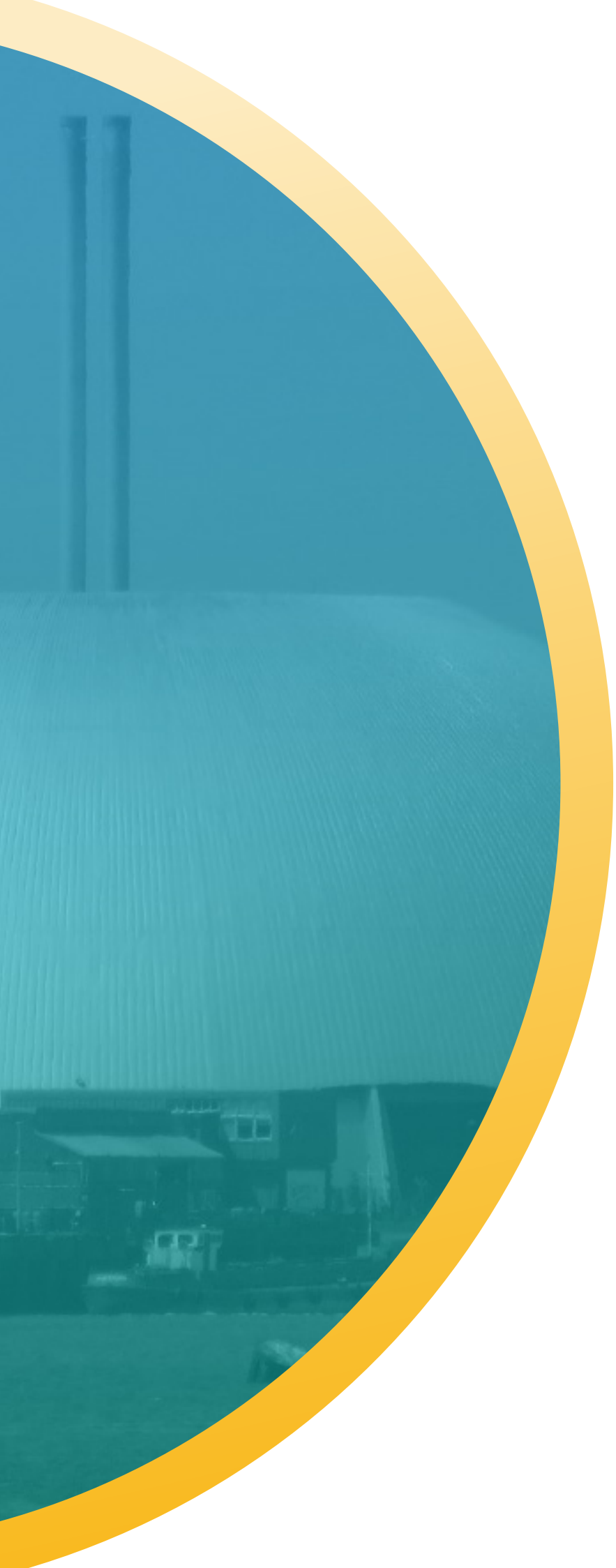

Residual Waste Infrastructure Review

Issue 12

July 2017

About Eunomia

Eunomia has significant experience of assessing the need for new infrastructure development in the energy and waste sectors on behalf of both public and private sector clients. Accordingly, we have provided market and technical due diligence services to a range of lenders and equity funds. Eunomia is also recognised as a leader in understanding the direction and trajectory of waste policy. We have advised Defra, Scottish Government, Welsh Government, Government of Ireland, the Environment Agency, OECD, UNEP, European Investment Bank and the European Commission on a range of waste-related issues since our incorporation in 2001. On behalf of our private sector clients, therefore, we use our knowledge regarding trends in legislation and wider developments in the industry to help to identify investment opportunities with clear prospects for success.

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1.0 Introduction to the 12th Issue

Eunomia's Residual Waste Infrastructure Review ('the Review') is a biannual study of the balance between arisings of residual waste, and the facilities available to treat it in the UK and Northern Europe. Because of the long lead-times and lifespans of some infrastructure, such as incinerators, it is important to understand the history of their development, the current position, and how the balance between the available capacity and the available residual waste is likely to change in future years. We therefore provide projections of residual waste arisings, and combine this with data we hold regarding facilities that are operational or on the path towards construction, so as to give an informed perspective on the future prospects of the waste treatment market.

As the level of residual waste treatment capacity increases, and the amount of suitable residual waste available for treatment declines, closing the capacity gap, it becomes increasingly important to have accurate data upon which to base projections for additional infrastructure requirements and to guide policy intervention. In this twelfth issue of the Review we examine the degree to which recycling rates are being constrained as residual waste infrastructure continues to be developed. We also explore the most significant areas of uncertainty that affect our current projections.

1.1 Data Uncertainties

Whilst data on household waste in the UK is relatively comprehensive, data on commercial and industrial waste remains stubbornly poor. This unfortunately gives rise to a significant area of uncertainty in any estimate of waste arisings, and in recent months, the level of uncertainty has been highlighted by Defra's release of revised estimates for Commercial and Industrial (C&I) waste in December 2016, which Defra further updated in February 2017.

The revised estimates substantially reduced the reported level of C&I waste arising (2012 UK estimate revised from 47.5Mt to 32.8Mt), due to a review, and revision of, the methodology used. Such a substantial reduction in waste arisings estimates would make a considerable difference to the amount of residual waste estimated to be available for treatment.

