Environmental benefits of new waste management facilities in Manchester, UK

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In 2002, the Greater Manchester Waste Disposal Authority drew up a long term strategy for improving recycling rates, providing waste processing and achieving resource and energy recovery. This strategy recognises the imperative to reduce disposal of biodegradable waste to landfill and thereby to reduce both greenhouse gas emissions and the carbon dioxide footprint arising from the conventional disposal of municipal waste. To implement the strategy, a £3.8 billion, 25-year private finance initiative contract was developed and awarded in April 2009 for the construction and operation of waste disposal facilities to process domestic refuse arising from nine of the ten boroughs within Greater Manchester. The new facilities include 25 household waste recycling centres, seven transfer loading stations, four in-vessel composting plants, a materials recovery facility and five mechanical biological treatment plants. This paper describes environmental benefits arising from the scheme including increased recycling rates, optimisation of carbon impact from transportation, energy from waste (by way of combined heat and power from generating and utilising biogas arising from on-site anaerobic digestion facilities), nutrient capture and recycling (through British Standard PAS100 and Animal By-product Regulations compliant composting) and improved environmental performance (including odour control) of the upgraded facilities.

1. Introduction

The Greater Manchester Waste Disposal Authority (GMWDA) is the largest of six joint waste disposal authorities in the UK and was formed in 1986 following the abolition of Greater Manchester County Council. The GMWDA serves nine of the ten Association of Greater Manchester Authorities (AGMA); Wigan is a statutory waste disposal authority in its own right and is represented on the GMWDA for administration purposes only. This represents approximately 1 009 815 households and a resident population of 2.27 million (Office of National Statistics, 2001). The GMWDA manages disposal of 5% of the nation's municipal waste, amounting to over 1.41 million tonnes in 2004/5, which had been reduced year on year to 1.1 million tonnes in 2009/10 (GMWDA, 2010). The activities of the GMWDA are driven by the substantial legislation and detailed policies at European, national and regional levels including the Environmental Protection Act (1990) (HMSO, 1990), which promotes a more sustainable waste management system to provide long-term global environmental protection.

Domestic waste collection services are undertaken by the waste collection authorities (WCAs), with some outsourcing to the private sector. This includes kerbside collection of dry recyclates (plastic bottles, cans and glass containers), paper/cardboard and of green garden waste (which is being extended to include food waste as facilities become available). The collection of commercial and industrial waste is generally undertaken by the private sector.

GMWDA operates a network of household waste recycling centres (HWRCs) for recycling and disposal of domestic waste by the public. Historically, GMWDA operated the following waste management facilities the locations of which are shown in Figure 1.

- (a) Four facilities for the reception, pulverisation and compaction of waste (delivered by the WCAs) for transport to landfill by road or rail located in Bredbury Parkway, Stockport; Cobden Street, Salford; Reliance Street, North Manchester; and Longley Lane, South Manchester. Each facility used a Dano process by Keppel Seghers to break down the material and is served by a rail connection for bulk transportation of waste to landfill.
- (b) Four transfer loading stations (TLS) where kerbside collected waste is delivered by the WCAs before being loaded into articulated lorries for disposal. These were located in Bury, Oldham, Rochdale and Tameside.
- (c) Two green waste shredding facilities at Longley Lane, South Manchester and Every Street, Bury, to treat garden waste prior to bulking and disposal.
- (d) An energy from waste (EfW) facility at Raikes Lane, Bolton, without rail access.

Landfill disposal was principally by rail to Roxby, Humberside (100 miles; 162 km), or by road to locations around Greater Manchester at Withnell, Chorley; High Moor, Oldham; or Risley and Arpley in Warrington.

