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FEASIBILITY STUDY TO DETERMINE THE VIABILITY OF AN INTEGRATED APPLIANCE RECYCLING SYSTEM

FINAL REPORT

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EXECUTIVE SUMMARY

The Department of Energy (DoE), in association with the United Nations Development Programme (UNDP) are implementing the appliance energy efficiency Standards and Labelling (S&L) Project, which aims to reduce energy consumption and greenhouse gas (GHG) emissions by influencing consumers to purchase more energy efficient appliances. The need for a feasibility study to determine the viability of an integrated appliance recycling system (where proper handling and disposal of appliances can be enforced to ensure that appliances are dismantled in an environmentally responsible manner at the end of their useful life) in South Africa stems from the S&L Project as the S&L Project must be implemented in the context of environmentally sustainable principles. This feasibility study focussed on developing an integrated appliance recycling system for large household appliances (LHA) in Gauteng (as this province has the highest population density and was therefore assumed to contain the highest number of appliances) which can subsequently be rolled out to the other provinces.

A Section 28 notice was published by the then Minister of Environmental Affairs for the Electrical and Electronic Equipment Industry to submit Waste Management Plans for approval on 06 December 2017. This study thus ultimately also aimed to assist the LHA manufacturers and importers in developing a waste management plan.

LITERATURE REVIEW

The study commenced with a detailed literature review of international WEEE management, which found that that various WEEE management systems exist which place upstream or downstream fees or taxes on EEE equipment to ensure that costs for collecting, transporting and recycling appliances are covered. Following this a legal review of international and South African law pertaining to WEEE was conducted which found that there is an existing legal framework which, with additions of norms and standards and regulations, could provide a legal framework within which an appliance recycling system could function. Lastly an investigation into the Section 28 notice mentioned above was conducted.

Upon reviewing the IndWMP plans submitted to the Department of Environmental Affairs (DEA), the consultants were of the opinion that the plans have good aspects, but that neither can be regarded as implementable in their present form. Neither addresses the crucial question of how initial operation of the respective recycling schemes will be funded (i.e. during the period prior to funds flowing back to the PROs through national treasury and the DEA/Waste Bureau). In addition, the consultants feel that the plans are too broad in terms of the range of product categories that they cover. The characteristics of the various product categories, including both their physical composition, the channels through which they travel, the end-users and trade associations involved, etc., are so diverse that it is difficult to see how effective end-of-life treatment and/or disposal can be ensured by means of a single plan and PRO.

Subsequent to the literature review a status quo investigation was undertaken into the status of appliance recycling in South Africa. The main conclusions drawn from the investigation include the following:

- Appliances in South Africa remain in use for longer periods than in developed countries due to old appliances often being sold/donated to people in lower income groups. This results in energy-inefficient appliances remaining in operation for extended periods.
- Although it was confirmed that appliances reaching the end of their functional life are available for recycling, very few appliances were observed at recyclers claiming to do recycling of large appliances.
- No evidence could be found that appliances are currently pre-treated for the environmentally sound recovery, treatment or safe disposal of harmful gases or hazardous materials.
- The investigations confirmed that there will be enough feedstock for commissioning and operation of an appliance recycling facility/facilities in Gauteng but this will be subject to appliances being recovered before they are recycled/disposed of in a cheaper but unsafe, unhealthy or environmentally damaging manner.

PROPOSED APPLIANCE RECOVERY AND RECYCLING SYSTEM

The study proposed three models for an appliance recovery and recycling system, viz. Models A, B and C. The locations where pre-treatment and recycling of the appliances take place, according to type of appliance (non-cooling and cooling) in each of the models, is summarised in the table below.

Pre-treatment includes safe removal of refrigerant gases, lubricating oils, motors and capacitors, PUR foam and other insulation, PCBs and PWBs, accessible cables and wires, most plastic components and other loose items.

The steel carcasses that remain after the above-mentioned components have been removed will be sent to accredited SMDs for final processing. Other recyclable materials will be sent to dedicated processing facilities with non-hazardous and hazardous residues sent to specialised facilities for safe treatment and/or disposal.

Model	Type of appliance	Pre-treatment location	Recycling location
Model A Initial Phase	All appliances	Appliance collection / drop-off depots	Scrap Metal Dealers (SMDs)
Model A Future Phase	Non-cooling	Appliance collection / drop-off depots	SMDs
	Cooling	Mechanised Appliance Recycling Facility (MARF)	MARF
Model B Initial Phase	All appliances	Central manual appliance recycling facility	SMDs
Model B Future Phase	Non-cooling	Central manual appliance recycling facility	SMDs
	Cooling	Central manual appliance recycling facility	MARF
Model C	All appliances	SMDs	SMDs

FINANCIAL MODEL

A financial model was developed in order to quantify the financial implications of adopting Model A or Model B (Model C was discarded due to the fact that SMD's would be very difficult to regulate). It became clear from an early stage that, in addition to income derived from the sale of recyclables, the environmentally-sound recycling of appliances would require substantial additional operational funding by means of advance recycling fees (ARFs), to be paid by appliance manufacturers and importers on their current unit sales volumes. Determination of the level of ARFs necessary to sustain operation of the proposed recycling system, and the rate at which ARFs would need to rise over time to accommodate the increasing number of appliances entering the recycling system, therefore became a key objective in the modelling process.

The model confirmed that, due to the high appliance sales volumes and the income arising from the imposition of ARFs, incoming cash flows would be substantial. Accordingly, if depots are constructed on a phased basis, for e.g. only one or two per year during the early stages of implementation, the funds necessary for CAPEX can be generated internally, i.e. it should not be necessary to source outside funding by way of borrowings, grants, etc.

The financial model also showed that centralised pre-treatment (i.e. pre-treatment at a single location rather than a number of dispersed facilities) and/or the introduction of a MARF increase the overall costs of the system, and therefore the level of advance recycling fees necessary to sustain it. Note that a lower ARF implies a lower cost to appliance manufacturers and importers, and by extension to customers purchasing new appliances.

The initial phase of Model A (no MARF) offered the lowest overall ARF level (R0.67 per kilogram in year 1). The ARF would need to escalate at a rate of 10.1% per annum (i.e. 4.1% above nominal inflation of 6%) to ensure long-term sustainability of the proposed recycling system. From the financial model, it was thus concluded that the initial phase of Model A is the preferred option. It should, however, be noted that if it becomes possible to secure some or all of the funding required for the establishment of a MARF from donors, the level of advance recycling fee could become much lower.

CORPORATE AND COMMERCIAL ARRANGEMENTS

Financing of the appliance recycling system will be by means of advance recycling fees levied on the national sales of all appliances. Practically, this will necessitate the establishment of the PRO for the appliance industry and ARCO.

It will be necessary for the PRO to consult with industry participants and ARCO in order to develop and approve capital and operational budgets for the recycling operation. This in turn will facilitate the setting of advance recycling fee scales for each category of appliance, and (i) the amounts payable to consumers as trade-ins, and (ii) amounts payable to SMME collectors, per appliance.

Going forward, the PRO will need to collect the advance recycling fees from manufacturers or importers on a periodic (preferably monthly) basis, and remit funds to ARCO in accordance with the approved budget. Any surplus funds will be invested appropriately with a financial institution.

The PRO will also be responsible for promotion of used appliance recycling by means of appropriate marketing and communication activities.

As the commercial or operational entity, ARCO will perform crucial functions in the recycling operations including:

- the establishment, capacitation and ongoing management of the appliance collection / drop-off depots;
- the recruitment, training, management and remuneration of all personnel employed at the ARCO head office and at the depots;
- the procurement, maintenance and securing of all fixed and movable assets associated with the recycling operations;
- the sourcing, capacitation and payment of SMME collectors;
- the accreditation of SMDs and the conclusion of off-take agreements with accredited SMD;
- the reconciliation of all used appliance stock received, treated, dismantled and sold to third-parties (accredited SMDs, etc.) including the recovery of monies from such third-parties;
- arranging for the safe disposal of all hazardous substances recovered from appliances; and environmental and safety auditing of the depots and SMME collectors, and the compilation of all statutory returns.

LEGAL FRAMEWORK

In terms of the legal framework required for the implementation of an appliance recovery and recycling system, this study found that an improved enabling legal framework for the recycling and recovery of WEEE is required to provide the requisite standard of legal certainty under the rule of law by the Constitution.

Firstly, National Norms and Standards for the Collection, Storage, Treatment, Recycling, Recovery and Disposal of WEEE (Norms and Standards) must be made in terms of section 19(3)(a) of NEMWA for the design, construction, operation and decommissioning of WEEE facilities. These Norms and Standards will ensure the responsible collection, storage, treatment, recycling, recovery and re-use of WEEE, and reduce environmental pollution, degradation, and public health impacts.

Secondly, section 69(1) of NEMWA empowers the Minister to make regulations to ensure the lawful administration and effective management of WEEE recycling in South Africa. The regulations must address different aspects of the WEEE recycling process such as producer obligations (financial obligations, labelling and product-design requirements, life cycle assessments), institutional arrangements (establishment and powers of Producer Responsibility Organisation (PRO)), requirements for WEEE operations, financial arrangements, information reporting and disclosure, enforcement notices, entry and inspection as well as offences and penalties.

PILOT PROJECT

For an appliance recycling project to be initiated, it is recommended that the project be implemented on a pilot basis as a means of testing the technical feasibility and financial viability of the project. The pilot project would allow for testing the effectiveness with which:

1) Appliances can be collected from a range of sources in a cost-effective manner.
2) Appliances can be pre-treated for harmful gases and hazardous materials to be removed, treated and / or safely disposed of before the appliances are passed on to third parties for further processing and recycling.

WAY FORWARD

Once the pilot project has been implemented and found viable, it is suggested that the initial phase of Model A be implemented. In short, this will entail the following:

- Drop-off depots (storage facilities) will be developed across Gauteng (Tshwane, Johannesburg, East Rand, West Rand and Southern Gauteng). SMME collectors will transport appliances to depots. SMME collectors will be linked to used appliance consumers whom require appliances to be collected by means of a mobile application.
- SMME collectors (or consumers) delivering appliances to depots will be paid per appliance delivered, and payment may be based on the appliance type, capacity, mass and condition (non-functional or functional).
- Prices paid to consumers for non-functional appliances will be determined by using prices at cash-for-scrap buyback centres (CSCs) as a yardstick, and prices paid for functional appliances will be determined by using prices paid for appliances at pawnshops as a yardstick.

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GLOSSARY OF TERMS AND ABBREVIATIONS

ARF	Advance Recycling Fee
AD	Appliance Collection/Drop-off Depot
AIT	Appliance Industry Trust (proposed name only)
ARCO	Appliance Recycling Company (proposed name only)
CSC	Cash for Scrap Buyback Centre
CEO	Chief Executive Officer
CFC	Chlorofluorocarbon
CFO	Chief Financial Officer
CIP	Critical Infrastructure Programme
CT	Communications Technology
DEA	Department of Environmental Affairs
DoE	Department of Energy
DTI (dti)	Department of Trade and Industry
EA	Environmental Authorisation
EEE	Electrical and Electronic Equipment
EPR	Extended Producer Responsibility
ERA	E-Waste Recycling Authority
GHG	Greenhouse Gas
IDC	Industrial Development Corporation
IT	Information Technology
IndWMP	Industry Waste Management Plan
LHA	Large Household Appliance
PACSA	Packaging Council of South Africa
PRO	Producer Responsibility Organisation
MARF	Mechanised Appliance Recycling Facility
Minister	Minister of Environmental Affairs

NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NEMAQA	National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004)
NEMWA	National Environmental Management: Waste Act, 2008 (Act 59 of 2008)
NIPP	National Industrial Participation Programme
NWA	National Water Act, 1998 (Act 36 of 1998)
NPSWM	National Pricing Strategy for Waste Management (GG no. 40200, 11 August 2016)
NPC	Non-Profit Company
PCB	Printed Circuit Board
PUR	Polyurethane
PWB	Printed Wiring Board
RSA	Republic of South Africa
ROSE	Recycling Oil Saves the Environment (ROSE) Foundation
SADA	South African Domestic Appliance Association
SAASA	SA Airconditioning Suppliers Association
SAWEEDA	South African Waste Electrical and Electronic Enterprise Development Association
SEDA	Small Enterprise Development Agency
SMD	Scrap Metal Dealer
SMME	Small Medium and Micro Enterprise
WIS	Waste Information System
WEEE	Waste Electrical and Electronic Equipment
WML	Waste Management Licence

1 INTRODUCTION

1.1 BACKGROUND

Since 2008, South Africa suffered a rash of electricity blackouts with Eskom being subjected to significant constraints. As a direct consequence of this, various electricity tariff increases were required that have affected negatively on the South African economy.

A positive aspect that follows from the electricity supply problem lies in the fact that the associated increases in electricity tariffs also create awareness around the cost of electricity and the need for people to become more energy conscious. It seems that South Africans not only started checking electricity bills regularly but also learnt to understand that energy saving needs to become part of our daily lives.

Although energy-saving lighting and solar heating were some of the first aspects to be addressed, there are still vast opportunities for energy savings not yet recognised by most South Africans, i.e. the need for domestic appliances to be more energy efficient. A possible reason for existing appliances not being replaced due to energy efficiency considerations may be due to a lack of awareness regarding the potential savings that can be achieved through energy efficient appliances. Another reason may lie in the socio-economic situation in South Africa – with old appliances being passed on from people with higher income levels to those with lower income levels when replaced. The latter phenomenon has the unintended consequence that people in lower income groups incur higher electricity bills due to appliances being less energy efficient.

When appliances are due to be replaced, it is also important to recognise that appliances that use less water and power and have a higher energy efficiency rating are often, but not necessarily, more expensive. However, these appliances offer better value, earning back the investment over time with lower utility bills. Determining how much electricity appliances and home electronics use can assist the public in understanding how much money is spent on the use of such appliances.

Discarded appliances not appropriately recycled become part of the high volumes of electric and electronic waste entering the waste stream – potentially having a significant impact on the environment. The variety of materials contained (many potentially harmful to both humans and the environment) further focuses attention on how these appliances and devices are handled in terms of decommissioning and disposal. The incorrect handling and treatment of old electrical appliances has potential adverse health and environmental consequences. However, if correctly handled, electrical appliances and devices entering the waste stream can be considered a resource. These items are a source of valuable metals such as copper, aluminium and gold, and extraction of these metals from used appliances and devices mitigates environmental damage necessitated by mining, manufacturing, transport and energy use.

In South Africa, WEEE is the fastest growing waste stream[1]. In 2008, a reported 1 to 2 million tonnes of white goods (large electrical goods used domestically), consumer electronics and IT equipment existed in South African households, which was expected to reach the waste stream between 2013 and 2018[2].

Whilst industrial and large-scale consumer WEEE streams are handled formally by a handful of large and smaller recycling companies, household streams are mainly directed to landfills – often ending up in informal recycling processes. Without the required facilities accessible to informal reclaimers for environmentally sound recycling of WEEE, WEEE is often burnt as a means of recovering precious and semi-precious metals. This not only results in significant amounts of air pollution (including the release of dioxins and furans, often in proximity of residential areas), but also results in soil and water pollution. WEEE not recycled, is in turn disposed of on landfills where it takes up landfill airspace, with the additional risk of heavy metals being released into the environment. Although some systems are available for computers, no organised takeback systems exist for appliances[3].

The Department of Energy (DoE), in association with the United Nations Development Programme (UNDP) are implementing the appliance energy efficiency Standards and Labelling (S&L) Project, which aims to reduce energy consumption and greenhouse gas (GHG) emissions by influencing consumers to purchase more energy efficient appliances. The need for a feasibility study to determine the viability of an integrated appliance recycling system (where proper handling and disposal of appliances can be enforced to ensure that appliances are dismantled in an environmentally responsible manner at the end of their useful life) in South Africa stems from the S&L Project as the S&L Project must be implemented in the context of environmentally sustainable principles.

1.2 PURPOSE OF REPORT

This study was aimed at determining the feasibility of an integrated appliance recycling system in South Africa. The need for the study arose out of the need for the energy efficiency S&L Project to be implemented in the context of environmentally sustainable principles, as mentioned above, but also as a result of a Section 28 notice by then Minister of Environmental Affairs, Ms Edna Molewa, for the Electrical and Electronic Equipment Industry to submit Waste Management Plans for approval. The notice was issued under sections 28(1) and 28(5) of the National Environmental Management: Waste Act, 2008 (Act 59 of 2008), in Government Gazette no. 41303. The DoE and UNDP intended for this study to assist the WEEE Industry in developing a waste management plan.

[1] Dittke, S., Newson, G., Kane, C., Hieronymi, K., Schluep, M., 2008. A material recovery facility in Cape Town, South Africa, as a replicable concept for sustainable e-waste management and recycling in developing countries. In: Global Symposium on Recycling, Waste Treatment and Clean Technology, Cancun, Mexico, October 12–15.

[2] Finlay, A. & Liechti, D. (2008). e-Waste Assessment South Africa. e-Waste Association of South Africa (eWASA), November.

[3] Ongondo, F.O., Williams, I.D. and Cherrett, T.J. (2011) How Are WEEE Doing? A Global Review of the Management of Electrical and Electronic Wastes. Waste Management, 31, 714-730.

1.3 STRUCTURE OF REPORT

The report comprises the following sections:

- Section 2: Summary of literature review
- Section 3: Industry Waste Management Plans
- Section 4: Status Quo
- Section 5: Development of appliance recovery system
- Section 6: Proposed appliance recovery and recycling system
- Section 7: Financial model
- Section 8: Proposed legal framework for appliance recovery and recycling system
- Section 9: Pilot project
- Section 10: Feedback from industry workshop
- Section 11: Conclusion
- Section 12: Recommendations.

2 SUMMARY OF LITERATURE REVIEW

This section of the report summarises the literature review that was undertaken and reported on in the report titled *Findings from literature review* attached to this report as Appendix A.

This summary of the literature review will be discussed under the following headings:

- International practice review
- Legal review.

2.1 INTERNATIONAL PRACTICE REVIEW

As a point of departure, WEEE management practices and standards throughout the world were reviewed.

Existing WEEE management systems considered included examples from the USA, various EU countries, Japan, China, India and some African countries. From this review it was found that various WEEE management systems exist which place upstream or downstream fees or taxes on EEE equipment to ensure that costs for collecting, transporting and recycling appliances are covered (Refer to Section 3.2.1 of the report titled *Findings from literature review* attached to this report as Appendix A.).

2.2 LEGAL REVIEW

The legal review considered the international and South African legal context.

2.2.1 INTERNATIONAL LEGAL CONTEXT

A summarised version of the international legal review is presented below. For a more comprehensive discussion of different aspects of the international regulation of WEEE, refer to Appendix B.

2.2.1.1 International Law

The global regulation of WEEE recycling is fragmented over different national and international regulatory frameworks, each with their own terminology and legal provisions that create legal uncertainty. On a supra-national level, European Union (EU) Law is more developed than the various multi-lateral environmental agreements (MEA) and the binding and non-binding principles of international environmental law that address the recycling, recovery and disposal of end of life (EoL) Electrical and Electronic Equipment (EEE). Given the hazardous content of WEEE that may be moved over national borders for recycling or disposal purposes, the Basel Convention of 1989[4] is the most applicable MEA that has binding legal provisions to state parties such as South Africa for the international movement and trade in hazardous waste. Other MEAs that focus on specific hazardous chemicals that may be

[4] *Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposa*l, Basel, 22 March 1989 in force on 5 May 1992.

relevant to the use of EEE include the Montreal Protocol of 1987, the Kigali Amendment of 2016, the Stockholm Convention of 2001 and the Minamata Convention of 2013.

2.2.1.2 EU Law

The EU regulates WEEE and the hazardous substances involved therein through primarily the Waste Electrical and Electronic Equipment Recast Directive of 2012[5] (WEEE Recast Directive), which is supported by the Restriction on Hazardous Substances (RoHS) Directive and the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) Regulation and EU environmental policies. The WEEE Recast Directive provides detailed requirements for producers and distributors to carry the cost for the collection, treatment, recycling and recovery of WEEE. The EU's experience with the original WEEE Direction showed that *the financial viability of the WEEE recovery process is material for ensuring success.* It follows that the approved financing schemes must promote producer responsibility**.**

2.2.1.3 United Kingdom

The Waste Electrical and Electronic Equipment Regulations 2013 (WEEE Recast Regulations) transposed the main provisions of the EU Recast WEEE Directive into the United Kingdom (UK) and resulted in changes to UK domestic law. All WEEE that originates in the UK must be collected at designated collection facilities and is then transported to Approved Authorised Treatment Facilities (AATFs) or Approved Exporters for treatment, recovery, recycling or re-use. All producers who place EEE onto the UK market must register with designated British authorities and must belong to a Producer Compliance Scheme (PCS).

Producers have to provide prescribed information to the operators of a PCS to which they belong to enable the operators to comply with registration, notification and reporting requirements to the authorities. Although small producers that place less than 5 tonnes EEE onto the UK market must also register with the appropriate authority, they are exempted from the strict requirements of producer responsibility and from belonging to a PCS. Producers are responsible for financing the costs of the collection, treatment, recovery and environmentally sound disposal of WEEE from private households as well as from non-private households according to a prescribed formula. The WEEE Recast Regulations also make provision for take-back obligations and WEEE design, marking, information disclosure and record keeping by producers and distributors as well as for government's policing powers.