Defra recognises that there is a high level of uncertainty in the statistics regarding C&I waste generation.[1] The main revisions Defra has made in its new estimates include:

[1] UK statistics on waste – December 2016 update
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/593040/UK_statsonwaste_statsnotice_Dec2016_FINALv2_2.pdf

- waste managed under exemptions;
- complexities around potential double counting of waste being managed at a number of sites; and
- the reporting of sludge and wastewater categories as dry weight in line with the requirements of the Waste Statistics Regulation (WStatR).

However, there continues to be data gaps around exemptions and reprocessors. There is no requirement in England to report waste handled and managed under exemptions, and a lack of reliable data on which to base assumptions. Accounting for potential double counting of waste being managed at a number of sites is further complicated by some waste going directly from transfer stations to reprocessors, which is not fully captured in the data.

We have closely examined the changes Defra has made and discussed the issue with representatives of the department. Our conclusion is that, while there may be merit in some of the changes that Defra has made, it is not clear that the result has been to deliver a more accurate total estimate of C&I waste arisings, owing to the lack of evidence for revised assumptions.

Furthermore, the purposes of our analysis, we are interested in residual waste stream that is suitable for treatment. Our modelled C&I residual waste arisings, based on C&I arisings data, are able to be reconciled with data on the quantity of residual waste sent to landfill at the standard rate, and known throughputs to operational facilities, net of household waste (for which data is reasonably accurate). In our view, there is not currently sufficient confidence in the revised figures, or sufficient supporting evidence from published landfill and treatment data, to justify any downward adjustments to our C&I residual waste arisings estimates.

However, Defra's recent engagement with this difficult area of data is welcome. It highlights the lack of clear, reliable data – for which there is an increasingly urgent need. As we move towards the point in time when the available treatment capacity matches the demand for it, the economic consequences of excess capacity will begin to loom ever larger, with the likelihood of business failures increasing, owing to the lack of sufficient feedstock available at a price that is financially sustainable.

1.2 Policy Context

Any projection regarding future residual waste arisings involves making assumptions regarding the future level of recycling that will be achieved. Over the last two decades, the UK's waste management policy has been to a large degree shaped by European Union waste legislation, which – by setting clear, long term targets for recycling of municipal waste, for reducing biodegradable municipal waste sent to landfill, and other waste management aims – has provided a considerably level of predictability to the direction of UK waste policy. Following last year's referendum on leaving the EU, there is no longer quite so much clarity.

The UK is currently working towards a 50% recycling target for household waste by 2020 set within the Waste Framework Directive. The UK is also still party to negotiations

around the EU's Circular Economy Package, which may be completed ahead of the UK exiting the EU. Although Defra ministers have not been wholly enthusiastic about the Circular Economy Package, Defra has indicated that it is working on the assumption that the UK will adopt the Circular Economy Package, possibly including the more stretching municipal recycling targets proposed for 2030 (70%). Even if the UK does not adopt European targets, the UK Government is currently analysing consultation responses on a draft industrial strategy that was published in January 2017, and whose aims included securing "the economic benefits of the transition to a low-carbon and resource-efficient economy".[2] Whether, and how, this translates into changes in waste management policy or practice remains to be seen.

Although there is now a greater degree of uncertainty regarding the UK's future recycling aims, we have continued to model a scenario in which the UK adopts and meets the EU's recycling targets, alongside the possibility that the UK achieves lower recycling levels.

1.3 Constraints to Recycling

Prior to forecasting the potential capacity gap, in this Issue, we have considered the potential impacts upon recycling resulting from increases in domestic treatment infrastructure which is already operational, under construction, or financially committed. This provides an update to analysis undertaken in issue 7 of the review where modelling indicated that maximum recycling was constrained to 66%.

It should be noted that this analysis only includes domestic infrastructure that has been primarily designed to process residual waste (i.e. incineration, gasification/pyrolysis and MBT) and therefore *excludes* other facilities which *might* process waste as a fuel source, i.e. licensed capacity at cement kilns, and WID-Compliant biomass facilities and *excludes* RDF exports. As per previous issues of the report, however, we do include the impact of this additional capacity in our forecast of a potential capacity gap (see Section 2.0).

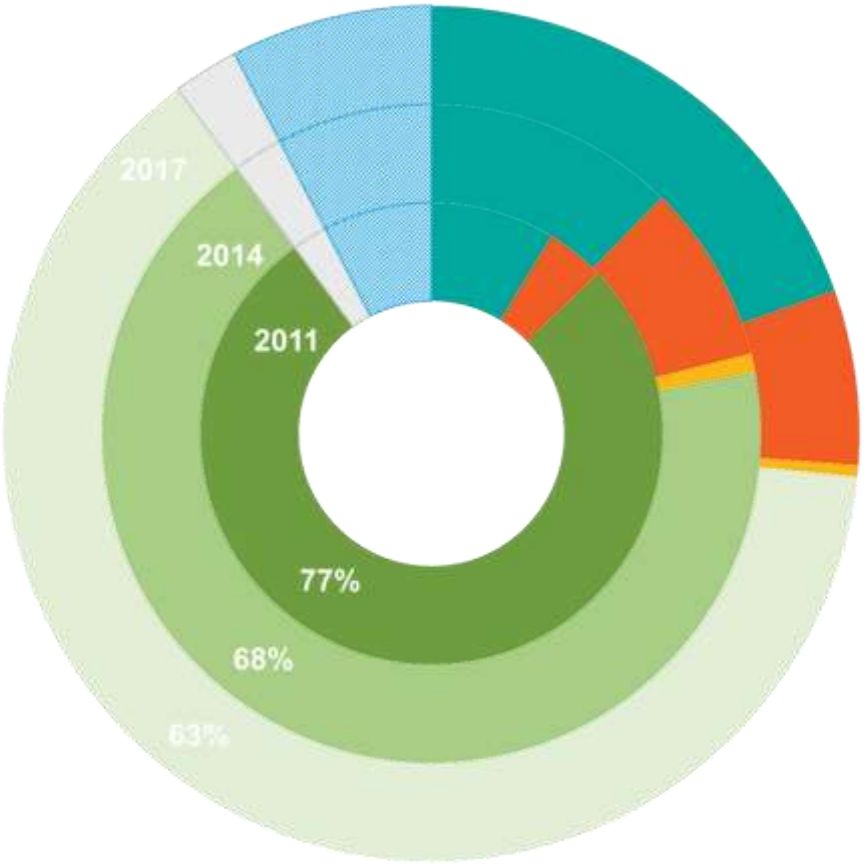
The results of this analysis, presented in Figure 1.1, shows that with the level of committed residual waste treatment infrastructure in 2011, the UK would still have been able to achieve a recycling rate of 77% by 2030 across household, commercial and industrial waste streams if all residual waste treatment infrastructure had been fully utilised. By 2014, increased levels of residual waste treatment infrastructure meant that if all residual waste treatment infrastructure was fully utilised, the maximum recycling rate achievable by 2030 had fallen by 9 percentage points to 68%.[3] In 2017, given the

