sell to have any impact on the market price. At a specific price, their only decision is how much to sell or buy, not at what price.
2. Buyers and sellers are perfectly informed.
3. Products are homogenous.
4. There is freedom of entry to and exit from the market.

It is questionable whether any of these assumptions completely apply to the RDF export market and so this model has not been used.

A model based on monopoly or monopolistic competition is not appropriate because of the structure of the market (see Section 3.2). Essentially, while there are some large companies involved in the sector, they are not large enough to be able to change the market price solely through their own actions.

Given the presence of a number of large companies in the RDF export market there is the possibility of using a game theory approach. However, this was discounted as it became clear through interviews with market participants that competition on price has been the norm in this market.

Finally, consideration was given to using an evolutionary approach. The perfect competition model assumes that the market is tending towards equilibrium, where the price signals the point at which marginal[1] demand for, and marginal supply of, disposal and recovery options are equal. In evolutionary models, this assumption does not hold because of rapid changes caused by innovation and technological change. While this approach has its attractions, it is relies heavily on the availability of detailed data on company costs, which are not available.

Lack of data is an ongoing theme throughout this report and is the primary reason why a modelling approach is required rather than a multiple regression analysis. Such an analysis could potentially tease out the correlations between multiple different factors, but it is not feasible because of a lack of time series data on crucial factors such as gate fees.

The best framework to use appears to be that of a bargaining model.

> 'Bargaining models are so-called ... because the final outcome depends on the relative bargaining power each [participant] has. In contrast to collective models, which provide a more general framework, bargaining models assume that the outcome in a cooperative context depends purely on what would happen if the bargaining process failed.
>
> In any bargaining situation, people are more able to achieve a favourable outcome for themselves when they can walk away if they do not like the outcome. How easy an individual finds it to walk away depends on what will happen if they do – that is, what their threat point or fall-back position is' (Himmelweit and Santos 2010).

4.2 Application of the bargaining model to the RDF export market

Many, if not most, of the interactions in the RDF export market are conducted within a bargaining framework between two parties. A critical negotiation is about the gate fee charged by the EfW plant operator. The various outcomes of this negotiation can be represented on a graph such as the one shown in Figure 4.1. The unusual numbering on the y-axis and the dotted red lines are explained below.

Figure 4.1 shows the hypothetical example of a situation in which the most that an exporter would be willing to pay as a gate fee is £100 and, conversely, that this is the most the EfW plant operator would be able to charge an exporter. The main reason for this boundary is the existence of an alternative method of waste disposal or recovery.

[1] In economics, the word 'marginal' can be taken to mean 'additional'. So the marginal cost, for example, is 'the change in total cost incurred as a result of producing an additional unit of output' (Costello and Mackintosh 2006).

Why would an exporter pay an EfW plant operator a gate fee of £101 when, for example, they could pay a nearby landfill site £100.50?

Given this limit on the gate fee in the negotiations, where will the price be set? It could be at almost an infinite number of values, all of which are charted by the blue line in Figure 4.1. It goes from the lucky exporter paying nothing and the unfortunate EfW plant operator receiving nothing at the top left to the exporter paying £100 and the EfW plant operator receiving £100 at the bottom right.

How can we 'zoom in' to the point on the blue line where the price might be set? It comes back to the point made by Himmelweit and Santos (2010) as quoted above: namely how easy it is for one of the participants in the negotiations to walk away. This in turn is influenced by the current state of the market: factors such as how long the participants can afford to wait if a deal falls through, and how many other market players there are for them to approach. In other words, this is about market power.

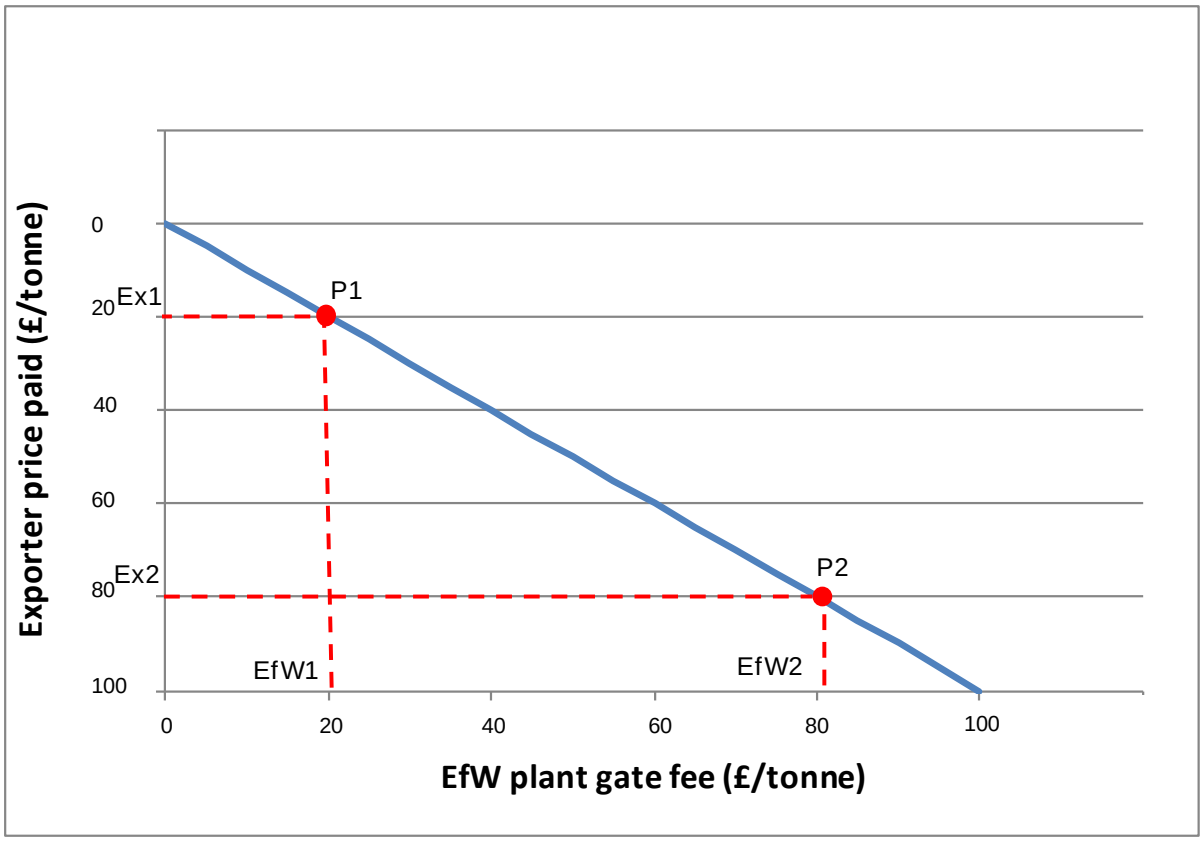


Figure 4.1 Market participants' share of the gate fee

Notes: It is possible for gate fees to become negative if demand for a waste stream is high enough, but that has not been seen in the RDF export market to date and so the theoretical minimum of £0 has been used.