No.	Project name	Facility
1	Nightingale Farm	HWRC
2	Adswold Road	HWRC
3	Arkwright Street	HWRC, TLS, MBT
4	Ash Road	HWRC
5	Bayley Street	HWRC, TLS
6	Beal Hey	HWRC
7	Boysnope Wharf	HWRC
8	Bredbury Park Way	HWRC, MBT, IVC, TLS, VEC
9	Cemetery Road	HWRC
10	Cobden Street	HWRC, TLS, MBT
11	Drinkwater Park	HWRC
12	Every Street	HWRC, TLS, Green Waste
13	Exide Batteries	IVC
14	Hurstwood Court	HWRC
15	Lester Road	HWRC
16	Longley Lane	HWRC, MRF, MBT, VEC, Green Waste
17	Lumns Lane	HWRC
18	Nash Road	IVC
19	Peel Lane	HWRC
20	Raikes Lane	TLS, EFW
21	Reliance Street	HWRC, MBT
22	Rose Hill	HWRC
23	Sandfold Lane	HWRC
24	Sinderland Road	HWRC
25	Spring Vale	HWRC
26	Union Road	HWRC
27	Chichester Street	HWRC, IVC, TLS

Figure 1. Greater Manchester waste project sites

In 2003, legislative and regulatory drivers towards a more sustainable and environmentally friendly approach to waste disposal included: the directive on the landfill of waste (EC, 1999, implemented through the Landfill (England and Wales) Regulations, 2002 (HMSO, 2002); Planning Policy Guidance 10: Planning and Waste Management (PPG10) (ODPM, 1999; and the National Waste Strategy for England, 2000 (DETR, 2000), which required a substantial reduction in the quantity of biodegradable municipal waste disposed of to landfill and imposed targets. Recognising this, GMWDA set about developing a municipal waste management strategy that was published in 2004. Guidance from the Department for Environment, Food and Rural Affairs (Defra, 2005) in preparing waste management strategies states that they must set out a long-term strategic vision in line with local, regional and national expectations and should ensure that the strategy covers a sufficient time period to prove attractive to investment while seeking not to constrain movement up the waste hierarchy. The 2004 strategy addressed the period to 2020 reflecting the corporate strategic objectives of GMWDA and was used as the output specification for the development of an outline business case to support long-term procurement. The overall aim is to maximise recycling and composting, protect human health and the environment of Greater Manchester through sustainable waste management by adopting the principles of the waste management hierarchy outlined in Figure 2. The hierarchy has been developed from the principles set out in the EU Fifth Action Programme for the Environment, 1993 (EC, 1993).

The various levels within the waste hierarchy can be considered in terms of the carbon dioxide impact.

Figure 2. The waste hierarchy

- (a) Waste prevention. The largest benefit is achieved by waste prevention by either reducing or eliminating demand. If consumption can be reduced the associated whole life-cycle embodied carbon dioxide is also reduced (including that for the initial production plus the subsequent disposal). Waste prevention can be led by legislators, through education, by way of public awareness campaigns or through customer pressure, for example for less packaging. Facilities such as visitor education centres (VEC) can be provided to educate school children and the general public to bring about such a culture change.
- (b) Reuse. By encouraging the purchase of reusable products, for example batteries or razors, the life of a product can be extended. Reuse should have the benefit of reducing the quantity of new products manufactured. Charity shops, furniture reuse schemes, E-bay (see <http://ebay.co.uk>), and other internet-based schemes such as Freecycle (see <http://www.freecycle.org>), widely used by the general public also facilitate this. However, for a WDA, reuse presents possible concerns over data protection and identity theft, electrical safety of goods that have been discarded and of propriety if people are seen to be getting something of value for free. Waste legally becomes the property of GMWDA and staff and the public are not permitted to remove items that have been deposited in the residual waste stream.
- (c) Recycling or composting. A variety of technologies have been developed to treat municipal waste as a resource. The benefits of this option can include creating a product for which there is demand, for example compost, preserving natural resources by recovering recyclates for reprocessing, reducing greenhouse gas formation by the capture of biogas. Technologies include in-vessel composting (IVC) of food and garden green waste to produce a saleable compost, material recovery facilities (MRFs) where dry recyclates (glass containers, aluminium, ferrous metals and plastic bottles) are sorted into the constituent components for recycling, mechanical biological treatment plants (MBT) where a MRF is often combined with anaerobic digestion (AD) followed by combined heat and power (CHP) engines (where the AD/CHP is recovery rather than recycling). The success of source segregation of waste to facilitate recycling depends on a variety of demographic and cultural issues and hence the recycling performance can vary significantly within individual WCA areas. For example, recycling rates tend to be higher in more affluent areas and garden waste volumes will correlate to areas with larger gardens. This can influence the residual waste characteristics and has implications for the operating envelope of treatment processes and must be carefully assessed and modelled at the design stage.
- (d) Energy recovery. A significant amount of municipal waste is unsuitable for recycling or composting but the residual waste contains material with calorific value

