

# THE STATE OF INNOVATION IN THE SOUTH AFRICAN WASTE SECTOR

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## ABSTRACT

The results of the first South African Waste Sector Survey shows that landfilling remains the main technology option for the management of waste in South African, with 90% of all waste generated, disposed of to landfill. However, the results show a surprisingly high level of waste innovation activity, with the private sector showing greater innovation activity than the public sector. An estimated 51.9% of private enterprises compared to 41.2% of municipalities indicated they had introduced new product innovations during the past five years, while 56.3% of private enterprises compared to only 35.3% of municipalities indicated they had introduced new process innovations. The private waste sector showed a greater tendency to introduce new technological innovations to the South Africa waste market, compared to municipalities who typically only introduced technological innovations to their own operations, with over 50% of private sector respondents indicating that they had introduced product or process innovations that were new to the South African waste market. The private waste sector also showed a greater tendency than municipalities to introduce technological innovations from overseas, with 26.1% of private enterprises indicating that they had sourced their product innovations mainly from abroad, and 34.7% their process innovations. It is hoped that this innovation activity displayed by the waste sector will translate into an increased diversion of waste away from landfilling towards recycling and recovery. However, given the current constraints facing the South African waste sector, creating an enabling environment for waste innovation is imperative to changing the sectors dependency on landfilling.

**Keywords:** Waste innovation, waste sector survey, technology

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## INTRODUCTION

South Africa is estimated to landfill approximately 90% of all waste generated (as at 2011) (DEA, 2012). However, the second national Waste Baseline Study and the national Waste Sector Survey suggest that significant opportunities for waste reuse, recycling and recovery exist in South Africa (DEA, 2012; DST, 2013). The Waste Research, Development and Innovation (RDI) Roadmap, developed by the Department of Science and Technology (DST), has set an ambitious goal of a “20% reduction (by weight) in industrial waste and a 60% reduction (by weight) in domestic waste, to landfill by 2024” in support of government policy to move waste up the hierarchy. Achieving these goals will require alternatives to ‘business-as-usual’, supported by both technological and non-technological innovation.

The South African government recognises the role that innovation can play in supporting improved industry competitiveness and economic growth (DTI, 2010; 2011; NPC, 2011). Government has mapped out a ten-year plan to stimulate innovation and to move South Africa towards a knowledge based economy, so as to enhance productivity, economic growth and socio-economic development (DST, 2007). By comparison, the European Union has looked extensively at the contribution of innovative firms to the Union’s competitiveness and job creation. The studies have looked at eco-innovation development and adoption and the competitiveness of European Union firms, and at new instruments to encourage the investment in process and marketing innovations (EC, 2012; 2012a). Their findings show that innovation can contribute to external competitiveness; that “*eco-innovating firms are, on the whole, more successful than conventional innovators*” and that “*innovation is the most important source for capturing value-added and developing or keeping competitive advantages*” (EC, 2012a:8; 2012a:69).

The first waste innovation survey was conducted as part of the South African Waste Sector Survey. The survey was aimed at establishing a baseline of the South African waste sector against which to monitor growth and impact. The results provide interesting insight into current waste innovation activity within the country for the year 2012 (DST, 2013).

## MATERIALS AND METHODS

### *Defining the waste sector*

Since the South African waste sector is not a clearly defined economic sector (e.g. SIC codes), it had not been previously mapped. The first step in undertaking the Waste Sector Survey was to define the sector. Furthermore, the South African waste sector is known to include both formal and informal sub-sectors, each of which play an important role in the management of waste in the country. The

Waste Sector Survey was specifically targeted at the formal waste sector and was directed at all organisations (public and private) active in the management of waste in South Africa.

For the purposes of the study, the formal waste sector was defined as including waste handlers (private and municipalities), waste equipment providers, waste consulting/engineering companies, waste research and development organisations, and waste sector associations. Where ‘waste handlers’ included any organisations undertaking city cleansing, waste collection and transport, storage and transfer, sorting and separation of recyclables, reprocessing or recovery of recyclables, treatment, and disposal (landfilling). The units of reporting for private waste sector organisations were based on the National Small Business definition of enterprise size, (National Small Business Amendment Act, 2003) (**Table 1**). Following analysis, the units for the waste sector were aligned with the well-defined South African Manufacturing sector, and the Electricity, Gas and Water sector (**Table 1**). The units of reporting adopted for the public waste sector were based on the Municipal Infrastructure Investment Framework (MIFF) categories (CoGTA, 2009) (**Table 2**).

