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Innovation in waste collection

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1 Introduction

The collection of waste by local authorities is, seemingly to the public, a simple process. In reality it has become a much more complex process including logistics; sociological factors that impact public behaviour in terms of recycling participation, waste minimisation; and dealing with the inappropriate disposal of waste like fly tipping.

The technology and techniques associated with these processes are not static and developments arise from technological change as well as new methods of utilising existing equipment. This report examines areas of innovation in waste management and considers how these might contribute to savings and efficiencies in the future.

1.1 What is innovative?

Innovation can be viewed as a continuous process evolving from established systems and extending to new ideas or “blue sky” thinking.

Innovation is often associated with risk, but it is an area where local authorities seldom take the lead as their priority is delivering a reliable service not adopting totally new concepts. However, innovations in other market sectors will be developed and once these developments have some track record and performance is proven then the risks of failure diminish.

This report will attempt to identify those techniques that are up and coming and are commercially available together with a high level assessment of the benefits that may be gained.

As a way of placing some scale on these ideas the new ideas or technologies will be classed as:

- Blue sky ideas
- Ideas/systems being trialled but where performance is not well known or available
- Available systems but not widely adopted

1.2 Where the opportunities lie

The broad sweep of innovative concepts is outlined in table 1 that identifies some key areas of new technologies. These can be summarised in to the following topics;

- management of data from collection systems to control and optimise use of assets,
- arrangement of collection systems and containers,
- vehicle operation and management,
- techniques for improving participation through education and promotion.

These issues are not mutually exclusive and some ideas interact across these grouping or in some cases they are separate developments that can work synergistically to provide greater benefits. An example of this is the combination bin identification technology (chips in bins), data communication with collection crews (data pad in cab) and the use of common data standards. In themselves, each of these technologies provides additional benefits but their real power comes when working together such that, for example, in the event of a missed bin, the crew can enter the reason for not collecting a particular bin and the logging system can identify how far along the round progress has been made and this is transmitted back to the central office in real time for action.

Similarly, when a resident makes a complaint about a missed collection, this can be done via the internet without recourse to a call centre and the resident would get an immediate response explaining why the bin was not collected. This might be an apology and a message saying that the collection is taking longer that day but with an expected time when the crew would be in the street to collect.

All of this could be achieved with either none or minimal manual intervention thereby saving the costs of the call centre and operations staff in dealing with the enquiry. From an operations point of view, the fleet manger can provide timely directions to crews to manage unexpected delays (e.g. due to road conditions or breakdown) and fully utilise crews by noting when the vehicles are finished or have spare capacity and then redirecting them, rather than accepting inefficiencies of existing practices like task and finish working. The data collection and management is probably the area where this interactive aspect is most relevant.

2 Areas of innovation

2.1 Data management approaches

There have been many assessments of the potential for the use of digital strategies to improve the management of services provided by local authorities^{1,2}. The application to the waste management sector largely relates to improving the management of interactions with the public via day to day requests such as new bin requests, missed bin complaints, requests for bulky waste collections etc. and the improvement of the management of vehicles and crews during their activities when they are away from the depot out in the field. The delivery of these two areas of efficiencies is separate but linked in that each can be implemented as standalone activities but there are benefits when performed together.

2.1.1 Channel shift

The concept of channel shift is to encourage the public to change their method of contacting the local authority from face to face or telephone to a web-based approach. This 'shift' is supported as the cost of each interaction has been estimated to be¹

Face to face	£5.51-£8.62 per interaction-
Telephone	£2.53-£4.00 per interaction
Web based	£0.15-£0.39 per interaction

Thus there is substantial benefit in increasing the use of the Internet to fully exploit the potential savings. However, this is not the whole story as once a contact is received this may require an action or further investigation to close out, which could potentially take up staff time. The key, therefore, is to link up the systems so that the enquiry/contact is completed with the minimal amount of manual intervention. The aim of the Local Digital Programme² "Common data standards" project was to optimise this so that over time the industry and suppliers would work with the data directly. Thus the example is that an enquiry for new recycling bins is posted via the web and the request is passed on to the team delivering the bins so that it appears on the following day's task list without any unnecessary officer time being used.

The benefits of this approach can be enhanced further by using common data standards this then enables the use of standard software packages, adding further to savings. Lewisham have indicated that adopting common data standards (the Open311 standard) allowed them to make saving of £118k when they introduced the "Fix my street" app.