which means that it is suitable in part to use as solid recovered fuel (SRF) in a waste to energy facility. The SRF replaces valuable fossil fuels (containing embedded carbon dioxide) to produce electricity and heat for industrial and community projects. As stated above, AD followed by CHP can be used to create a product that can be used for soil remediation (albeit with limited demand owing to likely contamination), heat and energy.

- (e) Disposal. Landfill is now the least-favoured option in the waste hierarchy and is the least attractive in terms of carbon dioxide impact. The availability of space in landfill sites has declined markedly in recent years (CBI, 2010) resulting in waste being transported over increasing distances for disposal. If material that could be recycled is disposed to landfill the resource becomes lost (or at least inaccessible). Biodegradable material disposed of in this way degrades giving rise to biogas, a mixture of carbon dioxide and methane. Methane is a particularly powerful greenhouse gas. Even if the biogas is captured and burnt in CHP engines, the capture rates are low when compared with AD as part of a MBT plant.

The landfill allowance trading scheme (LATS) is an instrument established under the Waste and Emissions Trading (WET) Act (HMSO, 2003), to monitor and regulate compliance with the landfill directive obligations and allows the disposal of permitted quantities of biodegradable municipal waste (BMW) to landfill. Since 2005/6 each WDA has been allocated an allowance under LATS and they are under a duty to ensure that this allowance is not exceeded. Unused allocation can be either banked or traded and financial penalties are incurred should the allowance be exceeded. The penalty set in 2005/6 if the allowance is exceeded is £150/tonne but the allowance decreases each year. Analysis and financial modelling by GMWDA suggested that residual waste treatment was required by 2010 if a deficit in allowances were to be avoided and that delay in providing this capacity until 2013 could result in a fine in excess of £50 million; hence positive action was essential.

2. Greater Manchester waste project

The Greater Manchester waste PFI project was conceived and developed against the legislative and technological background described above. The bidders were invited to develop a technical solution based on the principles of sustainability and partnership. The winning bid did not opt for a mass burn solution (for the reasons referred to above), utilised the existing sites and in-filled with new facilities where necessary to provide good geographic coverage (e.g. the Boysnope Wharf HWRC was constructed on a new site to serve Irlam and Cadishead), to achieve strategic targets. A search of new and emerging technology was undertaken and surveys were undertaken to understand the demographic trends and the waste quantity and composition. A complex waste model was developed and

sensitivity analyses were carried out to model different scenarios in waste growth to determine the capacity of the facilities required and to ensure that sufficient additional spare capacity was allowed to ensure that likely future trend would be provided for. It was decided to procure the contract by way of the private finance initiative (PFI), which is a mechanism to provide partnerships between the public and private sectors to provide the former with access to private sector funding to deliver major capital investment, and to deliver long-term operational efficiencies.

A £3.8 billion, 25 year PFI contract was awarded to Viridor Laing (Greater Manchester) Ltd in April 2009 for the construction and operation of waste disposal facilities over a 25 year period. The PFI contract, which is the largest waste PFI in Europe, includes a major £397 million project awarded to Costain for design and construction of new and upgraded waste collection and processing facilities. The technical solution selected is based on the use of the best available technological solution and represented the best option given the nature and volume of the material to be dealt with and the location of facilities to optimise transport arrangements while mitigating the risk of planning delays by reusing existing sites.