Table 1. Definition of enterprise size for the South African waste sector (total revenue per annum)

	<b>Waste revenue [US\$ million]<sup>‡</sup></b>
Large enterprises	> 5.1
Medium enterprises	1.3 – 5.1
Small enterprises	0.5 – 1.3
Very small enterprises	0.02 – 0.5
Micro enterprises	< 0.02

Table 2. Municipal Infrastructure Investment Framework (MIIF) categories

<b>MIIF category</b>	<b>Description</b>
A	Metropolitan municipalities (metros)
B1	Secondary cities, local municipalities with the largest budgets
B2	Local municipalities with a large town as core
B3	Local municipalities with small towns, with relatively small population and significant proportion of urban population but with no large town as core
B4	Local municipalities which are mainly rural with communal tenure and with, at most, one or two small towns in their area
C	District municipalities

### *Sampling*

To obtain as accurate a picture of the South African waste sector, no sampling was undertaken. The intention was to include all, or as many, public and private waste organisations in South Africa in the survey. At the request of DST, the results were not extrapolated to give a potential size of the sector,

<sup>‡</sup> At an exchange rate of US\$1 = ZAR10

but rather presented as a minimum size of the sector. Analysis of the results by statisticians concluded that due to the spread of participating companies and municipalities (by revenue and by employee number), and the inclusion of the top five waste companies and six of the eight metropolitan municipalities, the results presented in the Waste Sector Survey, are representative of the South African waste sector.

### ***Data collection***

Given the potentially large number of municipalities and private waste companies (>500) and their geographic distribution across the country, self-administered questionnaires were deemed the most appropriate means of collecting data on the South African waste sector. A questionnaire was prepared which addressed all of the information requirements of DST. Following piloting of the questionnaire and minor amendments, the final questionnaire was distributed via email in April 2013 to private companies and local and metropolitan municipalities. A hardcopy of the questionnaire, including a covering letter from DST, was also mailed to every local and metropolitan municipality, given the lack of email access in many of the municipalities.

### ***Defining innovation***

Innovation activity was assessed using the categories and definitions provided in the Oslo Manual (OCED, 2005). This included categories for product-, process-, marketing- and organisational-innovation. For the purposes of this study, the following definitions were adopted.

***PRODUCT innovation*** is defined as “the introduction of a new product (good or service), or a significantly improved product (good or service), such as user friendliness, components, software or sub-systems. The innovation (new or improved) must be new to your organisation, but it does not need to be new to the waste sector or market. It does not matter if the innovation was originally developed by your organisation or by another organisation”.

***PROCESS innovation*** is defined as “the introduction of a new or significantly improved process for making or delivering goods and services, e.g. methods of manufacturing products; new or significantly improved logistics, delivery or distribution of your products; or new or significantly improved supporting activities for your processes, such as maintenance and operating systems for purchasing, accounting or computing. The innovation (new or improved) must be new to your organisation, but it does not need to be new to the waste sector or market. It does not matter if the innovation was originally developed by your organisation or by another organisation”.

***ORGANISATIONAL innovation*** is defined as “the introduction of new or significantly improved knowledge management systems to better use or exchange information, knowledge and skills within your organisation; major changes to the organisation of work within your enterprise, such

*as changes in the management structure or integrating different departments or activities; new or significant changes in your external relations with other firms or public institutions, such as through alliances, partnerships, outsourcing or sub-contracting”.*

***MARKETING innovation** is defined as “significant changes to the design or packaging of a good or service; new or significantly changed sales or distribution methods, such as internet sales, franchising, direct sales or distribution licenses. The innovation (new or improved) must be new to your organisation, but it does not need to be new to the waste sector or market. It does not matter if the innovation was originally developed by your organisation or by another organisation”.*

### **Data analysis**

Data from all of the returned questionnaires were captured and analysed in Microsoft Excel. Data was verified for consistency and accuracy following complete capturing. Where fields had been omitted by the respondent, an effort was made to source this missing information, either from the respondent directly, or from data already publicly available. The results were collated and presented for the year 2012.