2.1.2 Data collection on vehicle

The collection of data from the operating vehicles comes in many forms from the use of bin identification and weighing, GPS tracking, cameras and the use of data pads by crews. The primary purpose of these data systems is to improve the control and operation of crews by the management.

I Fleet management

The simplest version of data collection is well established in fleet management and is often termed telematics. Telematics is where various data on vehicle operation is captured and stored this might be engine data on fuel efficiency, engine faults and service life's etc. This then allows the fleet manager to optimise the maintenance activities by identifying when engine components are starting to fail and pre-empting this by repairing the fault in advance so that there are fewer breakdowns on route. All the major vehicle suppliers offer this type of active engine management systems.

In addition, the data collected can also be used to assess vehicle performance and fuel efficiency an area that is largely determined by driver performance and thus this can identify drivers who may need additional training. Savings achieved through the use of these systems vary according to the

¹ Local Government Association, Transforming local public services using technology and digital tools and approaches, June 2014

² Department for communities and local government, Local Digital Programme, Making the case for data standards, March 2016, <http://www.localdigitalcoalition.uk/resource/making-the-case-for-data-standards-an-alpha-business-case/>

particular task being undertaken but the Energy Saving Trust³ suggest that fuel consumption can be reduced by up to 15% and improve vehicle productivity by up to 20%. Real examples from the NHS, Traffic Enforcement, 3663 etc., show that fuel savings are typically 5-10% and productivity improvements are 3-10%. In addition, there are reductions in accidents and insurance losses and therefore costs from improved driver performance and the improved ability to recover vehicles.

II Monitoring service delivery

The next step beyond telematics is to have operatives enter data regarding service delivery. A number of private sector operators are trialling this option and an earlier study by WRAP⁴ suggested that using a system to track and optimise the routing etc., showed savings could be made where active management of routing was possible but less benefit was gained where there was a static collection requirement such as is seen in household waste collection.

The use of Radio Frequency Identification (RFID)⁵ tags for bins has been controversial with significant press and public attention. Some 60 local authorities used these bin identification systems, with or without bin weighing, in 2009⁶ but data on their subsequent use and value has been more difficult to obtain. However, individual reports do suggest that an increasing number of authorities are adopting the technology. The savings opportunities are largely stated to be linked to allowing pay as you throw systems typically for commercial collections. However, the savings for the monitoring of missed bins or contamination of recycling bins is also stated by not quantified.

With regard to datapad entry versus automatic data collection there is anecdotal evidence that at critical points in the day a “press any key” attitude can occur by the operative reducing the value of the data. It is not clear if this incorrect data entry is down to poor training, low motivation or a deliberate act and it is likely to be a combination of all three. This performance can be addressed over time and illustrates the need to provide appropriate staff support. Other trials are looking at the use of cameras to provide the feedback on the bin collection status to reduce the requirements and dependency on the operatives to enter data into a tablet. However, these systems have been adopted widely in the logistics sector and it is probably only a matter of time before this occurs for waste collection.

Data capture from RCV collection can be useful in many ways, it provides data as to the progress of a collection vehicle, which can be helpful in relaying information back to the public in real time regarding when their bin should be collected or if their collection has been missed. Data of this sort can also be used to monitor contamination and other behavioural issues and enable much better targeted responses. Unfortunately there seems to be little definitive data that provides the financial benefits that accrue from the improved enquiry response handling. One example is Lewisham that introduced its Love Lewisham app in 2004 that covered a range of services including missed bin reporting, graffiti, fly tipping etc. and indicated that £800k was saved over 5 Years split been £500k from reduced call centre activity and £300k from reduced cost associated with dealing with the enquiry.

A requirement to achieve these benefits will be the transmission of the data back to the central ‘system’ in real time using 3G and 4G communication. In addition the software should ideally be linked to the web portal so that appropriate live data is visible to residents and this will maximise the channel shift opportunity and thereby reduce the officer time taken up.

However, the claims from system suppliers regarding savings from the ability to reroute vehicles and reprogramme the collection in real time may be overstated for household waste collection where there is a static collection requirement with limited variation in the demand, although operationally there may be some benefit for addressing vehicle breakdowns, missed bin collections, street cleansing, litter bin collections or fly tipping response. This is likely to make the operation more responsive and thereby provide a better service but how this translates in to cost savings is less clear at the moment.