2.2.2 SOUTH AFRICAN LEGISLATIVE CONTEXT

2.2.2.1 Environmental law

The National Environmental Management: Waste Act (Act 59 of 2008) (NEMWA) primarily regulates the treatment, recycling, recovery and re-use of WEEE in South Africa. The atmospheric impact of hazardous emissions from WEEE recovery, such as greenhouse gases (GHG) that contributes to climate change, is regulated by the National Environmental Management: Air Quality Act (No. 39 of 2004) (NEMAQA) and the effect of WEEE pollution on water sources by the National Water Act, 1998 (Act 36 of 1998) (NWA). In addition to these

[5] Directive 2012/19/EU (Recast) of 4 July 2012 which replaced Directive 2002/96/EC.

specific environmental management Acts (SEMAs), the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) provides the general legal framework for the management of the environment for WEEE in South Africa. These laws realise the right in section 24 of the Bill of Rights to an environment that is not harmful to the health or wellbeing of people and the obligation to have the environment protected for future generations. On its part, the Constitution is the highest law in South Africa that must be adhered followed.[6] South African environmental law is thus a progressive rights-based system that applies, in addition to common law legal liability to the environmental impacts from WEEE activities.

NEMA requires integrated environmental management and addresses general environmental impacts, pollution and degradation based on fundamental international environmental principles such as ecologically sustainable development, the preventative principle, the polluter pays principle, a cautionary approach, environmental impact assessment, and environmental equality.[7] The duty of environmental care in section 28(1) of NEMA gives effect to the polluter pays and other principles and it requires WEEE operators to take specific measures to prevent and address environmental pollution and degradation.

2.2.2.2 Waste law

2.2.2.2.1 General duty of waste management

Since WEEE falls within the scope of the legal definition of waste,[8] WEEE activities must be managed in accordance with the provisions of NEMWA and the regulations, norms, standards and policies made thereunder such as the National Waste Management Strategy (NWMS)[9]. WEEE that is generated by the holders of EEE must be managed and disposed of in accordance with the general duty in respect of waste management and the waste hierarchy.[10] This means that holders must avoid the generation of WEEE. Where it is not possible, they must minimise the toxicity and amounts of WEEE generated. Thereafter, holders must reduce, re-use[11], recycle[12] and recover[13] WEEE. Holders must prioritise the treatment of WEEE above disposal[14] thereof, and only do so in an environmentally sound manner. WEEE activities may not endanger human health or the environment or cause a nuisance through noise, odour or visual impact. Holders must also prevent the unlawful use of WEEE. In addition to the general

6 Section 1 of the Constitution. *Certification of the Constitution of Republic of South Africa* [1996] ZACC 26; 1996 (4) SA 744 (CC).

7 Section 2 of NEMA.

8 Section 1 of NEMWA.

9 GN 344 of 4 May 2012 published in GG No. 35306.

10 Section 16 of NEMWA.

11 Section 1 of NEMWA states that "**re-use**" means to "*utilise the whole, a portion of or a specific part of any substance, material or object from the waste stream for a similar or different purpose without changing the form or properties of such substance, material or object*".

12 Section 1 of NEMWA stipulates that "**recycling**" means "*a process where waste is reclaimed for further use, which process involves the separation of waste from a waste stream for further use and the processing of that separated material as a product or raw material"; dumping, placing or release of any waste into, or onto, any land*".

13 Section1 of NEMWA defines "**recovery**" as meaning the "*controlled extraction or retrieval of any substance, material or object from waste.*"

14 according to Section 1 of NEMWA waste "**disposal"** means the "*burial, deposit, discharge, abandoning, dumping, placing or release of any waste into, or onto, any land*".

duty, any person undertaking the reduction, re-use, recycling or recovery of WEEE must use fewer natural resources and be less harmful to the environment than disposal.[15]

2.2.2.2.2 Licensing of WEEE

The treatment, recycling or recovery of general and hazardous WEEE may qualify under certain circumstances as a listed waste management activity[16] that requires a waste management licence (WML) in terms of section 20 of NEMWA as well as environmental authorisation (EA) in terms of section 24F of NEMA based on an environmental impact assessment of such WEEE activities.

2.2.2.2.3 Alternative regulation of WEEE

The Minister for the environment (Minister) may declare WEEE in terms of section 14(1) of NEMWA as a priority waste and provides for specific management measures to improve the reduction, re-use, recycling, and recovery or to reduce the health or environmental impact of WEEE. Alternatively, section 17(2) of NEMWA empowers the Minster after public consultation to require certain parties to reduce, re-use, recycle and recover WEEE.[17]

The Minister is also competent to delicence the treatment, recycling, or recovery of certain volumes of WEEE, subject to compliance with specified requirements or standards.[18] A consultative process must be followed prior to the Minister's gazetting of the delisting.[19] The Minister can publish national norms and standards to provide technical uniformity and legal certainty for the design, construction, operation and decommissioning of WEEE facilities to enable responsible collection, storage, treatment, recycling, recovery and re-use of WEEE to limit and control environmental pollution and degradation caused by such processes.[20]

2.2.2.2.4 Extended Producer Responsibility

The core legal norm for the successful recycling process of WEEE is the principle of extended producer responsibility (EPR), which has been applied internationally in foreign waste law to WEEE management systems. Section 18(1) of NEMWA provides for EPR by allowing the Minister to take "*measures that extend a person's financial or physical responsibility for a product to the post-consumer stage of the product".*[21] The EPR program covers extensive information such as its scope, financial, institutional and administrative arrangements, percentage of EEE to be recovered, EEE labelling requirements, life cycle assessment of EEE

15 Section 17(1) of NEMWA.

16 Section 19(1) and (3)(a) of NEMWA as per GN R921 of 29 November 2013.

17 Section 17(1) of NEMWA.

18 Section 19(2)(b) and (3)(a) of NEMWA. Section 19(5) empowers a MEC, with the Minister's concurrence, to publish a similar notice for a specific province. An example is the delicencing of waste emanating from the scrapping or recovery of motor vehicles at specified facilities. See Item 4, Category C to Schedule 1 of GNR 921 of 29 November 201, as amended. See Item 4, Category C to Schedule 1 of GNR 921 of 29 November 201, as amended.

19 Section 19(10) of NEMWA.

20 Section 19(2)(b) and (3)(a) of NEMWA. See the Standards for Scrapping or Recovery of Motor Vehicles, GN 925 of 29 November 2013 for an example of national standards that were published to control the scrapping or recovery of old motor vehicles and vehicle parts through approved processes and facilities. Specific vehicle parts were identified that have special (separate) legal requirements e.g. tyres prescribed by the Tyre Regulations, 2009.

21 Section 1 of NEMWA.

by producers, and technical requirements to producers for the design, composition, manufacturing and packaging of WEEE.[22]

2.2.2.2.5 Waste Pricing

The National Pricing Strategy for Waste Management (NPSWM)[23] was formulated in terms of section 13A of NEMWA and it provides for the determination of waste management charges and collection of such charges through the national fiscal system. The aim of the NPSWM is to fund the re-use, recycling or recovery of waste as well the implementation of industry waste management plans for those activities that generate specific waste streams. The NPSWM contains the basis and guiding methodologies for determining different price strategies and different rates for WEEE management.[24] The detailed waste management charges, specific collection procedures and allocation to the Waste Bureau will be further determined by Treasury through a money bill.[25]

Although WEEE pricing will be further discussed elsewhere, it is important to note at the outset that one of the key findings of the international literature study confirmed that the choice of methodology for the funding mechanism of the WEEE recovery process is pivotal for its success. This aspect was an important shortcoming of the European Union (EU) WEEE Directive of 2002 to which the Recast Directive of 2012 stated: "*financing schemes have to contribute to high collection rates, as well as to the implementation of the principle of producer responsibility.*"[26]

2.2.2.2.6 Industry Waste Management Plans

The Minister has in terms of Sections 28(1) and (4) of NEMWA called upon the EEE industry to submit industry waste management plans (IndWMP) to demonstrate how they will ensure the environmentally sound management of WEEE. This is discussed further in Section 3 below.

2.2.2.2.7 Waste Management Bureau

The Waste Management Bureau (Waste Bureau) in the DEA will be involved with various aspects of the WEEE project, as it is responsible for the developing and monitoring of industry waste management plans, best practices and norms and standards for waste minimisation, re-use, recycling and recovery as well as for the disbursement of incentives and funds derived from waste charges in sections 13B and 13C of NEMWA.[27]

2.2.2.3 Other law

In addition to the above legislation, various other South African laws may regulate different aspects of the WEEE recovery process. The Second-Hand Goods Act, 2009 (Act 6 of 2009) (SGA) may apply to parties that refurbish EEE and recycle WEEE by registering as dealers in second-hand goods and forming a dealers' association which have restrictive implications for the WEEE sector. Holders that treat WEEE must ensure that their operations do not fall within

22 Section 18(2) of NEMWA.
23 GN 904 of 11 August 2016.
24 Section 13A(2)-(4) of NEMWA.
25 Section 13B of NEMWA.
26 Item 22 of Directive 2012/19/EU of 4 July 2012 (Recast Directive) which replaced Directive 2002/96/EC.
27 Section 34E(1) of NEMWA.

the scope of the Precious Metal Act, 2005 (Act 37 of 2005) for example by smelting gold or platinum group (PGM) metals, which requires a refining licence. The export from South Africa of treated, recycled or recovered WEEE is regulated by both the International Trade Administration Act, 2003 (Act 71 of 2003) (ITAA) that requires a permit from the International Trade Administration Commission (ITAC) and by the NEMWA waste export regulations that requires the DEA's consent for the export of certain wastes.[28] Finally, section 59(1) of the Consumer Protection Act, 2008 (Act 68 of 2008) (CPA) requires suppliers (producers, importers, distributors and retailers) to receive without charge from consumers any goods and their components, remnants, containers or packaging, which national legislation prohibits their disposal or deposit into the common waste collection system. Section 59(2) of the CPA further allows consumers to dispose or deposit the above-mentioned goods or articles at a collection facility provided for by a regulation or an IndWMP.

[28] GN R22 of 21 January 2019.

3 INDUSTRY WASTE MANAGEMENT PLANS

This section of the report details the call for industry waste management plans (IndWMPs) from the DEA under the following headings:

- Department of Environmental Affairs (DEA) calls for industry waste management plans
- Financial provisions in the National Pricing Strategy for Waste Management (NPSWM)
- Existing proposed IndWMPs.

3.1 DEPARTMENT OF ENVIRONMENTAL AFFAIRS CALL FOR INDUSTRY WASTE MANAGEMENT PLANS

A Section 28 notice by then Minister of Environmental Affairs, Ms Edna Molewa, for the Electrical and Electronic Equipment Industry to submit Industry Waste Management Plans (IndWMPs) for approval was issued in Government Gazette (GG) no. 41303 on 06 December 2017. The notice was issued under sections 28(1) and 28(5) of the National Environmental Management: Waste Act, 2008 (Act 59 of 2008).

Once approved, producers of Electrical and Electronic Equipment would be required to register (voluntarily) with at least one industry waste management plan approved by the Minister within one month of approval of an IndWMP or as soon as the producer comes into existence after the approval of an IndWMP.

The IndWMPs submitted to DEA had to provide information about the following aspects:[29]

- the amount of WEEE that is generated;
- measures to prevent pollution or ecological degradation;
- targets for WEEE minimisation (reduction, re-use, recycling and recovery);
- measures to minimise the WEEE generation and disposal;
- management measures for WEEE, phasing out the use of specified substances;
- reduction of WEEE through changing packaging;
- product design or production processes;
- informing the public about the environmental impact of electrical appliances;
- financial contribution to support consumer-based WEEE reduction programmes; and
- implementation period of the IndWMP, monitoring methods and reporting of the IndWMP and other necessary matters.

Refer to GG no. 41303 attached to this report as Appendix C.

[29] Sections 28(4) and 30(2) of NEMWA.

3.2 FINANCIAL PROVISIONS IN THE NATIONAL PRICING STRATEGY FOR WASTE MANAGEMENT

GG no. 41303 stated that all IndWMPs should 'be aligned to the National Pricing Strategy for Waste Management (Extended Producer Responsibility; government managed model) as published under Government Notice 904 of 11 August 2016)'.

The NPSWM states that:

'…it is the DEA's intention to implement…EPR schemes in South Africa' (s. 5.3). The concept of EPR is summarised in section 3.2.1 below.

Refer to section 3.3.2 of the report titled *Findings from literature review* attached to this report as Appendix A for further detail regarding the NPSWM.

3.2.1 EXTENDED PRODUCER RESPONSIBILITY

Following the legal principle of EPR in section 18 of NEMWA, the responsibility for end-of-life treatment and safe disposal of products is placed on the manufacturer, producer and/or importer of such products.

In South Africa, EPR schemes have been stipulated within the National Pricing Strategy for Waste Management (NPSWM) in accordance with the provisions of NEMWA.

For a detailed explanation of EPR, refer to section 3.3 of the report titled *Findings from literature review* attached to this report as Appendix A.

3.2.2 INDUSTRY MANAGED VERSUS GOVERNMENT MANAGEMENT EXTENDED PRODUCER RESPONSIBILITY SCHEMES

The NPSWM specifies that:

'Existing voluntary initiatives that are effecting EPR schemes will continue to follow the Industry Managed Model as depicted in Figure 3-1 below. The Government managed Model will be followed for all plans that the Minister or MEC calls for in terms of section 28 of the NEMWA'.

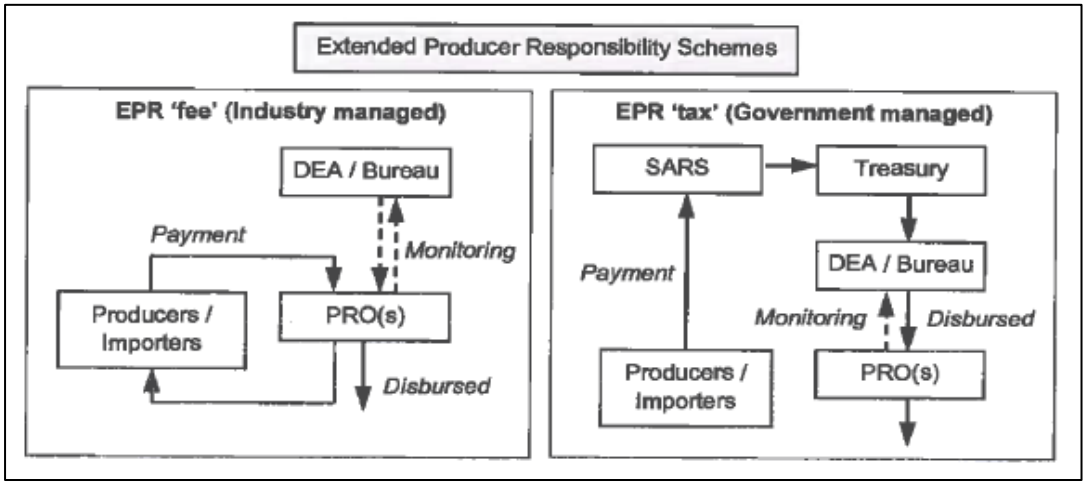
The essential differences between the government managed and industry-managed models can be summarised as follows:

- Setting of EPR fees/taxes: In the industry-managed model, EPR fees are set by a producer responsibility organisation (PRO) representing the manufacturers, producers or importers; in the government-managed model, EPR taxes (or product taxes) are set by means of a 'money bill', i.e. Act of Parliament, based on input from the DEA.
- Collection of EPR fees/taxes: In the industry-managed model, EPR fees are collected by the PRO representing the manufacturers, producers or importers; in the government-managed model, EPR taxes (or product taxes) are collected by SARS.

- Disbursement of EPR fees/taxes: In the industry-managed model, EPR fees are disbursed by the PRO for purposes of recycling, safe treatment and/or disposal of used products; in the government-managed model, EPR taxes are disbursed by National Treasury to the DEA or Waste bureau. Only a (unspecified) portion of the funds will be allocated to actual recycling/safe treatment and/or disposal of products.

Figure 3-1 below illustrates the differences between the two models.

Figure 3-1: Approach to the collection and disbursement of EPR charges (NPSWM fig. 5)



3.3 EXISTING PROPOSED INDUSTRY WASTE MANAGEMENT PLANS

Following the notice for IndWMPs to be submitted to the Department of Environmental Affairs (DEA), the following organisations (only those of which the consultants are aware) submitted plans:

- E-Waste Recycling Authority (ERA);
- South African Waste Electrical and Electronic Enterprise Development Association (SAWEEDA).

3.3.1 E-WASTE RECYCLING AUTHORITY (ERA)

The ERA plan sets out the following objectives:

- The establishment and implementation of a national unified E-WASTE management system.
- The establishment of a national E-WASTE management authority to implement the E-WASTE IndWMP.
- The definition of all key stakeholders, the roles that they are expected to play, as well as the registration and accreditation of all stakeholders who wish to participate in the E-WASTE management system.
- The setting of targets for E-WASTE collection, recycling, processing and disposal.
- The structure for setting of a waste management charge, which is initially to be levied equally on all imported and locally manufactured EEE placed on the South Africa market, whether new or second-hand. This levy is based on a standard rate per kilogram of EEE.

- The establishment of programmes and activities aimed at addressing the challenges and opportunities presented by E-WASTE and ensuring the equitable and sustainable application of resources accruing from the E-WASTE management levy to support these programmes and activities.
- The development of a Local Enterprise Development strategy.

The plan proposes that the ERA acts as the PRO for the electrical and electronics industry. The plan covers a broad range (10 categories) of e-waste, one of which is large household appliances. There is no differentiation based on market value or toxicity. Proposed pricing of levies is based on mass per category.

The plan sets out four tiers of accredited WEEE recyclers; the tiers are based on annual processing capacity, and attendant compliance requirements (institutional, technical, environmental and reporting) are set out for each tier. Accreditation would be undertaken by the ERA.

A first year (assumed) budget of R542 million is set out, of which only 26% is allocated directly to recycling subsidies, with the remainder allocated to enterprise development, education and awareness, research and development and administration. A subsidy of R3.50 per kilogram is proposed for all tiers of the recycling system; additional amounts of R6.00 and R30.00 per kilogram are proposed for CRT and problematic/high hazardous e-waste, respectively.

The per-kilogram rate at which the EPR levy (tax) will be set has not been specified; however, it is stated in the plan that 'the ERA assumes that the budget presented for the implementation of the IndWMP will be fully covered by the DEA/Waste Bureau, and that the e-waste levy (tax) will be aimed at specifically raising this budget. This assumption is vital to the successful implementation of the plan.'

It should be noted that, although the ERA plan was prepared in accordance with the government-managed model mandated by the s. 28 notice calling for IndWMPs from the electrical and electronics industry, the plan cited 'a strong preference from industry to manage the plan', and devoted an appendix to setting out 'potential challenges and concerns' regarding the government-managed model mandated by the DEA.

3.3.2 SOUTH AFRICAN WASTE ELECTRICAL AND ELECTRONIC ENTERPRISE DEVELOPMENT ASSOCIATION (SAWEEEDA)

The SAWEEEDA plan sets out the following primary objectives:

- To support Government's existing environmental policy, legislation and international instruments that South Africa is party to in respect of the management of e-waste (e.g. the Basel Convention)
- To create a vibrant, effective, efficient and broad-based economic model to facilitate sustainable development in pursuance of a developmental state and rapid economic transformation

- To ensure a cost-effective model, utilising public-private partnerships to promote job creation and skills development (high and low end) in order to be globally competitive in the e-Waste Industry.

The plan envisages the creation of approximately 6 200 jobs over the period 2019–2023. The estimated first-year cost is R850 million, of which R300 million is for setting-up costs.

The plan envisages the establishment of a producer registry that will be responsible for the registration of all producers (and importers, etc.) of electrical and electronic equipment, and for the collection of EPR fees on behalf of SARS. This producer registry would be an independent company, separate from the PRO.

Significant consideration is given to institutional arrangements and governance in the plan, in respect of the PRO itself (SAWEEDA), the SAWEEEDA foundation, the Producer Registry, etc. As with the ERA plan above, four tiers of recyclers are proposed – all recyclers would be required to obtain SAWEEDA accreditation in order to participate in the plan.

Different from the ERA plan, the SAWEEDA plan sets out a contribution of R3.50 per kilogram of produced or imported electronic and electrical equipment. It is not clear how this figure was arrived at, or what portion of the amount collected would flow back to SAWEEEDA through the DEA/Waste Bureau.

3.3.3 CONSULTANTS' OPINION OF THE ERA AND SAWEEDA PLANS

While each of the above plans has good aspects, the consultants feel that neither can be regarded as implementable in their present form. Neither addresses the crucial question of how initial operation of the respective recycling schemes will be funded (i.e. during the period prior to funds flowing back to the PROs through national treasury and the DEA/Waste Bureau).

