

Refuse Derived Fuel – A European Market Heading for Overcapacity

Mike Brown

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During the last five years, the residual waste market has been transformed from one whose geography was largely defined by a country's borders to one that has become truly European in nature. Increasing, and now significant, tonnages of refuse derived fuel (RDF) and solid recovered fuel (SRF) are moving across national boundaries. In the UK, for example, the export of RDF and SRF has grown from 250,000 tonnes per annum (tpa) in 2011 to 3.4 million tpa in 2015.

The rise of the export trade has tended to break the link between the waste each country produces and the amount of waste treatment infrastructure it can support. Some countries already have more treatment capacity than waste; and some of these are still building new facilities that will need to be fuelled by imports. Within this changing and complex environment, how much scope is there for further development of residual waste treatment facilities such as energy from waste (EfW) incinerators and mechanical and biological treatment plants in the UK and Northern Europe?

At Eunomia Research & Consulting Ltd., we have been keen observers of the emerging trends. Twice a year for the last five years, we have published a Residual Waste Infrastructure Review, looking at the current and future balance between the amount of residual waste being generated and the treatment capacity available to divert it from landfill. But where we have previously focused only on the UK, in the latest issue of the report – published in May 2016 – we decided that the changing shape of the market meant it was now necessary to consider the balance of supply and demand across much of Northern Europe, including:

- Ireland,
- The Netherlands,
- Germany,
- France,
- Belgium,
- Denmark,
- Sweden,

- Norway,
- Poland,
- Czech Republic and
- United Kingdom

All of these EU Member States are actively involved in trading RDF or SRF with others within the group and therefore form a natural *cluster* of countries in Northern Europe (the *Northern Cluster*).



Figure 1: The *Northern Cluster*

The principal drivers of change in the residual waste market in these countries have been EU targets – the landfill diversion targets set by the Landfill Directive, and the targets for recycling – or preparation for reuse – of municipal solid waste (MSW) set by the Waste Framework Directive. Some Member States have advanced faster than others; for example, Belgium has achieved 55 percent recycling, while France is currently languishing at 21 percent.

Beyond 2020, all Member States are beginning to consider how they will meet the targets held within the European Commission's (*the Commission*) Circular Economy Package. [1] The recent legislative proposal includes a target for 65 percent recycling – or preparation for reuse – by 2030, albeit one from which a number of Member States (not those in the Northern Cluster) would have a derogation until 2035. Only one calculation method that can be used to assess compliance, compared with

the four available for the 50 percent target, and as a result the 2030 target will be considerably more demanding for some states to meet.

Looking across the Northern Cluster, is it foreseeable that at some point we will have sufficient treatment capacity to manage all the residual waste that is likely to arise? Recent experience has proven that residual waste can travel cost-effectively, whilst evidence recently published by the RDF Industry Group demonstrates that carbon dioxide (CO₂) emissions from transport are relatively insignificant when compared with those from wider waste processing activities.[2] It therefore makes sense to consider capacity and waste across the cluster as a whole.

Of course, where low-cost landfill continues to be available in Member States, this is likely to constrain the amount of waste that it is cost-effective to export. However, for either commercial or regulatory reasons, the supply of such landfill is likely to decline. As this happens, it will become increasingly attractive to use existing dedicated EfW infrastructure in neighbouring countries, alongside other plant suitable for processing RDF or SRF, including industrial multi-fuel CHP facilities and cement kilns.

The 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 the capacity potentially available in future.

The data presented throughout this article draws upon information held within Eunomia's internal database, which is updated on an ongoing basis using a combination of publicly available information and that provided to us by national governments and industry. It holds information on every residual treatment facility across Europe, including data on capacity and electrical output. Consistent international figures on residual waste arisings can be challenging to produce due to differences in reporting conventions and definitions – e.g. of MSW and C&I waste. Efforts to address these challenges mean that some data may vary from its presentation elsewhere.