³ Energy Saving trust, A guide to telematics,

http://www.energysavingtrust.org.uk/sites/default/files/Telematics%2Bguide_WEB%2BONLY.pdf

⁴ WRAP, Waste collection – In-cab technology Trial, Oct 2010,

http://www.wrapni.org.uk/sites/files/wrap/WRAP%20In-cab%20ISYS%20and%20Bakers%20Trial%20Report%20Final%20for%20approval%2006_07_10%20HG.pdf

⁵ Radio Frequency Identification

⁶ Big brother Watch, Lifting the lid, Dec 2009, <https://www.bigbrotherwatch.org.uk/liftingthelid.pdf>

2.2 Capacity restriction

The largest savings can be accrued through the mechanisms that manage to either increase waste minimisation, or at least change behaviour so that materials are directed to the lower cost options typically recycling rather than residual disposal. There are a group of concepts/ideas that are aimed specifically at trying to influence behaviours by reducing the availability of residual waste collection either through the reducing the frequency of collection or the reducing the capacity of the bins provided. Authorities in the northwest region are implementing both reduced frequency (Bury, Salford and Manchester) and reduced residual waste bin capacity moving to 140 litre or 120 l wheeled bins on fortnightly collection, for example many Welsh authorities, Bolton and Oldham. These approaches are largely operating on the concept of restricted residual disposal capacity as a driver to affect behaviour and improve recycling or reduce waste production in the first place. The evidence base for the relative effectiveness of bin size verses collection frequency is uncertain at present but both are having the desired impact. However the reduced collection frequency does offer additional savings, as it requires fewer vehicles. The evidence currently available suggest that increases in recycling rate of circa 10% points is occurring in the areas where this is happening and associated reported savings of £500k to £2m⁷.

It should be noted that some of these options are being tested in the modelling element of this work as described in appendix 4.

2.3 Variable charging

The concept of variable charging for waste collection has been adopted in several countries and provides a direct incentive for the householder to minimise waste and recycle more on the basis that there are lower costs for the recycling collections compared to the residual waste collections. There are several approaches to either paying by container size, paying per lift or paying by weight. Experience from around the world^{8,9} is variable but studies indicate that waste reduction and increases in recycling can be up to 10%. Currently this is not permitted by legislation in England but could be an area that the City Region could consider in the future if it obtains more control over waste services.

2.4 Vehicle developments

2.4.1 Alternative fuels

A significant portion of the cost of operating collection vehicles comes from fuel. Almost all vehicles are currently operated on diesel fuels and whilst this has distinct climate change benefits there are concerns over the air quality impacts from NOx and particulates. There are pressures to move vehicle fuels to less polluting forms and thereby provide benefits to the environment. The principle alternatives are;

- Electric
- Hybrid
- Hydrogen/fuel cells
- Natural gas (CNG/LNG/LPG)
- Biofuels
 - Biomethane
 - Biodiesel from crops
 - Used cooking oil

These all target improving climate impacts compared to diesel and in one form or another these technologies are all being demonstrated. In general, the use of alternative fuels is more expensive than diesel apart from natural gas derived fuels where the costs are more competitive but there are set up issues concerned with fuel supply and vehicle replacement that need to be taken into account. Gas fuel can typically provide savings of up to 40% on fuel cost. However, due to the current limited

⁷ Enright, J and Beasley J, Delivering Waste Efficiencies in the North West, Local Partnerships, March 2016

⁸ Husaini I.G., Garg A., Kim K.H., Marchant J., Pollard S.J.T. and Smith R. (2007). European household waste management schemes: their effectiveness and applicability in England. Resources, Conservation and Recycling, 51, (1), 248-263.

⁹ CIWM, Direct and variable charging for household residual waste – Overview of key issues, Jan 2007

number of gas-refuelling stations a filling station network would be required within the region to allow the vehicles to refuel.

Suppliers of gas-fuelled vehicles estimate payback periods of between 1 and 3 years but this would depend on the number of vehicles adapted and the usage patterns.

The largest benefit from LNG/CNG vehicles is that they have substantially lower air emission^{10 11} providing greenhouse gas reductions (10-20%) and reductions in particulates of up to 90% and improvement in NOx emissions (30%). The greenhouse gas benefits are improved substantially if the gas is generated from biogas rather than natural gas.

It is important to note that this change could be applied to any or all local service vehicles and thus buses, emergency vehicles and smaller cars and vans and thus the potential for savings is wider than the waste service.