A major consultation process to obtain planning permissions was undertaken with stakeholders, particularly local planning authorities, and the general public.

The new facilities include:

- (a) 25 new or refurbished household waste recycling centres providing a network of facilities within a notional three mile radius (GMWDA, 2007) of each household within Greater Manchester
- (b) seven transfer loading stations
- (c) four in-vessel composting plants to treat co-mingled food and green garden waste located at Bredbury Park Way, Stockport, Nash Road, Trafford Park; Chichester Street, Rochdale; and land in Bolton
- (d) two education centres at Longley Lane, Sharston and Bredbury Park Way, Stockport
- (e) a materials recovery facility for processing dry recyclates
- (f) five mechanical biological treatment plants located at the four waste reception facilities described above plus a new site at Arkwright Street, Oldham.

A further £200 million contract was awarded for a CHP plant at the existing chemical plant of Ineos Chlor at Runcorn, which in phase one of the development will have a capacity to process 375 000 tonnes per annum (tpa) of material that is not recycled as SRF. Initially 275 000 tpa will be provided through the PFI contract with the remainder being supplied by Viridor Waste Management generating 29 MW and 26 t/h of steam. The Energy

From Waste (EfW) plant at Bolton will continue to process 110 000 tpa generating income which was included in the financial model, hence the benefit will be passed on to council tax payers.

3. Carbon dioxide footprint

The carbon dioxide footprint of the activities of the GMWDA is predominantly determined by the way waste is managed. By diverting biodegradable waste from landfill there are significant reductions in methane emissions, and recycling results in far fewer emissions compared with the extraction of energy-intensive raw materials such as metals. Although highly visible, transport is only a minor component of waste management carbon dioxide emissions. In 2009/10 GMWDA made an estimated net saving equivalent to 94 739 tonnes of carbon dioxide (GMWDA, 2010), which it estimates will be increased to 400 000 tonnes by 2020. The dispersed network of HWRC and TLS facilities provides the opportunity to bulk up material locally while the MBT plants are also located close to the urban centres they serve. The rail heads provide carbon dioxide savings over road transport. The most significant increase in carbon dioxide footprint will arise from the five MBT sites, but this will be offset by increased recycling and improved environmental performance of the new plants when compared with the original facilities. Table 1 outlines the impact of new plants on carbon dioxide footprint.

Home composting is recognised as being one of the most environmentally friendly means of disposing of specific types of food and garden waste. As such home composting is promoted by both the GMWDA and the individual WCAs through their websites and by way of publicity campaigns, through promoting the purchase of compost bins, and by linking with wider events such as International Compost Awareness Week.

4. Waste collection

The GMWDA and the WCAs have carefully coordinated the roll out of kerbside collection of various types of recyclables and waste and general campaigns to raise awareness of recycling initiatives to coincide with new facilities becoming available. All WCAs have adopted a four-stream system of collecting materials which are delivered into the PFI. Practice does vary between the WCAs both in terms of the number and size of bins (which also varies based on property type) and the frequency of collections. The frequency of collection of green garden waste generally changes seasonally.

Moving to multiple bins has a marginal impact on operating costs as the rounds can be adjusted such that the refuse collection vehicles are filled, but the biggest cost of operating these is transporting the waste to the depot.

