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Sustainability Appraisal and Life Cycle Analysis of Strategic Waste Management Options

Summary report for the South West Wales Regional Waste Group

ea/br/bl/std/vr10thanni

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Background

This report summarises work completed by Environment Agency Wales (EAW) as part of the requirement to review the South West Wales Regional Waste Plan (RWP).

The RWP was first published in 2003/4 in accordance with the requirements of Technical Advice Note 21[1] (TAN 21). Six strategic waste management options were appraised using a set of 22 indicators to determine a preferred waste management method for the plan. In these assessments, completed by SLR consulting, the preferred option was determined to be a "Mechanical and Biological Treatment led strategy"[2] whereby any remaining residual waste following recycling and composting of source separated materials, is treated using Mechanical and Biological Treatment facilities. It was assumed that the amount of waste landfilled would be reduced such that 2020 Landfill Directive targets would be met in 2013 as would all other relevant waste strategy targets.

The Welsh Assembly Government appointed EAW to revisit this assessment and complete a life cycle analysis and sustainability appraisal to determine the Best Practicable Environmental Option (BPEO) and Sustainable Waste Management Option (SWMO)[3] as part of the upcoming review of the SW Wales RWP.

Methods

Before the appraisal began, 19 waste management options (detailed in figure 1) were developed and agreed at the Regional Waste Group (RWG) member level. It was decided that all options should include the same high levels of recycling and composting (for municipal waste this is over 50% of the expected waste arising). The principal differences between the options are due to the selected waste treatment technology used to manage the residual waste.

The options incorporate a range of waste treatment technologies including new and emerging facilities such as mechanical and biological treatment (MBT), pyrolysis, gasification as well as more established methods such as incineration with energy recovery.

RWG members reviewed the original 22 indicators used in the creation of the RWP and it was agreed that the indicators were still appropriate for the review. The suite of indicators is shown in figure 2. The sustainability appraisal provides a quantitative or qualitative assessment of each indicator for the agreed waste management options, enabling comparison of the overall performance of each option. The RWG also agreed revised forecasts for the expected arising of municipal, industrial, commercial, agricultural and construction and demolition waste streams for South West Wales in 2013.

The indicators were derived using three different methods. Eight of the environmental indicators were generated using the Environment Agency's WRATE[4] software. WRATE is a life cycle analysis tool designed to evaluate the environmental impacts and benefits of waste management systems. It supersedes the previous life cycle tool WISARD as it incorporates a greater range of waste management technologies that could not previously have been assessed. The appraisal is the first ever project to be delivered using WRATE.

A panel of waste management professionals considered a number of the other criteria. These were the more qualitative environmental and social indicators. The remaining indicators were created using generic data based on a range of published sources as well as data specific to the project derived from modelling assumptions (such as the assumed recycling rates). The calculation method for each indicator is also indicated in figure 2.

[1] Planning Policy Wales Technical Advice Note 21: Waste, WAG (2001)
[2] Regional Waste Plan for South West Wales, SLR (2003)
[3] Using methods from "Strategic Planning for Sustainable Waste Management: Guidance on Option Development and Appraisal", ODPM 2002
[4] Waste and Resources Assessment Tool for the Environment, Environment Agency (2007)

Figure 1 Waste management options considered in the Sustainability Appraisal

Option 0
'Do Nothing' strategy
(This option is included for assessment purposes only – as a baseline to compare the other Options against). The same front-end levels of recycling and composting as the other options with no further treatment and all residual waste sent to landfill.

Option 1
A landfill-led strategy for residual waste
High recycling and composting levels followed by *low* levels of thermal treatment of residual waste using either:

- Pyrolysis (Option 1A), or
- Gasification (Option 1B), or
- Incineration with energy recovery (Option 1C)

All remaining residual waste would then be sent to landfill.

Option 2
An Energy from Waste-led strategy for residual waste
High recycling and composting levels with all remaining residual wastes, where possible, being treated by *high* levels of thermal treatment using either:

- Pyrolysis (Option 2A), or
- Gasification (Option 2B), or
- Incineration with energy recovery (Option 2C)
- Anaerobic digestion (Option 2D)

Any remaining residual waste would then be sent to landfill.

Option 3
An MBT/BMT-led strategy for residual waste
High recycling and composting levels, all remaining residual wastes being sent to MBT/BMT with the output recovered / disposed of using either:

- Pyrolysis (Option 3A), or
- Gasification (Option 3B), or
- Incineration with energy recovery (Option 3C), or
- Fuel to off-site energy use (Option 3D), or
- On-site Anaerobic digestion (Option 3E), or
- Landfill (Option 3F)

For Options 3A–3E, any remaining residual waste would then be sent to landfill.