An additional benefit from the use of gas as a fuel for HGVs is that the noise emitted is substantially lower (4-10 dB_A reduction¹²) which may facilitate longer working hours or operating at night when there is less congestion in city centre locations. This will provide additional savings due to increased vehicle utilisation and reduced delays from traffic.

The development and use of alternative fuels will become more dominant in the future, as the Climate Change Act requires the UK to reduce its carbon emissions by 80% by 2050. A key initiative of this is the strategy that will result in all new vehicles being zero carbon by a date prior to 2050 so that the on road fleet in 2050 is predominantly zero carbon. Thus probably by 2040 government policies will be in place that make this a reality either by encouragement or enforcement. Obviously it is impossible to be certain regarding the methodology that will be adopted as the government has not decided yet as this would be in Carbon Budget 6 and 7 and currently only Carbon Budget 5 is starting to be discussed.

The technologies for electric and hydrogen HGV operation is still in its infancy but working examples of hybrid diesel/electric HGVs are operating in America and demonstration/research vehicles on Hydrogen are operating. This means that there will be some time before these technologies reach the performance levels necessary for use in front line services.

2.4.2 Safety developments

The waste industry and waste collection in particular has a less than enviable history on safety. The proximity of operatives to the rear of a vehicle, the requirement for frequent reversing and working on busy streets has resulted in many accidents where operatives or the public are injured or where material damage occurs to the vehicle and buildings/other vehicles due to collisions. Many improvements are being made to vehicles that manufacturers are marketing and they largely relate to either improving the design of the cab so that direct vision is improved through the windows and particularly on the near side where cyclists can remain unseen and affected when turning left. In addition the use of cameras and sensors has improved the ability to monitor the rear and other blind spots on a vehicle so that the driver has greater visibility and thereby can hopefully avoid incidents.

The savings that accrue from improved safety is difficult to assess. In general these will increase the costs of new vehicles and thus there is an upfront cost. Savings are possible from reduced insurance costs and the reductions in costs associated with dealing with the aftermath of accidents such as arranging replacement vehicles, management time in dealing with the disrupted service etc. Insurance providers are investigating the impacts and will in due course pass on the savings through the actuarial evaluations. However, such savings will be evidenced based and therefore after the event based on claims history.

10 Well-to-Wheels Analysis of Future Automotive Fuels and Powertrains in the European Context', CONCAWE, EUCAR and EU JRC, March 2007. <http://ies.jrc.ec.europa.eu/WTW>

11 NGV Network, natural gas vehicle industry & the NGV network, <http://www.ngvnetwork.co.uk/wp-content/uploads/2015/11/NGV-Network-Position-Paper-v9-Oct-15.pdf>

¹² Department for Transport, Annex to the Low Emission HGV Task Force recommendations on the use of natural gas and biomethane in HGVs.

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289185/annex-recommendations.pdf

There is some evidence that some insurers are providing discounts for domestic drivers when installing “dash cams”¹³ but these devices are generally used for evidence gathering in the event of an accident and purportedly improve driver behaviour as well as facilitating the level of fraudulent insurance claims.

The following table (Table 1) provides a summary of potential innovations in waste management:

¹³ The car crash cameras that could cut your car insurance, Telegraph , 27 Apr 2014, <http://www.telegraph.co.uk/finance/personalfinance/insurance/motorinsurance/10788346/The-car-crash-cameras-that-could-cut-your-car-insurance.html>

Table 1 Long list of innovation in waste collection

Innovative idea	Details	Purported benefits	Likely value of benefit	Noted challenges	Status of development/trials	Demonstrated where
Vehicle operation						
Alternative fuels	Conversion to LPG, CNG/LNG	Lower op costs but higher capital Cleaner emissions options to use renewable upgraded biogas	Overall cost balance for HGV is neutral to benefit. Fuel up to 40% cheaper but offset by capital costs	Reduced range Requires refuelling infrastructure at depot	Developed but not widely adopted	UK, Europe, Linköping (biogas bus system)
	Electric vehicles	Reduced emission, lower noise levels, decarbonisation of fuel as network decarbonises	Needs detailed evaluation of costs Lower noise may permit night collection	Limited range but probably suitable for urban collections	Electric HGV still at demonstration stages	BMW, Berlin, Germany ¹⁴
	Hydrogen fuel cells	Climate change benefits	Unknown	Still in development	Still in development	USA, Toyota ¹⁵
On vehicle weighing	Use to manage vehicle utilisation and optimise round planning with “on the fly” changes	Better management of vehicles in the field	Limited benefit for static collection demand routes		Established technology, not widely used in UK LA sector	Biffa, Denis Eagle ¹⁶