## **RESULTS AND DISCUSSION**

The following broad topics were included in the Waste Sector Survey – waste sector and technologies, basic organizational status, employee status, financial status, and technological and non-technological innovation. The results of the innovation status are presented in this paper. For the full results, the reader is referred to the final Waste Sector Survey report (DST, 2013).

The following section presents the results on innovation in the South African waste sector, with a focus on product- and process- innovation (technological) and marketing- and organisational-innovation (non-technological) innovation.

### **Innovation activity**

Participants were asked “*During the past five years, did your organisation introduce new or significantly improved waste goods or services (PRODUCT innovations) or significantly improved waste processes (PROCESS innovations) to its operations?*” The results (**Figure 1**) show greater innovation activity<sup>§</sup> (technological and non-technological) amongst the private waste sector than amongst municipalities. 51.9% of private enterprises compared to 41.2% of municipalities indicated they had introduced new product innovations, while 56.3% of private enterprises compared to only 35.3% of municipalities indicated they had introduced new process innovations.

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<sup>§</sup> Where innovation activity is defined for the purposes of this study as the sum of product, process, organisational and marketing innovation.

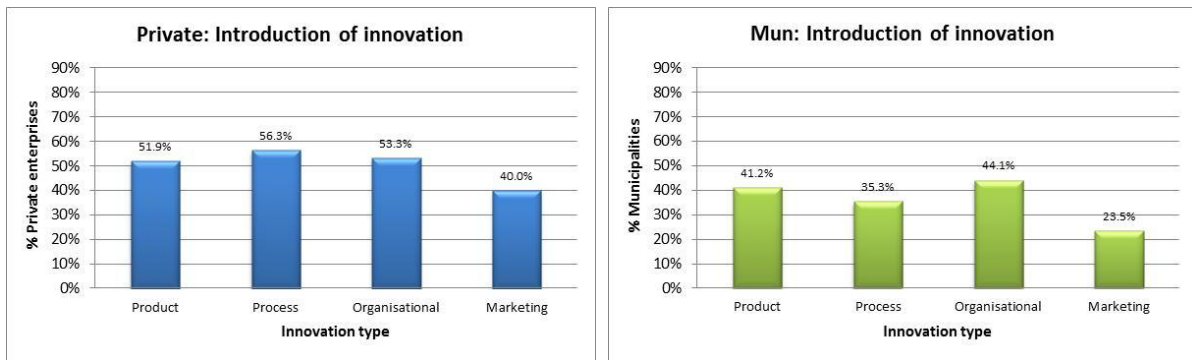


Figure 1: Introduction of innovation within the private and public (municipalities) waste sectors

With respect to non-technological innovations, when asked “*During the past five years, did your organisation introduce new or significantly improved ORGANISATIONAL innovations to its operations?*”, 53.3% of private companies compared to only 44.1% of municipalities indicated they had. When asked “*During the past five years, did your organisation introduce new or significantly improved MARKETING innovations to its operations?*”, only 40.0% of private companies compared to only 23.5% of municipalities indicated they had. The lower adoption of marketing innovation by municipalities makes sense, since municipalities do not need to market their services, unlike the competitive private waste sector.

### ***Market for product and process innovations***

Where respondents had indicated that they had introduced new product or process (technological) innovations, they were requested to indicate the level of novelty of the innovation, i.e. whether the innovation was:

- New to the South African waste market (i.e. “*You introduced a new or significantly improved product or process innovation into the waste market before your competitors*”)
- Only new to your organisation (i.e. “*You introduced a new or significantly improved product or process innovation that was already available from your competitors in the waste market*”)

The private waste sector showed a greater tendency to introduce new technological innovations to the wider South African waste market, compared to municipalities who typically only introduced technological innovations to their own operations (**Figure 2**). Over 50% of private sector respondents indicated that they had introduced product or process innovations that were new to the South African waste market.