1. Summary of current infrastructure

As detailed in Table 1, and shown in Figure 2, the key data for the Northern Cluster can be summarised as follows:

- Currently, the 11 countries of the Northern Cluster have a combined 104.2 million tpa of *effective* residual waste treatment capacity, either *operating*, *under construction*, or which is *committed*, i.e. has reached financial close;
- This capacity is made up of:
 - * 383 dedicated EfW incineration facilities;
 - * 13 Advanced Conversion Technology (ACT) facilities;
 - * 103 pre-treatment facilities – using either mechanical-biological treatment (MBT) or autoclave technologies;

- * 73 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).
- This includes considerable amounts of new capacity that is being developed. Examples include Viridor's 300 ktpa energy from waste (EfW) incineration plant in Oxwellmains, Scotland, Covanta's 600 ktpa EfW incineration plant in Poolbeg, Dublin, and an additional 192 ktpa line at the Delfzijl facility in Holland.
- It excludes any *non-committed* treatment capacity – i.e. that which has not reached financial close or remains at the planning stage; – in practice, it is likely that some additional treatment capacity will be developed, beyond the currently committed level.

Table 1: Residual waste arisings and treatment capacity in Northern Cluster countries

Country	Residual Waste Arisings (tonnes, 2015 (est.))			Total Effective Treatment Capacity ktpa	No. of Facilities				
	House- hold	Commer- cial and Industrial	Total		Incine- ration	ACT	MBT (and other pre- treatment)	IED Compliant Biomass (and co- firing)	Cement Kilns
	kt	kt	kt						
Belgium	2,200	1,200	3,400	3,800	16	0	0	0	4
Czech Republic	3,200	1,500	4,700	1,400	5	0	0	0	6
Denmark	1,900	2,300	4,200	4,900	35	0	0	1	1
France	21,400	12,100	33,500	14,500	97	1	4	0	33
Germany	20,200	15,000	35,200	37,900	105	0	63	40	31
Ireland	900	700	1,600	1,100	3	0	0	0	3
Nether- lands	4,000	3,400	7,400	8,500	13	0	0	1	1
Norway	1,400	3,100	4,500	2,000	22	2	0	3	2
Poland	6,100	16,100	22,200	2,600	5	0	0	0	10
Sweden	2,200	3,500	5,700	8,000	35	0	0	9	3
United Kingdom	15,300	10,600	25,900	19,500	47	10	36	19	8
Total	78,800	69,500	148,500	104,200	383	13	103	73	102

Increasing tonnages of RDF and SRF are moving across Member State boundaries. In this context, whilst RDF from the Czech Republic is unlikely to be transported to Ireland, for example, it can readily (depending upon the gate fee) be sent for processing to an EFW plant in Germany. This would reduce the supply of German treatment capacity available for RDF from the Netherlands; and the most economical option might then be for this Dutch waste to be treated using surplus capacity in Sweden.