	Before 2003	After 2012
Transport	Originally single bin weekly collection by WCAs Transport of compacted waste by rail to landfill at Roxby (100 miles; 162 km) Transport of waste by road to landfill sites around Greater Manchester	Multiple collection of up to four dustbins by WCAs Transport of SRF to Runcorn for disposal in EfW plant Local disposal of recyclates for further processing
Facility consumption	Electricity for building services and bulky crusher for dealing with large bulky items	Electricity for building services plus considerable mechanical plant at MBT and IVC sites Natural gas for RTO (odour control at MBT plants), standby boiler, and sludge dryers Chemicals for odour control, effluent treatment and sludge conditioning
Facility outputs	Limited CHP capacity utilising landfill gas. EfW facility in Bolton (10 MW generating capacity) Other limited recycling outlets	Ongoing CHP using diminishing biogas yield from closed landfills. Power generated (10 MW generating capacity at MBT plants plus 10 MW from EfW facility) Heat used within the MBT digestion process and at Runcorn SRF to plant at Runcorn (29 MW generating capacity in phase one) Recyclates Compost

Table 1. Impact of new plants on carbon dioxide footprint

	Before 2003	After 2012
Household disposal	Co-mingled single bin solution	Source segregated using a combination of BMW, dry recyclates, paper and card, green and food waste
Public tipping	Civic amenity 'tip' – generally co-mingled	HWRC – source segregated domestic waste that is either low volume, excessive volume, environmentally polluting or has high value
Collection frequency	Weekly collection	Less frequent collection of different wastes (neutral approach adopted). Hybrid vehicles emerging
Processing	Some separation (organic fines / inorganic and over-sized material)	Mechanical separation, pulping/digestion or composting of organics,
Driver	Cost	Carbon dioxide footprint/cost

Table 2. Changes in waste collection practices

Table 2 outlines the changes in waste collection practices.

5. Visitor education centres (VECs)

Two new VECs have been constructed at the existing facilities at Longley Lane, Sharston, and at Bredbury Park Way, Stockport, to complement two existing centres at Hurstwood Court, Bolton, and Pilsworth, Bury. Each is equipped to enable educational visits from schools and community groups (aged seven years old and over) to enable them to learn about what happens to their waste, the environmental impact of consumption, waste prevention, recycling, composting and reuse. All sites comprise a number of different waste treatment facilities so pupils will be able to learn about dealing with waste according to the waste hierarchy. The buildings have been designed to the latest building regulations providing good thermal efficiency.

6. Carbon dioxide benefits of new HWRC designs

The new and refurbished HWRC facilities provide the general public with improved access to the services of the GMWDA enabling them to recycle an increased number of materials and products, see Table 3 for a summary of the capacity of HWRCs. To drive a culture change, the general public are considered as customers and the facilities are designed to be safe, clean and easy to use to provide them with a positive experience. Opening hours are 8 am to 6 pm (Greenwich mean time) and 8 am to 8 pm (British summer time) every day except Christmas day and New Year's day. Coloured surfacing is used to delineate between areas for cars and areas for pedestrians. The public access road is segregated from plant and machinery and elevated to enable material to be put into skips without having to climb steps. The facilities are clearly labelled and laid out to minimise queuing, thereby reducing carbon dioxide emissions and making the experience more pleasurable. This

will increase the likelihood of return visits and improve waste consciousness hence increasing recycling rates and conversely reducing the likelihood of material not being recycled. A courteous 'meet and greet' approach to staffing is adopted. The installation of improved security, CCTV monitoring and vehicle number plate recognition systems enables improved management of commercial traders to reinforce the principle of the 'polluter pays'.

Recycling rates can vary widely due to a combination of demographics, site layout, operating practices and familiarisation of the general public with new facilities. GMWDA has commissioned a study of customer satisfaction with the new facilities, which has shown the sites to have been well received.

7. Carbon dioxide benefits of transfer loading stations

There are seven strategically sited TLSs across Greater Manchester, which are important in reducing the transport distances of waste collection vehicles, that may only carry small loads owing to the need to access narrow residential roads. Table 4 gives details of the capacity of these TLSs. Transferring waste in larger articulated lorries for onward transport reduces vehicle miles and the associated carbon dioxide emissions. Each TLS comprises a large warehouse building with reinforced concrete push walls (so called because they enable a front loader to push waste against them) forming segregated bays for paper and card, co-mingled dry recyclates, bulky waste and residual waste to be tipped and then loaded into larger articulated lorries for transfer to other facilities for processing.