In addition, our view is that the plans are too broad in terms of the range of product categories that they cover (although this was essentially 'forced' on the electrical and electronic industry by the s. 28 notice). The characteristics of the various product categories, including both their physical composition, the channels through which they travel, the end-users and trade associations involved, etc., are so diverse that it is difficult to see how effective end-of-life treatment and/or disposal can be ensured by means of a single plan and PRO.

3.3.4 STATUS OF PROCESS

Currently the plans submitted to the DEA are under review. There has been no indication as to when a final decision will be made.

4 STATUS QUO

This section of the report details the status quo investigation undertaken into the status of appliance recycling in South Africa. This is discussed under the following headings:

- Summary of consultation process
- Appliance recycling and disposal in Gauteng
- Findings.

4.1 SUMMARY OF CONSULTATION PROCESS

As part of the project, the consulting team undertook a rigorous stakeholder and public consultation process. During this process, the following parties were consulted:

- Institutional
    - Department of Energy (DoE)
    - Department of Environmental Affairs (DEA)
    - Department of Trade and Industry (dti)
- Producer/Product Responsibility Organisations (PROs) that submitted Industry Waste Management Plans
    - E-waste Recycling Authority (ERA)
    - South African Waste Electrical and Electronic Enterprise Development Association (SAWEEDA)
    - Packaging Council of South Africa (PACSA)
- Existing Industry PROs
    - The Glass Recycling Company
    - Recycling Oil Saves the Environment (ROSE) Foundation
- Waste industry
    - Recyclers – DESCO, Remade Recycling, Enviroclaim, Computer Scrap Recycling
    - Scrap Metal Dealers
- Other industries
    - Smelters - SCAW Metals
    - Refineries –Rand Refinery
    - Refrigerant Gas industry – A-Gas
- Appliance industry
    - South African Domestic Appliance Association (SADA)
    - Manufacturers/importers – LG, MS Airconditioning

- Possible funders
    - Industrial Development Corporation (IDC)
    - Department of Trade and Industry (DTI)
- Recycling plant manufacturers
    - Akura

Consultations took place in various formats, including face-to-face meetings, Skype meetings and plant visits. Notes were taken at each consultation meeting. These notes are attached to this report as Appendix D.

4.2 APPLIANCE RECYCLING AND DISPOSAL IN GAUTENG

Pertinent information collected during the consultation process is summarised below under the following headings:

- WEEE sources
- WEEE recycling in Gauteng
- WEEE recycling at smelters and refineries in Gauteng
- Preliminary consultation with large household appliance manufacturers
- Consultations with existing Producer Responsibility Organisations (PROs)
- Consultations with potential funders
- Setting of Standards
- Quantitative study of large household appliances in South Africa
- Conclusion

4.2.1 WEEE SOURCES

During the consultation process, the following primary sources of large household appliances were identified:

- Consumers
- Cash-for-scrap dealers (non-functional appliances)
- Pawnshops (functional appliances)
- Repair shops (functional and non-functional appliances)
- Manufacturers (rejects/take backs within the guarantee period – safe destruction to remove from market)
- Importers (some take back within the guarantee period)

4.2.2 WEEE RECYCLING IN GAUTENG

During consultation with, and site visits to the premises of WEEE recyclers, the consultants found that although WEEE recyclers accept appliances, they do not receive many appliances for recycling. WEEE recyclers have various methods of sourcing appliances for collection from consumers, ranging from public drop-off facilities to allowing the public to make bookings for collection via telephone and websites. The appliances made available by consumers are either

donated to the WEEE recyclers, or the WEEE recyclers remunerate the owners – mostly on a Rand per kilogram basis.

Appliances secured from the sources mentioned in section 4.2.1 above are either sold as-is for use as spare parts; for repairs and reselling by appliance repair shops; or dismantled with (i) metal parts sent to scrap metal dealers (SMD), (ii) plastic sent to plastic processers and (iii) the remaining 5–10% being disposed to landfill. The consultants did not find any evidence that appliances are pre-treated to remove refrigerants (such as CFC-12, HCFC-22, HFC-410A, HFC-32 present in all cooling appliances) and foam blowing agents (CFC-11, HCFC-141b, only present in fridges) or hazardous materials (lubricating oils and polyurethane (PUR) foam) before being sent to SMDs.

WEEE recyclers manually strip appliances and send the stripped carcasses to SMDs. Several parties interviewed claimed that the majority of fridges or freezers that reached them no longer contained any refrigerants. It is uncertain how this is verified without any pre-treatment of appliances being undertaken, and it is therefore assumed that the harmful gases mentioned above are simply released into the atmosphere during dismantling.

Cooling appliances are reportedly sent to SMDs with the insulation, which contains hazardous particles and gases, intact. The consultants were not able to engage with SMDs directly, despite various attempts made to consult with the SMD industry and could therefore not verify the process followed in terms of safe handling of harmful gases and hazardous components in SMD operations.

From consultation, the consultants identified two mechanised metal shredders in South Africa, of which one is owned by Universal Recycling Company and the other by SCAW Metals.

In summary, the conclusion was finally drawn that large numbers of intact and semi-stripped appliances may be delivered to scrap metal dealers, where they are completely stripped and bulked before the metal is transported to furnaces, and recyclable plastics sold to plastic recyclers. No evidence could be found that appliances are currently pre-treated for the environmentally sound recovery, treatment or safe disposal of harmful gases or hazardous materials.

4.2.3 WEEE RECYCLING AT SMELTERS AND REFINERIES IN GAUTENG

Smelters receive ferrous metals in a baled or shredded form (primarily for increased payloads) from, amongst others, SMDs. The consultants met with representative of SCAW Metals Group (SMG). SMG accepts loads in 8 tonne or larger trucks. They also have a SMD division to which smaller loads can be delivered. Currently, no pre-treatment of appliances is done by SMG before the appliances are shredded. Once the metal carcasses from appliances have been shredded, the different ferrous and non-ferrous metals are separated by means of electro-magnets and eddy currents.

Ferrous metals are sent to the furnaces, and non-ferrous metals are sold to third parties. The remainder of the materials are disposed to landfill but the company is investigating the option of using plastics as a fuel source in cement kilns. This option is unlikely to be attractive for the near future as the demand for cement is low due to South Africa's poor economy and the resulting state of the construction industry. In addition to the limited demand, several 'green

energy' projects commissioned (or due to be commissioned) are generating Refuse Derived Fuels (RDF), resulting in an increased supply, while offtake remains limited. Related to this, representatives from the smelter pointed out that appliance designs have over the years changed in the sense that less steel is being used – with steel components in more recent designs being replaced with plastic ones.

The smelter has a capacity of 200 tonnes per hour and is currently only processing 800 tonnes per day – confirming availability of excess smelter capacity in Gauteng. SMG would be interested in receiving and processing metal carcasses recovered from the proposed appliance-recycling project.

4.2.4 PRELIMINARY CONSULTATION WITH LARGE HOUSEHOLD APPLIANCE MANUFACTURERS

The consultants engaged with the following large household appliance manufacturers regarding IndWMPs:

- LG
- DEFY (not available for direct consultation)
- MS Airconditioning.

4.2.4.1 LG

From consultation with LG Electronics (LG), it was surmised that, with LG not being members of SADA, they were not aware of legislation relating to the need for submission of IndWMPs. However, LG did confirm their willingness to participate in such recycling initiatives, if EPR funding is 'not just another form of taxation' but that the funds will be used for its intended purpose – i.e. to promote and facilitate environmentally sound appliance recycling in South Africa.

LG also expressed the need for the playing field to be levelled, i.e. that all appliance manufacturers/importers be treated evenly.

As one of the largest appliance manufacturers/importers in the country, LG is committed to participate in an appliance-recycling programme in South Africa and offered to put awareness material and place call centre contact-details for accredited collectors of unwanted appliances on their brochures and in their marketing materials.

4.2.4.2 DEFY

During consultation with the ERA representative related to the call for IndWMPs, it was mentioned that DEFY had approached ERA regarding a 'differential rate for white goods' and that DEFY had also reportedly stated that 'they reserved the right to undertake their own appliance recycling' (see Appendix D), in which case it is assumed that they do not see themselves as being subjected to an advance recycling fee.

Note that because the viability of recycling depends on economies of scale and availability of the required feedstock, it is important that all parties involved in the recycling of WEEE (and in this instance large household appliances) pool resources for the process to be cost effective and sustainable.

4.2.4.3 MS Airconditioning

In as far the possible introduction of ERP levies are concerned, MS Airconditioning suggested that the levies be differentiated by category, for example in terms of kW rating rather than mass (for split-unit air conditioners). Lighter plastics used in lower quality products will result in such appliance manufacturers/importers having an unfair advantage over those with more durable appliance designs if levies are based on appliance mass.

Note that similar considerations apply to other types of appliance. For example, in the case of fridges, the argument can be made that EPR fees should be based on the cubic capacity of the fridge, rather than mass. Ultimately, the setting of ERP fees will probably have to be on product-type-by-product-type basis, with the actual basis being agreed between the manufacturers and/or importers concerned.

4.2.5 CONSULTATIONS WITH EXISTING PRODUCER RESPONSIBILITY ORGANISATIONS (PROS)

Consultations were held with two existing PROs, viz. The Glass Recycling Company (TGRC) and the Recycling Oil Saves the Environment Foundation (ROSE).

ROSE was established by the petroleum industry in 1994; TGRC was established in 2006 by the two local manufacturers of glass packaging and major brand-owners, viz. users of glass packaging (incl. SA Breweries, Heineken, Tiger Foods, etc.)

Common features of these two PROs include:

- Both are voluntary organisations (per the NPSWM definition) and pre-date the NPSWM policy
- Both have full buy-in from their respective industries
- Neither plays any direct role in their respective recovery or recycling value-chain
- Their mandates are specific with respect to the types of product they recover for recycling (i.e. only specified types of glass or oil are collected for recycling)
- In both cases, there is an established demand for all recovered / recycled material
- Both make use of SMME collectors, and assist with capacitation and in certain cases partial funding of these collectors
- Both undertake marketing and advocacy of recovery/recycling in their respective industries
- The board of each PRO consists of non-executive directors representing industry participants; the only executive director is the CEO
- Both are registered as non-profit companies (NPCs)
- Excluding collectors, staff numbers are low: between 4 and 12.

As regards the collection of recycling levies:

One PRO (The Glass Recycling Company) has engaged independent auditors to determine the advance recycling levies payable by the various parties. This ensures that the PRO is not party to sensitive competitive information in respect of the manufacturers.

In the other case, producers self-declare their quantities to the PRO.

In both cases, certain imported products (for example foods and cosmetics imported in glass jars/bottles, and specialist lubricating oils) are undeclared (for levy purposes); SARS (customs and & excise) is of some assistance in this regard but fortunately quantities are not material.

The existing PROs which function well without government input set a precedent for industry managed WEEE recycling plans.

4.2.6 CONSULTATION WITH POTENTIAL FUNDERS

Consultations were held with two potential funders of appliance recycling activities, viz. the IDC (Industrial Development Corporation of South Africa) and the DTI (Department of Trade and Industry, Government of South Africa).

Findings are summarised below.

4.2.6.1 IDC

The IDC cannot invest in a non-profit company (NPC), i.e. only for-profit companies can be funded.

The most important factor that the IDC takes into account when assessing applications for funding is 'revenue risk', i.e. how secure is the funding in terms of quantum and variability (for this and other reasons, the IDC would be in favour of an industry-managed funding model, per the NPSWM policy).

In order to mitigate revenue risk, the IDC would like to see full control over physical (i.e. used appliances + any recycled material recovered) and money-flows throughout the (Large Household Appliance) LHA recycling chain.

The entity funded by the IDC could be either the Mechanised Appliance Recycling Facility (MARF), and/or the proposed appliance collection or drop-off depots.

The IDC expressed the view that LHA manufacturers and importers 'should invest in the MARF'; amongst other considerations, this is likely to ensure that there is 'full buy-in to the recycling system by these parties.'

IDC funding can be either short or long-term; interest rates are based on perceived risk, and would be referenced to the SA prime rate, i.e. percentage points above or below prime.

4.2.6.2 DTI

DTI (or related) funding could potentially be available for various components of the LHA recycling model, as follows:

- SMME collectors: Funding could be sourced from the DTI itself, or from the Small Enterprise Development Agency (SEDA)
- Appliance collection or drop-off depots: Funding could be via the National Industrial Participation Programme (NIPP; projects of between R3 million and R10 million). This funding is secured through 'obligors', viz. multinational companies enjoying or seeking participation in the SA market.

- The MARF: Funding could be via the Critical Infrastructure Programme (CIP). The definition of critical infrastructure could potentially be revised or expanded in future to include waste, under headings such as resource recovery and the circular economy[30]. Up to R50 million per funding application would be available.

4.2.7 SETTING OF STANDARDS

The consultants have not come across any form of formal appliance recycling in SA and this finding was supported by the representative of the ERA. The representative believes that this may be due to the absence of relevant Norms and Standards for safe and environmentally sound treatment and disposal of large household appliances.

Although the requirements for environmentally sound management of appliances may be captured in various other sets of environmental legislation, *there are no official norms and standards for environmentally sound management, recycling and disposal of large household appliances.* There is thus nothing forcing parties recycling appliances to meet set environmental standards. Furthermore, the cheapest (not environmentally sound) way of recycling appliances may remain the preferred option until such time that all participants of the appliance recycling industry are required to operate differently.

After detailed investigations undertaken in Gauteng, it was concluded that there are currently no systems for environmentally sound pre-treatment of large household appliances before any form of recycling is undertaken.

4.2.8 QUANTITATIVE STUDY OF LARGE HOUSEHOLD APPLIANCES IN SOUTH AFRICA

A quantitative study to determine realistic numbers of various types of appliances discarded annually was undertaken. Refer to section 3.2.4 of the report titled *Findings from literature review* attached to this report as Appendix A.

4.2.9 FINDINGS

From the in-depth investigations undertaken regarding the status of appliance recycling in Gauteng (which was the focus of the study), the following conclusions were drawn:

- When large appliances are no longer fit for use by the purchaser of the new appliance, they often end up being sold or donated to people in lower income groups. This results in energy-inefficient appliances remaining in operation for extended periods.
- Due to the above, appliances remain in use for much longer than those appliances in developed countries.
- Although it was confirmed that appliances reaching the end of their functional life are available for recycling, very few appliances were observed at recyclers claiming to do recycling of large appliances.
- Scrap metal dealers were approached for consultations but they did not respond to requests for interviews or availing of information. The conclusion was finally drawn that large numbers of intact and semi-stripped appliances may be delivered to scrap

[30] This revision / expansion of the definition is currently under consideration by the DTI.

metal dealers, where they are completely stripped and bulked before the metal is transported to furnaces, and recyclable plastics sold to plastic recyclers.

- No evidence could be found that appliances are currently pre-treated for the environmentally sound recovery, treatment or safe disposal of harmful gases or hazardous materials.
- The investigations confirmed that there will be enough feedstock for commissioning and operation of an appliance recycling facility/facilities in Gauteng but this will be subject to appliances being recovered before they are recycled or disposed of in a cheaper but unsafe, unhealthy or environmentally damaging manner.
- The financial viability of a large appliance recycling facility will be influenced by the economies of scale and it is therefore important that resources be combined for the project to be sustainable in the long term.
- Some large appliance manufacturers or importers of large appliances were unaware of the legal requirements due to be imposed on them in terms of extended producer responsibility.
- In general, there seemed to be a willingness from appliance manufacturers or importers to participate in an appliance-recycling project, subject to their financial contributions being ring-fenced and used for recycling of such appliances, and subject to the playing field being levelled for all stakeholders affected by the recycling project.
- The logistics of getting access to non-functional appliances may be problematic since there is limited interest from appliance retailers to get involved in the recovery (e.g. trade-ins), storage and/or transport of used appliances.
- There is a need for the establishment of well dispersed and easily accessible collection or drop-off points where appliances can be bulked and stored before being pre-treated and/or transported to a centrally located appliance recycling facility.
- The fact that there is no evidence of the existence of formal facilities dedicated wholly or chiefly to appliance, recycling suggests that such recycling is not seen to be commercially viable.

5 DEVELOPMENT OF APPLIANCE RECOVERY AND RECYCLING SYSTEM

This section of the report focuses on the key factors considered in developing the proposed appliance recovery system. These are discussed below under the following headings:

- Sourcing of appliances
- Logistics
- Treatment of appliances
- Disposal of non-recyclable hazardous and non-hazardous materials
- Conclusion.

5.1 SOURCING OF APPLIANCES AND LOGISTICS

As the recovery of all used energy-inefficient functional appliances and the majority of used, non-functional appliances will be associated with the purchase of a new appliance; such used appliances should preferably be recovered and recycled in parallel with the sale of the new appliances.

From an energy perspective, appliances recovered for recycling should be functional when recovered and recycled to prevent its continued use. However, non-functional appliances will also be recycled from an environmental point of view as a means of conserving natural resources, and to have harmful gases and hazardous materials removed from the environment.

5.1.1 TRANSPORT

The following options were considered for transporting used appliances between consumers and the treatment facility/facilities:

Table 5-1: Options considered for transportation of used appliances between consumers and the treatment facility/facilities

SYSTEM	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Consumer transport system	Consumers with access to their own (appropriate) transport could deliver used appliances to the drop-off facility or any of the facilities.	Consumers do not have to wait for appliances to be collected and can drop appliances off when it suits them. No dedicated WEEE collection system is required.	Consumers that do not have access to a car with a trailer or a light delivery vehicle (LDV) are excluded. No economies of scale with individual appliances transported.
Trade-in system	Used appliances are accepted by retailers as trade-ins when similar new appliances are purchased. Old appliances are collected from consumers when new appliances are delivered.	Consumers do not have to make any effort to transport used appliances. No dedicated WEEE collection system is required.	Collection of used appliances during delivery of more than one new appliance on a single round could (during the offloading process) delay delivery due to the old appliances already collected being stacked close to the loading door of the delivery vehicle. This may require rearrangement of loads every time that an old appliance is loaded into the vehicle. Collected used appliances will require storage space in the warehouse from which new appliances were dispatched. Additional administrative processes required to keep record of all used appliances received as trade-ins; and appliances subsequently released

SYSTEM	DESCRIPTION	ADVANTAGES	DISADVANTAGES
			from retailers' premises for bulk transport to recycling facility.
Small scale appliance recycler, pawnshop or appliance repair shop transport system	Small-scale appliance recycler, pawnshop or appliance repair shop dispatch own vehicle in response to a telephonic or website request. Appliances subsequently collected in bulk and delivered to large central recycling facility.	Consumers do not have to make effort to transport used appliances. Bulking of appliances before dispatch to large central recycling facility provides improved economies of scale during secondary transport.	Small numbers of appliances collected over large catchment areas renders primary collection system quite costly, resulting in lower prices offered to consumers for used appliances. More parties involved in collection chain increases costs.
Contracted third party transporters system	Third parties contracted for collection and transport of used appliances from consumers to appliance recycling facility/facilities. Such parties may be appointed on a fixed contract basis, or as-and-when-required by the owners of facilities. Contracted transporters may be Small Medium and Micro Enterprises (SMMEs), a formal transport company or a formal waste management company.	Increased job creation. Dedicated transport system with contracted collectors allows for increased control over collections.	Accreditation system required third parties to ensure effective control. Additional costs incurred through collection by external parties.

5.1.2 COLLECTION POINTS

Due to the need for viable payloads during transport of appliances over longer distances, together with the need for enough feedstock to make development and operation of an appliance recycling facility financially viable, there may be a need for bulking of appliances in areas closer to source, i.e. closer to consumers owning used appliances. Therefore, two options exist in terms of the area used for collection of appliances.

Appliances can either (i) be transported directly from consumers to a centrally located appliance recycling facility, or (ii) be taken to various well-dispersed and easily accessible collection facilities from where the appliances can be transported to the main facility in bulk.

Table 5-2: Options considered for collection points

SYSTEM	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Direct Transport of WEEE	Appliances transported directly from the consumer to a central recycling facility.	No additional administration and management required at transfer facilities.	Increased costs resulting from long transport distances with low payloads.
Transfer of WEEE	Appliances taken to well-dispersed and easily accessible transfer facilities for bulking and transport to central recycling facility.	Short distances travelled when payloads are poor. For longer transport distances, used appliances are bulked for improved payloads and lower transport costs.	Additional dispersed collection facilities to be developed. Additional administration and management required at various facilities. Control of facilities may be problematic.

The following entities were considered to act as collection facilities:

Table 5-3: Options considered for collection facilities

ENTITY	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Retailers	Retailers provide facilities for drop-off or collection of used appliances.	Retailers are well spread and easily accessible to consumers. Retailers can exchange old appliances for new appliances purchased.	Floor space in retail premises is expensive and may be limited. Additional administration to keep record of all used appliances dropped off or received as trade-ins; and appliances subsequently released from retailers for bulk transport to central recycling facility.