¹⁴ <http://www.wired.co.uk/article/bmw-40-tonne-electric-truck>

¹⁵ <http://freightinthecity.com/2016/11/toyota-to-explore-hydrogen-fuel-cell-potential-for-hgvs/>

¹⁶ <http://vwsLtd.co.uk/>



Innovative idea	Details	Purported benefits	Likely value of benefit	Noted challenges	Status of development/trials	Demonstrated where
	Use to implement “Pay as you throw” to encourage waste minimisation and higher recycling participation	Improved recycling participation, waste minimisation	Up to 10% of waste disposal costs	Not allowed by UK legislation	Established, but many approaches.	Eire, Canada
Bin identification - Chipped bins	Installation of RFID tags on bins	Facilitates the monitoring of progress and completion of collections identifies which bins have been collected. On its own of limited value but combined with on vehicle weighing and live data transfer to data centre can facilitate improved control and management of vehicles	Depends on how these are used with other systems	Public opposition to perceived infringement of privacy	Well established	At least 60 LAs ⁶
Vehicle telematics	Provision of data feedback from engine to facilitate maintenance	Improve vehicle condition monitoring allows improved, fuel efficiency, operational life of vehicle and reduced unplanned downtime		Costs of additional sensors and data handling plus analyses systems, only effective if data is acted upon i.e. skill set of fleet managers	Established systems available to most new HGV vehicles	Veolia, Biffa, Serco, Urbaser
Crew data	Data pads in vehicles linked to GPS and missed bin reporting	Improved responsiveness to correct operational issues and address complaints	Depends on integration with other systems, limited value on its own	Operator training required to avoid inappropriate data entry	Commercial systems available	Biffa

Innovative idea	Details	Purported benefits	Likely value of benefit	Noted challenges	Status of development/trials	Demonstrated where
	Managing/redirecting crews/round planning	Improved responsiveness to correct operational issues and address complaints	Improved responsiveness to problems in service delivery.	Household collections unlikely to see significant flexibility	Established technology	
Data standards	Use of common data standards between all aspects of the service	Use and refinement allows the systems to be integrated and facilitates channel switching that is a more cost effective methodology of dealing with complaints and issues reducing the costs of handling these.	£100-200k/a per authority		Demonstration programme	Local Digital Coalition ²
Route planning software	The optimisation of waste collection rounds can provide substantive savings and efficiencies. Whilst this can be a bought in service and conducted on a periodic basis, this can also be linked to other systems with live planning responding to issues and missed bins etc.	Optimisation of route to avoid unnecessary travel. Improving vehicle and crew utilisation.	Dependant on how well existing rounds are organised, Typically 5-10% savings achieved.	Complexity and level of fixed elements in system reduce the possible flexibility.	Well established technology. Linking of systems is moderately novel	Widespread
Vehicle safety observations systems	360° cameras	Provision of additional vision for drivers to reduce reversion collisions and avoids collisions with pedestrians and cyclists		Training costs	Relatively new on market but growing supply base	Most vehicle suppliers

Innovative idea	Details	Purported benefits	Likely value of benefit	Noted challenges	Status of development/trials	Demonstrated where
	Improve visibility from improved cab design	Changes in can design to improve the visibility of pedestrians and cyclist reduced cost of vehicle damage			Variation in market delvers with some suppliers more active in the area but established technology	Most vehicle suppliers
	Improve reversing sensors	Reduced collision with pedestrians etc., lower noise pollution			Established technology on offer from suppliers	Most vehicle suppliers
Collection body configurations	Single pass designs, split plus food	Split body vehicles with forward stillage compartment provide opportunity to collect 3 materials on a single pass route. The front compartment can be held for glass or food waste with the two compacted compartments for residual and recycles or partially segregated recycles (fibre/containers)		<p>In the past split bodied vehicles have contamination issues</p> <p>The scaling of compartments can limit the overall payload if rates of different materials do not match expected levels.</p> <p>Vehicle size can be problematic in narrow streets</p>	Widespread developments, no standard design agreed upon	Various