It is possible to imagine two situations at the extreme ends of the blue line. In the first, the EfW plant operator is desperate for feedstock to ensure the plant continues to generate revenue, while the RDF exporter knows that many of the EfW plant operator's competitors are in a similar situation. Hypothetical threat points for each in the negotiation over the gate fee are shown by the dotted red lines, with Ex1 (on the y-axis) marking the maximum price the exporter is willing to pay before walking out of the negotiations and EfW1 (on the x-axis) showing the minimum price the EfW plant operator will accept before doing the same.

At the other end of the scale, imagine a situation in which RDF exporters are desperate to offload their material and the EfW market in the receiving country is saturated. Within

the £100 limit, the EfW plant operator can almost name their price, while the RDF exporter has little choice but to pay.

In each case the dotted lines form a triangle with the blue line; the market price will lie somewhere on that blue line segment. The answer as to where was proposed by John Nash and is known as the Nash Bargaining Solution (Nash 1950). The detailed mathematics produces a surprisingly simple solution, which is that the price agreed on would be at the mid-point of the blue line segment, as shown by the points P1 and P2 on the graph.

What is useful about this concept is that it is very flexible. The effect of changes in market power has already been discussed, but there are other examples. To reflect an increase in the maximum gate fee that can be charged, the graph is redrawn with longer axes and the blue line extending between zero on the y-axis and the new maximum on the x-axis. When there is a change in the costs of one participant but not the other, the blue line segment will shrink with the mid-point moving in favour of the other participant.

A particular graph such as the one in Figure 4.1 can show a snapshot of the market, but the model itself is not static and a series of graphs can show changes in the market over time.

5 Assumptions

These assumptions relate to different parts of this report, but are brought together here for ease of reference.

5.1 Data

Some of the available data cover the whole of the UK, while some cover only England. However, as around 80% to 85% of total UK RDF – if not more – comes from England (AMEC 2013), this report uses the simplifying assumption of treating all datasets as if they cover just England.

5.2 Recovery and disposal routes

Assumption 1

Illegal waste sites have not been included as a disposal or recovery route.

This is due to a lack of data on illegal site gate fees.

Assumption 2

RDF production is not required for material sent to English EfW plants or landfill.

According to a personal communication from D. Owens (Residual Waste Team Leader, Defra, 2014):

> 'The vast majority of waste that goes to UK EfW plants is local authority mixed municipal waste and does not go through the preparing, baling and wrapping stage but straight to land transport and into an EfW plant in the same way as landfill. There may be some sorting or possibly shredding at most, but the waste would not be baled and wrapped. A lot of commercial and industrial waste will also be managed in this way ... It is really hard to say whether these [preparing, baling and wrapping] costs... are always incorporated into the cost of using UK EfW plants'.

Assumption 3

The level of waste production in the economy and the incomes of RDF producers are exogenous to the conceptual framework used in this report.

Waste is created as part of the production of goods and, to a lesser extent, services. For most such goods and services, demand increases as consumers' incomes increase. In theory this should feed through into increased waste generation both in the commercial and industrial sectors that do the producing and in the local authority sector that collects post-consumer waste. This in turn might be expected to feed through to increased RDF production as incomes increase. However, there is some disagreement over whether this relationship between income and waste generation still exists – see, for example, Green Investment Bank (2014) and WRAP (2014b). Furthermore, the rapid expansion of the RDF market during a period of unimpressive GDP gains by the UK economy suggests that any influence on RDF production caused by increasing incomes would be very difficult to tease out from the data.

Another way of looking at this issue in the context of this report is to think about income relating to the market participant in question, which in this case will be the RDF producer. If the producer's income changes, might this affect the amount of RDF

produced and exported? Intuition suggests that, all other things being equal, a company that receives a lower income per tonne of waste it takes in will be more likely to extract higher levels of recyclates and to look for cheaper disposal options for its residual waste. However, a lack of data makes it impossible to assess whether this intuition is correct.

Assumption 4

All the recyclates that can be economically removed from the waste have been.

Assumption 5

The costs and income from sorting and selling recyclates have not been included in the recovery and disposal routes.

Assumption 6

The only effect of recyclate prices is to increase or decrease the amount of residual waste available.

Assumptions 4–6 boil down to the simplifying assumption that the amount of residual waste available will be treated as exogenous to the analysis produced as part of this project. Because this is a large and possibly contentious assumption, the detailed reasoning behind it is set out below. It is important to note that this is not the same as assuming that the amount of RDF produced and exported is exogenous; far from it. As the thought experiment below shows, it is the relative prices of different disposal routes that should determine the level of RDF exports.

Imagine that a company receives a tonne of mixed waste. It adds as much value as possible to that material by separating out recyclates where it is economic to do so and is left with an amount of residual waste that it then needs to pay to dispose of. The company's profits come from two sources:

- separation and sale of the recyclates
- taking the task of organising the disposal of the waste as a whole off the hands of the waste producer

If the price of recyclates increases then the company separates more out and receives a higher income for that material. But no matter what the price of recyclates, there is almost always likely to be some residual waste remaining. To maximise its profits, the company needs to find the cheapest method of disposing of this residual material. If the company produces enough residual waste to require two disposal routes (one via RDF production and export, the other to landfill) and the price of recyclates increases, meaning there will be less residual waste requiring disposal, it makes sense to send less of this material to the most expensive disposal route. So whichever option is the most expensive – either landfill or RDF production followed by export – is the one that the company will use less of.

The point of this thought experiment is to illustrate that, whatever the profits from their recycling processes, companies in this sector still have a separate decision to make regarding the disposal of their residual waste. Therefore, for the purposes of this report, it is assumed that the only effect of recyclate prices is to increase or decrease the amount of residual waste available. This impact has not, so far, been enough to stop the use of the most expensive form of residual waste disposal – English landfill – so it is reasonable to assume that any option cheaper than landfill will be used to its full extent.

5.3 The market

Assumption 7

As set out in Section 4.2, many – if not most – of the interactions in the RDF export market are conducted within a bargaining framework between two parties.

Assumption 8

The RDF export market is tending towards short-term equilibrium where the price signals the point at which marginal demand for, and marginal supply of, disposal and recovery options are equal.

Assumption 9

As set out above, almost all exports will take place below the cost of disposal using English landfill.

Assumption 10

Much of the data used to build up the prices of these different options are given as costs, but discussion with industry contacts suggests that it is not unreasonable to assume that cost and price are equivalent in this context.

Assumption 11

Sea transport costs are calculated based on a return journey for a single articulated lorry with an assumed payload of 40 tonnes.

5.4 The analysis

Assumption 12

It is only England that is driving increased demand for disposal and recovery routes in countries such as the Netherlands, Germany and Sweden.

Assumption 13

Only disposal and recovery routes to the Netherlands, Germany and Sweden have been included in the analysis because these are the most important export markets for English RDF.