[2] HM Government (2017) *Building Our Industrial Strategy*, January 2017, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/611705/building-our-industrial-strategy-green-paper.pdf

[3] This is marginally higher than the maximum rate reported in issue 7 of the review due to a small decrease in the estimated total quantity of waste arising in 2030.

level of residual waste treatment infrastructure already committed, we forecast a that the maximum recycling rate achievable in 2030 if all treatment capacity is fully utilised has fallen to 63%.

Figure 1.1: Total Forecast Waste in 2030 and Constraints on UK Recycling



		Key	2011	2014	2017
Residual Waste Treatment Capacity (ktpa)	Operational		7,000	9,900	15,800
	Under Construction		3,300	7,100	5,300
	Other Committed Capacity		-	700	400
	Total Committed Capacity		10,300	17,700	21,400
Other waste (unsuitable for residual treatment) (kt)			6,100	6,100	6,100
Landfill (continuing requirement) (kt)			2,000	2,000	2,000
Recycling / Composting / Reuse (kt)			62,100	54,700	51,000
Total Arisings in 2030 (kt)					**80,500**

1.3.1 Constraints from Additional Capacity with Consent

In the analysis above we only consider the infrastructure which is already committed. In addition to this there is over 14 million tpa of capacity (excluding WID-compliant biomass and cement kilns) with planning consent, of which at least some may reach financial close and be developed. Each new facility that is built would therefore further constrain the maximum level of recycling. Should 20% of this capacity be developed, then the maximum level of recycling achievable would decrease by 3% to 60%. Similarly,

if 40% of this capacity was developed, then the maximum level recycling would decrease to 57% (and it follows also that if 100% of this capacity was developed, the maximum recycling rate achievable would fall to 49%).

2.0 UK – Capacity Gap Projections

Eunomia has revised and updated its analysis of the gap between UK residual waste arisings and available treatment capacity to reflect the changes that have occurred since Issue 11 of the Residual Waste Infrastructure Review, and to take account of the most recent available data.

2.1 Developments Since 11th Issue

Our analysis shows that the UK's capacity gap has dropped since Issue 11, which was published in November 2016. Residual waste arisings suitable, and available, for treatment now exceed operational treatment capacity by 7.0 million tonnes, down from the 10.2 million tonnes we last reported.

We consider two future scenarios impacting on the amount of residual waste available:

- Scenario 1: the UK continues to apply current and planned EU recycling targets leading to further reductions in residual waste; and
- Scenario 2: the UK meets existing (household) recycling targets for 2020; thereafter, recycling rates remain constant for household waste to 2030, while a modest increase occurs in C&I recycling rates.

The two scenarios have different implications as far as the expected level of UK residual waste is concerned.

Since the last Residual Waste Infrastructure Review a number of facilities have commenced operations. These include:

- Suez Cornwall ERC (240,000 tpa);
- Suez Severnside (400,000 tpa);
- Suez Wilton (430,000 tpa); and
- Mercia Waste Management's EnviRecover (200,000 tpa)

Since the last Residual Waste Infrastructure Review a number of facilities are now under construction, including:

- Wheelabrator Parc Adfer (200,000 tpa);
- UBB Javelin Park (190,000 tpa);
- Kemsley Mill (550,000tpa).