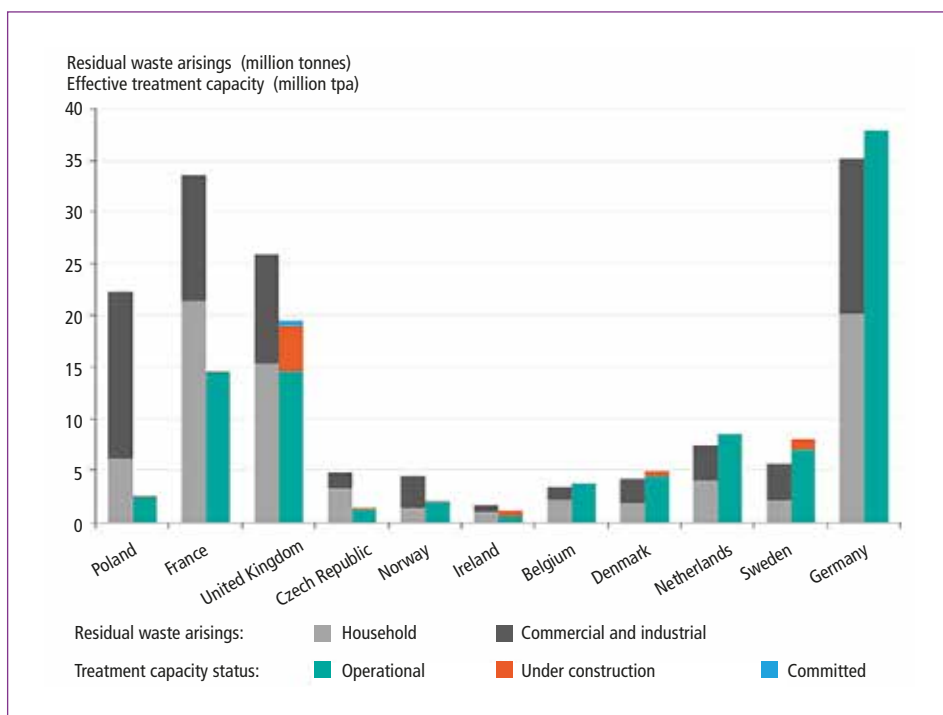


Figure 2: Residual waste arisings and *effective* treatment capacity in Northern Cluster countries

The Northern Cluster has been modelled as a *closed system*, excluding exports and imports of RDF to and from countries outside of this system. This approach will have resulted in a small over- or under-estimate of the capacity gap, but not one that affects the overall findings of the analysis. Eunomia plans to broaden the number of countries within the analysis in future issues of the report.

2. Modelling future residual waste arisings

To forecast waste arisings, both waste growth rates and recycling rates must be considered. For the former, the rates presented in Table 2 have been applied across all the selected countries. The assumption is perhaps unlikely to be accurate for any individual country, but in aggregate represents a reasonable estimate for the Northern Cluster as a whole, based on the following rationale:

Household waste

The countries with significant net outward migration are likely to see a fall in household waste arisings, and vice-versa – those with net inward migration are likely to see arisings grow. Based on the profile of the countries included in the Northern Cluster, this approach results in an overall increase in population and thus arisings;

Commercial waste

As per the above rationale and outcome with regard to household waste;

Industrial waste

As industrial activity is declining in some, yet increasing in other, Northern Cluster countries – compared with the baseline year, – it seems most sensible to assume that overall arisings remain flat.

In terms of recycling rate targets for household waste arisings, we have assumed that all countries meet the aforementioned 2020 (50 percent) and 2030 (65 percent) targets within the Waste Framework Directive and Circular Economy Package respectively.¹

Waste Type	Annual Waste Growth Rates	Recycling Rates Achieved	
		2020	2030
	%	%	%
Household	0.5	50	65
Commercial	0.5	65	75
Industrial	0.0	70	80

Table 2:

Waste growth and recycling rate assumptions

Modelling future residual waste treatment capacity

The estimate of treatment capacity looks only at facilities that are currently operational, under construction, or have reached financial close. This could be regarded as an underestimate: there are likely to be both a significant number of facilities in earlier stages of development, as well as a range of new facilities which have not yet been announced.

We have assumed that no facilities will close over the time period to 2035, unless this has already been confirmed publicly by the operator. Our model therefore assumes that over time, all other facilities are either retrofitted or replaced with facilities of the same scale; a trend which we have observed for EfW facilities in recent years across Europe. In reality, however, the replacement facilities are generally of a larger capacity and therefore, this assumption could also be seen as an under-estimate of the levels of future capacity.

Putting together the above two main model inputs, *future residual waste arisings* and *residual waste treatment capacity*, determines the *capacity gap* for the Northern Cluster: how much residual waste is *potentially available* to operators or developers of new treatment facilities.

As shown in Figure 3, the results of the analysis suggest that, based on the above assumptions the capacity gap will fall from the current level of 53 million tonnes to a situation of potential overcapacity from 2026 onwards.

The level of excess supply of treatment capacity then rises to 13.6 million tpa by 2030, thereafter decreasing to 10.6 million tpa by 2035 as waste arisings grow while recycling levels off at 65 percent. If additional capacity, beyond that which is currently committed, is developed, we may arrive at overcapacity earlier, and the level of excess supply may be greater.