Innovative idea	Details	Purported benefits	Likely value of benefit	Noted challenges	Status of development/trials	Demonstrated where
	Multi modal vehicles Plan for using a multi modal vehicle in urban areas, linked with water and rail transport.	The studies have indicated a reduced road miles and improve vehicle utilisation.	Study suggest that circa £320kpa per borough savings, but dependant on savings from reduced transfer station requirements, and intermodal benefits represent approximately 50% of these savings	Whilst the trials have shown some success, take up of the technology has been limited. Further analysis of the reasons why is needed. Likely causes are capacity issues, problem locating demounting sites. Requirements for specialist unloading arrangements	Trials completed and reported. No further action planned. Viewed as available but not widely adopted.	Aberdeen, LB Bexley, LB Redbridge RB Kensington and Chelsea
Promotion /education						
Mobile applications	Various programs to encourage and facilitate appropriate waste behaviours E.g. Cardiff app targeted at student to issue reminders of when bin day is etc. Brighton apps to provide information on recycling services, locations, materials etc.	Method to reach groups that may not use traditional information routes	Unknown requires implementation and evaluation		Still concepts and ideas trying to get funding	Cardiff Brighton



Innovative idea	Details	Purported benefits	Likely value of benefit	Noted challenges	Status of development/trials	Demonstrated where
Enforcement activities	Intervention teams, for difficult areas terrace backs etc.	Improvement in complex collection areas where lack of “ownership”		Dealing with challenging behaviour from public		Wirral
	Stickers/notices, non-collection	Research shows that negative messages appear to have more impact than positive ones i.e. “don’t put x in here” on a the residual bin is more effective than “please put x in here”	Improved contamination rates in recycling possibly some lift in recycling rates		Established technology although still detailed development on the messages	Widespread but lack of common approaches



Innovative idea	Details	Purported benefits	Likely value of benefit	Noted challenges	Status of development/trials	Demonstrated where
	Reward schemes	Increased participation in recycling and reuse schemes	3% uplift in recycling participation in areas of schemes	Linking reward to participation	Recent reviews suggest that these types of scheme have limited benefit	Bracknell Forest, Dudley, LB Bexley, Sandwell, Calderdale
Innovation in waste prevention programme	mixture of schemes to support repair and redistribution of waste items (mainly furniture and WEEE) or food Key common elements seem to be community/charity engagement and local focus	Improved diversion, community benefits of furniture/white goods in to disadvantaged populations, training and employment		Requires significant management to maintain viability of schemes Relatively modest quantities diversion although social benefits can be viewed		WRAP scheme ¹⁷
Streetscene	Recycling bins and presentation/advertising	Improved presentation leading to better separation and hence higher recycling			Available design and support via WRAP, not adopted in all areas.	WRAP
	Compacting litter bins (big belly solar)	Reduced collection frequency, improved planning of collection reduced street cleaning costs	High cost		Developing market with a few examples in the UK	Islington

¹⁷ <http://www.wrap.org.uk/content/innovation-waste-prevention-fund-england>



Innovative idea	Details	Purported benefits	Likely value of benefit	Noted challenges	Status of development/trials	Demonstrated where
	Underground banks (Cambridge trial)	Reduced frequency of collection Reduced vandalism Less flytipping	High cost Possibly, some specialised equipment required Reduced visibility to users		Limited market with few examples in the UK	Cambridge
	Larger litter bins	Reduced frequency of servicing	Reduced costs due to optimising fleet use.		Trial	Sefton
Collection strategies						
Collection frequency	Reduced residual waste collection frequency to provide pressure to recycle and minimise waste	Improvements in recycling rate reduced collection costs as weight per lift increased.		Public opposition, holiday timetabling	Trials operating of 2 3and 4 weekly collections, some large deployments	Fife, Bury, Salford, Powys, Oldham, Somerset
Bin capacity	Restriction of residual and expansion of recyclate capacity to promote recycling participation	Improvements to recycling rate		Public opposition	Variety of schemes operating	Bolton, Many Welsh authorities, Vale of White Horse, South Oxfordshire
	Limitation of side waste, closed bin lid policies etc.	Reduced litter and street cleaning costs, improved recycling performance		Enforcements costs	Variety of schemes operating	Neath Port Talbot, Solihull, Huddersfield