Some new facilities replace existing buildings but provide improved segregation. Increased TLS capacity is required within the GMWDA area to deal with the increased kerbside

Site	Design capacity	Scope of work	Recycling rate 2005/2006	Recycling rate 2009/2010
Blackhorse Street, Blackrod	6000	Upgraded site	34.07%	69.99%
Union Road, Bolton	5000	Upgraded site	34.59%	75.00%
Cemetery Road, Radcliffe	12 000	Rebuilt site	35.67%	61.42%
Clifton Road, Prestwich	6000	Upgraded site	38.17%	64.81%
Every Street, Fernhill	20 000	Extended site	38.05%	48.10%
Reliance Street, Newton Heath	15 000	Extended site	37.65%	52.04%
Longley Lane, Sharston	30 000	Rebuilt site	17.05%	52.04%
Sandfold Lane, Levenshulme	20 000	Upgraded site	28.69%	45.45%
Arkwright Street, Oldham	18 000	Rebuilt site	21.85%	46.18%
Chandos Street, Shaw	8000	Upgraded site	38.80%	52.70%
Peel Lane, Heywood	6000	Upgraded site	42.70%	51.69%
Springvale, Middleton	12 000	Upgraded site	32.59%	47.19%
Chichester Street, Rochdale	20 000	Extended site	36.38%	48.15%
Cobden Street, Salford	12 000	Upgraded site	28.56%	36.66%
Lester Road, Little Hulton	12 000	Upgraded site	42.22%	65.12%
Lumms Lane, Swinton	15 000	Rebuilt site	34.25%	57.92%
Adswood Road, Adswood	25 000	Extended site	27.31%	42.35%
Bredbury Park Way, Bredbury	25 000	Rebuilt site	24.87%	46.11%
Rose Hill, Marple	12 000	Rebuilt site	38.28%	46.25%
Ash Road, Droylsden	12 000	Rebuilt site	19.33%	29.08%
Bayley Street, Stalybridge	28 000	Rebuilt site	25.34%	35.29%
Woodhouse Lane, Altrincham	28 000	Rebuilt site	27.07%	57.03%
Boysnope Wharf, Irlam	15 000	New site	—	—
Raikes Lane, Bolton		Replaced by Hurstwood Court	40.39%	53.07%
Torkington Road, Hazel Grove		Closing (replaced by Rose Hill and Adswood)	37.57%	46.24%
Hurstwood Court, Bolton	28 000	New site	—	—
Chester Road, Stretford		Existing site	24.65%	53.07%
Total dry recycling			20.17%	39.97%
Total green recycling			9.55%	12.18%
Cumulative total			29.72%	48.17%

Table 3. Household waste recycling centre (HWRC) capacity
(tonnes per annum)

source segregated collection so three totally new facilities are being constructed.

8. Carbon dioxide benefits of in-vessel composting (IVCs)

The IVC plants are industrial-styled buildings with forced air extraction to prevent egress of odour. Inside the buildings they comprise a shredder and a composting cage where food and garden waste is added at the top. Material is held in the cage for a period of 12–14 days before being removed from the bottom having been held at a temperature above 70°C for more than 1 h. Once removed from the cage the compost enters a maturation hall where it is stored for a further period of 42 days during which the composting process is completed. It is intended to

market the product as compost for sale or for soil improvement, partly offsetting the cost of refuse disposal in Greater Manchester. Table 5 gives a summary of IVC plant capacity.