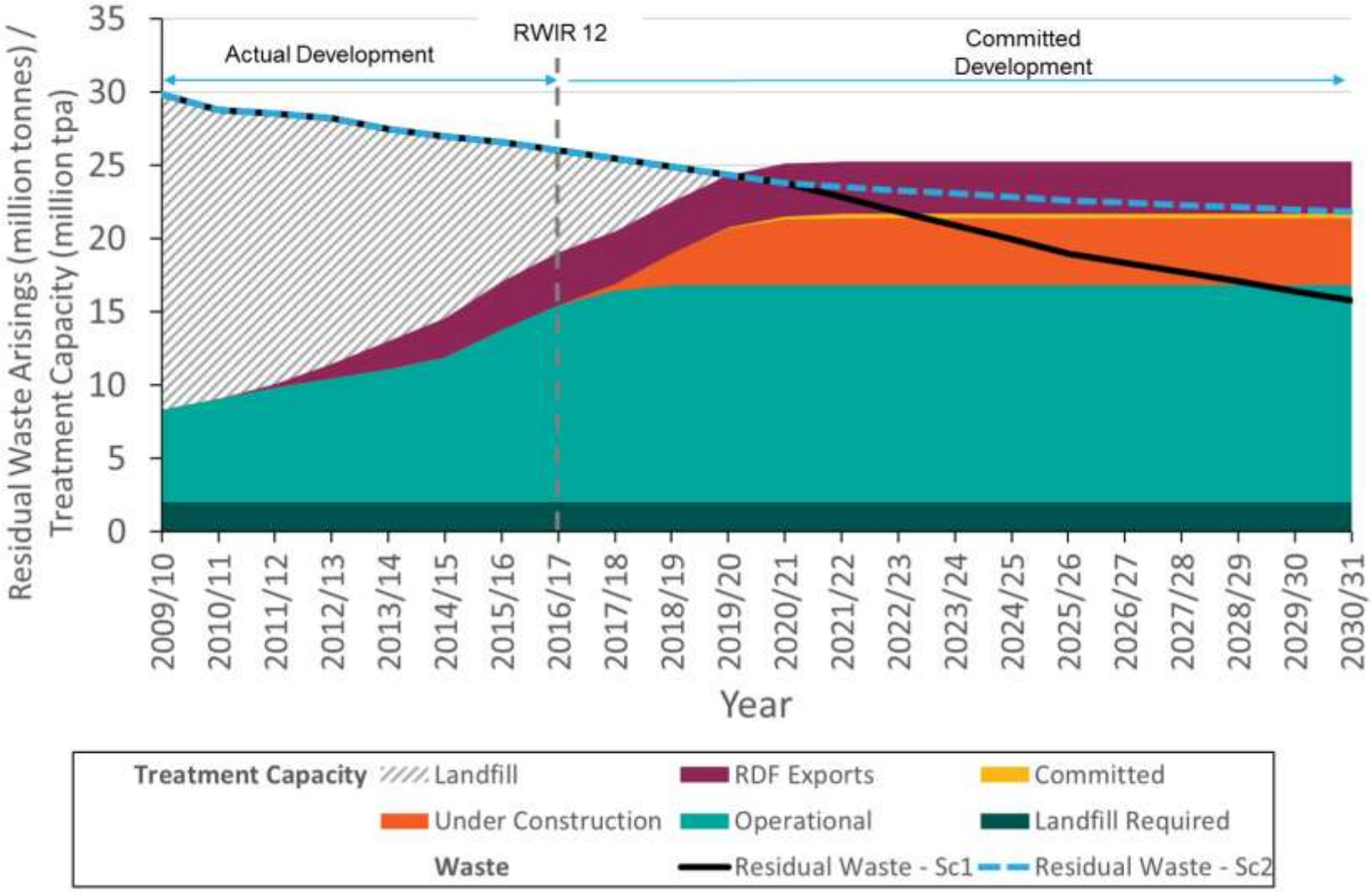
There are now 13.5 million tonnes of 'effective' operational capacity, with a further 4.8 million tpa of effective treatment capacity currently under construction or committed (i.e. financial close has been reached).[4]

In recent years, the UK's residual waste market has become increasingly influenced by the availability of spare capacity in treatment facilities on the continent. UK exports of RDF reached 3.6 million tonnes for 2016. Initial provisional data for 2017 shows a small decline from 2017 levels.

It appears likely that spare capacity on the continent will continue to grow. A number of EfW facilities are under construction, while residual waste arisings are set to decline as each nation strives to reach recycling targets for 2020 and beyond. Filling this capacity with residual waste from neighbouring countries will remain an attractive option, and it is unlikely that many facilities will close, especially where they have been built into district heating networks.

[4] 'Effective' treatment capacity means capacity which has had the effect of pre-treatment facilities removed to avoid double-counting of available capacity.

Figure 2.1: Residual Waste Capacity Gap in the United Kingdom



2.2 The UK's Capacity and Requirements

Since 2009/10, the UK's residual waste treatment infrastructure sector has seen significant development. Effective treatment capacity has more than doubled from 6.3 million tonnes to 13.5 million tonnes. Alongside the increase in treatment capacity, the quantity of residual waste suitable for treatment has fallen from an estimated 29.9 million tpa to 26 million tpa.

Looking to the future, in scenario 1, our analysis suggests that the UK's supply of capacity will exceed the available quantity of residual waste in 2020/21 (or in 2023/24 if the export of RDF is excluded from the analysis).[5] The level of excess demand rises to 9.5 million tonnes in 2030/31 (or 5.9 million tonnes if RDF exports are excluded). In scenario 2, the modelling indicates that that the UK's supply of capacity will exceed the available quantity of residual waste in 2020/21, with the level of excess supply rising to 3.4 million tonnes in 2030/31. If exports are excluded from the analysis, treatment capacity that is already committed broadly balances with the projected level of residual waste requiring treatment in 2030/31.

The analysis excludes all 'non-committed' capacity (i.e. that which has not reached financial close), and so effectively assumes that no further projects progress beyond the planning stage, although as noted above, a considerable number of facilities have already reached this stage. Therefore, should new projects be developed, the excess of capacity relative to demand for treatment may occur earlier and/or ultimately reach a higher level.

2.2.1 Development Activity

In addition to the already committed facilities shown in Figure 2.1, there is continued development activity in the planning pipeline, summarised in Table 2.1.