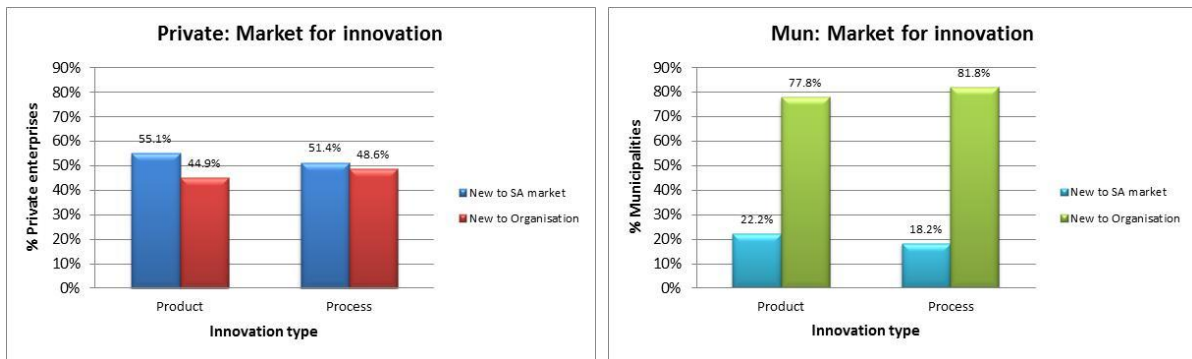


Figure 2: Market for the innovation, within the private and public (municipalities) waste sectors

### *Origin of technological innovations*

Finally, respondents who had introduced new product and process (technological) innovations, were asked to indicate whether these waste innovations had originated mainly in South Africa or from abroad (**Figure 3**)?

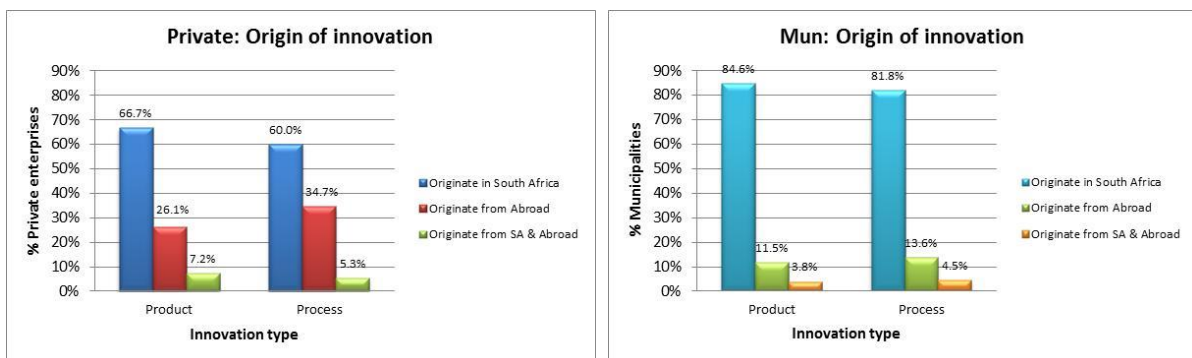


Figure 3: Origin of the innovation, for the private and public (municipalities) waste sectors

The private waste sector showed a higher tendency than municipalities (**Figure 3**) to introduce technological innovations originating from other countries (non-South African in origin), with 26.1% of private enterprises indicating that they had sourced their product innovations mainly from abroad, and 34.7% their process innovations. This is higher than the figure of 24.0% for the broader South African business sector reported on in the South African Innovation Survey for 2008 (HSRC, 2011). It would be interesting to assess this against more recent innovation figures for the South African business sector, to see whether the waste sector does in fact source more of its technological innovation from abroad compared to other economic sectors. However, there has been no published business innovation report for South Africa, since 2008. The results suggest encouraging levels of local innovation and localisation of inbound technologies.

### ***Planned introduction of new technological innovations***

When respondents were asked “*Is your organisation planning to implement new technological innovations in the coming two years?*”, 60.9% of private waste companies and 55.2% of municipalities indicated that they would be, which is encouraging from the perspective of innovation activity (**Figure 4**). However, it would be interesting to visit those organisations who indicated they would be implementing new technological innovations, to get a sense of what types of technologies will be implemented and whether these technologies reflect, and support, a move away from landfilling to alternative waste management options.