Option 4
An autoclave-led strategy for residual waste
High recycling and composting levels, all remaining residual wastes being sent to autoclave with the output recovered / disposed of using either:

- Pyrolysis (Option 4A), or
- Gasification (Option 4B), or
- Incineration with energy recovery (Option 4C), or
- Fuel to off-site energy use (Option 4D), or
- Landfill (Option 4E)

For Options 4C to 4D, any remaining residual waste would then sent to landfill.

N.B. It was not possible to assess options 4A and 4B following guidance from the Environment agency's LCA Advisor that the fibre produced would be unsuitable for use for advanced thermal treatment (pyrolysis/gasification).

Figure 2 Sustainability Appraisal Objectives and Indicators

Sustainability Objective	Sustainability Indicator	Method of Measurement	Weighting
Environmental & Health Objectives			
1. To ensure prudent use of land and other resources	1(i) Depletion of abiotic resources 1(ii) Land take	WRATE output Generic Data	1.83 1.44
2. To reduce greenhouse gas emissions	2(i) Greenhouse gases emitted	WRATE output	1.45
3. To minimise adverse impacts on air quality and public health	3(i) Emissions which are injurious to public health 3(ii) Emissions contributing to air acidification 3(iii) Emissions contributing to depletion of the ozone layer 3(iv) Extent of odour problems 3(v) Extent of dust problems 3(vi) Dioxin emissions	WRATE output WRATE output WRATE output Professional Judgement Professional Judgement WRATE output	1.09 0.59 0.98 0.39 0.50 0.49
4. To conserve landscapes and townscapes	4(i) Extent of visual and landscape impacts	Professional Judgement	1.11
5. To protect local amenity	5(i) Extent of noise, litter and vermin problems	Professional Judgement	0.51
6. To minimise adverse effects on water quality	6(i) Emissions contributing to eutrophication 6(ii) Extent of water pollution	WRATE output WRATE output	0.55 1.03
Socio-Economic Objectives			
7. To minimise local transport impacts	7(i) Total waste kilometres 7(ii) Transport along roads other than motorways	Generic Data Generic Data	1.51 0.66
8. To provide employment opportunities	8(i) Number of jobs likely to be created	Generic Data	1.26
9. To provide opportunities for public involvement and education	9(i) Extent of opportunities for public involvement and education (concerning sustainable waste management practices)	Professional Judgement	0.79
Waste Management Service Delivery Objectives			
10. To minimise costs of waste management	10(i). Costs of management and disposal, including material and energy revenues	Generic Data	1.72
11. To ensure reliability of delivery	11(i) Likelihood of implementation within required timescale, taking account of maturity of technology, necessary level of public participation, and the need for planning permission (taking account of scale of development and likely perceived adverse impacts)	Professional Judgement	1.51
Public Framework Objectives			
12. To conform with waste policy	12(i) Percentage composted 12(ii) Percentage recycled 12(iii) Percentage landfilled	Generic Data Generic Data Generic Data	0.92 1.05 1.62

To enable the indicators to be combined and an overall score determined, it was necessary to put each indicator score onto a common scale. The indicators in their raw format had a range of different units. The indicators were 'valued' by assigning the best performing option for a given indicator a value of 1 and the worst performing a value of 0, the options in between were then assigned a valued score between 0 and 1 relative to each other. Following the valuing process, the 22 indicators can then be summed producing a valued score for each option.