[5] Essentially, the residual waste treatment market has become a European one, so it seems unlikely that excluding RDF exports would be a sensible assumption.

Table 2.1: Development Activity

	Number of new facilities (since last issue)	Capacity of new facilities (million tpa)	Total number of facilities	Total capacity (million tpa)
Planning Consents Granted	3	0.24	114	14.4
Planning Applications Submitted	9	1.6	16	2.5

Each time a facility reaches financial close or begins construction, the likelihood of nearby facilities reaching financial close falls. However, the lead-times involved in the development process, and the associated level of inertia in the system, mean that the pace at which developers respond to the emergence of over-supply of capacity may not be sufficiently rapid to prevent some level of excess capacity coming on stream. Developers may attempt to counteract the approaching levels of excess capacity by securing long term feedstock arrangements in advance of development.

Furthermore, as the capacity gap closes, facilities operating successfully at lower gate fees than those currently in use may out compete existing facilities. In these cases, developers may not be discouraged from moving forward, even if there are concerns regarding excess capacity, as their model may be based on securing feedstock by undercutting other facilities. The emergence of greater price competition may be a challenge for those already in the market, especially those operating at relatively high marginal cost.[6]

An excess of residual waste treatment facilities has the potential to undermine resource efficiency, and the incentive to handle waste in more environmentally friendly ways in accordance with the legally binding waste hierarchy.[7] As residual waste availability decreases, facilities will compete more intensely to receive that waste. For waste that is not governed by pre-existing contractual arrangements, the price of treatment will increasingly move towards the marginal cost of providing the service. In other words, residual waste treatment gate fees would fall, which would directly affect the economics of recycling, but may limit the attraction of exporting RDF to facilities elsewhere in Europe.

[6] Eunomia Research & Consulting (2016) *Investment in Advanced Conversion Technologies: Has the Time Finally Arrived?*, November 2016, http://www.eunomia.co.uk/reports-tools/investment-in-advanced-conversion-technologies-act/

[7] HM Government (2011) The Waste (England and Wales) Regulations 2011, S.I. 2011/988

2.3 Assumptions

The forecast above is based on a number of assumptions for each scenario, which we set out in this section with further detail provided in Appendix 1.

2.3.1 Residual Waste Arisings

Residual waste has been decreasing steadily for the last two decades, which has been brought about by policies introduced partly in response to European Directives. In the event that UK waste policies begin to follow a different path, some of the pressures that have helped to drive down residual waste arisings may be released.

In general, overall waste arisings tend to be positively correlated with economic growth. The OBR has recently downgraded its expectations regarding UK growth, saying:

> *"over the time horizon of our forecast any likely Brexit outcome would lead to lower trade flows, lower investment and lower net inward migration than we would otherwise have seen, and hence lower potential output."*[8]

Under both scenarios, we conservatively retain the assumptions regarding waste arisings that we have used in previous issues of this review, as shown in Table 2.2.

Table 2.2: Waste Arisings Change Assumptions

Waste Stream	Annual Waste Arisings Change
Household	+0.5%
Commercial	+0.5%
Industrial	-1.0%

2.3.2 Recycling Rates

A key factor in determining the amount of residual waste that requires treatment is the level of recycling that the UK achieves.

In scenario 1 we assume that England and Northern Ireland continue to achieve compliance with the targets set by the European Commission, and that the adoption of circular economy approaches results in improvements in the recycling rate across all household, commercial and industrial waste streams.

In scenario 2 we assume that England and Northern Ireland achieve compliance with the existing target for 2020, and the household recycling rate then remains constant, with a more modest increase in recycling rates across commercial and industrial waste.

[8] http://budgetresponsibility.org.uk/overview-of-the-november-2016-economic-and-fiscal-outlook/

Table 2.3: Recycling Assumptions (England and Northern Ireland)

Waste Type	Scenario 1		Scenario 2	
	2020	2030	2020	2030
Household	50%	65%	50%	50%
Commercial	65%	75%	65%	70%
Industrial	70%	80%	70%	75%

In both scenarios Scotland and Wales are assumed to achieve the targets that have been set by their devolved administrations of 70% by 2025.

2.3.3 Facility Efficiencies

For the first time in our analysis we have accounted for facilities not operating at their full capacities. We assume that incinerators operate at 95% of their capacity, and apply a further 20% reduction to MBT and gasifiers owing to increased unplanned facility downtime for these technologies.

2.3.4 RDF Exports

This report does not attempt to analyse RDF exports in detail, as its focus is on the development of infrastructure in the UK. For both scenarios, we therefore assume RDF exports will remain at 3.6 million tonnes for 2017, and thereafter remain constant.

3.0 Northern Cluster – Capacity Gap Projections

In this section we update our analysis of the balance of supply and demand across 11 European states, which was first presented in the 10th Issue of the Review. The countries we include in our analysis are:

- Belgium
- Czech Republic
- Denmark
- France
- Germany
- Republic of Ireland
- The Netherlands
- Norway
- Poland
- Sweden
- United Kingdom

Each of these countries is actively involved in trading RDF or SRF with others within the group, and together they form a natural trading 'cluster'. Due to their geographical proximity (as shown in Figure 3.1) in Northern Europe we refer to them as the 'Northern Cluster'.

Figure 3.1: The Northern Cluster

Our analysis below presents an estimate of the current and future residual waste treatment 'capacity gap' for the Northern Cluster. This relates to the tonnage of residual waste which is 'potentially available' to operators or developers of new treatment facilities relative to capacity estimates.