The plants provide an intensive but low-energy process to enable co-mingled food and green garden waste to be composted to produce a product which is approved under the Animal By-products Regulations (ABPR) (Defra, 2002) for application to land. In addition the product has BSI PAS100 (BSI, 2005) accreditation which demonstrates that the product is safe, reliable and of high-performance compost. The principal carbon dioxide benefit is derived by diverting biodegradable waste from landfill, which would otherwise produce methane, a potent greenhouse gas. Once the food and

Site	Paper and card		Co-mingled recyclates		Bulky		Residual	
	Highest anticipated throughput	Design capacity	Highest anticipated throughput	Design capacity	Highest anticipated throughput	Design capacity	Highest anticipated throughput	Design capacity
Every Street, Fernhill	10 000	12 000	6500	8 000	25 000	30 000	55 000	60 000
Bayley Street, Stalybridge	13 500	15 000	11 000	13 000	15 000	20 000	40 000	45 000
Raikes Lane, Bolton	15 500	20 000	11 000	15 000	19 000	25 000	–	–
Chichester Street, Rochdale	10 500	15 000	8500	12 000	7500	10 000	60 000	65 000
Cobden Street, Salford	12 500	14 000	10 000	11 000	–	–	–	–
Arkwright Street, Oldham	11 500	15 000	8500	10 000	–	–	–	–
Bredbury Park Way, Stockport	3950	10 000	2270	5 000	–	–	–	–

Table 4. Transfer loading station (TLS) capacity (tonnes per annum)

garden waste is composted and incorporated into the land this also creates a carbon dioxide sink where a proportion of the carbon dioxide is stored.

One of the plants has been constructed at an existing facility within Greater Manchester resulting in reduced carbon dioxide footprint from transport. Three plants are on new sites obtained for the PFI contract. As these are within urban areas it has necessitated the construction of enclosed facilities with odour control rather than the windrow operation (laying out in rows which can then be turned to facilitate drying) within a Dutch barn which is possible when the facilities are located in countryside. The IVC buildings at Bredbury and Chichester Street employ rainwater harvesting, which reduces water

consumption at those sites resulting in a saving in the carbon dioxide associated with water treatment and transmission.

9. Carbon dioxide benefits of MBTs

The MBT plants comprise a mechanical material recycling facility to separate the biodegradable material from residual waste and extract recyclates such as ferrous and non-ferrous metals. Inorganic material such as sand and grit is then removed from the organic fraction which is passed to anaerobic digestion where the biomass is broken down liberating biogas comprising carbon dioxide and methane. The biogas is combusted using CHP engines to produce electricity and heat efficiently, which reduces carbon dioxide emissions compared with using the electricity imported from the national grid which is produced mainly from fossil fuel sources. The MBT plant at Arkwright Street is to be constructed in two stages with construction of the AD CHP facilities deferred until a later date. Selection of the number of process units at each plant represents a compromise in terms of capital and operational cost and operational flexibility and risk. For example, the plants are equipped with two or three digesters, and two CHP engines to deal with the anticipated variations of waste quantity and composition. Generally standby units have not been provided but rather critical strategic spares have been identified and procured for those items which cannot be repaired or replaced within a 24 hour period.

Site	Annual throughput
Chichester Street, Rochdale	25 000
Bredbury Park Way, Stockport	54 000
Over Hulton, Bolton	50 000
Nash Road, Trafford Park	50 000
Total	179 000 (seasonal)

Table 5. In-vessel composting (IVC) plant capacity (tonnes per annum)

Site	Highest annual throughput	Design capacity	Arkwright Street Fines	Output of ABPR approved material	Installed CHP capacity: kW
Reliance Street, Newton Heath	87 000	100 000	–	28 000	2 × 1235
Longley Lane, Sharston	120 000	130 000	–	–	2 × 1063
Cobden Street, Salford	70 000	90 000	8760	–	2 × 1063
Bredbury Park Way, Stockport	86 000	110 000	23 381	–	1560 + 1232
Arkwright Street, Oldham	87 000	110 000	–	–	–
Total	450 000	540 000	32 121	28 000	9514

Table 6. Mechanical biological treatment (MBT) facility capacity (tonnes per annum unless shown otherwise)

The MBT plants will be net importers of electricity during daytime operation but will generate surplus electricity from the CHP engines at night and weekends which will be exported to the electricity grid as green energy eligible for renewable obligation certificates (ROCs). Locating the new facilities on existing brown-field sites in urban areas imposes space constraints and requires robust environmental protection measures to mitigate the risk of planning delays arising from the perceived risk of odour nuisance owing to the proximity to commercial and residential properties. Alternatively, moving the plant out of town would result in increased vehicle numbers, more mileage resulting in increased congestion, plus the adverse impact of green field development.