¹ In achieving the 65 percent recycling rate target in the Circular Economy Package, Member States may be able include outputs from residual waste treatment process (e.g. captured metals from incinerator bottom ash)

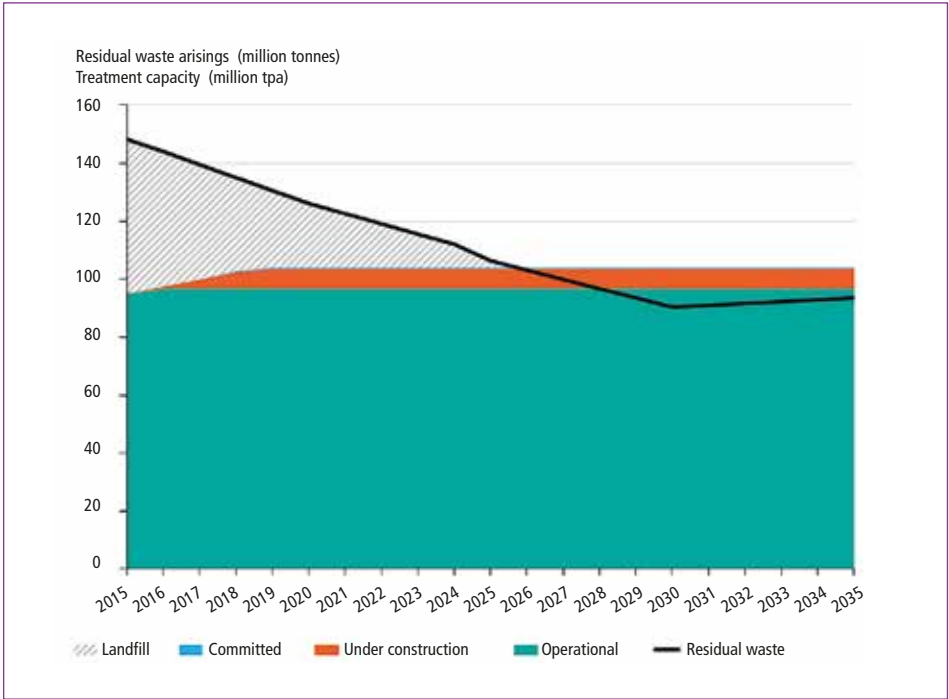


Figure 3: Potential future residual waste capacity gap in Northern Cluster countries (2015 to 2035)

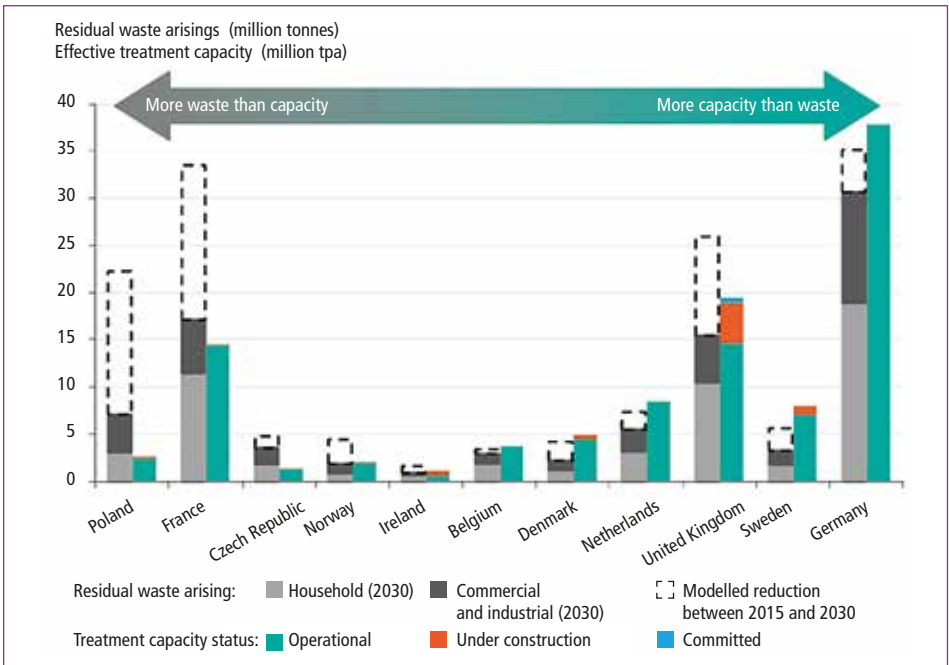


Figure 4: Residual waste arisings and treatment capacity in Northern Cluster countries (2015 to 2030)

At the time of writing, some countries, such as Germany, Sweden, Denmark and the Netherlands, already have excess treatment capacity, as presented in Figure 4. Assuming that they do not close down plant, any further increase in their recycling rates – in response to current or future targets – will result in the further need to import RDF and SRF from abroad.