6 Analysis

6.1 Why did RDF exports begin in July 2010 and not before?

On 23 June 2010, the Environment Agency (N. Homer, personal communication, 2014) released a decision stating, inter alia, that:

- ‘Exports of municipal waste are prohibited.
- Exports of treated municipal waste from a waste management facility are potentially permitted.
- We do not prescribe the level of treatment required, but make clear that the waste must have undergone some sort of treatment but this may comprise mere physical treatment such as shredding, sorting and compaction.
- The waste destined for export must meet the requirements of the destination facility.
- The waste must be destined for recovery, not disposal.’

With regards to the last statement, the following explanation by CIWM (2014) may prove useful.

> ‘A Municipal Solid Waste Incinerator (MSWI) could be classified as either a recovery operation (R1 - Use principally as a fuel or other means to generate energy) or a disposal operation (D10 - Incineration on land) ...
>
> In 2003, the European Court of Justice made two judgements that established principles to differentiate between R1 operations and D10 operations. To be classed as an R1 operation the process must meet the following criteria:
>
> - The combustion of waste must generate more energy than the consumption of energy by the process itself;
> - The greater part of the waste must be consumed during the operation;
> - The greater amount of the energy generated must be recovered and used (either as heat or electricity);
> - The waste must replace the use of a source of primary energy.’

The revised Waste Framework Directive uses an energy efficiency formula to put these criteria into practice. If an EfW plant meets the benchmark values calculated using the formula then it is classed as a recovery – rather than a disposal – operation.

The logic behind the Environment Agency’s decision stems from the UK Plan for Shipments of Waste, which bans shipments of waste to and from the UK for disposal. In tandem with Article 3(5) of the Waste Shipments Regulation (WSR), which states that shipments of mixed municipal waste are subject to the same provisions as shipments of waste destined for disposal, this Plan means that the export of mixed municipal waste from the UK, whether for disposal or recovery, is not permitted. As a result, mixed municipal waste must be made into RDF before it can be exported.

Several of the industry contacts spoken to as part of this research cited this decision as key to starting the RDF export market. The emergence of the RDF export market the month after the decision was publicised therefore looks not to be a coincidence.

6.2 Why has there been an overall trend of rapid growth in the English RDF market?

The Environment Agency's regulatory decision started the English RDF export market. Its rapid growth is typical of what happens when a new low-cost competitor enters a pre-existing market. An example might be the spectacular growth of low-cost airlines in the UK and some other airline markets. There are therefore two interesting sub-questions:

- Is there a price differential between RDF exports and other, pre-existing recovery and disposal routes?
- If there is such a price differential, what is causing it?

Table 3.1 gives cost data for a range of different recovery and disposal routes. However, interpretation is easier if these data are presented as a bar chart as shown in Figure 6.1, which is simply a graphical representation of the range in the 'Total' column in Table 3.1. It might be easier to think of each range as being made up of several horizontal bars each representing the costs associated with a particular combination of facilities and transport options. For example, an English EfW plant with excellent transport links and close to a large conurbation is likely to be at the lower end of the English EfW ranges. Similarly, a Dutch EfW plant located right next to the dockside in Rotterdam would be lower down the Dutch EfW range than a competitor located further inland with the attendant extra transport costs.

Although there is considerable overlap, it appears that substantial parts of the Dutch and Swedish price ranges – and some parts of the German price range – are cost competitive or cheaper than English EfW plants and landfills. This makes sense. Why would English companies export RDF if it was cheaper to treat or dispose of it in England?

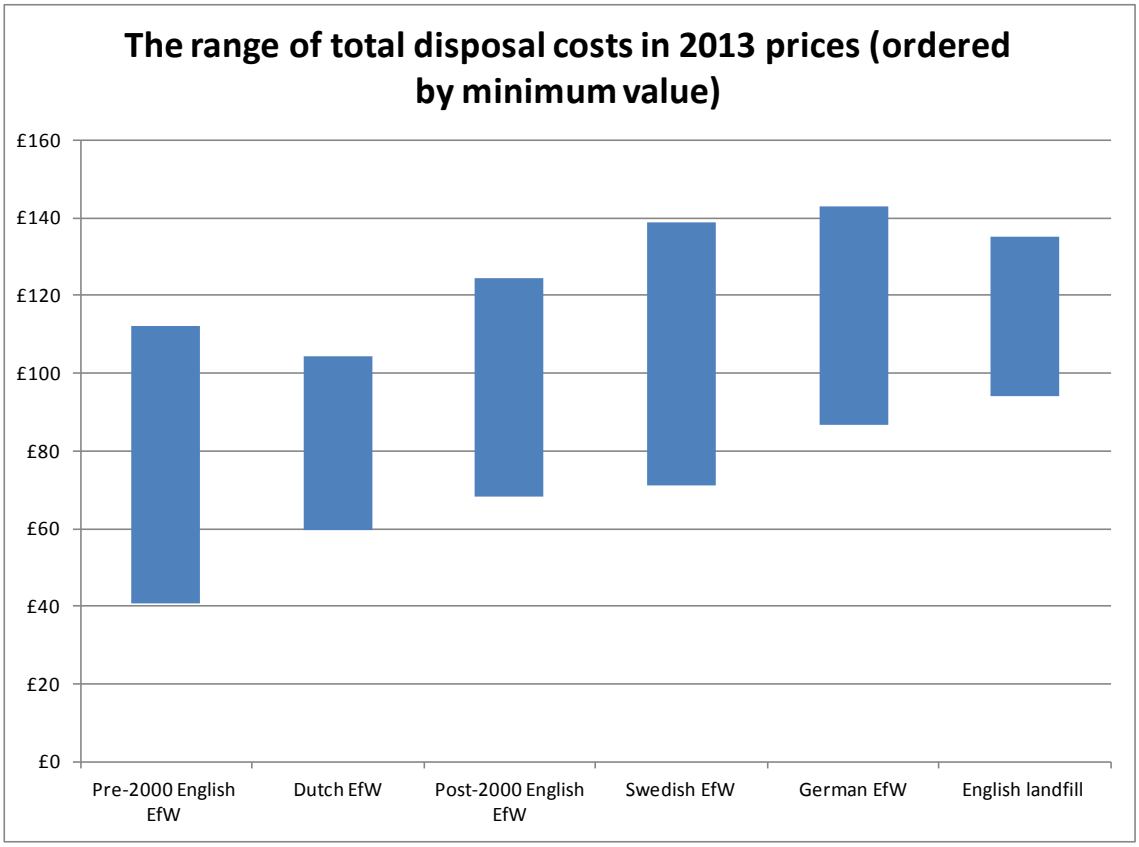


Figure 6.1 Range of total recovery and disposal costs

Notes: In 2013 prices
Ordered by minimum value

This brings us to the next question: the cause of the price differential between the various routes. As set out above, there is currently less EfW capacity than residual waste potentially available for treatment in England and many (though not all) commentators expect this situation to continue for at least the next five years.

If export is not an option and there is not enough EfW capacity, where does any residual waste go next? The answer is landfill, but the landfill tax escalator has made this an increasingly expensive option. The rise in RDF exports therefore suggests that one or both of the following observations is true.

1. Most recovery routes using English EfW facilities and landfills are more expensive than continental European EfW facilities.