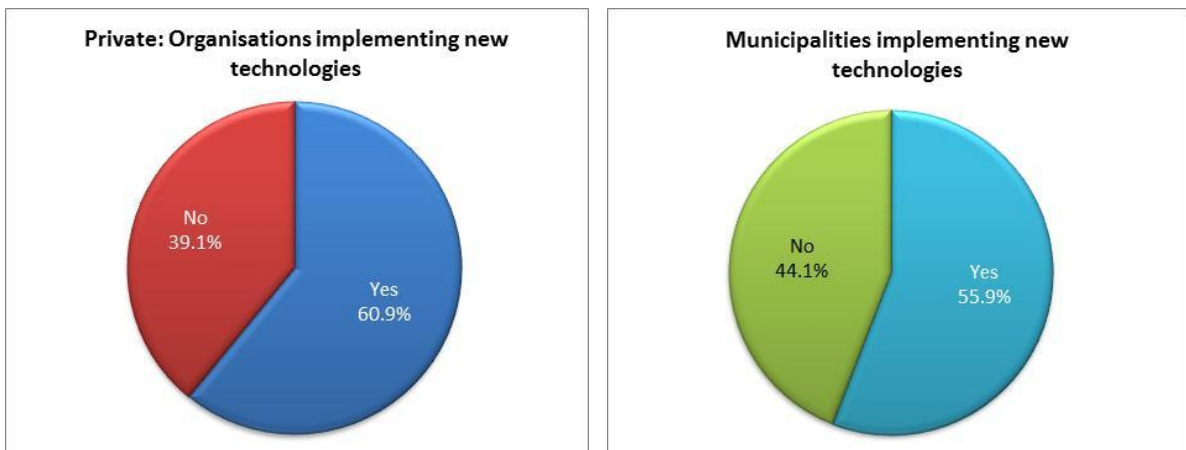


Figure 4: Planned introduction of new technological innovation

### ***Innovation in the private sector***

Taking a closer look at innovation activity within the private waste sector, there appears to be a correlation between enterprise size (total waste revenue) and the adoption of innovation. **Figure 5** shows that the larger the waste organization (financially), the greater the likelihood of innovation activity (technological and non-technological). This makes sense, as there is a financial risk attached to introducing new innovations, a risk which is more easily carried by larger, more financially secure companies. With increasing company size, there is also a need for ensuring competitive advantage, and hence the need for continuously innovating and adapting. **Figure 5** shows that large enterprises had the highest innovation rate, with 68.8% of large enterprises showing innovation activity, compared to an innovation rate of 20.5% for micro enterprises.



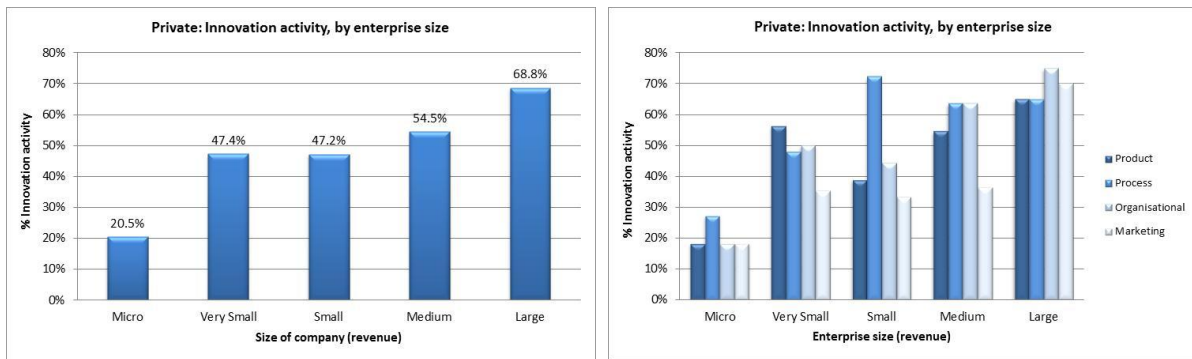


Figure 5: Innovation activity by enterprise size (total)

These findings are in line with innovation activity for South Africa (HSRC, 2011) and with international research findings, which show a correlation between enterprise size and innovation (Balasubramanian and Lee, 2008). It is encouraging to note that the South African waste sector reflects the general innovation trend for the South African business sector (HSRC, 2011), with increasing innovation activity with increasing enterprise size. However, percentage wise, the South African waste sector appears to lag behind the norm for the South African industry and service sectors, on innovation activity. This may reflect the slow move away from landfilling in South Africa to alternative waste management options and the slow uptake of innovation. This is likely to change in coming years with the strong policy drive towards alternative waste management practices and the need for companies to reinvent themselves to remain competitive.