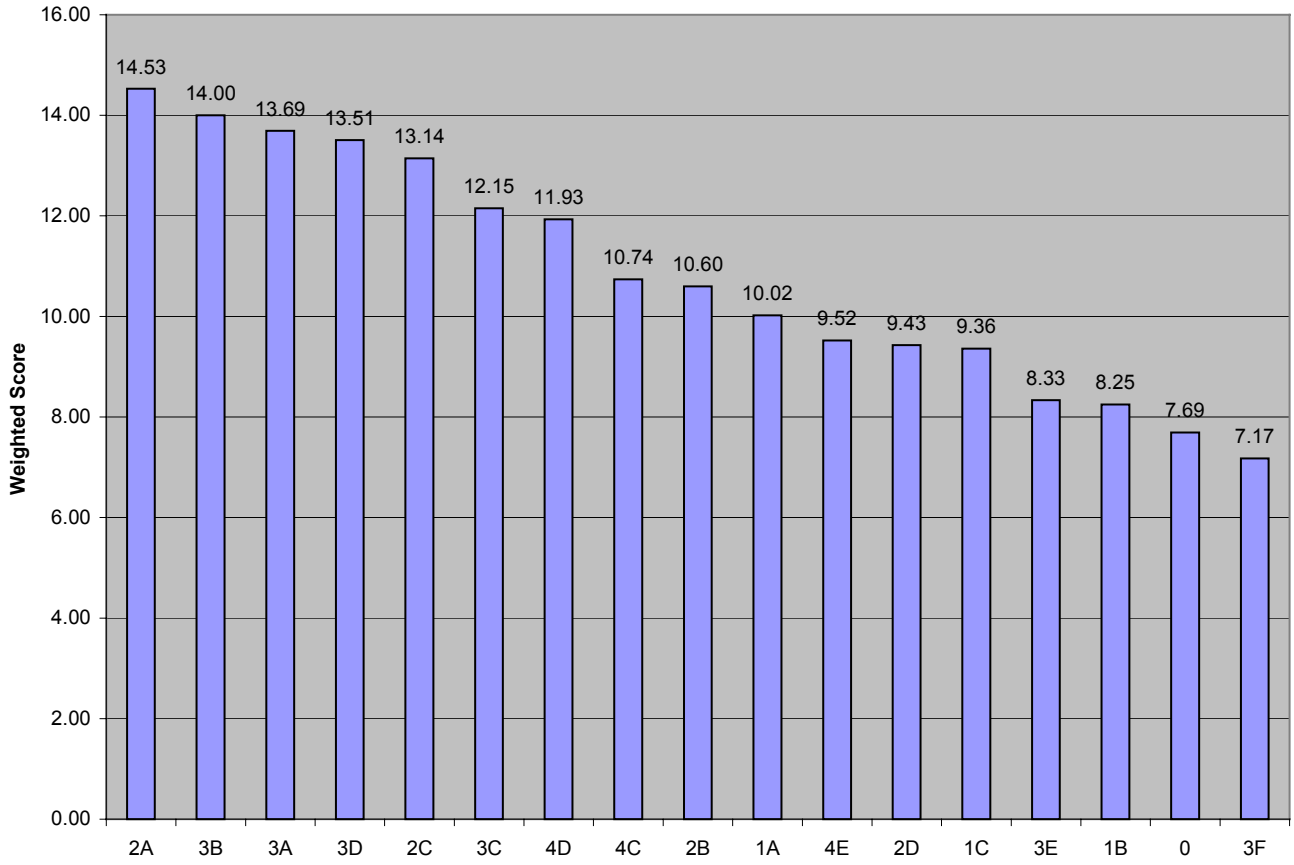
The valued option score assumes that each indicator is carries equal importance however, it is accepted that decision-makers are likely to attach more importance to some indicators or criteria than to others. By eliciting and applying 'weights' to the valued performance information, the relative importance of indicators has been taken into account.

Waste stakeholders including local authorities, government agencies and waste trade associations of the RWG were given an opportunity to provide their weighting of the indicators to capture a range of opinions and perspectives. Each organisation was given 22 points to divide between the 22 indicators, according to their perceived relative importance. The weightings agreed for each indicator are shown in figure 2.

Results

By following the methods above, a valued and weighted score taking account of all 22 indicators has been calculated for each option. The results of this are presented in figure 3 in ranked order (a higher score is preferable)

Figure 3 Valued and weighted sustainability appraisal scores for South West Wales



Conclusions

Option 0 was included for comparison purposes and does not score well. This reflects the situation whereby all residual waste is landfilled. As well as the poor performance scores for the sustainability appraisal, this option would not be followed for municipal waste due to the requirement of the Landfill Directive to divert biodegradable waste from landfill.

Option 1 (do minimum thermal treatment) performs less well than option 2 (energy from waste-led strategy) indicating that it is more desirable to replace all landfill disposal with thermal treatment with energy recovery rather than a partial replacement. Option 4 relies on a technology that is commercially unproven for municipal waste in the UK and did not perform particularly well for SW Wales.

Option 2B scores less well than 2A or 2C due to the high amount of reject from the dirty Materials Recovery Facility (MRF) process that is required to produce a Refuse Derived Fuel (RDF) prior to gasification. Options 2D, 3E and 3F are all MBT processes with no thermal treatment and therefore still have a high requirement for the landfill disposal of outputs.

Whilst it is difficult to conclusively say that one option significantly out performs the others, the results for SW Wales RWG indicate that waste management systems incorporating high levels of thermal treatment, or MBT followed by thermal treatment make up the top six options. As all of these options scored well in the appraisal, and in order to provide flexibility in the waste planning process, the conclusion from this sustainability appraisal is that any of the highest scoring options could be considered when reviewing the Regional Waste Plan.

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