2. Some recovery routes using English EfW facilities are cheaper than those using continental facilities but they do not have enough capacity. The material they would take if there was more capacity goes to landfill. However, an increasing proportion of that waste stream is now going to continental European EfW facilities instead because some of these are a cheaper option than English landfills.

Why might some treatment or disposal routes involving the production and export of RDF, with all its attendant costs, be cheaper than English EfW facilities or landfill?

EfW plants have high fixed costs which means that, when gate fees are low, it is often better to run at a small, temporary loss rather than not taking in material at all (A. Krajewski, personal communication, 2014). In 2009 and 2010, over-capacity in the Dutch EfW market was getting worse and plant operators were desperate for more

supply. This meant they were prepared to compete with each other on cost (J. de Swart, personal communication, 2014).

Using the bargaining framework discussed in Section 4.2 (Figure 4.1 is reproduced below as Figure 6.2 for ease of reference) it appears that, early in the development of the RDF export market, exporters had the upper hand in negotiations and therefore the price was set closer to P1 than P2. But as more and more exporters realised the opportunity to be had, RDF importers found that they had more than enough material available and it was their relatively cheap incineration capacity that was becoming scarce and therefore valuable. This shifted the continental European gate fees more towards P2.

The values on the axes of Figure 6.2 are used for illustrative purposes. But while it is not possible to produce an exact maximum value to replace £100 in the figure, it is possible to get a reasonable idea of what range that figure lies in.

The key to doing so is to understand the maximum price an exporter would be willing to pay to a continental European EfW plant for taking a tonne of RDF. Landfill is the only legal alternative disposal route for residual waste if an EfW plant is not available. It would not make sense to export RDF if it was cheaper to send the material to an English landfill, so the cost of doing so must be the maximum price exporters are prepared to pay. This is confirmed by the advertising on the website of AEB Amsterdam which states:

> 'Thanks to our high energy and raw materials recovery we can offer you a compatible price offer both referred [sic] to landfill or traditional EfW plants. To make sure all sails smoothly, we will make a customised waste-plan in which all cost and travel options best suiting your situation are considered' (AEB 2014).

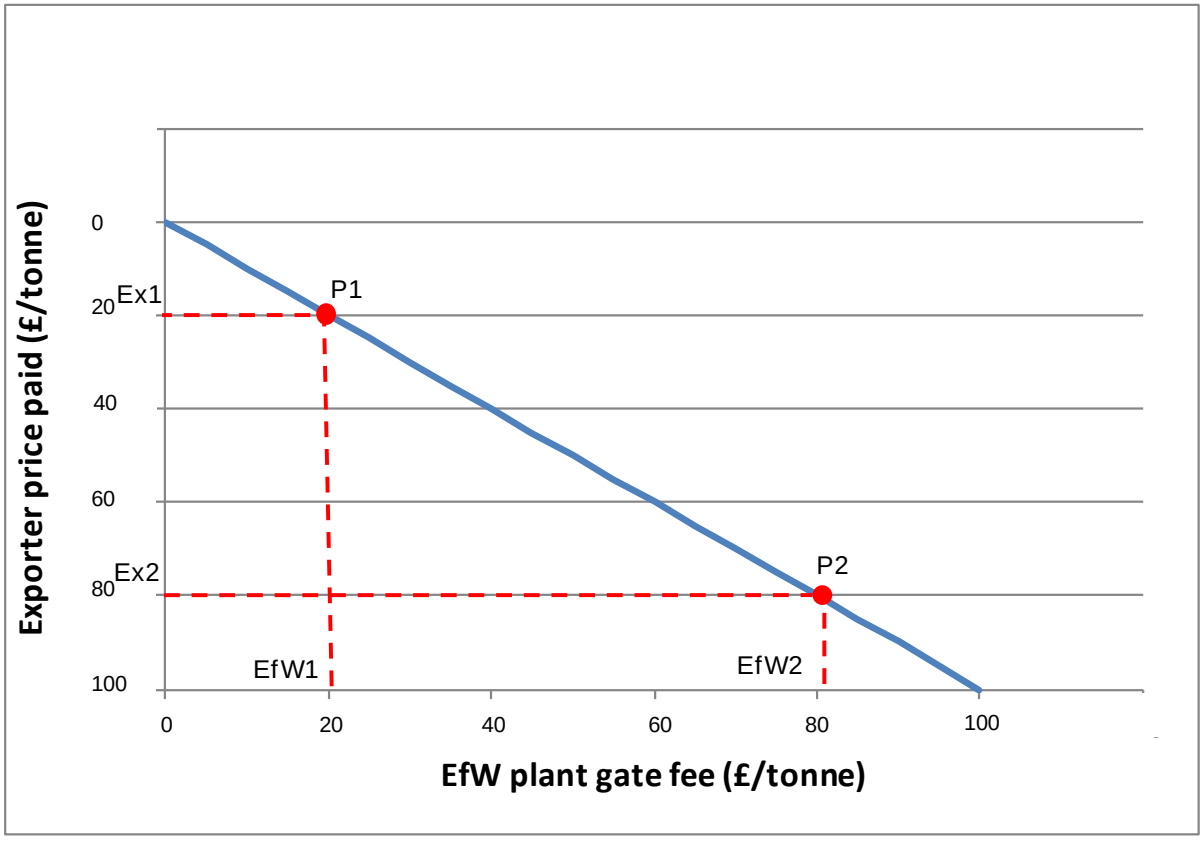


Figure 6.2 Market participants' share of the gate fee

As Figure 6.1 shows, there is a range of costs attached to the landfill disposal route. This is due partly to differences in transport costs between sites, but mostly to the wide range of gate fees charged. This in turn is down to local circumstances, such as a lack of competing waste treatment outlets within a reasonable travel time. The range of costs of routes using English landfill as a disposal option is from about £94 to £135. It is also likely that landfill sites in areas with good transport links to ports such as Felixstowe, Bristol, Southampton and Hull have been forced to lower their gate fees as much as possible so as to compete with RDF exports.

The exact price of any specific consignment will depend on negotiations between the exporter and the importing EfW plant. However, it seems safe to say that at present the prices of these consignments lies somewhere between £94 and £135 and is probably closer to the bottom end of that range.

Bear in mind that this is the total price to the exporter of transporting the waste to the landfill site and paying the gate fee for it. If transport costs are removed from the price range above, the lower price limit drops to between £84 and £89 and the upper limit to £125 to £129.

6.3 Why do exports appear to be levelling off?

The large price differential between sending residual waste to English facilities and sending it abroad has clearly driven the growth in the English RDF export market. However, the evidence set out above also suggests that this price differential has changed over time. What effect might this have had on the market?

Although time series data are only available for English EfW and landfill gate fees, and for the landfill tax, presenting these data in a graph is instructive – see Figure 6.3.