To secure environmental permits for the new facilities, to be a good neighbour and to make schemes politically acceptable, it is necessary to implement measures to prevent nuisance from odour. Odour treatment facilities at the MBT plants in Greater Manchester include acid scrubbers and regenerative thermal oxidisers (RTO) at four plants and an acid scrubber and biofilter system at one plant. Similarly, a large odour treatment plant comprising a scrubber and carbon dioxide filters has been provided at each of the IVC plants. The RTOs will consume natural gas directly to reduce the odour nuisance while the other odour control systems will also have a significant carbon dioxide footprint.

The heat from MBT plants is reused wherever possible. CHP waste heat is used to heat digesters and hygienisation tanks by

Site	Highest anticipated annual throughput	Design capacity (excluding paper)
Longley Lane, Sharston	84 428 tonnes per annum at 16 t/h	90 000 tonnes per annum at 16 t/h

Table 7. Mechanical recycling facility (MRF) capacity

way of a hot water system, and exhaust gases are used as part of the feed air for drying. However, to improve the calorific value of digestate to enable it to be burned in the energy from waste plant, natural gas, a carbon dioxide fuel, is consumed in sludge dryers. This has the further benefit of achieving mass reduction thereby reducing transport costs. Table 6 presents an outline of MBT facility capacity.

10. Carbon dioxide benefits of MRF

A new MRF has been constructed at Longley Lane, Sharston. Dry recyclates comprising glass bottles and jars, food and drinks cans and plastic bottles are tipped in a loading bay. The MRF comprises a largely automatic series of conveyors and mechanical equipment which separates the various recyclates into the constituent components. The recyclates are then removed in bulk for recycling as the raw material for manufactured goods. This results in significant carbon dioxide savings as it requires far less energy to recycle material into new products rather than extracting raw materials. Table 7 gives a summary of MRF capacity.

11. Green waste capacity

Green waste facilities have been constructed at Longley Lane and Every Street to replace existing facilities. The material processed predominantly originates from HWRC facilities and is shredded and bulked up for onward transfer for windrow

Site	Annual throughput	Scope of work
Every Street, Fernhill	60 000	Rebuild of existing facility
Longley Lane, Sharston	70 000	Rebuild of existing facility
Total	130 000 (seasonal)	

Table 8. Green waste facility capacity (tonnes per annum)

composting on the Fylde peninsular. Table 8 outlines the capacity of each green waste facility.

12. Construction aspects

Considerable environmental benefits were realised during the construction period by careful management of the spoil arising from work across the 25 sites. To minimise the quantity of spoil to be disposed of early discussions were held with the Environment Agency who granted a project-wide waste transfer exemption licence which enabled spoil to be transferred between individual sites within the project thereby enabling the balancing of spoil across the sites and minimising waste. Some remediation of contaminated soil was undertaken on site thereby reducing disposal to landfill. Concrete arisings were crushed, screened and reused as fill, minimising the need to import stone and reducing transport costs. Stone columns were used in place of auger or driven piles at a number of sites, reducing the need for steel or concrete which have a greater carbon dioxide footprint.

13. Conclusions

The improvements being made to the infrastructure for dealing with municipal waste in some parts of the country can be likened to the improvements made to our wastewater infrastructure by the Victorians in the nineteenth century. While we must move to a zero waste economy, this does not mean zero production, rather that waste is treated as a resource from which value is extracted to the benefit of the economy but of most importance to ensure sustainable benefits to the environment. The new facilities being constructed in Greater Manchester will enable processing of solid waste in line with the waste hierarchy, bringing considerable carbon dioxide benefits and avoiding the emission of harmful greenhouse gases through waste prevention, reuse, recycling and energy recovery.

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