ENTITY	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Municipal waste facilities	Municipal public drop-off facilities used for the collection of used appliances.	Public drop-off facilities are well spread and readily accessible. Lower costs for provision of appliance collection facilities at existing municipal sites.	Poor security at municipal facilities may lead to appliances being stolen. Environmental risks associated with inappropriate management of appliances that become accessible to unauthorised reclaimers in the absence of effective control measures. Limited unutilised space available at municipal waste drop-off facilities.
Cash-for-scrap buyback centres	Existing Cash-for-scrap buyback centres used for drop-off of used appliances.	Cash for scrap centres well spread and readily accessible to all income groups. Facilities often developed in areas where land costs are low.	Informal nature of cash-for-scrap buyback centres likely to result in (i) insufficient control being exercised over used appliances, and (ii) existing premises not allowing for formal upgrade.
Scrap Metal Dealers	Existing Scrap Metal Dealers (SMDs) used for drop-off of used appliances.	Scrap Metal Dealers (SMDs) available in several industrial areas throughout Gauteng. Formal nature of SMDs allows for upgrade of facilities to serve as collection points. Scrap metal dealers already recipients of most used appliances in Gauteng.	Appliances may not be treated in an environmentally sound manner. Appliances unlikely to be made available to central recycling facilities located elsewhere.

ENTITY	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Dedicated drop-off facilities	Dedicated facilities are provided for drop-off and collection of used appliances.	Owner of appliance recycling programme has full control over appliances delivered.	Additional costs for development of dedicated facilities. Additional administration and management required at various facilities. Control of facilities may be problematic.
Existing Recycler Infrastructure	Existing packaging material recycler infrastructure used for drop-off and collection of used appliances.	Most of the required infrastructure are already in place and spread throughout Gauteng. Existing packaging material recyclers familiar with management and storage of recyclable materials.	It may result in the project being controlled by third parties dictating the type of activities undertaken. Limited storage space may be available.

5.1.3 STORAGE AND BULKING

Used appliance storage facilities are to be provided such that the risk of harmful gases being released into the atmosphere, or hazardous materials like oils being released into the soil, surface water or groundwater, be limited. It is further to be ensured that the necessary health and safety measures are put in place for protection of employees working in appliance storage facilities.

Although various options exist for storage of used appliances collected as part of the appliance recycling project, it is to be appreciated that there will be logistical limitations in terms of available storage space (with the initial appliance recovery rate unknown). Buffer capacity is therefore to be provided within the system to ensure a constant supply of feedstock but without any component of the appliance recycling system being overloaded.

A second consideration was that double-handling should, where possible, be avoided for the flow of used appliance to be streamlined but without unnecessary additional costs incurred.

The following options were considered for storage and bulking of used appliances:

Table 5-4: Options considered for storage and bulking of used appliances

SYSTEM	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Storage at dedicated drop-off / collection depots	Buffer storage capacity provided at dedicated drop-off/collection depots – allowing feedstock to be delivered as required by the recycling facility.	Well-spread and easily accessible collection points allows for more flexibility in the system used for buffer storage of used appliances. It is easier to increase storage capacity at several small facilities than at one large facility. Separating cooling (containing refrigerants) and non-cooling appliances are easier at facilities where smaller numbers of appliances are stored. Used appliances dispatched to recycling facility at a rate high enough to provide enough feedstock for optimal operation. In the event of planned or unplanned shutdowns of the recycling facility, excess feedstock can be held back until the backlog is cleared.	Additional costs for provision of dedicated drop-off/collection facilities. It requires additional management, administration and stricter control over used appliances received and feedstock subsequently dispatched to the recycling facility.
Storage at retailers	Storage facilities provided at retailers responsible for management of appliances collected as trade-ins or dropped off by consumers.	Retailers are familiar with management of appliances. Appliances collected during delivery of new appliances transported directly to retailer warehouse. Buffer storage provided for smaller volumes of appliances, making the management thereof easier.	Floor space in retail premises is expensive. Available storage capacity at retailers limited and will not allow excess appliances to be stored as buffer capacity.

SYSTEM	DESCRIPTION	ADVANTAGES	DISADVANTAGES
			Planned or unplanned shutdowns at recycling facility could lead to used appliances not being collected from consumers for extended period (until backlog has been cleared). Additional administration and management required at various facilities.
Bulk storage at recycling facility	As part of the development of a recycling facility, enough storage capacity is provided not only for normal operations but also for bulk capacity during shutdowns.	Additional administration and management required at several facilities is avoided. Once delivered to the recycling facility, the appliances remain on the same premises for pre-treatment and recycling.	Storage of used appliances will be difficult to manage when the full range of appliances collected are dispatched to the recycling facility. (Separating cold and non-cold appliances is important due to special pre-treatment process required for cold appliances).
Storage at Municipal waste facilities	Municipal public drop-off facilities provided with infrastructure required for buffer-storage capacity.	Buffer storage provided for smaller volumes of appliances, making the management thereof easier. It is easier to increase storage capacity at several small facilities than at one large facility.	Limited / lack of control may result in used appliances being diverted to unauthorised reclaimers not adhering to the required environmental standards. Additional administration and management required at various facilities.
Storage at existing recycling facilities	Existing packaging recycling facilities used as storage facilities.	Recyclers are familiar with management of recyclables. Buffer storage provided for smaller volumes of appliances, making the management thereof easier.	Additional storage capacity may require additional infrastructure. Additional administration and management required at various facilities.

5.2 TREATMENT OF APPLIANCES

5.2.1 APPLIANCE PRE-TREATMENT

The presence of GHGs including refrigerants as well as hazardous materials like blowing agents, oils, mercury, etc. creates the need for appliances to be pre-treated before it can be recycled in a safe and environmentally sound manner. The extent of the pre-treatment process is dependent on the type of appliance to be recycled. Appliances with refrigerants and blowing agents like fridges and freezers would for instance require more extensive pre-treatment than that required for other large household appliances like washing machines, stoves, dishwashers, etc.

The pre-treatment required for non-cooling appliances requires removal of loose items, removal of printed circuit boards (PCBs) as well as removal of switches and globes containing hazardous metals like mercury.

For cooling appliances, pre-treatment is taken further with removal of refrigerants, oils as well as motors and condensers. Insulation materials can only be removed manually where the necessary measures are taken to prevent release of blowing agents, or ignition of flammable insulation materials. Where a Mechanised Appliance Recycling Facility (MARF) (see Figure 5-1) is provided, pre-treatment of cooling appliances may be undertaken at the recycling facility itself, with insulation materials only removed as part of the mechanised recycling process.

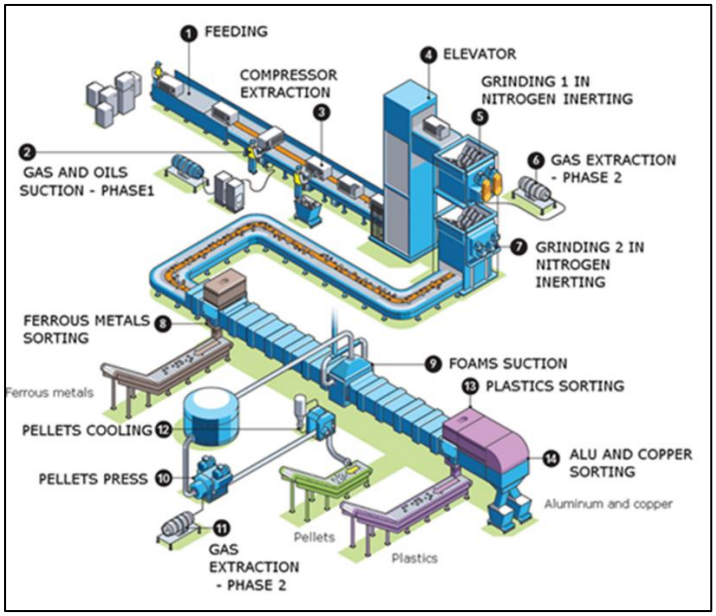


Figure 5-1: Typical Mechanised Appliance Recycling Facility (MARF) used for recycling of fridges / freezers

Without the necessary pre-treatment, it would not be safe for the respective appliances to be made available to scrap metal dealers for disassembly and subsequent recycling.

The following options were considered regarding the location for pre-treatment of appliances:

Table 5-5: Options considered regarding location for pre-treatment of appliances

LOCATION	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Drop-off/Collection Depots	When delivered to drop-off or collection depots, appliances are pre-treated before being stored and finally transported off site.	Once pre-treated to the level required, appliances can be made available to accredited scrap metal dealers for further processing in an environmentally sound manner. A mechanised appliance recycling facility (MARF) to be built once viability of appliance recycling has been demonstrated.	Additional cost to construct depots. Additional administration and management required at various facilities. Additional skilled staff and specialised equipment will be required. Additional control to ensure environmental compliance by all depots.
Pre-treatment at Mechanised Appliance Recycling Facility (MARF)	All appliances collected are transported to the MARF where pre-treatment is done at a central facility.	No additional cost to construct depots. Less management and administration required. Only one facility where environmental compliance is to be ensured.	Cold and non-cold appliances have to be kept separate. Cold and non-cold processing lines may be required, adding to the cost of the facility if pre-treated non-cold appliances are not diverted to SMDs.
Pre-treatment at dedicated facilities other than depots or Mechanised Appliance Recycling Facility (MARF)	In the absence of space at municipal drop-off facilities or packaging recycling facilities, pre-treatment undertaken at dedicated facilities.	Appliances are all pre-treated at a facility that specialises in pre-treatment. Single facility to control environmental compliance during pre-treatment.	Double-handling leading to additional costs. Additional administration and management required at various facilities.

5.2.2 APPLIANCE RECYCLING

Appliance recycling can only be done in an environmentally sound manner once pre-treated to a level where harmful gases and hazardous materials have been successfully removed.

The following options were considered regarding the location for the recycling of appliances to take place:

Table 5-6: Options considered regarding location for recycling of appliances

LOCATION	DESCRIPTION	ADVANTAGES	DISADVANTAGES
Appliance recycling at collection / drop-off depots	Recycling manually undertaken at collection or drop-off facilities once hazardous materials were removed.	MARF not required, resulting in cost saving. More jobs created. Lower energy consumption.	Manual recycling of cold appliances is problematic. More control required at various facilities.
Appliance recycling at accredited Scrap Metal Dealers (SMDs)	Recycling manually undertaken at scrap metal dealers once hazardous materials were removed.	MARF is not required, which results in cost saving. More jobs created. Lower energy consumption.	Only appliances of which harmful gasses and hazardous materials have been removed can be sent to SMDs. Accreditation system for third parties will be required. Control of third parties may be problematic.
Appliance Recycling at Mechanised Appliance Recycling Facility (MARF)	Recycling undertaken mechanically at central MARF.	Mechanical removal or shredding of PUR foam easier than manual removal. Increased capacity.	Expensive to construct and operate MARF. Less jobs created.

5.3 DISPOSAL OF NON-RECYCLABLE HAZARDOUS AND NON-HAZARDOUS MATERIALS

The highest priority should be given to recycling of materials recovered from the appliance recycling process; followed by the second priority of having materials used for energy recovery. The latter may be achieved by using high calorific materials as a fuel source, for instance in cement kilns.

Non-recyclable hazardous materials remaining as residues from appliance recycling are to be disposed of on appropriately licensed, developed and operated waste treatment or disposal facilities. This could be a combination of publicly owned (municipal) landfills, as well as privately owned hazardous waste incinerators or landfills.

Gases can be recycled provided different refrigerants remain separated during extraction and containerisation. The gases are; however, to be destroyed (flared) when refrigerants are mixed.

5.4 CONCLUSION

From the above analysis, it was concluded that the following options for an appliance recovery and recycling project are the most viable in the long term:

- Logistics and supply
    - A contracted third-party transporters system
    - A network of well dispersed and easily accessible depots for bulking and transport of appliances to a MARF
    - Buffer storage capacity provided at depots allowing for feedstock to be delivered as required to the MARF
- Treatment
    - Pre-treatment of appliances at depots. Pre-treated appliances are to be transported to the MARF for further recycling.
- Disposal
    - The highest priority should be given to recycling of materials recovered from the appliance recycling process; followed by the second priority of having materials used for energy recovery. Gases can be recycled provided different refrigerants remain separated during extraction and containerisation.

A proposed system for appliance recovery and recycling is detailed in section 6 below which takes into consideration the various considerations as detailed in the section.

6 PROPOSED APPLIANCE RECOVERY AND RECYCLING SYSTEM

This section of the report discusses the proposed appliance recovery and recycling system under the following headings:

- Physical flow models
- Corporate and commercial structure
- Information and money flows.

6.1 PHYSICAL FLOW MODELS

Three models regarding the physical flows of used non-functional and functional appliances from consumers to a point where the appliances can be recycled in an environmentally sound manner have been developed. Each of these models will be implemented in phases, depending on the number of appliances recovered. These models are Models A, B and C and are discussed in more detail below.

6.1.1 MODEL A

From the investigations undertaken, it became evident that there could be a need for the establishment of well dispersed and easily accessible collection or drop-off points where appliances can be bulked and stored before being transported to a centrally located appliance recycling facility.

In this model, used appliances will be pre-treated at two types of facilities, i.e. depots (in the initial phase); and depots combined with a MARF (in the future phase).

6.1.1.1 Initial phase

Used appliances will be collected from consumers by independent SMMEs and transported to centrally located collection and drop-off depots (storage facilities) spread across Gauteng (Tshwane, Johannesburg, East Rand, West Rand and Southern Gauteng). Depots could typically be established in old industrial buildings. SMMEs will be linked to a mobile application (APP) like the mobile application used by UBER, advising SMMEs nearest to the appliance of the need to have a used appliance collected from a consumer, appliance repair shop, pawnshop, retailer, manufacturer, importer, etc.

SMMEs (or consumers) delivering appliances to depots will be paid per appliance delivered, and payment may be based on the appliance type, capacity, mass and condition (non-functional or functional). Used appliances should in all instances still contain most of their gases as well as all parts containing hazardous materials.

In addition to collection of used appliances when advised by the mobile application, SMMEs will also be able to source additional non-functioning or functioning appliances from local communities, pawnshops, cash-for-scrap buyback centres (CSCs), repair shops, etc., provided that the prices paid for used appliances remain within the set price brackets. Prices offered by cash-for-scrap buyback centres (CSCs) will be used as a yardstick when setting prices for

non-functioning appliances; and prices offered by pawnshops will be used as a yardstick when setting prices for functioning appliances.

In the initial phase (Refer to Figure 6-1), the depots will act as small appliance recycling facilities and will have the following functions:

- Interim storage of all incoming appliances
- Pre-treatment of non-cooling and cooling appliances, *inter alia*, including safe removal of refrigerant gases, lubricating oils, motors and capacitors, PUR foam and other insulation, PCBs and PWBs, accessible cables and wires, most plastic components and other loose items.
- Bulking of pre-treated non-cooling and cooling appliances for more cost-effective transport to accredited SMDs.

The steel carcasses that remain after the above-mentioned components have been removed will be sent to accredited SMDs for final processing. Other recyclable materials will be sent to dedicated processing facilities with non-hazardous and hazardous residues sent to specialised facilities for safe treatment and/or disposal.

Receiving, inspecting and recording of used appliances delivered to the collection/drop-off depots is to be undertaken by full-time staff appointed for the project. Inspections undertaken will include testing of appliance motors to determine if the appliance delivered is functional. Recording of the appliance data will, *inter alia,* include its serial number (where available), together with a new barcoded stock number provided on the appliance – tracking its movement from delivery at the depot to the point of final destruction (recycling/disposal).

In addition to the need to keep control over used appliances received and feedstock recycled, a safe recycling or disposal certificate will also be issued to consumers and retained for audit purposes. The latter will also be made available to manufacturers or importers that are contributing towards an advance appliance recycling fund. Where possible, payments made for appliances received will be by means of an EFT or mobile application and depots should preferably not be required to handle cash.

A percentage of advance appliance recycling fee contributions may have to be allocated towards operation and maintenance of the MARF. Although financial viability of the MARF without external funding should be the goal as a means of increasing sustainability of used appliance recycling, this may not be possible and will to a large extent depend on the value of recyclable materials recovered.

It is assumed that donor funding may be acquired to fund the capital required for all or part of the infrastructure required (collection or drop-off depots; MARF; etc.), although this may not be necessary in practice if the advance recycling fees are implemented some time before physical roll-out of the various facilities takes place.

6.1.1.2 Future phase

In the future phase all operations will remain the same as in the initial phase but as the MARF would by then have been commissioned, all fridges and freezers will be bulked at depots and

sent to the MARF for pre-treatment and subsequent processing. Non-cooling appliances and air conditioners will continue to be treated at depots.

In the future phase (Refer to Figure 6-2), the depots will have the following functions:

- Interim storage of all incoming appliances
- Pre-treatment of non-cold appliances, *inter alia*, including safe removal of lubricating oils, motors and capacitors, PCBs and PWBs, accessible cables and wires, mineral-wool insulation and ballasts, refrigerant gases (from air conditioners only), most plastic components and other loose items.
- Bulking of all pre-treated non-cold appliances for more cost-effective transport to accredited scrap metal dealers for final processing.
- Buffer storage and bulking for more cost-effective transport of untreated cold appliances as feedstock to MARF for subsequent pre-treatment and final processing.

In the future phase (Refer to Figure 6-2), the MARF will have the following pre-treatment and final processing functions:

- Removal, safe treatment and disposal of refrigerant gases and lubricating oils.
- Stripping of motors, cables etc.
- Shredding and recovery of all remaining metal, plastics, glass as well as insulating PUR foam, etc. for separation and recycling, or environmentally sound treatment and disposal.

6.1.2 MODEL B

In Model B, all operations will remain the same as in Model A, but instead of developing decentralised depots spread throughout Gauteng, a single centralised recycling plant will be developed in phases over time to match the required capacity – treating both cold and non-cold appliances.

6.1.2.1 Initial phase

The function of the central recycling facility will, during the initial phase, focus on pre-treatment of both cold and non-cold appliances for subsequent dispatch of safe and environmentally sound appliances to accredited SMDs for final processing (refer to Figure 6-3). This will imply that all functional and non-functional appliances collected throughout Gauteng will be transported to a single recycling facility that may be situated, for instance, on the East Rand where the bulk of Gauteng's recycling industries are based.

During the initial phase, the central recycling facility will thus have the following functions:

- Pre-treatment of non-cold and cold appliances, *inter alia*, including safe removal of refrigerant gases, lubricating oils, motors and capacitors, PUR foam and other insulation, PCBs and PWBs, accessible cables and wires, most plastic components and other loose items.
- Bulking of pre-treated non-cold and cold appliances for more cost-effective transport to accredited SMD.

6.1.2.2 Future phase

Once a large enough number of fridges and freezers are received at the central recycling facility for cost effective introduction of a MARF, such appliances will, as part of the future phase, be treated in the MARF located on the same premises, with pre-treated non-cooling appliances still made available to accredited SMDs for final processing (refer to Figure 6-4).

During the future phase, the functions of the central recycling facility will be as follows:

- Non-cooling appliances
    - Pre-treatment of non-cooling appliances, inter alia, including safe removal of lubricating oils, motors and capacitors, PCBs and PWBs, accessible cables and wires, mineral-wool insulation and ballasts, most plastic components and other loose items.
    - Bulking of all pre-treated non-cooling appliances for more cost-effective transport to accredited scrap metal dealers for final processing.
- Cooling appliances
    - Removal, safe treatment and disposal of refrigerant gases and lubricating oils.
    - Stripping of motors, cables, etc.
    - Shredding and recovery of all remaining metal, plastics, glass as well as insulating PUR foam, etc. for separation and recycling, or environmentally sound treatment and disposal.

6.1.3 MODEL C

In Model C (refer to Figure 6-5), all cooling and non-cooling appliance collection operations will remain the same as in the initial phase of Model A, but instead of developing decentralised depots spread throughout Gauteng (e.g. Tshwane, Johannesburg, East Rand, West Rand and Southern Gauteng), existing SMDs will be approached to treat both cooling and non-cooling appliances. SMDs could be approached through a periodic tender process, thus meeting demand as it arises. This obviates the need for an initial and future phase insofar as pre-treatment is concerned.

The function of the SMDs will be pre-treatment of both cooling and non-cooling appliances, whereafter pre-treated appliances will be recycled like other non-hazardous metal items. SMDs will be required to meet certain criteria, including:

- Providing a dedicated area, protected against the elements, for pre-treatment of appliances
- Safe removal, handling and storage of all hazardous gases, liquids, insulation materials and other hazardous items
- Proper record-keeping
- Willingness to be accredited and subsequently audited or inspected at any time.

Once pre-treated, cooling and non-cooling appliances can be dismantled for recycling.

SMDs will be required to perform the following activities:

- Pre-treatment of non-cold and cold appliances, *inter alia*, including safe removal of refrigerant gases, lubricating oils, motors and capacitors, PUR foam and other insulation, PCBs and PWBs, accessible cables and wires, most plastic components and other loose items.
- Recovery of all remaining metal, plastics, glass as well as insulating PUR foam, etc. for separation and recycling, or environmentally sound treatment and disposal.

SMDs will be entitled to sell all recyclables for their own account. Hazardous gases and liquids, hazardous items such as capacitors, PCBs and PWBs, switches, lamps, etc. must be safely removed from appliances, safely handled and appropriately stored by the SMDs, for collection and safe treatment or disposal by the operating entity within the proposed appliance recycling model ('ARCO': see section 6.2.2) at ARCO's expense.