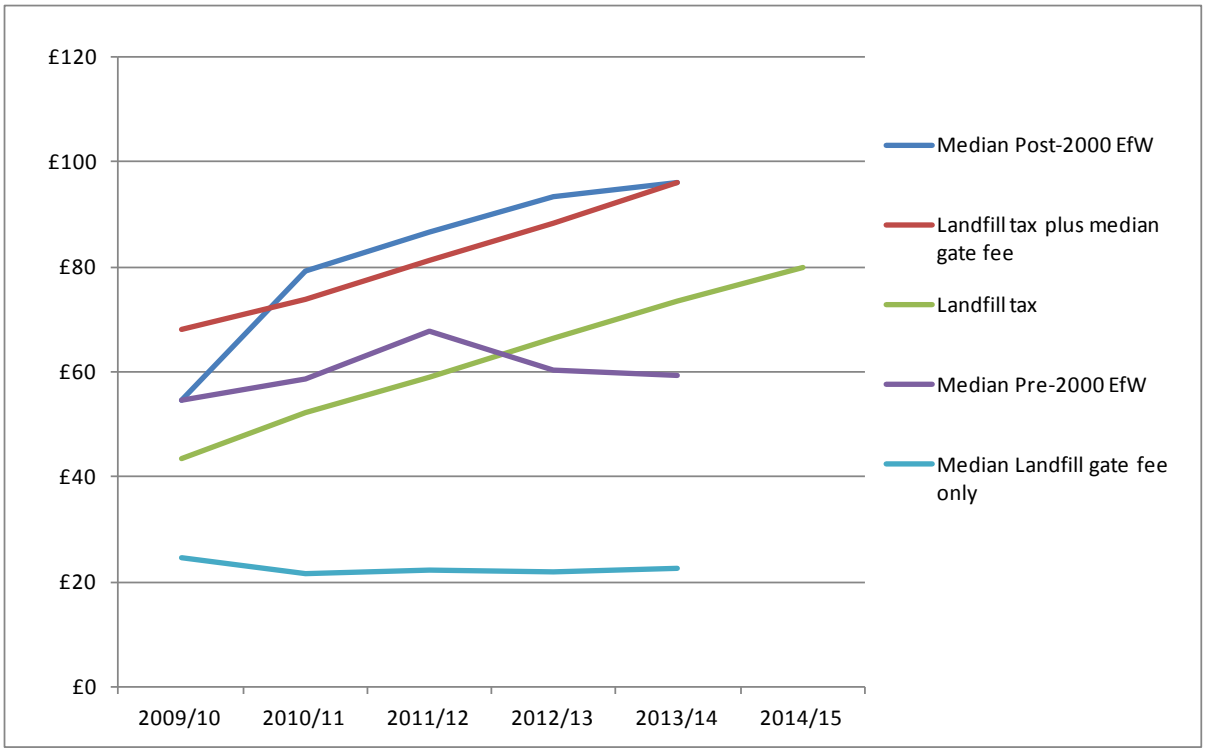


Figure 6.3 Changes in gate fees and landfill tax over time

Notes: 2013 prices

Figure 6.3 shows that, broadly speaking, landfill site gate fees have remained level in real terms over the past five years. Landfill tax has increased steadily over this time and therefore so has the total cost of disposing of waste at English landfill sites. Another interesting feature of Figure 6.3 is that the gate fees of post-2000 EfW plants appear to have tracked the total cost of landfill disposal, while those of pre-2000 EfW plants have not. This distinction between the two types of plant is made by WRAP who point out that they are built in a different way and consequently operating costs tend to be lower in pre-2000 facilities.

Potential explanations for these trends are as follows. As more and more waste is recycled and as the cost of disposal in landfills is driven up, landfills themselves have had to do all they can to minimise their own gate fees. Post-2000 EfW plants in England are in the same position as EfW plants abroad; they know that they are the only legal alternative to landfill and so can afford to just undercut it as a disposal route. The situation with pre-2000 EfW plants is trickier to explain, but could be linked to the setting of long contract terms with their major customers – notably local authorities.

Waste treatment contracts can last for anything from four up to 25 years or more, with approximately half of those surveyed by WRAP being 25 or more years in length (WRAP 2014a). When some of the contracts currently in force were signed, landfill tax was much less than it is now and the size of its increase had not been foreseen. This means that what Figure 6.3 is showing could be is the lingering effect of those long-term contracts. In addition, older plants can afford to charge lower gate fees as they will have repaid much of the capital borrowed to pay for their construction.

The evidence above suggests that Dutch (and some English) EfW facilities set their gate fees at a level designed to just undercut disposal in English landfills. They know there is not enough EfW capacity in England and that the landfill disposal route is therefore their main competitor. Given this, one would expect to see some sort of relationship between the level of landfill tax in England and exports of RDF. Figure 6.4 confirms this.

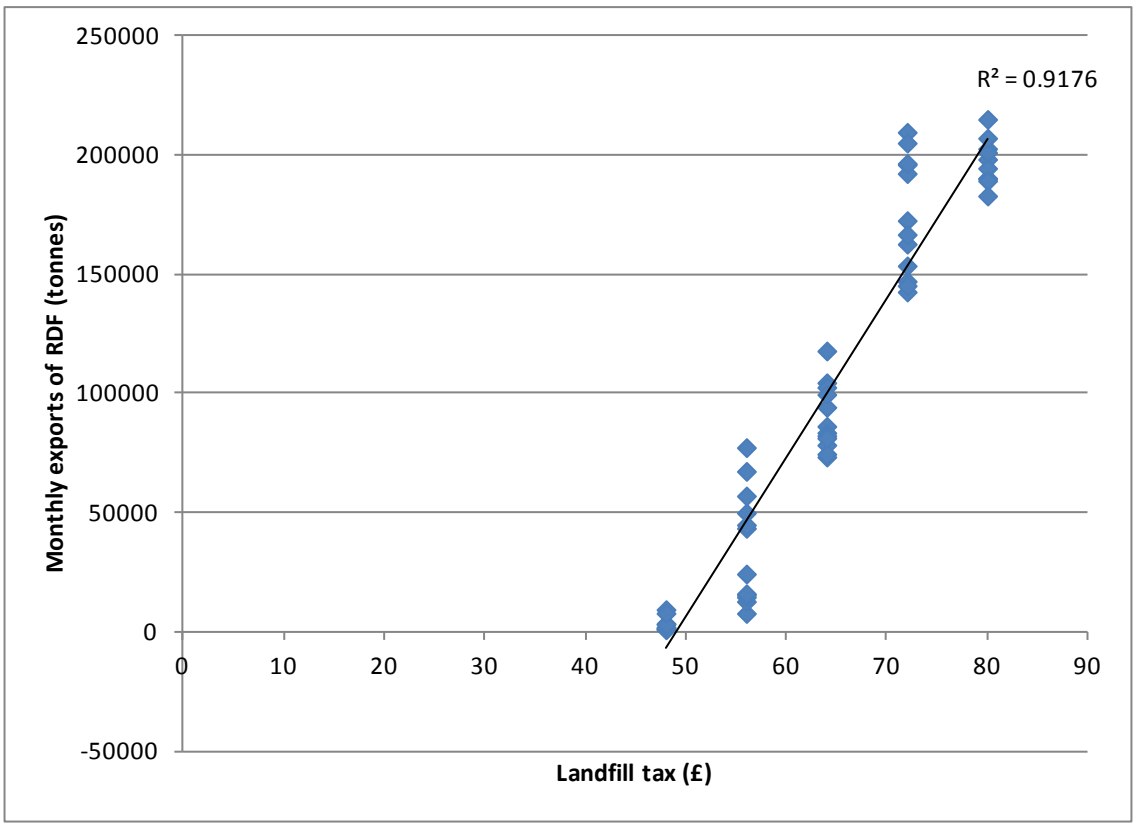


Figure 6.4 Relationship between RDF exports from England and level of landfill tax

There is a significant correlation between the level of landfill tax and the level of English exports as shown by the high R^2 value of 0.92 (to two decimal places) of the graph in Figure 6.4. While correlation does not prove causation, the graph does appear to support the evidence above, that is, it shows that the change in the level of landfill tax explains just over 90% of the change in the level of RDF exports.