Innovative idea	Details	Purported benefits	Likely value of benefit	Noted challenges	Status of development/trials	Demonstrated where
Working patterns	4 day collection extended working day	Reduced bank holiday disruption, more effective operation due to longer operational day Opportunities to carry out ad hoc works on Mondays		Availability of tipping points out of hours	Practiced by many authorities	KBTG ¹⁸
	Night-time working	Reduced congestion and thus improved efficiency	£300k reported	Noise, crew management	Operational in some areas but not widespread	Sefton
	Double shifts/longer working day	Extending the working day to allow two shift operation improves utilisation of vehicle and infrastructure	Operation in commercial spaces more effective and less disruptive to traffic	Access for maintenance, access for tipping, noise in early late periods	Concept	
Co-collecting commercial waste with domestic	Where commercial collections are performed these are done by the same vehicle	Improved collection efficiency		Segregating data on quantities Collection frequencies for commercial waste may not suit household waste	Practiced by some authorities and therefore consider not novel but not fully adopted.	
Arrangement of materials collected	Comingled recyclates	Improved material capture and reduced costs for collection		Requires MRF and impacts on quality hence recyclate value	Commonly applied	widespread

¹⁸ <http://www.keepbritain tidy.org/Documents/Files/KBT%20Network/ATN%20Refuse%20Collection%20-%20%20day.pdf>



Innovative idea	Details	Purported benefits	Likely value of benefit	Noted challenges	Status of development/trials	Demonstrated where
	Glass inclusion	Increased tonnage collected		Impact on recycle value, MRF design more difficult	Commonly applied	widespread
	Two stream fibre/containers	Gains the benefits of Comingled whilst minimising degradation of quality		Space requirements for additional containers	Commonly applied	widespread
	Food waste	Targets a stream not currently captured		Relatively costly collection	Commonly applied	widespread
	Clinical waste collection/ absorbent hygiene products	Restructuring to get NHS and LA responsibilities refined Correct allocation of costs to appropriate bodies.	Reduced costs to LA	No cost saving to public purse only reallocation to/from NHS		
Multi-occupancy buildings Collection systems for flats and similar households	Vacuum collection systems	Reduced collection costs bridge waste to		Long term management costs, pipe wear, potential blockages		LWARB paper ¹⁹
	Chutes			Limited to two types		
	Door to door	Improved recycling participation		Complex to deliver expensive		

¹⁹ <http://www.lwarb.gov.uk/wp-content/uploads/2015/05/Waste-management-planning-advice-for-flatted-properties-case-studies.pdf>



Innovative idea	Details	Purported benefits	Likely value of benefit	Noted challenges	Status of development/trials	Demonstrated where
Fly tipping prevention/enforcement						
Variable charging	Pay as you throw concepts	Greater recycling and waste minimisation participation		Change is regulatory powers required	Garden waste regularly performed otherwise no in UK but other country experience is available	Blaby Sniffer OECD study
Additional material collections	EEE, textiles batteries	Captures additional materials that do not fit with other collections		Combination with collection vehicle design	Available as a technique but not widely used but growing	Vale WH/ South Oxfordshire
HWRC management	ANPR to track commercial use	Reduced trade waste abuse		Public opposition	Commercially available	widespread
	Height barriers	Reduced trade waste abuse		Public opposition	Normal technology	widespread
	Permit systems	Reduced trade waste abuse and cross boundary traffic		Public opposition		widespread
Revenue generation						
Green waste charging	Move to separate food waste and charging for green waste as an annual fee	Reduced costs of treatment and potential for AD of separate food waste	Ranges but typically charges are £30-£50/hh	Reduces the amount of recycling	Commonly applied	Widespread



Innovative idea	Details	Purported benefits	Likely value of benefit	Noted challenges	Status of development/trials	Demonstrated where
Commercial waste collection	Expanding service to capture large part of C&I and optimise economies of scale			Frequencies of collection may not match domestic collections		
Enhanced produce responsibility	Controls on products in region and fiscal measures to promote waste min and recyclable design					
Recyclate markets LA development	Pulping plants			Impacts on reporting of recycling as now rejects don't count		Proposals for Leeds and Essex, currently not built
	Plastics sorting/cleaning plant		Limited especially given current market value of plastics	Scale issues	Existing plants but privately owned	
	Bulky waste refurbishment	Normally linked to 3 rd sector benefits, education, training and employment				
	WEEE refurbishment	Normally linked to 3 rd sector benefits, education, training and employment				

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