Contracts awarded to SMDs by ARCO would be for (say) three years, conditional on SMDs meeting all of their contractual obligations in terms of environmentally safe recycling practices. Contracts would be renewable for further three-year periods, at the option of ARCO.

In their tenders, SMDs would stipulate the prices that they are willing to pay ARCO per appliance, for appliances delivered to them by SMME appliance collectors. Such prices would then be included in their contract with ARCO.

Note that where required, due to insufficient capacity of SMDs, ARCO would still be able to develop and operate appliance drop-off/collection depots of its own, along the lines envisaged in Model A above. These depots would then function in parallel with any contracted SMDs.

FEASIBILITY STUDY TO DETERMINE THE VIABILITY OF AN INTEGRATED APPLIANCE RECYCLING SYSTEM

6.1.4 COMPARISON OF MODELS

The advantages and disadvantages of the physical flows of the three proposed models, i.e. Models A, B and C, are discussed in Table 6-1 below.

Table 6-1: Advantages and disadvantages of the physical flows of Model A, B and C

	MODEL A	MODEL B	MODEL C
Advantages	Depots allow for shorter transport distances for appliances collected from source. Depots allow for bulking of appliances for better payloads and more cost-effective transport over longer distances. Starting off with a single depot, depots can over time be added as dictated by appliance recovery rates in different parts of Gauteng. It is easier to add additional decentralised depots than to increase the size of the central recycling facility if required to accommodate increased appliance recovery rates. Smaller capital investment for infrastructure and smaller land parcels required. Less capital investment required at the future MARF facility.	No capital investment for depots situated throughout Gauteng. No double-handling at depots leading to additional costs. No additional costs for bulk transport of cold appliances between depots and the future MARF. No additional administration and management required at various depots. Easier to control all pre-treatment activities in one central recycling facility, rather than at decentralised depots. No additional capital costs to construct depots. Jobs created at central facility that allows for better control.	Makes use of an existing recycling industry. Depending on the ease with which agreement can be reached with the required number of SMDs spread across Gauteng, it may be easier to implement, since SMDs are already in operation. It reduces the amount of capital expenditure required for implementation of an appliance recycling programme. No double-handling at depots leading to additional costs. No additional administration and management required at depots. Allows for limited regulation of participating SMDs that are accredited.

FEASIBILITY STUDY TO DETERMINE THE VIABILITY OF AN INTEGRATED APPLIANCE RECYCLING SYSTEM

	MODEL A	MODEL B	MODEL C
	Depots act as buffer storage and appliances can be released to MARF as and when feedstock is required. Depots provide backup to each other and will not necessarily all be closed in the event of accidents or labour unrest. Job creation spread throughout Gauteng. Pre-treated appliances will be sent to the closest accredited SMD(s), minimising transport distances and costs.		Upskills SMDs in terms of environmentally sound, healthy and safe recycling procedures. No need for buffer storage as appliances are treated at SMDs as and when feedstock arrives. SMDs provide backup to each other and will not necessarily all be closed in the event of accidents or labour unrest. Job creation spread throughout Gauteng.
Disadvantages	Double-handling leading to additional costs. Additional administration and management required at various facilities. Control of many depots may be problematic. Additional capital costs to construct depots. Additional operational costs to operate depots.	Longer distances to be travelled by SMME collectors and consumers. Potentially low payloads. No buffer storage. Pre-treated appliances may have to be transported longer distances to accredited SMD(s) and/or price-competition between SMDs for pre-treated appliances will be lessened if fewer SMDs compete for these appliances.	SMDs may be unwilling to participate, in view of the obligations that will be placed on them in terms of environmentally sound, healthy and safe appliance recycling prescripts. Dedicated facilities, equipment and suitable trained labour to be provided may only be effectively utilised for the duration of the contract. SMDs may not be prepared to be subjected to accreditation and ongoing auditing processes.

FEASIBILITY STUDY TO DETERMINE THE VIABILITY OF AN INTEGRATED APPLIANCE RECYCLING SYSTEM

MODEL A		MODEL B	MODEL C
			Other than terms and conditions of operating contract (that may only relate to appliances delivered by SMMEs), ARCO will not have any control over the standard of operation of SMDs. Extensive and ongoing control to be exercised to ensure that appliances are appropriately pre-treated before being disassembled for recycling. This will be difficult to enforce, as SMDs are known to be difficult to regulate.

FEASIBILITY STUDY TO DETERMINE THE VIABILITY OF AN INTEGRATED APPLIANCE RECYCLING SYSTEM

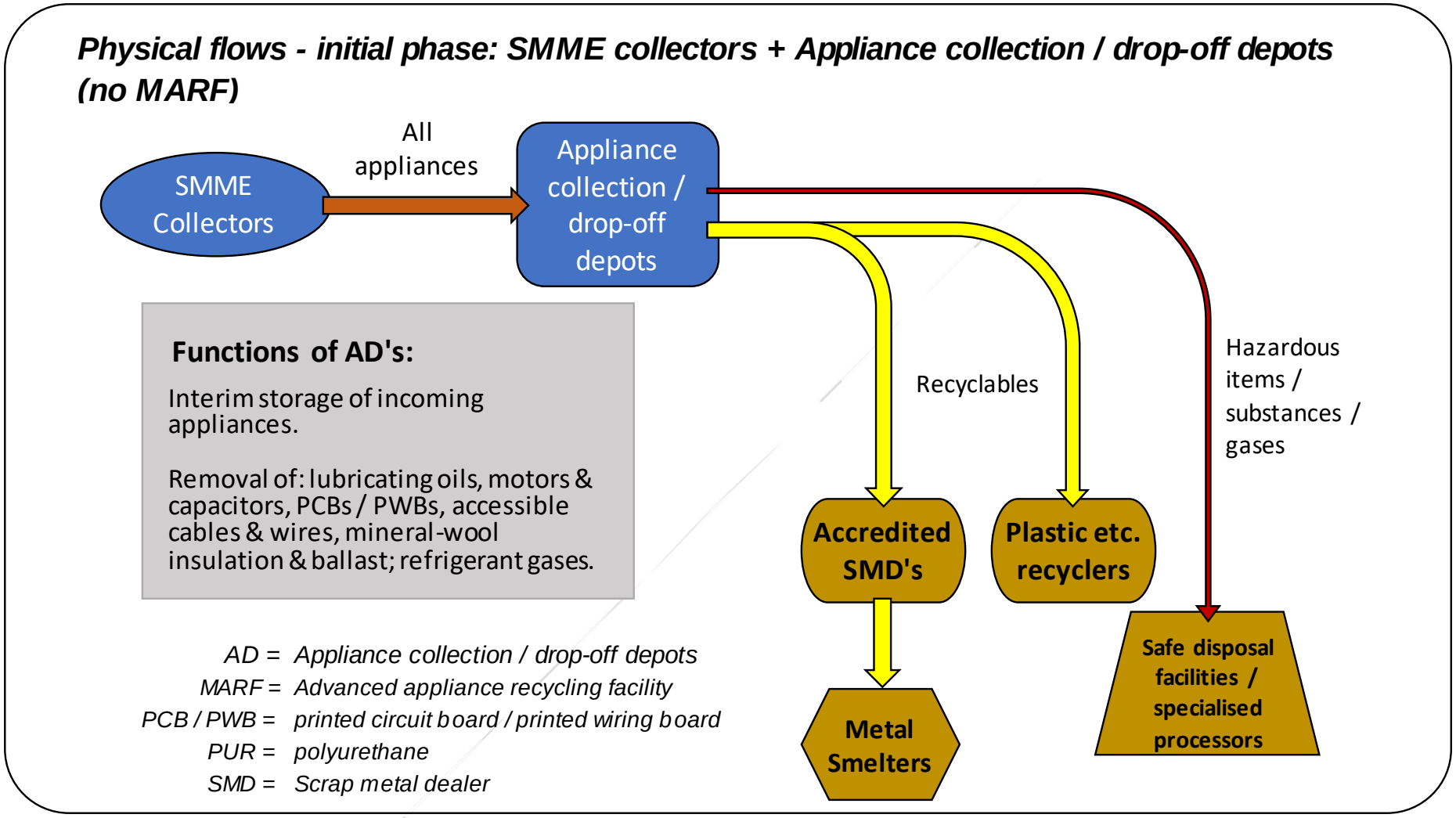


Figure 6-1: Physical Flows (Model A: Initial Phase - before the (MARF) has been commissioned)

FEASIBILITY STUDY TO DETERMINE THE VIABILITY OF AN INTEGRATED APPLIANCE RECYCLING SYSTEM

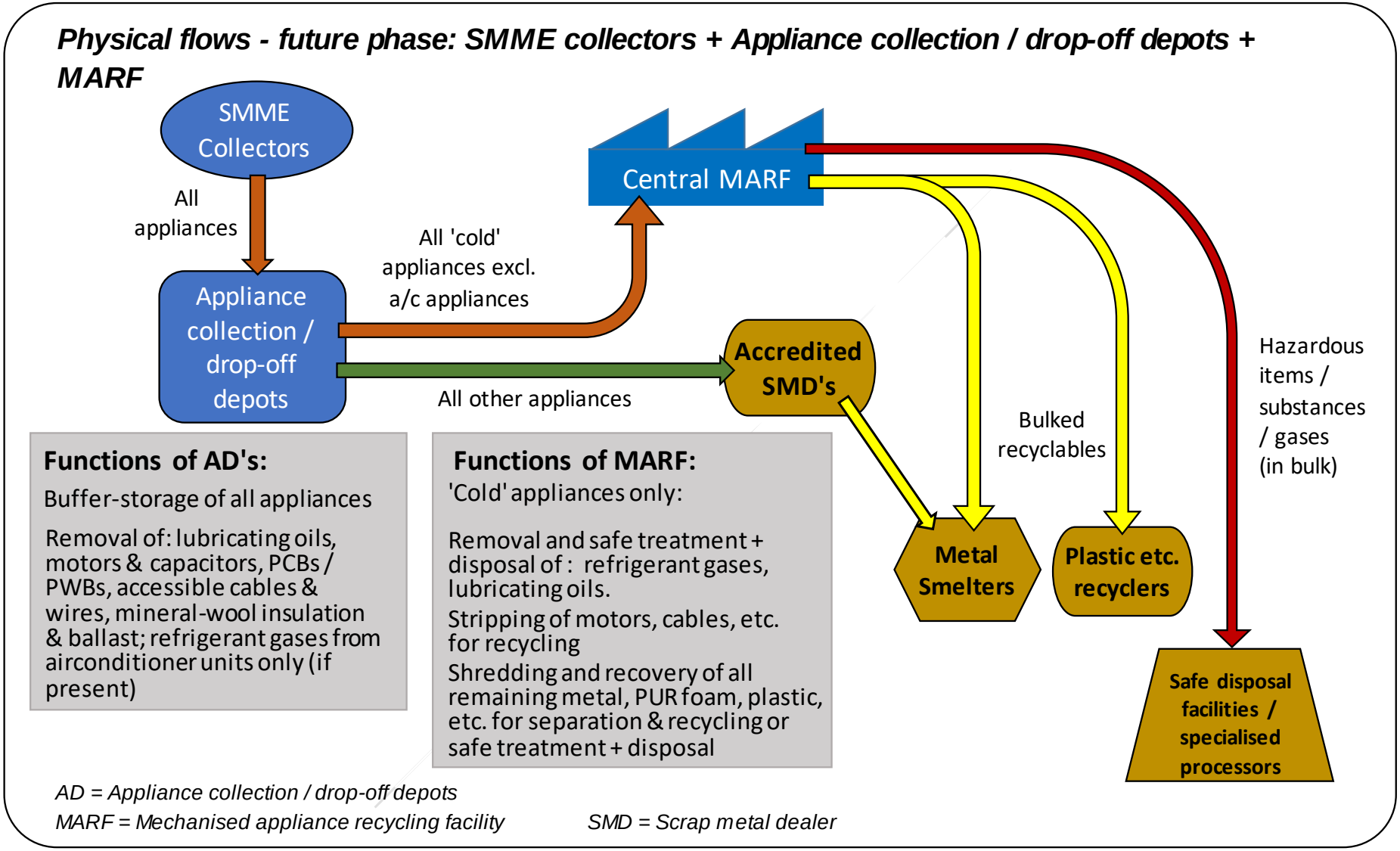


Figure 6-2: Physical Flows (Model A: Future Phase - after the (MARF) has been commissioned)

FEASIBILITY STUDY TO DETERMINE THE VIABILITY OF AN INTEGRATED APPLIANCE RECYCLING SYSTEM

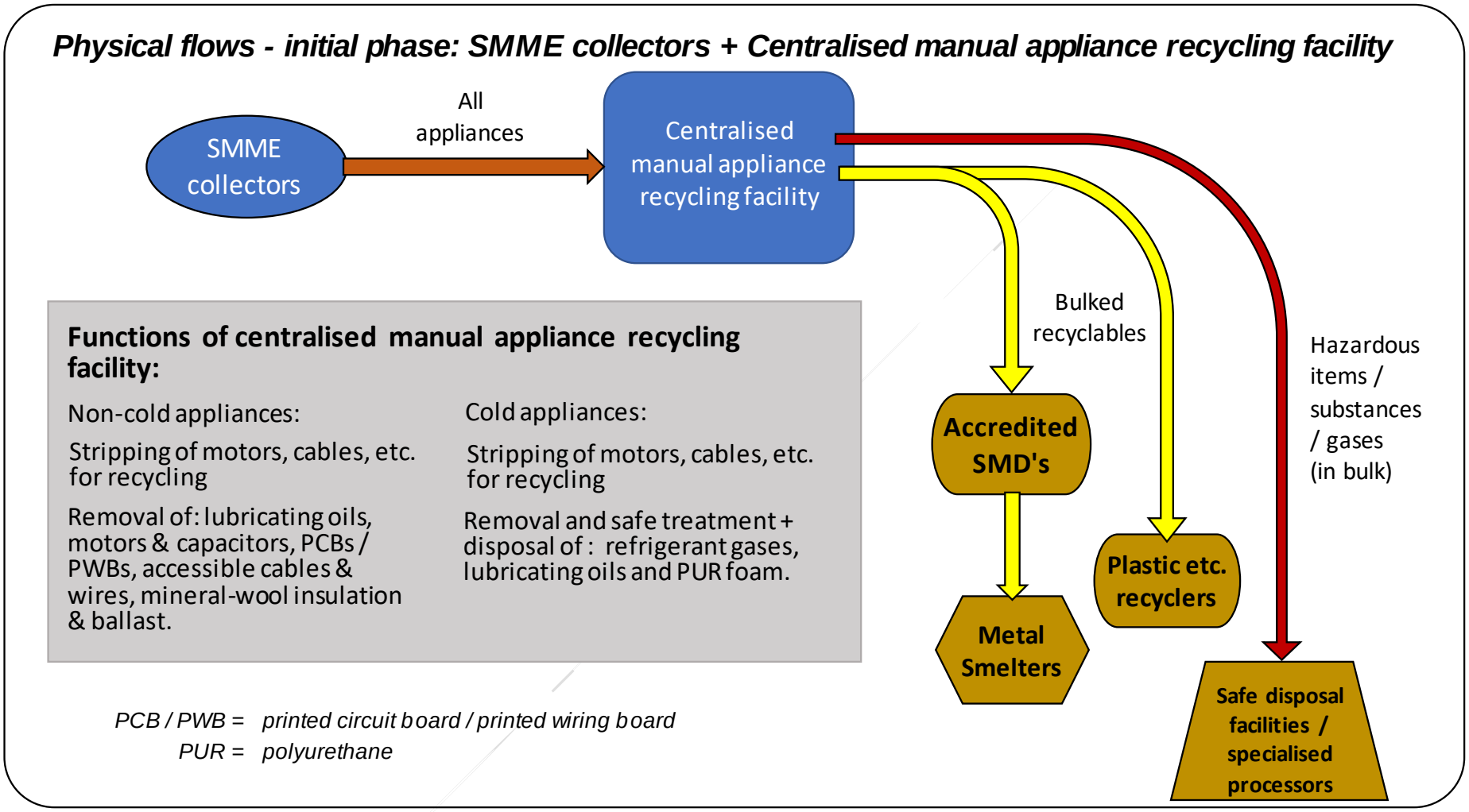


Figure 6-3: Physical Flows (Model B: Initial Phase)

FEASIBILITY STUDY TO DETERMINE THE VIABILITY OF AN INTEGRATED APPLIANCE RECYCLING SYSTEM

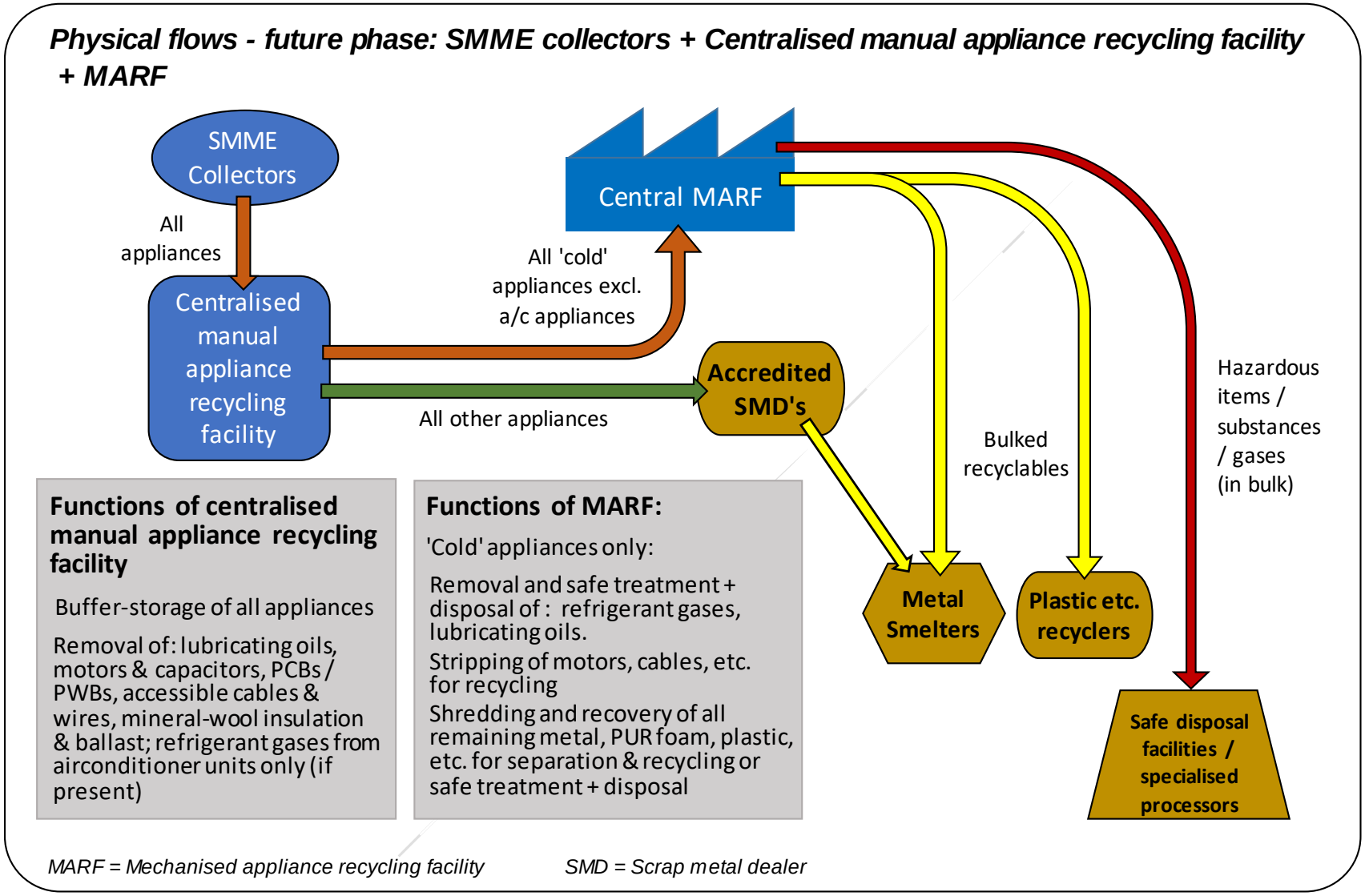


Figure 6-4: Physical Flows (Model B: Future Phase)