Some new and existing facilities will be confident of out-competing other plant in respect of gate fees. Even if the problem of excess capacity is recognised, developers of such plant may not be discouraged as they will expect to be able to source sufficient waste to meet their operating requirements. The emergence of greater price competition, however, will be a challenge for others, especially those operating at relatively high marginal cost. This could result in some plant being forced to close prior to the end of their design-life.

3. Forecasting the UK's future capacity requirements

The UK's position makes for an interesting example of how the combination of declining waste arisings, rapid expansion in the waste treatment sector and increases in export lead to a risk of excess capacity, which Eunomia has been warning of for several years. As shown in Figure 5, the latest modelling indicates that, whether the UK reaches EU recycling targets or falls somewhat short of them, the capacity gap in the country is likely to decrease quickly and transition into overcapacity.

MBT and SRF

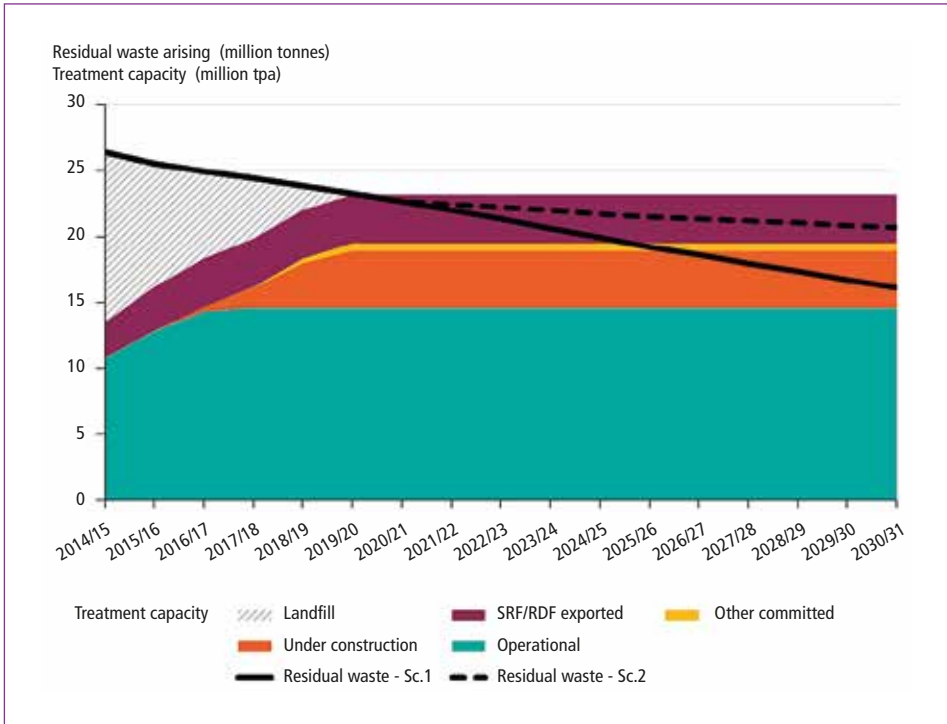


Figure 5: Potential future residual waste capacity gap in the United Kingdom

The speed with which this change occurs depends on the amount of waste that the country produces. This in turn depends on our recycling rate. Figure 5 shows two scenarios. In both it is assumed that the UK meets the 2020 municipal waste recycling target of 50 percent – although slow progress in England in recent years means that this is by no means certain. After that, the scenarios diverge.

- In the first, EU targets are met, and high recycling is achieved in C&I waste management.
- In the second scenario, progress is made, but ultimately the UK falls short of EU targets for municipal waste recycling, while C&I recycling rates stagnate post-2020.

The modelled recycling rates are detailed in Table 3.

	Scenario 1		Scenario 2	
	2020	2030	2020	2030
	%	%	%	%
Household	50	65	50	60
Commercial	65	75	65	65
Industrial	70	80	70	70

Table 3:

Recycling assumptions for the two scenarios

Note: These recycling rates are those modelled for England and Northern Ireland only. Slightly higher household recycling rates are modelled for Scotland and Wales in line with national targets

Set against the assumptions on residual waste arisings, the treatment capacity considered in the analysis is limited to plant that is operational, under construction, or has already reached financial close. At present, 4.9 million tpa of *effective* treatment capacity is under construction or committed.² All other planned plant is excluded, although in practice a number of facilities are close to reaching this development stage and could ultimately be built.