**Figure 5** also provides a breakdown of the innovation activity type within the different size classes of enterprises. Within large enterprises, 65.0% of enterprises had adopted product innovations, 65.0% process innovations, 75.0% organisational innovations and 70.0% marketing innovations. This compares to micro enterprises, where only 18.2% of enterprises had adopted product innovations, 27.3% process innovations, 18.2% organisational innovations and 18.2% marketing innovations.

Government has identified the need to “*direct and provide increased support to SMEs to develop and commercialise high technology products and processes*” with the aim of creating “*more successful and innovative SMEs that will use new systems and innovations to produce new products for global and local markets*” (DTI, 2010:47). As such, while Government supports and stimulates the uptake of technological innovation across the waste sector in order to encourage a shift away from landfilling to alternative waste management options, it must also invest in programmes which will stimulate an uptake of innovation in micro-, very small- and small- companies.

### ***Innovation in the public sector***

As with private waste companies, municipalities also show increasing levels of innovation activity with increasing municipal size, with the exception of the small B4 municipalities which show surprisingly elevated levels of innovation activity (**Figure 6**). However, in discussing these results with key stakeholders in the sector, there was general surprise at the higher than expected innovation activity by municipalities (although still lower than the private sector). To clarify this point, it must be noted that innovation is not only considered a world first, ground-breaking technology. Innovation includes new to the country, new to the waste sector and new to the organisation (levels of novelty). If one therefore starts from a very low base, the introduction of a simple product or process, new to the organisation (e.g. a rear-end loader vehicle or composting), may be considered innovation.

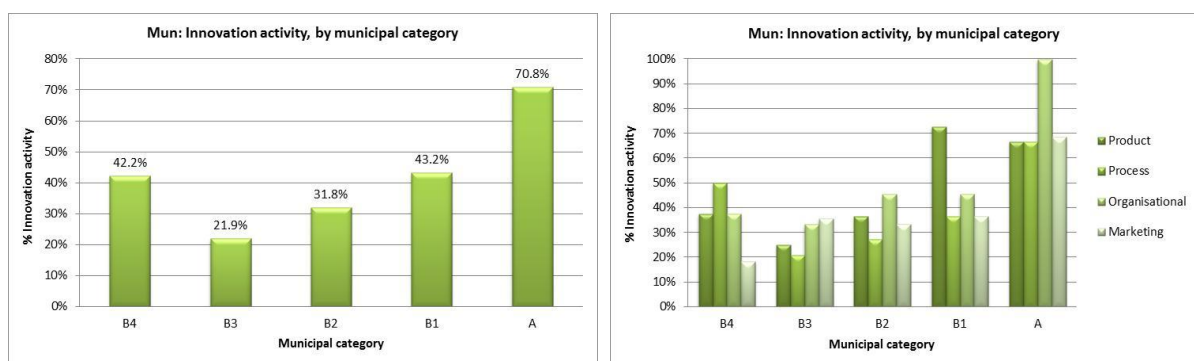


Figure 6: Innovation activity, by municipal category (total)

### ***Obstacles to innovation***

The DST report on “*Current and Required Institutional Mechanisms to Support Waste Innovation*” (DST, 2012), identified seven broad themes of issues affecting the introduction of waste innovation in South Africa. These included:

- legislative
- economic and financial
- institutional
- behaviour and perceptions
- infrastructural
- information sharing and collaboration, and
- human capital development

These obstacles to waste innovation were revisited during the Waste Sector Survey, by asking the question “*Which of the following constraints has your organisation recently experienced in*

implementing technological or non-technological innovations?”\*\* The results presented in **Figure 7**, confirm that economic/financial and legislation remain the two predominant constraints, for both the public and private waste sectors.