It should be noted that reporting methods vary across the Northern Cluster. Figures ought to be treated with caution, especially as regards comparison between Member States, because of varying data collection methods, the lack of recent data, and the complexity of waste-treatment streams. As described in section 1.1, applying different methodologies and assumptions to estimate waste quantities can have a significant impact on the results. As a result of our efforts to account for different reporting conventions and varying definitions of MSW and C&I waste across Europe, our presentation of some data may differ from figures given elsewhere. For clarity, the data sources for each country are shown in Appendix 1.

We are happy to receive any comments that would enable us to further improve the data for future editions of this report.

3.1 Summary of Current Infrastructure

The current situation of each of the Northern Cluster countries is detailed in Table 3.1, and shown in

Figure 3.2. In summary:

- The 11 countries now have a combined 101.4 million tpa of 'effective' residual waste treatment capacity either 'operating', 'under construction', or which is 'committed', i.e. has reached financial close;[9]
- This capacity is made up of:
    - 388 dedicated EfW incineration facilities;
    - 14 Advanced Conversion Technology (ACT) facilities;
    - 103 pre-treatment facilities (using either mechanical-biological treatment (MBT) or autoclave technologies);
    - 72 Industrial Emissions Directive (IED) compliant biomass facilities, including facilities already co-firing residual waste; and
    - 102 cement kilns capable of processing solid recovered fuels (SRF).[10]

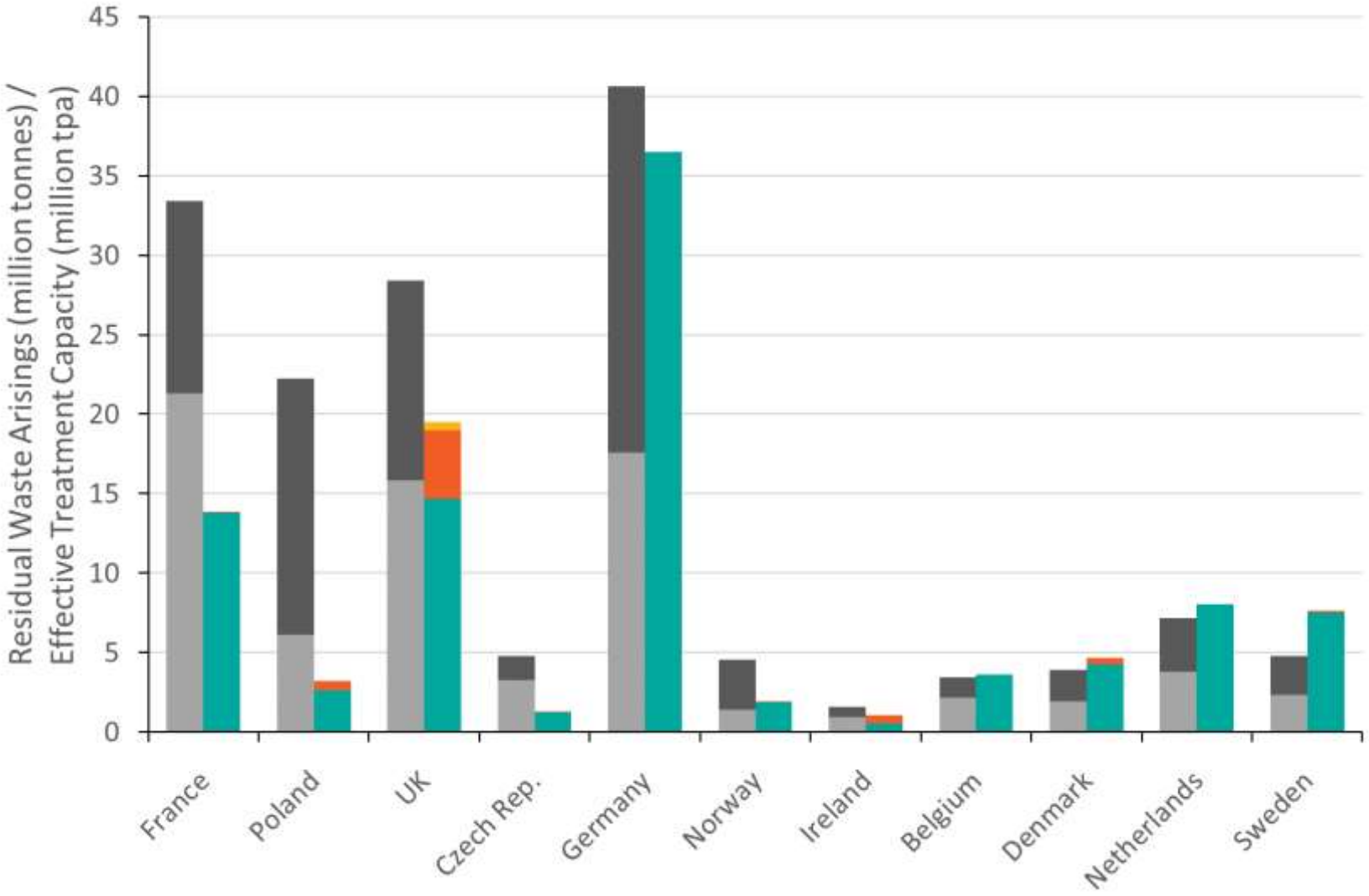
[9] 'Effective' treatment capacity accounts for the double-counting effect of pre-treatment capacity.

[10] Only dry-kilns were included in the analysis, except in cases where we are aware of wet-kilns accepting SRF. The capacity is calculated based on a 40% fuel substitution rate with SRF (in energy terms). For the UK we used current permitted capacity of cement kilns.