An additional driver for exports could be the level of total costs associated with landfill disposal (A. Krajewski, personal communication, 2014). Although Figure 6.3 shows that the median landfill gate fee in England has stayed relatively flat over the period under study, Krajewski states that several sites have closed in the past few years and maintains that this trend is likely to continue. This has had, and will continue to have, two important impacts on costs.

- Haulage costs to the next available landfill site will, in general, increase.
- As the number of landfill sites continues to fall, the remaining operators will be able to increase their gate fees in areas where it is logistically difficult for their customers to find alternative disposal methods.

This makes explicit the fact that local geography will play a crucial role in determining where it is cost-effective to export RDF from and therefore, potentially, how much is exported.

All the evidence therefore points to the price of RDF disposal increasing even as demand for such disposal routes also increases. On the face of it, this seems to go against the traditional view of supply and demand, in that as the price increases we would expect demand to fall not rise.

However, the evidence also offers an explanation for this phenomenon and it comes back to the bargaining framework set out in Figure 6.2. The maximum price at which RDF exports are economic is set by the cost of disposal in English landfills. At the beginning of the English RDF export market, the exporters had more market power and so foreign EfW gate fees were low, with the exporters getting the benefit of the difference between these fees and the landfill gate fee they would otherwise have had to pay. However, as more exporters spotted this opportunity, demand for foreign EfW capacity rose and the balance of power shifted to the EfW plants. This meant they could charge higher and higher gate fees until they were able to set their price at just under the gate fee for English landfill sites.

As the landfill tax escalator pushed up the cost of landfill disposal, so it became economic for exporters to access foreign EfW plants further afield. This brought in more capacity and led to demand increasing further.

Figure 6.4 suggests that levels of exports have stabilised. While it is not possible to state conclusively that this is due to the removal of the landfill tax escalator, the evidence suggests that this is likely to be the case. It should also be noted that this is not a case of fitting the theory to the data. The first draft of this report was written using the latest available data, which covered the period up to June 2014, at which time it was not at all clear that RDF export levels had stabilised. However, the data presented above were used to make the prediction that RDF exports, while fluctuating on a monthly basis, would be unlikely to rise any further.

6.4 What might be causing the short-term fluctuations in exports from month to month?

It does seem likely that the effect of the landfill tax on the cost of disposal at English landfills is the major driver of change in the RDF export market. However, the R^2 value of 0.92 (to two decimal places) in Figure 6.4 indicates that the level of landfill tax does not explain around 10% of the change in the level of exports. There are also clear fluctuations in monthly export levels, so what else might be having an impact on the market?

One possibility is changes in exchange rates. Although exchange rates have been included to some degree in the costs set out in Table 3.1, is it worth including them as a separate category of costs? This is because it is possible to stockpile RDF – which can in some circumstances lead to serious environmental problems – in response to the prevailing exchange rate or the expectation of future exchange rate levels.

The way to examine this issue is to see if there is any correlation between the average monthly sterling–euro exchange rate and monthly RDF export levels over the whole time period under investigation. Figure 6.5 shows that there is not; although there might appear to be two groups of points in the scatterplot that might separately show some level of correlation, further analysis shows this not to be the case. A similar relationship holds for the sterling–Swedish krona exchange rate (data not shown).

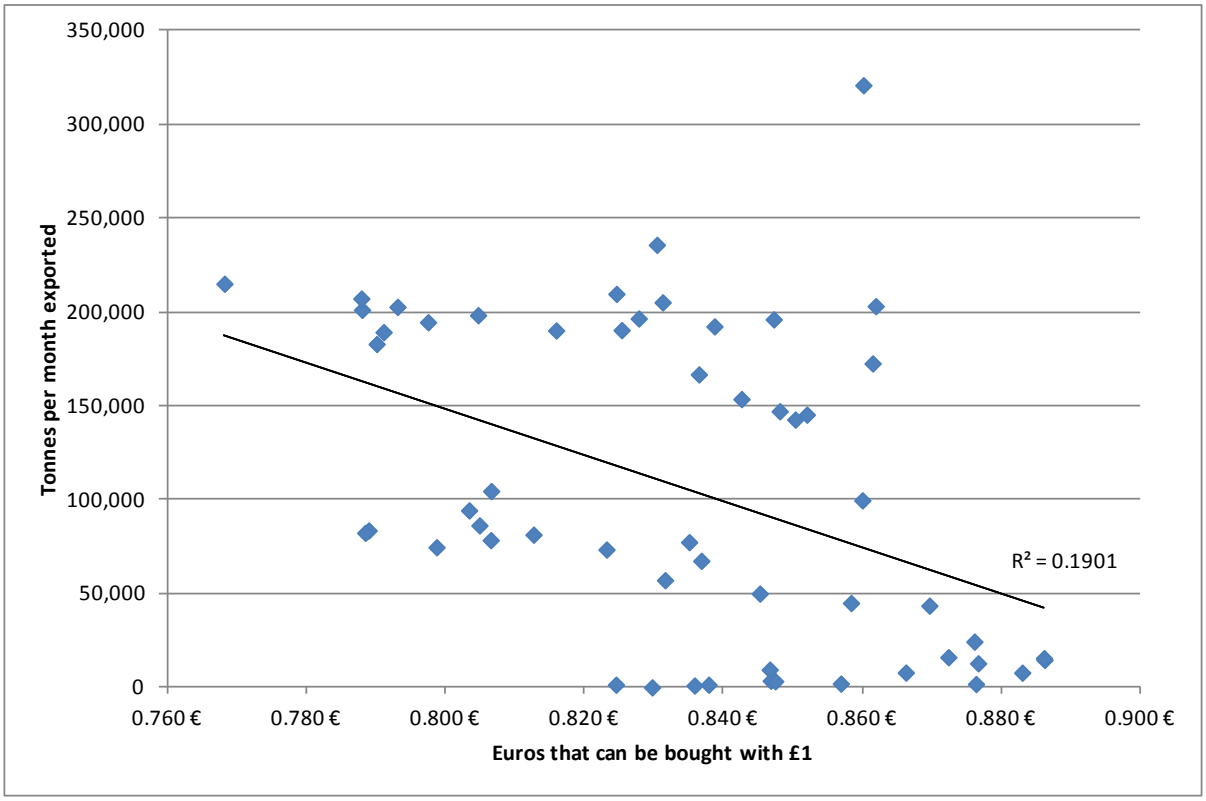


Figure 6.5 RDF exports from England plotted against the £–€ exchange rate

It might also be argued that there is likely to be a time difference between when the export is organised, when it actually occurs and when payment is made. However, shifting the export levels so that they are matched against an earlier or later exchange rate makes very little difference to the level of correlation.