In addition, it is conservatively assumed that RDF exports to other European countries will rise to 3.7 million tpa in 2016/17, while flat-lining thereafter. The UK is already a significant user of the international residual waste market. In 2015, the UK exported c.3.4 million tonnes for treatment in other European countries, up from c.2.6 million tonnes the previous year. Initial data published by the UK Environment Agency for the first three months of 2016 suggests a further increase is likely; indeed, the prospect of significant additional spare capacity across the Northern Cluster through the 2020s suggests that there may be scope for UK exports to grow still further.

The results for Scenario 1 suggest that the capacity gap between residual waste arisings and available treatment capacity will decrease from the current (based on 2014/15 arisings data) level of 12.9 million tonnes, and that the supply of capacity will exceed the available quantity of residual waste in the UK in 2020/21 – or in 2025/26 if the

² *Effective* treatment capacity means capacity which has had the effect of pre-treatment facilities removed to avoid double-counting of available capacity

export of RDF is excluded from the analysis.³ The level of excess supply of treatment rises to 7.1 million tonnes in 2030/31 – or 3.4 million tonnes if the export of RDF is excluded from the analysis.

Under Scenario 2, the results suggest that an excess of treatment again occurs in 2020/21 but thereafter rises less quickly, reaching 2.5 million tpa in 2030/31. If RDF exports are ignored, however, excess supply of residual waste treatment may not occur before 2030.

In making these predictions, it is important to recognise that not all infrastructure developments run smoothly. Growing doubts over the development of Air Products' Tees Valley gasification facilities culminated in April of this year with the company announcing that the project was to be abandoned due to technical difficulties. Having previously applied a reduced probability weighting to the plant, Eunomia has now removed this plant's capacity from the analysis completely.

Air Products' travails have raised more questions about the feasibility of ACT technologies as a treatment for residual waste. Eight ACT facilities either currently being built around the UK, or scheduled to begin construction soon, and several more are trying to reach financial close; there is continued interest in how they may fare. While the specific technologies being deployed at these facilities differs from that employed by Air Products, ACTs using residual waste as a feedstock appear not yet to have been fully proven.

And last, but certainly not least, the recent Brexit referendum decision in the UK injects a degree of uncertainty into future recycling projections. The vote occurred after the preparation of this analysis, and as yet it is too early to say with confidence whether the UK's future relationship with the EU will be one that requires compliance with current and future directives on waste. However, it is probable that any agreement that gives the UK access to the single market would entail accepting laws of this kind. Any implications for the export of RDF from the UK will also emerge gradually, but provided that the economic case for exports continues there is little reason to think there will be any insuperable legal impediment.

As Europe advances towards a more circular economy, it becomes ever more important to understand the implications this has for each country's need for residual waste treatment. The investment required to develop each new plant is considerable, and the lifespan of a facility is typically 25 years or more. The choices that are made today will be with us far into the future, and could impede – or be overtaken by – developments that can already be foreseen. If we are to use our limited resources wisely we must ensure that our infrastructure is tailored to meet the needs we are likely to have a decade or more from now, not just those that now face us.

³ Essentially, the residual waste treatment market has become a European one, so it seems unlikely that excluding RDF exports would be a sensible assumption. The most likely scenario for the *repatriation* of currently exported waste is one where UK prices for residual waste treatment fall, which might be expected to occur once UK treatment capacity exceeds the supply of residual waste, net of exports.

4. References

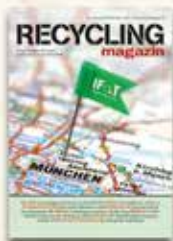
- [1] European Commission: Proposal for a Directive of the European Parliament and of the Council Amending Directive 2008/98/EC on Waste, 2015/0275
- [2] RDF Working Group: RDF Export: Analysis of the Legal, Economic and Environmental Rationales. August 2015, <http://www.eunomia.co.uk/reports-tools/rdf-export-industry-group-report/>

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