FEASIBILITY STUDY TO DETERMINE THE VIABILITY OF AN INTEGRATED APPLIANCE RECYCLING SYSTEM

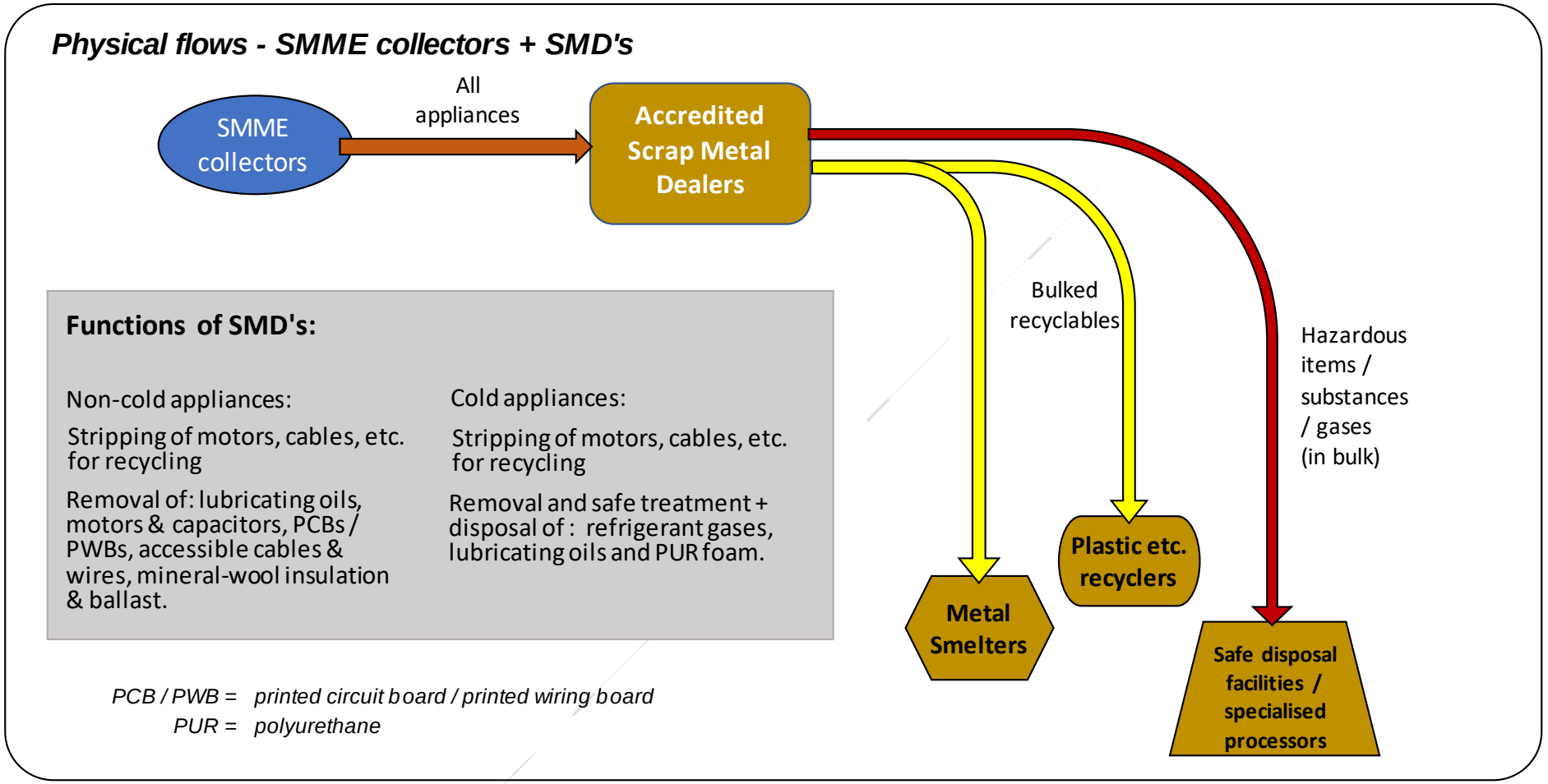


Figure 6-5: Physical Flows (Model C)

FEASIBILITY STUDY TO DETERMINE THE VIABILITY OF AN INTEGRATED APPLIANCE RECYCLING SYSTEM

From the comparison of the physical flow models and with the financial model still to be developed, Model A and Model B were considered to be viable options. Model C was; however, discarded for the following reasons:

- There is at present no evidence that SMDs undertake a system of self-regulation to ensure that appliances are treated and disposed of in a safe and environmentally sound manner. In the past, some regulating authorities expressed its concern about legal compliance by some SMDs.
- The lack of cooperation by SMDs and refusal to interact with the project team during the consultation process may be reasons for concern in terms of the willingness of SMDs to be subjected to an auditing process, not only for the purpose of accreditation, but for as long as the Model C system is in use.
- The risk of appliances not being collected through the proposed appliance recycling programme still being treated and disposed of in the incorrect manner exists, since there will be no tracking system for appliances that were delivered to SMDs directly. If an appliance recycling project is implemented, legislation can require that only pre-treated appliances may be present at SMDs, and that it will also only be permitted at accredited SMDs. The need for extensive monitoring of SMDs (irrespective of whether they were accredited), will be very difficult.
- The financial model of extended producer responsibility funding to assist in ensuring that the appliance recycling is undertaken to the required standards, may be difficult to control. Funds acquired from the EPR fund will be allocated to several SMDs that will in turn be required to prove that they did in fact pre-treat the appliances to the required standards. If similar financial support is to be provided for pre-treatment of appliances not collected through the appliance recycling project, it may make the implementation of control measures even more difficult.
- In addition to SMDs that are registered with the Regulating Authorities, there are also SMDs that are not on record. Such SMDs, not meeting the required environmental standards, will have a financial advantage over SMDs that are in compliance with the required health, safety and environmental standards.

6.1.5 ROLES AND RESPONSIBILITIES

It is envisaged that the parties involved in the appliance recycling project will have the following roles and responsibilities:

(Refer to Figure 6-1 to Figure 6-5 above)

- Appliance Consumers
    - Establish whether there is a need for non-functional or functional used appliances to be replaced or upgraded.
    - Take cognisance of energy efficiency when new appliances are purchased.
    - Have energy inefficient appliances donated/sold directly to depots or the MARF, or alternatively make use of the mobile application to book an appointment with the SMME used appliance collectors.
    - Insist on a collection note and safe disposal certificate for each appliance made available for safe and environmentally sound recycling or disposal. Full

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details on appliance type, make (with serial number where available), consumer details, collector details as well as date and time of the transaction is to be recorded.

- Appliance Collectors
    - Promote appliance collection and transport service and motivate consumers to make use of such a service.
    - Deliver appliances collected to nearest depot and obtain a delivery note providing details of the appliance similar to that captured during collection from the consumer.
    - SMME collector to receive payment from depot at weekly intervals by means of an EFT or mobile application, and in turn pay consumers that made appliances available for recycling. The difference between the price paid to the consumer for any used appliances collected and the amount paid to the collector by the collection or drop-off depot is to cover the cost of transport and provide an income for the SMME operating as an appliance collector.
- Depots (Model A: Initial phase)
    - Manage receipt of appliances from consumers and SMME collectors, issue receipts with details of the appliances similar to that captured during collection from the consumer.
    - Ensure that all cooling and non-cooling appliances are appropriately pre-treated.
    - Make pre-treated appliances available to accredited scrap metal dealers for recycling.
    - Maintain database on used non-functional and functional appliances received, pre-treated, stored and dispatched.
- Depots (Model A: Future phase)
    - Manage receipt of appliances from consumers and SMME collectors, issue receipts with details of the appliances similar to that captured during collection from the consumer.
    - Ensure that all cooling and non-cooling appliances are appropriately pre-treated based on the facilities available at the facility undertaking the recycling (scrap metal dealer or MARF).
    - Keep buffer stock of untreated cooling appliances in storage and supply MARF with the feedstock required to ensure optimum operation of the facility. Fridges or freezers are also to be pre-treated before being dispatched to accredited scrap metal dealers during the initial phase – i.e. before the MARF is commissioned.
    - Pre-treated non-cooling appliances in excess of what is required as top-up feedstock for optimum operation of the MARF, are to be made available to accredited scrap metal dealers for recycling.
    - Maintain database on used non-functional and functional appliances received, pre-treated, stored and dispatched to MARF (or accredited scrap metal dealers – where applicable).

FEASIBILITY STUDY TO DETERMINE THE VIABILITY OF AN INTEGRATED APPLIANCE RECYCLING SYSTEM

- MARF (Model A: Future phase)
    - Receive untreated primary feedstock of non-functional and functional fridge or freezer appliances from collection or drop-off depots for environmentally sound pre-treatment and safe recycling or disposal based on the most appropriate technology selected.
    - Receive pre-treated top-up feedstock of non-functional and functional non-cooling appliances from collection or drop-off depots for environmentally sound and safe recycling or disposal based on the most appropriate technology selected.
    - Where separated from depots, transport of feedstock between depots and the MARF to be arranged and funded by the MARF.
    - Capturing of data on all appliances received, recycled and disposed of.
    - Issue safe disposal certificates for appliances recycled or disposed of.
    - Centralised Manual Recycling Plant (Model B: Initial phase)
    - Manage receipt of appliances from consumers and SMME collectors, issue receipts with details of the appliances similar to that captured during collection from the consumer.
    - Ensure that all cooling and non-cooling appliances are appropriately pre-treated.
    - Make pre-treated appliances available to accredited scrap metal dealers for recycling.
    - Maintain database on used non-functional and functional appliances received, pre-treated, stored and dispatched.

- Centralised Manual Recycling Plant (Model B: Future phase)
    - Manage receipt of appliances from consumers and SMME collectors, issue receipts with details of the appliances similar to that captured during collection from the consumer.
    - Ensure that all cooling and non-cooling appliances are appropriately pre-treated based on the facilities available at the facility undertaking the recycling (scrap metal dealer/MARF).
    - Keep buffer stock of untreated cooling appliances in storage and supply the MARF with the feedstock required to ensure optimum operation of the facility. Fridges or freezers are also to be pre-treated before being dispatched to accredited scrap metal dealers during the initial phase – i.e. before the MARF is commissioned.
    - Pre-treated non-cooling appliances in excess of what is required as top-up feedstock for optimum operation of the MARF, are to be made available to accredited scrap metal dealers for recycling.
    - Maintain database on used non-functional and functional appliances received, pre-treated, stored and dispatched to the MARF (or accredited scrap metal dealers – where applicable).

- MARF (Model B: Future phase)
    - Receive untreated primary feedstock of non-functional and functional fridge or freezer appliances from SMMEs or consumers for environmentally sound

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pre-treatment and safe recycling or disposal based on the most appropriate technology selected.
- Capturing of data on all appliances received, recycled and disposed of.
- Issue safe disposal certificates for appliances recycled or disposed of.
- Retailers
- Record data (including serial numbers) of relevant appliance categories sold and upload information onto the database.
- Create awareness and promote the appliance recycling programme.
- Manufacturers or importers
- Develop products that are energy efficient with reduced hazardous material content. When due for recycling, appliances should be easy to disassemble.
- Oversee activities and functioning of the company managing recycling programme.
- Make advance appliance recycling fee contributions for appliances included in the project, based on manufacturer or importer's sales of the respective products in South Africa.
- Create awareness and promote the appliance recycling program, including the payment for old appliances handed over for safe and environmentally sound recycling.

6.2 CORPORATE AND COMMERCIAL STRUCTURE

The corporate and commercial structures for the proposed appliance recovery and recycling models [31] (the models) are shown in Figure 6-6 (Model A) and Figure 6-7 (Model B).

Note that prior to setting-up any of the entities mentioned below, a thorough analysis will need to be undertaken in order to determine the most appropriate corporate structure, taking into consideration both the institutional aspects as well as the commercial and financial aspects, including liability for income tax. This analysis should be undertaken by a suitably experienced commercial law firm.

The purpose and structure of each proposed element in the diagrams (Figure 6-6 and Figure 6-7) are outlined in more detail in the paragraphs that follow.

6.2.1 PRODUCER RESPONSIBILITY ORGANISATION FOR APPLIANCE INDUSTRY

In line with the principles set out in the NPSWM, the PRO (Producer Responsibility Organisation) for the appliance industry will need to be a non-profit company.

The PRO's functions and responsibilities (to be clearly defined in the memorandum of incorporation of the PRO) will be broadly as follows:

- To ensure that the extended producer responsibilities of subscribing [32] manufacturers and importers are fully carried out.
- To provide oversight of the appliance recovery or recycling model, in terms of regulatory (environmental, health, safety, etc.) requirements. *Inter alia*, this will

[31] The term 'model' is used here to avoid confusion with 'plan', as used in 'Industry Waste Management Plan'.
[32] I.e. to the appliance recycling system as set out herein.

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involve ensuring that all appliances entering the recovery or recycling system are properly recorded, stored and safely or responsibly treated; that all wastes (especially hazardous or environmentally problematic wastes) arising from the treatment process are properly dealt with, and that safe disposal certificates are received and recorded for audit purposes.

- To engage and appropriately remunerate independent professional service providers, including:
- Environmental auditors: these auditors will conduct environmental audits on facilities within the model.
- 'Audit Bureau': the Audit Bureau (probably a firm of financial auditors) will determine amounts due and payable by appliance manufacturers and importers in respect of advance appliance recycling fees, and will collect monies due and pay them over to the PRO.
- To disburse monies to ARCO (The Appliance Recycling Company – see below) in accordance with an approved budget. In this regard, the PRO will play a central role in the setting of advance appliance recycling fees to be paid by manufacturers and importers (see below).
- To publicise and create awareness of the need for environmentally sound recovery and recycling of used appliances, and the ways in which consumers can participate in the proposed model or programme.

The PRO will have a board of directors consisting of non-executive representatives from all subscribing manufacturers and importers (i.e. one member from each of the top 5 manufacturers or importers [by market share], and one for all smaller manufacturers or importers); the only executive director of the PRO will be the CEO or managing director.

6.2.2 APPLIANCE RECYCLING COMPANY

This company (likely to be a proprietary limited company but could also be an NPC) will be the operating entity within the model. It will own all the assets associated with the appliance recovery or recycling model (other than those outsourced to third parties, such as the SMME appliance collectors, bulk pre-treated appliance transporters, etc.), and will be the employer of the personnel required to operate and/or manage the various operations (appliance collection or drop-off depots, MARF, etc.), unless ARCO decides that these functions should also be wholly or partially outsourced.

ARCO will handle all the commercial aspects associated with appliance recovery, handling, storage, treatment, etc. It will negotiate offtake agreements with scrap metal dealers and processors of other recyclable material, as well as enter into necessary arrangements with general and hazardous-waste disposal companies, and any other outside service providers.

ARCO will prepare and submit an annual budget to the PRO for approval, and will also be expected to submit monthly management accounts to the PRO. The approved budget will be subject to quarterly review by the PRO.

As most (approximately 95%) of the operational funding of ARCO will be by means of advance appliance recycling fees paid over by appliance importers and manufacturers, the level at which these fees are set will be crucial to ensuring that the model functions effectively. ARCO

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and the PRO will therefore jointly agree on what the fees should be, at least on an annual basis.

ARCO will be the licence-holder in respect of all required environmental licences and authorisations, both for the depots under its control, and for the MARF.

ARCO will have a board of directors consisting of the CEO (and possibly CFO) and a number of non-executive directors having for example relevant legal, commercial and operational expertise.

6.2.3 THE APPLIANCE INDUSTRY TRUST

The Trust will be the sole shareholder in ARCO. This will have the effect of removing any potential conflicts of interest if ARCO generates an operating surplus. Under such circumstances, the Trust will control the application (i.e. utilisation) of such surplus, which will only be permitted to a defined list of beneficiaries. These beneficiaries will probably include ARCO itself (to be applied for example in the expansion of ARCO's operations to provinces other than Gauteng, construct new depots, construct a MARF, etc.) but also a broader range of activities such as for example the training of refrigeration technicians, and the promotion of safe and environmentally sound recycling more generally in South Africa.

The trustees of the Trust can be drawn both from within the appliance industry and outside, for example recognised environmental specialists, developmental experts, financial experts. The CEO of ARCO should be an 'ex officio' trustee of the Trust.

FEASIBILITY STUDY TO DETERMINE THE VIABILITY OF AN INTEGRATED APPLIANCE RECYCLING SYSTEM

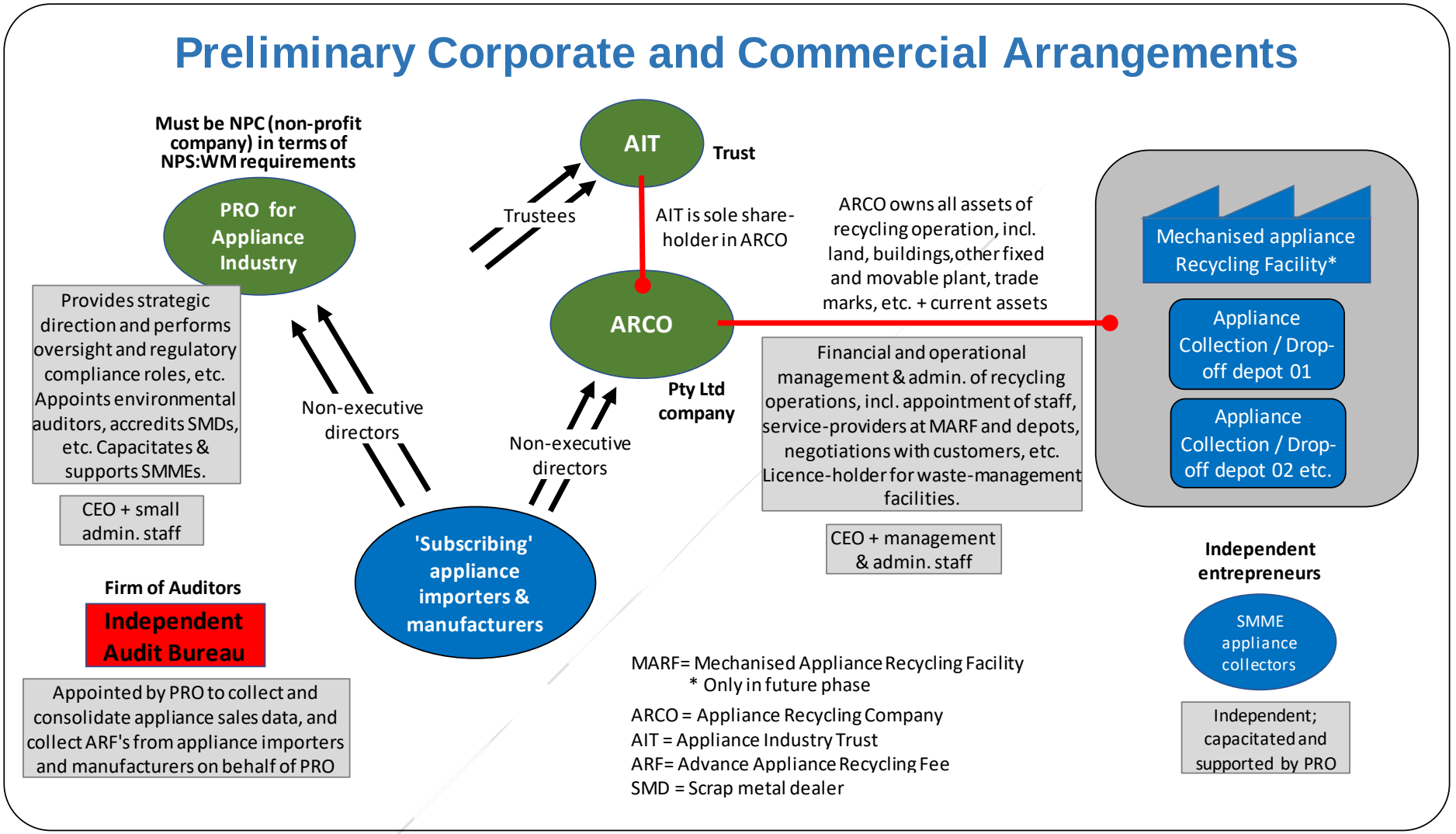

Figure 6-6: Preliminary Corporate and Commercial Arrangements (Model A)

FEASIBILITY STUDY TO DETERMINE THE VIABILITY OF AN INTEGRATED APPLIANCE RECYCLING SYSTEM

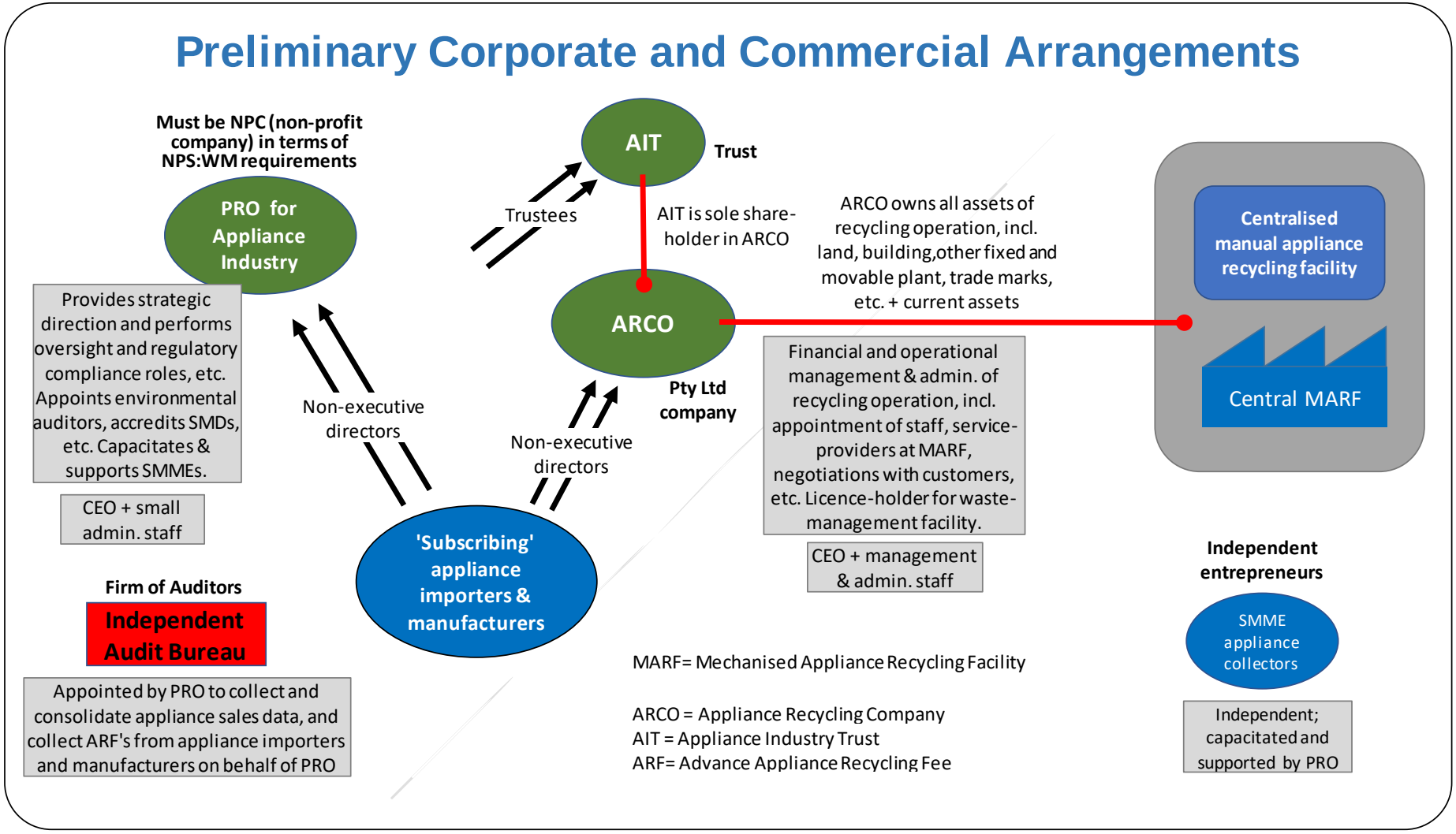

Figure 6-7: Preliminary Corporate and Commercial Arrangements (Model B)

FEASIBILITY STUDY TO DETERMINE THE VIABILITY OF AN INTEGRATED APPLIANCE RECYCLING SYSTEM

6.3 INFORMATION AND MONEY FLOWS

The management of project funds and information and money flows for Models A, B and C are discussed below.