This result is supported by a personal communication in 2014 from K. Doran (General Manager, Seneca Environmental Solutions), who stated that while his company has an

‘eye to the exchange rate’, this only extends as far as a broad-brush analysis about the likely direction of future exchange rates, rather than anything more detailed, such as the use of hedging strategies. His experience of working with Dutch EfW plants is that they are focused on the price that they can get at the time of negotiation, which includes the exchange rate as it stands at that time.

Overall, the effect of exchange rate changes appears to be too small to have much influence on the decisions of actors in the market, especially compared with the level of landfill tax. For example, the highest exchange rate during the period under study occurred in June 2011 and the lowest in January 2015. Using the maximum euro value of German gate fees, which is €70, the difference between this amount expressed in sterling using these high and low exchange rates is £8.26. This is around 6% of the total overall cost at the high end of the German EfW recovery route and around 9.5% at the low end.

The percentages of the minimum and maximum total costs of each treatment or disposal route contributed by different parts of the supply chain are shown in Tables 6.1 and 6.2 respectively. The two tables show very similar results in terms of the categories that contribute most to the total cost of each recovery or disposal route.

- In the case of English landfill, it is landfill tax.
- Gate fees are more or less important for all the recovery routes.
- RDF production costs are critical contributors to the foreign recovery routes.
- Sea transport costs can become important to the Swedish EfW route if they start to rise.

This suggests that, while it is possible that changes in the prices of important inputs may be having a small effect on export levels, ultimately the prime driver of the market still appears to be the landfill tax. This is because the cost of landfill is what foreign and perhaps some English EfW plants benchmark their gate fees against.

To double check this conclusion, the question of what impact the falling oil price might have had on English exports of RDF was examined in a related project. Despite the oil price falling by about 33% between January 2013 and December 2014, it was concluded that changes in fuel costs, which make up between 1.5% and 6% of total costs, are unlikely to have had any major effect on export levels. The price of the plastic wrap (made from oil) used to contain bales of RDF is also likely to have had virtually no effect on the price of RDF, again because it makes up a very small percentage of total costs. These conclusions are supported by the data on export levels, which do not appear to have fallen since January 2013 (Figure 1.1).

Table 6.2 Percentages of minimum total costs contributed to each route by various categories

	Preparing, baling and wrapping RDF	English on-land transport	Landfill tax	Port costs	Sea transport	European on-land transport	Gate fees
Pre-2000 English EfW	0%	13%	0%	0%	0%	0%	88%
Post-2000 English EfW	0%	7%	0%	0%	0%	0%	93%
English landfill	0%	5%	85%	0%	0%	0%	10%
Dutch EfW	29%	6%	0%	7%	0%	0%	58%
German EfW	22%	5%	0%	5%	0%	14%	55%
Swedish EfW	29%	6%	0%	7%	0%	13%	44%

Table 6.3 Percentages of maximum total costs contributed to each route by various categories

	Preparing, baling and wrapping RDF	English on-land transport	Landfill tax	Administration and port costs	Sea transport	European on-land transport	Gate fees
Pre-2000 English EfW	0%	9%	0%	0%	0%	0%	91%
Post-2000 English EfW	0%	8%	0%	0%	0%	0%	92%
English landfill	0%	7%	60%	0%	0%	0%	33%
Dutch EfW	26%	7%	0%	9%	7%	0%	51%
German EfW	20%	6%	0%	7%	11%	9%	48%
Swedish EfW	23%	7%	0%	8%	23%	7%	33%

7 Market projections

The evidence presented in this report suggests that, provided there is more English waste than there is English EfW capacity, landfill will remain the disposal method of last resort and therefore the fundamentals of the market will not change significantly.

If English waste generation falls to the point where there is enough EfW capacity to handle it all, or conversely if the amount of English EfW capacity rises to achieve the same result, then the functioning of the market will change. It is already clear that foreign EfW plants, especially in the Netherlands, can run at lower gate fees than they are currently charging. If English landfill ceases to be the disposal route against which they set their costs, foreign EfW plants would simply move to benchmark themselves against the next most expensive option, which is likely to be newly built English EfW plant. As Figure 6.3 shows, it is likely that these plants could also charge lower gate fees – the current lack of competition in the market has allowed them to track the price of landfill disposal. Which plants survive is therefore likely to be down to a mix of factors including:

- plants' gate fees and the associated costs of accessing them, such as transport
- contract negotiations,
- political and regulatory influences

If there is a fall in the amount of waste generated in other EU Member States, this will make foreign EfW plants more reliant on English RDF. Exactly what effect this will have on the price of RDF treatment depends on how much spare capacity there is and how much waste the plants with that capacity are competing for. It is, for example, conceivable that if Dutch waste generation fell significantly while levels of residual waste in England remained static, then the price charged by Dutch RDF plants could fall significantly.

Figure 3.2 shows exports of RDF to the Netherlands levelling off from around July 2013, while simultaneously exports to Germany and Sweden began to grow. What this probably indicates is that the Dutch market – or at least that part of it with the lowest costs for English exporters – is becoming saturated.

Estimates of 'over-capacity' in 2010 in the Netherlands, Germany and Sweden are given by Tolvik Consulting (2011) as 1.1 Mt, 4.2 Mt and 0.6 Mt respectively. These annual numbers can be crudely converted into monthly equivalents by dividing by 12, giving available capacity figures of 92,000 tonnes, 350,000 tonnes and 50,000 tonnes per month for the Netherlands, Germany and Sweden respectively.

Levels of English RDF exports to the Netherlands peaked at around 130,000 tonnes per month in October 2013 and thereafter hovered around 110,000 tonnes per month (Figure 3.2). This suggests it is difficult to calculate exactly the maximum amount of treatment capacity that is theoretically available, although it is possible to estimate it. This is probably because there is no single price for treating 'a tonne of waste'. Different customers will be able to negotiate different rates at different times depending on conditions in the market. Some rates will be on long-term contracts, others offered on the spot market. Different waste streams will command different prices for treatment and so on. This complexity means that the amount of treatment capacity available at a particular price can change over time.

There are a number of possible explanations as to why the Dutch market has become saturated. English RDF exports could have climbed to the point at which either the

cheaper Dutch capacity has all been taken up or the increased demand has raised the price of that capacity to the point where it has become economic to investigate other markets.

It has been suggested that, as the economic recovery took hold in the Netherlands during 2013 and 2014, the amount of municipal waste coming from the areas around the Dutch EfW plants began to increase (K. Doran, personal communication, 2014). As this waste commands a higher gate fee than imported RDF, the amount of capacity available to English exports at current market prices would have begun to fall.