Table 3.1: Residual Waste Arisings and Treatment Capacity in Northern Cluster Countries

Country	Residual Waste Arisings (tonnes, 2016(est.))			Total Effective Treatment Capacity (ktpa)	No. of Facilities				
	Household (kt)	Commercial & Industrial (kt)	Total (kt)		Incineration	ACT	MBT (and other pre-treatment)	IED Compliant Biomass (and co-firing)	Cement Kilns
Belgium	2,200	1,200	3,400	3,600	16	0	0	0	4
Czech Republic	3,100	1,500	4,600	1,300	5	0	0	0	6
Denmark	1,900	1,900	3,800	4,700	35	0	0	1	1
France	20,200	11,700	31,900	13,900	97	1	4	0	33
Germany	17,700	22,300	40,000	36,500	105	0	63	41	31
Ireland	900	600	1,500	1,100	3	0	0	0	3
Netherlands	3,700	3,300	7,000	8,100	13	0	0	1	1
Norway	1,400	3,000	4,400	1,900	22	2	0	3	2
Poland	5,800	15,300	21,100	3,200	10	0	2	1	10
Sweden	2,300	2,400	4,700	7,600	35	0	0	8	3
United Kingdom	15,200	12,300	27,500	19,500	47	11	34	17	8
Total	**74,400**	**75,500**	**149,900**	**101,400**	**388**	**14**	**103**	**72**	**102**

Figure 3.2: Residual Waste Arisings and 'Effective' Treatment Capacity in Northern Cluster Countries



The detailed methodology used to determine the level of effective residual waste treatment capacity is provided in Appendix 1, available as a separate document.

3.2 Forecast of the Northern Cluster's Capacity and Requirements

The results of our analysis are shown in Figure 3.3, which indicates that the capacity gap will fall from the current level of 56.7 million tonnes to a situation of potential over-supply of capacity from 2028 onwards.

Improvements in recycling rates lead the excess supply of treatment capacity to rise to 8.7 million tpa by 2030. Thereafter, it decreases to 5.2 million tpa by 2035 due to continued growth in waste arisings with no compensating increase in recycling.

Our approach to modelling the future capacity requirements of the 'Northern European' cluster is detailed in Appendix 1.

Figure 3.3: Potential Future Residual Waste Capacity Gap in Northern Cluster Countries (2016 to 2035)

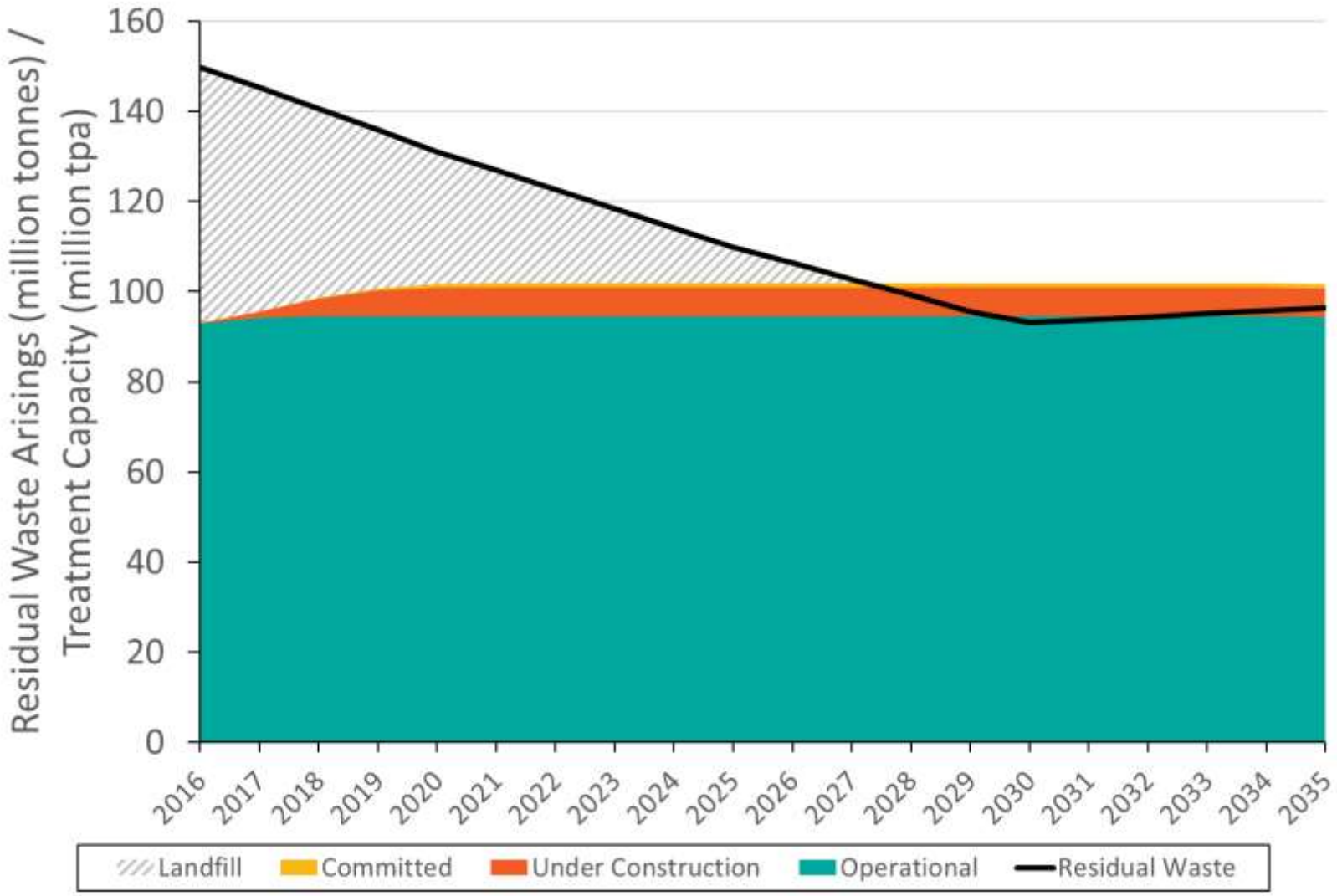


Figure 3.4: Residual Waste Arisings and Treatment Capacity in Northern Cluster Countries (2017 to 2030)