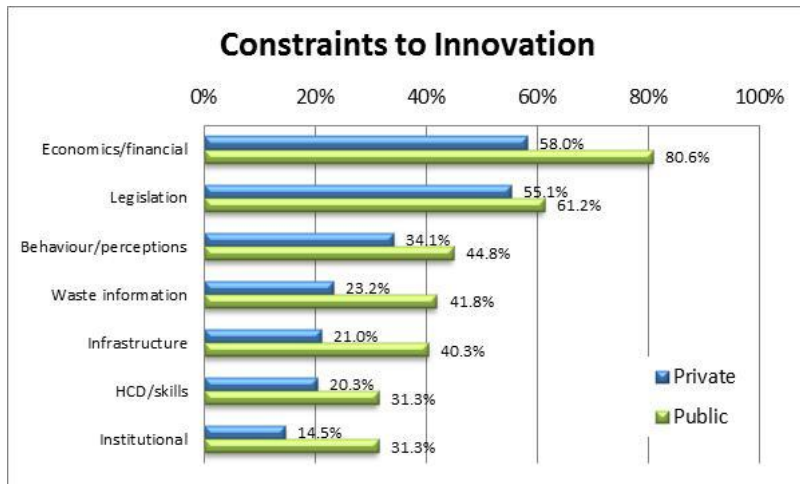


Figure 7: Recognised constraints to waste innovation in South Africa

However, in discussion with respondents there appears to be a significant difference between the public and private sectors interpretation of economic/financial constraints. For municipalities, the issues remain largely around available budget (finances) to render waste services, with a sense that existing budgets are too small to make any significant impact in the management of waste. However, considering that South African municipalities receive at least US\$832 million per annum to address waste issues, the problem may be more around the use of this funding than the availability of funding. For the private sector, the issues are more around economics and the broader waste management system. Issues raised include price distortions in the market, making landfilling still much cheaper than recycling or waste-to-energy alternatives. For example, the cost of waste-to-electricity, as opposed to coal-to-electricity, makes waste-to-energy a more expensive alternative, especially in the absence of incentives or disincentives to correct these distortions.

Legislative issues, in particular the definition of waste, which respondents feel constrains reuse and recycling opportunities, and bureaucratic and slow authorisation and licencing processes, remains a ‘threat’ to innovation<sup>††</sup>. This links closely with a point raised in the Waste Sector Survey, that many companies involved in the recycling and reprocessing of waste materials (metal, plastic, paper, glass, etc.) do not see themselves as being part of a ‘waste’ sector (DST, 2013). Their disassociation with the waste sector may be in an effort to circumnavigate the ‘heavy’ legislative requirements placed on

\*\* It must be noted that while the question was phrased specifically in terms of obstacles to waste innovation, some respondents have suggested that these are also obstacles to doing business, and not only obstacles to innovation.

†† It is noted that the Department of Environmental Affairs had just revised the definition of waste through the National Environmental Management: Waste Amendment Act at the time of writing this paper.

waste activities. Or, it may be an encouraging move towards seeing waste as a secondary resource. The strong commitment by government to improve the management of waste, reflected through the implementation of legislation, has been shown to stimulate growth in the sector (i.e. growth in the number of enterprises) (DST, 2013). However, environmental legislation, in this case waste legislation, is a double-edged sword. While it has the potential to stimulate new sector development, growth and resultant innovation, if over-regulated it can hinder or slow this innovation. The trick for government is therefore to find a balance between encouraging and controlling.

Regarding infrastructure, as a constraint, the results show that the private sector has been more effective at introducing new technological innovations. The fact that infrastructure is a major constraint for municipalities but not for the private sector, highlights the importance of collaboration between the private and public sectors, and the need for private sector support to municipalities.

## **CONCLUSION**

Employing a minimum of 29,833 people and with a financial value US\$1.53 billion, or 0.51% of GDP, the formal South African waste sector is showing positive levels of innovation activity in moving waste up the hierarchy away from landfilling.

The positive response by the private waste sector to introduce new technological and non-technological innovations to the South African waste market (not only to their own organisation), suggests that they have an important role to play in transferring these innovations into the public sector. The private waste sector is therefore a potential partner to support the transfer of technological innovations from supplier (local and abroad) into municipalities. Mechanisms to further support partnerships between the public and private sectors must be explored (not only through the formal public-private partnership (PPP) route). Government must identify means of encouraging and supporting the introduction of technological innovation across the waste sector, so as to encourage a shift away from landfilling towards alternative waste management options. Mechanisms to address the relatively slow uptake of innovation by micro-, very small- and small- enterprises in the waste sector must also be explored.

It is hoped that this innovation activity in the waste sector will translate into alternative waste management practices on the ground, with increased tonnages of waste being diverted away from landfilling towards recycling and recovery. However, an assessment of the obstacles to waste innovation highlight that in particular, the economics and financing of waste, and waste legislation, may dampen the translation of innovation activity into actual technological and non-technological

innovations. Creating an enabling environment for waste innovation is therefore imperative to supporting the sectors move away from landfilling towards waste prevention, recycling and recovery.

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