6.3.1 SOURCE OF PROJECT FUNDS

For each of the three models, funds are envisaged to be sourced exclusively by way of advance recycling fees (ARFs) payable by manufacturers, producers and importers of appliances. In practice, these fees will have to be set per appliance category on a suitable and equitable basis, and will be payable in respect of all new products placed onto the market by such manufacturers, producers and importers. (Note that in the financial model, a uniform per-kilogram ARF has been used for the sake of convenience, for all large household appliances.)

6.3.2 MANAGEMENT OF PROJECT FUNDS

Although payment of advance appliance recycling fees from importers or recyclers would be compulsory (and may therefore have to be legislated), such fees should not be taxes but rather advance recycling fees. The general consensus among industry participants is that these fees should be ring-fenced and used exclusively for appliance recycling.

Fee contributions should be collected and controlled by an industry representative body such as an independent company that is to be audited at regular intervals. Depending on the financial model, the company ultimately responsible for implementation of the appliance recycling project should, according to stakeholders in the appliance industry, not be government-controlled (like *Buyisa-e-Bag*) but should be set up on the principles of the ROSE Foundation or The Glass Recycling Company.

Even though appliance manufacturers or importers would recover advance recycling fee contributions on national sales (thus avoiding disparity in appliance prices between provinces, and spreading the financial burden on national level), fees will initially only be used for appliance recycling in Gauteng. Depending on the success of the project in Gauteng, appliance recycling may in future be extended to other regions where there are sufficient numbers of used appliances to make the implementation of such a project financially viable and sustainable (e.g. Cape Town, eThekwini)

6.3.3 MODEL A: INITIAL PHASE

A simplified picture of the envisaged information and money-flows in the initial phase of operation of Model A (i.e. before a MARF is established) is shown in Figure 6-8 below.

6.3.3.1 Principal information flows include:

- Importers and manufacturers → audit bureau: sales volumes by product category; this facilitates the compilation of overall sales volumes by product category, which then flows:
- Audit bureau ⟶ PRO: the above information will then be used by the PRO and ARCO to determine the advance appliance recycling fees payable for various product categories, in order to sustain ARCO's budget for the ensuing year (or other period).

FEASIBILITY STUDY TO DETERMINE THE VIABILITY OF AN INTEGRATED APPLIANCE RECYCLING SYSTEM

Note that it will be vital for budgeting purposes to set quotas for the maximum number of appliances that ARCO will accept in any period. This is necessary to obviate swamping of the recovery and recycling model, which would in turn lead to an unsupportable quantum of payments to consumers and/or SMME collectors.

- PRO ⟶ audit bureau: the advance recycling fees (as set above) payable for various product categories. These will be used by the bureau to compute relevant invoices, which will flow:
- Audit bureau → appliance importers and manufacturers: invoices for advance appliance recycling fees due.

Information flows between ARCO and other entities in the model will include:

- ARCO → Appliance collection or drop-off depots: monthly quotas (see above) for appliances recovered and processed at each depot; prices to be offered to call-in customers for appliances, by type.
- ARCO → SMME appliance collectors: prices offered to collectors for appliances, by type; maximum buy-back prices to be paid for appliances to consumers, dealers, etc.; available depot appliance quotas.
- Appliance collection or drop-off depots → ARCO: monthly records of stock received from SMME collectors and other sources (see above); schedules of stock pre-treated and recyclables despatched to scrap metal dealers and recyclers, etc.; schedules of hours worked by hourly-paid staff and other employment information, etc.
- ARCO → PRO: ARCO's monthly management accounts and operational reports including schedules listing all treatment or safe disposal records.
- ARCO ⟶ accredited scrap metal dealers, plastic and other recyclers, etc.: consolidated invoices for all recyclable materials delivered by or collected from depots, supported by the relevant weighbridge records, etc.
- ARCO → DEA, WIS: all regulatory or compliance reporting associated with operation of the proposed appliance recycling model.
- SMME collectors → appliance collection or drop-off depots: monthly schedules of all appliances, by type, delivered to each depot. This information will be checked against the depot's own records.

6.3.3.2 Principal money flows include

- Appliance manufacturers and importers → Audit bureau: advance appliance recycling fees due.
- Audit bureau → PRO: total amount of advance appliance recycling fees, less agreed audit bureau fees.
- PRO → ARCO: monthly or periodic funding as required and budgeted.
- ARCO → appliance collection or drop-off depot staff and suppliers: payment of facility salaries and wages; payments for supplies and services, etc.
- ARCO → SMME appliance collectors: payment for all appliances delivered to depots, at relevant ruling prices, and reimbursement of all buy-back payments made to consumers, dealers, etc. in respect of appliances delivered by / collected from them.

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- SMME collectors → consumers, dealers, etc.: buy-back amounts for appliances collected[33].

6.3.4 MODEL A: FUTURE PHASE

In the envisaged future phase of operation of Model A (i.e. when a MARF has been established), information and money flows will remain substantially the same as those set out above for the initial phase. However, these flows will need to be expanded to include the MARF, as depicted in Figure 6-9 below.

In respect of **information flows**, the principal additional flows will include:

- ARCO → MARF: monthly quotas (see above) for appliances to be processed; prices to be offered to any call-in customers for appliances, by type.
- Appliance collection or drop-off depots → MARF: monthly records of stock received from collectors and other sources (see above); schedules of stock pre-treated and/or forwarded to the MARF for treatment; schedules of recyclables despatched to scrap metal dealers and recyclers, etc.
- MARF → ARCO: monthly records of stock received from depots and other sources; schedules of stock treated and recyclables despatched to scrap metal dealers and recyclers, etc.; schedules of wastes delivered to or collected by waste disposal and/or waste treatment companies; schedules of hours worked by hourly-paid staff, and other employment information, etc.

In respect of **money flows**, the principal additional flows will include:

- ARCO ⟶ MARF staff and suppliers: payment of facility salaries and wages; payments for supplies and services, etc.

6.3.5 MODEL B

A simplified picture of the envisaged information and money-flows of operation of Model B is shown in Figure 6-10 below.

6.3.5.1 Principal information flows include:

- Importers and manufacturers ⟶ Audit bureau: sales volumes by product category; this facilitates the compilation of overall sales volumes by product category, which then flows:
- Audit bureau ⟶ PRO: the above information will then be used by the PRO and ARCO to determine the advance appliance recycling fees payable for various product categories, in order to sustain ARCO's budget for the ensuing year (or other period). Note that it will be vital for budgeting purposes to set quotas for the maximum number of appliances that ARCO will accept in any period. This is necessary to obviate

[33] It is envisaged that consumers will insist on payment for appliances at the time of collection. As these amounts will accumulate to a considerable sum for a collector over a month, it may be necessary for ARCO to make advance payments into a kitty for each collector, against which they will then draw to fund such payments. Exact details and amounts will be determined at a future stage.

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swamping of the recovery and recycling model, which would in turn lead to an unsupportable quantum of payments to consumers and/or SMME collectors.

- PRO → Audit bureau: the advance appliance recycling fees (as set above) payable for various product categories. These will be used by the bureau to compute relevant invoices which will flow:
- Audit bureau → appliance importers and manufacturers: invoices for advance appliance recycling fees due.
- SMME collectors → centralised appliance recycling facility: monthly schedules of all appliances, by type, delivered to the facility. This information will be checked against the facility's own records.

Information flows between ARCO and other entities in the model will include:

- ARCO → centralised appliance recycling facility: monthly quotas (see above) for appliances recovered and processed at the facility; prices to be offered to call-in customers for appliances, by type.
- ARCO → SMME appliance collectors: prices offered to collectors for appliances, by type; maximum buy-back prices to be paid for appliances to consumers, dealers, etc.; available MARF appliance quotas.
- Centralised appliance recycling facility → ARCO: monthly records of stock received from collectors and other sources (see above); schedules of stock pre-treated and recyclables despatched to scrap metal dealers and recyclers, etc.; schedules of hours worked by hourly-paid staff and other employment information, etc.
- ARCO → PRO: ARCO's monthly management accounts and operational reports including schedules listing all treatment or safe disposal records.
- ARCO → accredited scrap metal dealers, plastic and other recyclers, etc.: consolidated invoices for all recyclable materials delivered by or collected from MARF, supported by the relevant weighbridge records, etc.
- ARCO → DEA, WIS[34]: all regulatory or compliance reporting associated with operation of the proposed appliance recycling model.
- SMME collectors → Centralised appliance recycling facility: monthly schedules of all appliances, by type, delivered to facility. This information will be checked against the facility's own records.

6.3.5.2 Principal money flows include:

- Appliance manufacturers and importers → Audit bureau: advance appliance recycling fees due.
- Audit bureau → PRO: total amount of advance appliance recycling fees, less agreed audit bureau fees.
- PRO → ARCO: monthly or periodic funding as required and budgeted.
- ARCO → Centralised appliance recycling facility staff and suppliers: payment of facility salaries and wages; payments for supplies and services, etc.
- ARCO → SMME appliance collectors: payment for all appliances delivered to centralised appliance recycling facility, at relevant ruling prices, and reimbursement

[34] The National Waste Information System (of the DEA).

FEASIBILITY STUDY TO DETERMINE THE VIABILITY OF AN INTEGRATED APPLIANCE RECYCLING SYSTEM

of all buy-back payments made to consumers, dealers, etc. in respect of appliances delivered by or collected from them.

- SMME collectors → consumers, dealers, etc.: buy-back amounts for appliances collected[35].

[35] It is envisaged that consumers will insist on payment for appliances at the time of collection. As these amounts will accumulate to a considerable sum for a collector over a month, it may be necessary for ARCO to make advance payments into a kitty for each collector, against which they will then draw to fund such payments. Exact details and amounts will be determined at a future stage.

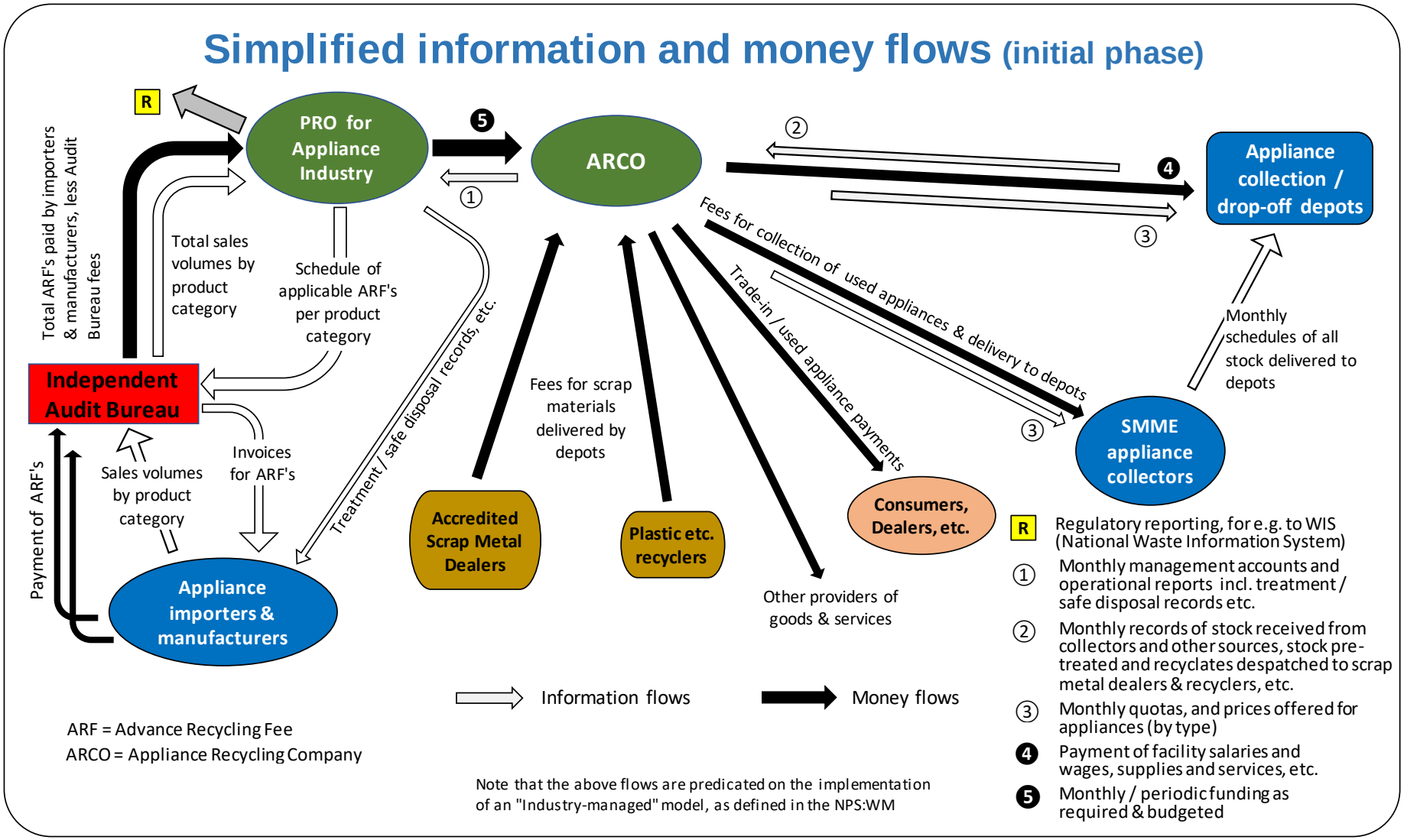

Figure 6-8: Simplified information and money flows (Model A: Initial phase)

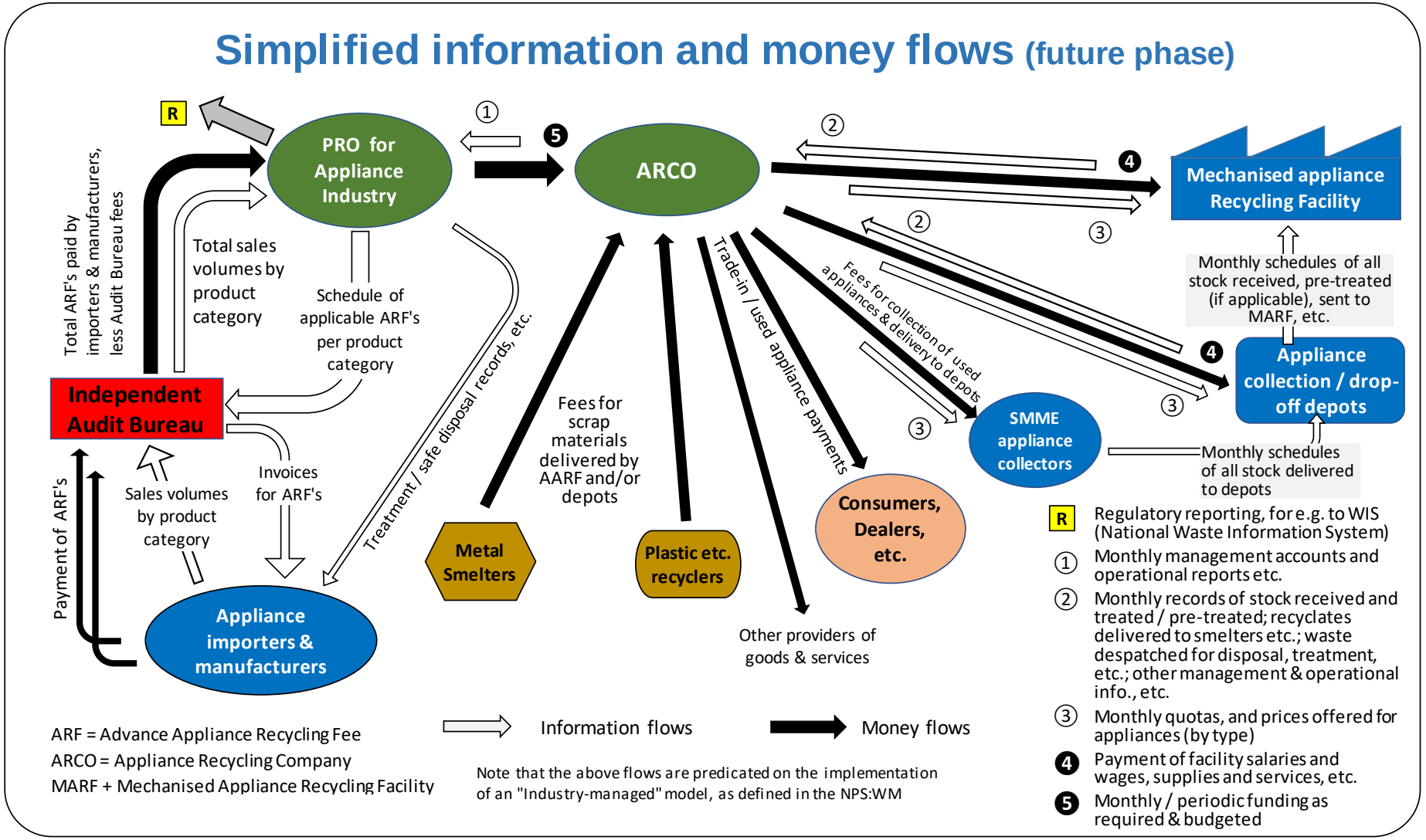

Figure 6-9: Simplified information and money flows (Model A: Future phase)