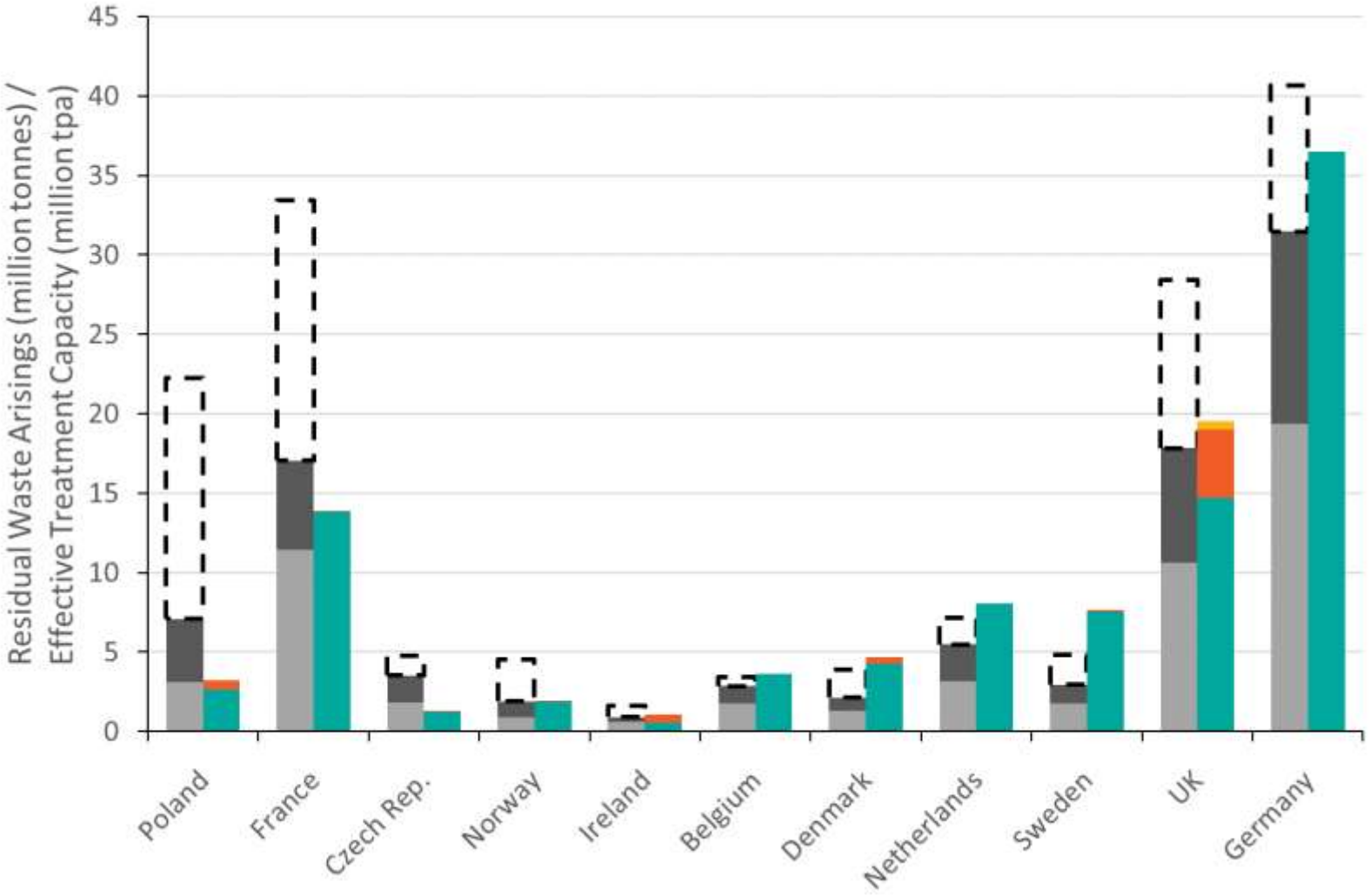


Figure 3.4 shows that some countries, such as Sweden, Denmark and the Netherlands, already have more treatment capacity than residual waste. Assuming that overall waste arisings evolve broadly as we have indicated, any further increase in their recycling rates (which will be required in response to the Circular Economy Package targets) will result in such countries needing to either:

- increase imports of RDF and SRF from other Member States;
- switching feedstock to biomass; or
- take treatment capacity offline.

In the context of reduced available tonnage of residual waste, price competition is likely to become more intense. However, developers who are confident that their proposed new facilities can out-compete other plant in respect of gate fees may not be discouraged from investing due to concerns relating to access to feedstock. While some established plant will also be well placed to compete, it will be a challenge for others, especially those operating at relatively high marginal cost. Intensifying competition may not be sustainable, and could result in some plant being forced to close prior to the end of their design-life.