Put against this argument is the launch of the Dutch Waste to Resources programme in January 2014. This aims to reduce the amount of residual waste generated by Dutch citizens from 10 Mt per year (NB this is not in line with the value given in Figure 3.6) to 5 Mt per year over the next 10 years (van der Mei 2014), while at the same time maintaining the amount of Dutch EfW capacity at the same level (B. van Bolhuis, personal communication, 2014). While the effects of this policy do not appear to have had much effect on RDF exports yet, there is clearly the possibility that more Dutch EfW capacity will gradually become available to English exporters in the near future, leading to higher exports.

7.1 Handling uncertainty

The analysis above highlights how difficult it is to create market projections. If the analyst is not careful they simply end up reeling off a list consisting of 'on the one hand this, on the other hand that' – much as appears above. This is because there are such a large number of factors – some of which have already been set out – that could change the level of English RDF exports over the coming years. Examples of these factors are given in Table 7.1.

Table 7.1 Factors that could change level of RDF exports from England

Area of change	Examples
Demand side	• Levels of English residual waste generation • Levels of residual waste generation in key RDF export markets • Levels of residual waste generation in countries that export RDF to the same markets as England
Supply side	• New EfW facilities being built in England • English landfill sites closing • New EfW facilities being built and old ones being closed in key RDF export markets • New EfW facilities being built and old ones being closed in countries that export RDF to the same markets as England
Regulatory and political landscape	• Changes to the landfill tax • Changes to recycling targets in England and abroad • Expectations that recycling targets will become more stringent and landfill tax will rise • Changes to the definition of RDF

Area of change	Examples
	• New EU directives on resource efficiency • Changes to support mechanisms for renewable heat and power either in the UK or abroad
Wider social and economic changes	• Increased recycling and resource efficient behaviour in England and abroad • Changes in recyclate prices • Changes in input costs such as freight haulage and fuel rates

There are so many factors that it is not possible to agree what the future of this market might be. However, this is not an unusual situation. The best way to approach it is through the use of scenario planning, as outlined below. SITA has carried out such an exercise and two of their market scenarios are shown in Figure 7.1.

The green area in Figure 7.1 shows annual RDF exports for the whole of the UK under a scenario where a large amount of UK EfW capacity comes online and some continental European capacity is either closed or is subject to increasing demand from other RDF exporting nations. The yellow bars illustrate the possible results if the reverse were to occur.

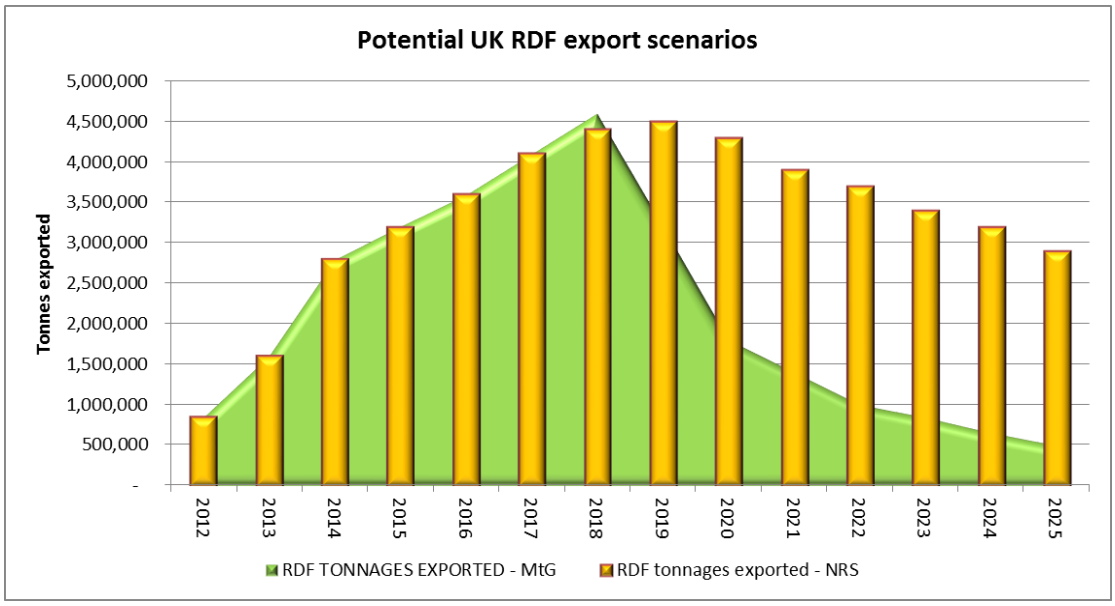


Figure 7.1 Two of SITA's potential RDF export scenarios

Source: Hayward (2014)

To make the best use of the SITA analysis (Hayward 2014), two things need to happen.

First, a group of experts in the area should be convened to look at the possibility of undertaking dependency modelling and scenario planning work using the Delphi process.

- **Dependency modelling:** 'At its core dependency modelling is such a simple concept – if this event happens, what impact does it have on other events? … Some of the dependencies are not immediately obvious, and need working through – i.e. modelling – to understand all the dependencies' (O'Leary 2012).

- **Scenario planning:** The use of scenarios – or plausible stories – 'that can be used by policy makers and stakeholders to discuss the future and explore the implications for …policy' (Environment Agency 2006).
- **The Delphi process:** '… a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem. To accomplish this 'structured communication' there is provided: some feedback of individual contributions of information and knowledge; some assessment of the group judgment or 'view'; some opportunity for individuals to revise views; and some degree of anonymity for the individual responses' (Linstone and Turoff 1975).

Second, better data should be sought. This exercise should focus on English and key continental European country gate fees, sea transport costs and sea transport futures.

The quantitative analysis produced as part of this report can be used to turn the scenarios produced by the expert workshops from qualitative descriptions of possible future worlds into quantitative outcomes that emerge as a logical result of the conditions in those worlds.

This section sets out a number of ideas for further research. Note that these are recommendations and not commitments to undertake work.

8 Conclusions

So what has caused the trend in exports of RDF from England since 2010?

The market began in June 2010 after a regulatory decision by the Environment Agency based on the UK Plan for Shipments of Waste, which allowed the export of RDF. It has grown rapidly since due to a greater demand for EfW capacity than currently exists in England. This in turn was caused by material being shifted from landfill by the landfill tax and landfill diversion targets, and by the lower cost of some continental European EfW facilities.

This demand has meant it is economic to produce RDF and export it to continental Europe, especially the Netherlands, Sweden and Germany, provided these routes cost less than disposal in English landfills. The landfill tax has therefore been a key driver in diverting waste from landfill and consequently for the RDF export market. This is shown by the high correlation between export levels and landfill tax rates, with continental EfW facilities setting their gate fees at a level designed to just undercut this disposal route. The data also show that the market may be levelling off as RDF export routes become as expensive as English landfill.

These conclusions are supported by evidence from industry contacts as well as a basic quantitative analysis of the English RDF export market.

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List of abbreviations

CHP	combined heat and power
EfW	energy from waste
GDP	gross domestic product
Mt	million tonnes
RDF	refuse derived fuel

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