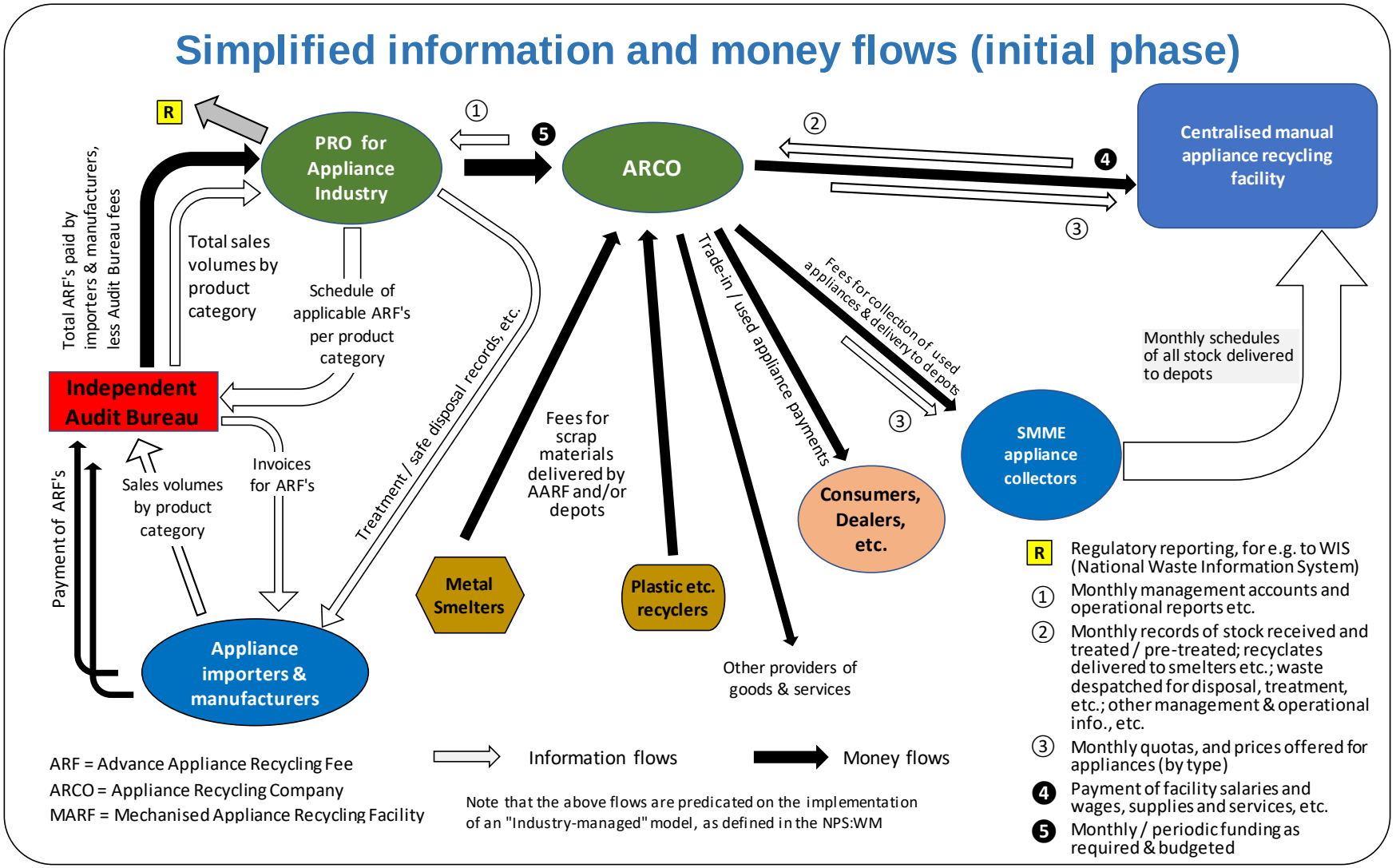

Figure 6-10: Simplified information and money flows (Model B: initial phase)

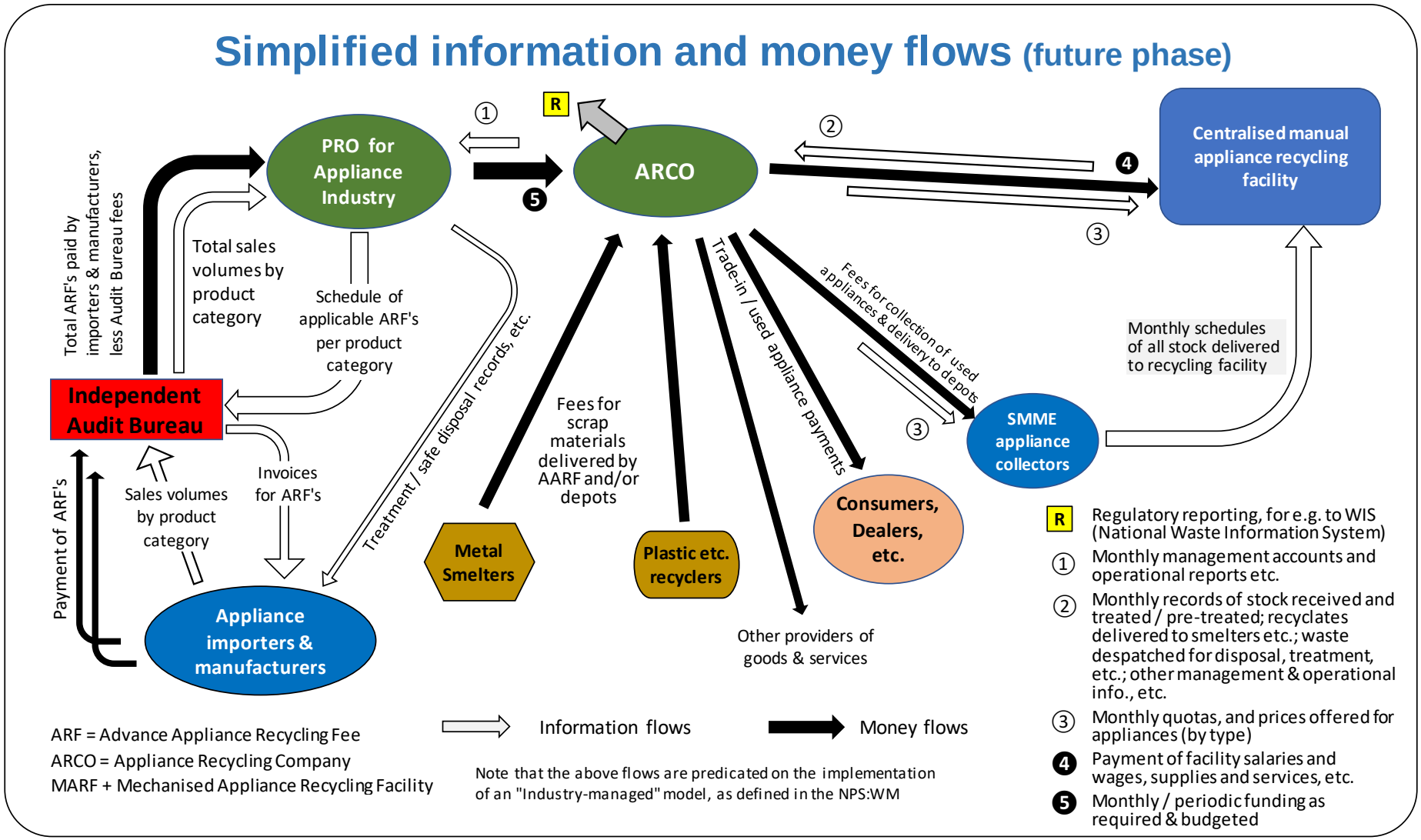

Figure 6-11: Simplified information and money flows (Model B: future phase)

7 FINANCIAL MODEL

This section of the report discusses the financial model created for the various physical flow models. The model is discussed under the following headings:

- Purpose of the model
- Main features of the model
- Important notes concerning the financial model
- Results for proposed recycling models
- Comparison of results
- Conclusion

7.1 PURPOSE OF THE MODEL

The financial model was developed in order to quantify the financial implications of adopting any of the recycling models proposed herein.

Although the sale of recyclables was expected to provide income for the formalized recycling system, it became clear from an early stage that the environmentally-sound recycling of appliances would require substantial additional operational funding, particularly in view of the logistics associated with collection of old appliances from consumers, dealers, etc., as well as the buy-back amounts considered necessary to encourage consumers to make discarded appliances available for environmentally sound recycling. Such additional funding would have to be sourced by way of advance recycling fees (ARFs) paid by appliance manufacturers and importers on their current unit sales volumes. The latter is similar to extended producer responsibility (EPR) systems implemented in developed countries throughout the world.

It was therefore also necessary to determine at what level(s) these ARFs should be set.

7.2 MAIN FEATURES OF THE MODEL

The model was created to provide a 20-year forecast of the cash flows associated with each of the proposed recycling models. A 20-year period was considered prudent, in view of the capital investment required to establish the appliance recycling depots, and more particularly the mechanized appliance recycling facility (MARF), in the event of that being viable.

All likely CAPEX (capital expenditure) and OPEX (operating expenditure) associated with the models were quantified, using reasonable assumptions, as set out in more detail in Appendix E. Cost escalation has also been incorporated into the model, with differential rates being applied in respect of wages, maintenance, insurance, etc.

A cash flow model has a number of advantages, including the ability to determine what level of external funding (if any) would be required for CAPEX under different conditions, as well as providing an insight into the required levels of ARFs required in order to sustain formalized appliance recycling over time.

In this regard, it is important to note that the introduction of a formalized appliance recycling system is unlikely to result in large volumes of used appliances entering the system in large

numbers initially; despite awareness programmes, the adoption of formalized recycling is likely to be slow at first, before gaining momentum as more and more consumers become aware of and choose this method. It is also likely that there will be an upper limit to the proportion of discarded appliances that enter the formal recycling process, i.e. it will never be possible to capture all discarded appliances. The expected trajectory in terms of the percentage of discarded appliances entering the formal recycling system over time is therefore expected to follow a so-called logistic curve, as illustrated below.

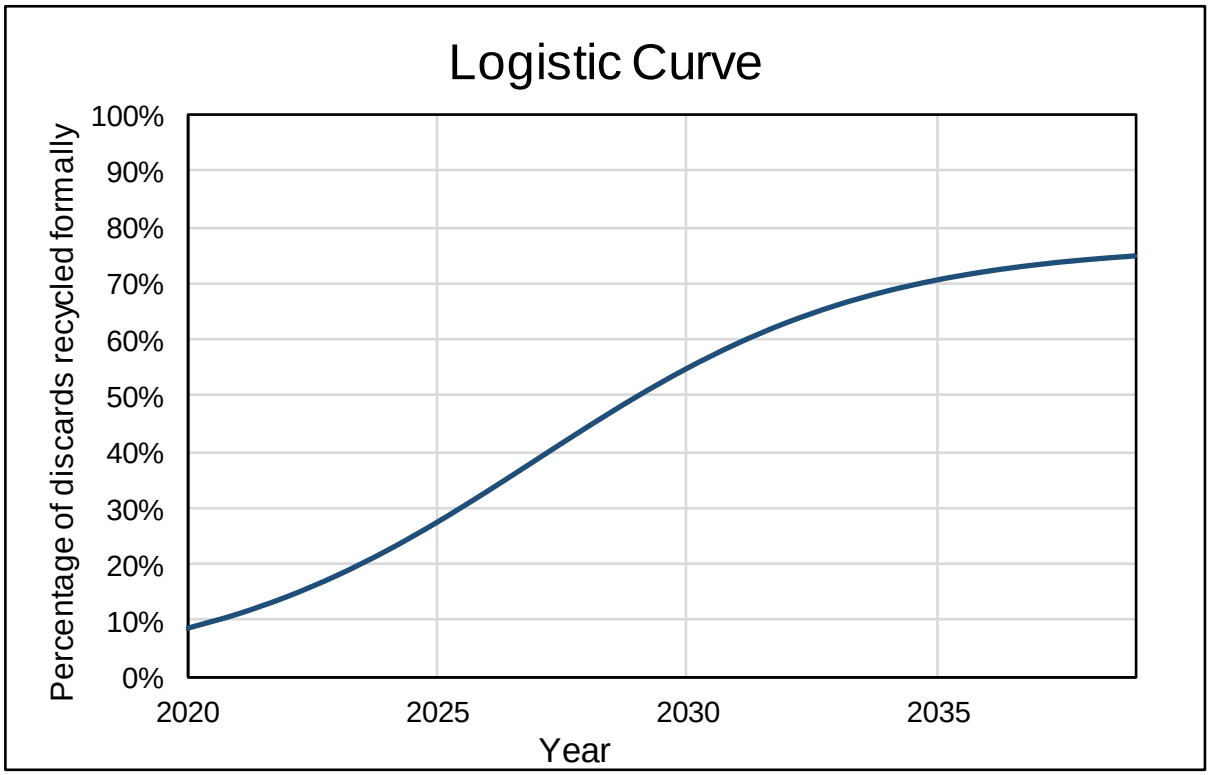

Figure 7-1: Logistic curve

Details of the actual curves used in the model can be found in Appendix E.

As there is a cost associated with the processing of each appliance entering the formal recycling system, the implication of the above is that the overall real (i.e. excluding inflation) costs of operating the system will also increase over time as more discarded appliances are captured.

As indicated above, the majority of ongoing operational funding for the recycling operation will have to come by way of ARFs levied on unit sales of new appliances. Although the number of appliances sold is likely to increase over time due to the growing population, increasing affluence, etc., such increase will not match the growth in the number of appliances entering the formalized recycling system. In consequence, ARFs will have to rise at a rate greater than inflation until well into the future.

From the above, it can be seen that there are already two key variables that must be included in the financial model, viz. the number of appliances entering the formalized recycling system, and projected levels of new appliance sales.

A further variable that must be considered is the price that can be achieved for sales of recyclables. These prices can fluctuate widely, due to supply and demand factors, and to the prices of comparable raw materials. Many recycling projects in South Africa have failed due to overreliance on income from the sale of recyclables.

Each of the variables mentioned above has an effect on the cash flows of the proposed recycling models. This effect can either be assessed by means of sensitivity analyses, which demonstrate the effect of changing variables one at a time, or by means of a computational process in which all the variables are allowed to fluctuate simultaneously according to set probability distributions. The financial model is then "run" iteratively in order to determine the so-called "expected values" of key metrics, by means of "*Monte Carlo simulation*". The process, which has been utilised here, is described in more detail in Appendix E.

7.3 IMPORTANT NOTES CONCERNING THE FINANCIAL MODEL

- Models are only as accurate as the assumptions upon which they are based. One of the chief advantages of a financial model is that it facilitates comparison of alternatives (in the present case, Model A vs. Model B or Model C, with MARF vs. without MARF, etc.). As many of the assumptions apply across all the alternatives, the effect of errors in such assumptions are to this extent neutralised; this means in turn that the comparative assessments can be expected to be more reliable than the absolute results for each of the options compared.
- In the financial model, recycling of appliances is limited to those originating in Gauteng. However, ARFs will apply to appliances sold throughout South Africa. If formalized recycling is at some future stage rolled out more broadly in the country, ARF rates will have to increase further in order to cope with greater numbers of discarded appliances.
- At an early stage in the financial modelling process it became apparent that, due to the high appliance sales volumes and the income arising from the imposition of ARFs, incoming cash flows would be substantial. Accordingly, if depots are constructed on a phased basis, for e.g. only one or two per year during the early stages of implementation, the funds necessary for CAPEX can be generated internally, viz. it should not be necessary to source outside funding by way of borrowings, grants, etc. By extension, if the MARF is only developed 5 or 10 years after introduction of the formalized recycling system, the substantial portion of CAPEX for this can also be funded internally.
- The implications of the previous point suggested that cumulative cash flow would be a particularly important metric for the assessment of the alternative recycling models; in particular, it would be important to ensure that cumulative cash flow was positive through the 20-year modelling period. This therefore became an important objective when determining the required ARF levels.

7.4 RESULTS FOR PROPOSED RECYCLING MODELS

For illustrative purposes, the key model inputs and the results of the financial modelling process will be discussed here for Model A, including a MARF.

The key input variables in this case are:

NPV discount rate	Advance recycl-ing fee (ARF) per kg (year 1)	Base infla-tion rate	Corpor-ate tax rate	Interest rate on borrowed funds	MARF construc-ted in year .. (" N " = no MARF)	Recyclate value 'penalty' at depots (to account for poor segrega-tion, etc.)	ARF growth above base infla-tion rate:	MARF plant cost inflation above base inflation rate:
25.0%	R0.75	6.0%	0.0%	10.0%	10	-25%	4%	5%

ARF 'growth acceleration factor':	1.2

Note: interest rate on surplus funds invested = 75% of borrowing rate.

While most of the variables are self-explanatory, the following may need some clarification, viz.:

- NPV discount rate: The discount rate should reflect both the actual cost of capital associated with the firm or entity undertaking the envisaged project, as well as the risks associated with the project. For simplicity, the first element is taken to be the interest rate that a commercial bank would charge the entity; with the prime lending rate (i.e. the interest rate at which banks will lend to their best customers) at 10.25% in South Africa at the time of writing, an interest rate of around 12–13% could be anticipated for this project. To take account of normal/average commercial risks, a premium of 5–6% would be added to the above in order to determine the discount rate for NPV purposes. However, additional risks are associated with the current project, including the risks that the costs associated with (i) collecting and processing the used appliances and (ii) incentivising customers to part with these appliances, are significantly higher than have been assumed. Additionally, as most of the income required to operate the proposed recycling system will be collected by way of advance recycling fees payable by suppliers of new appliances, care needs to be taken to ensure that these fees are conservatively estimated, i.e. that negative surprises are avoided. In view of these project-specific risks, a relatively high discount rate of 25% has therefore been applied here.
- Advance Recycling Fee (ARF) per kilogram (year 1): A per-kilogram rate has been used in the financial model for the sake of simplicity, as it facilitates relatively easy computation of the mass of the various materials contained in the respective appliances. The financial model applies this rate to the average expected mass of the various categories of appliance in order to yield per-appliance rates (in this case R38.25 for fridges and freezers, R33.00 for air-conditioning appliances, and R27.00 for non-cold appliances). In practice, it is anticipated that ARFs will be set on a more equitable basis, for example on a per-litre of capacity basis (fridges and freezers), and a per-kilowatt basis for air-conditioning appliances, etc.)
- The year in which the MARF is constructed. The financial model accommodates the construction of the MARF at any stage during the 20-year modelling period. However, from a practical point of view, the MARF will probably only be constructed once two

criteria are met, viz. (i) the volume of fridges and freezers passing through the recycling system justifies investment in a mechanized appliance recycling facility, and (ii) sufficient financial reserves have been accumulated to fund the high CAPEX associated with the MARF. Construction in or around the tenth year of operation has been found to yield satisfactory results. (Note that the financial model has been developed on the basis that the MARF will only come into full operation in the year after construction. This means that CAPEX is expended in year 10 in the current example, while the benefits (and costs) associated with operation of the MARF only come into effect in year 11. It should also be mentioned that the function of the depots changes once the MARF is operational, viz. only non-cold appliances and air conditioners are pre-treated at the depots once the MARF is in operation, whereas all appliances are pre-treated at the depots prior to this point. The effect of this is that depot throughput increases once the MARF is operational, without a concomitant increase in depot operating costs. For the same reason, the rate at which new depots have to be added to cater for increased volumes of appliances passing through the system slows down after the MARF comes into operation.)

- Recyclables penalty: It has been assumed that the value (i.e. selling price) of recyclables produced at the depots will be less than that for those produced at the MARF, due to inferior segregation of metals in particular, and the lack of shredding - resulting in ferrous metals being sold as sub-grade.
- ARF growth above inflation rate: as mentioned above, ARFs will need to increase at a rate higher than base inflation in order to accommodate the increased volumes of appliances passing through the recycling system over time, notwithstanding the fact that sales of new appliances are expected to increase over time. (A premium of 4% per annum has been found to yield satisfactory results.).
- ARF growth acceleration factor: this is a safety mechanism which allows the financial model to increase the ARF at a higher rate in cases where cumulative cash flows are seen to be falling at any time during the 20-year modelling period. In the example above, base inflation is at 6% and ARF growth is 4% above inflation; this means that ARFs will be increasing at a rate of 10% per annum under normal circumstances. However, in the case of falling cumulative cash flows, this rate would be increased automatically by the model to 12% per annum (i.e. 1.2 x 10%), viz. at 6% above base inflation.
- MARF cost inflation above base inflation rate: as the bulk of the mechanical components of the MARF will be sourced from Europe, an allowance has been made for depreciation in the Rand:Euro exchange rate over time.
- Corporate (income) tax rate: Although this rate can be set at any value (the current rate applicable to for-profit companies is 28%), the rate has been set to zero here, as it is anticipated that the various entities comprising the appliance recycling system (in particular the PRO and ARCO) will be non-profit companies. (Note that depreciation allowances in respect of CAPEX are taken into account by the financial model, in case it becomes necessary to treat ARCO as a for-profit entity.)

Other important inputs include the expected volumes (numbers) of discarded appliances passing through the recycling system, and the projected sales of new appliances. In the interests of brevity, these inputs are not discussed here but are dealt with in some detail in Appendix E.

Key outputs from financial model in the case of Model A – with MARF.

Results from the *Monte Carlo* simulation process (500 iterations) are as follows:

Table 7-1: Results from *Monte Carlo* simulation

Consolidated *Monte Carlo* simulation results

Expected* values:

Minimum cumulative cash-flow =	**R57m**
NPV of 20-year cash-flows @ 25% =	**R370m**
NPV of ARFs @ 10% =	**R2,590m**
Annual effective ARF escalation =	**10.3%**
Total F+F appliances treated =	**4,801,000**
Total A/C appliances treated =	**1,824,000**
Total non-cold appliances treated =	**2,889,000**
Overall total all appliances treated =	**9,500,000**
Total person-years: all personnel =	**4,700**
Total person-years: semi- & un-skilled =	**3,500**
Tot. person-yrs: SMME collectors + assistants =	**6,700**
Total person-years: all personnel + SMME collectors & assts. =	**11,400**
Number of depots operating in year 20 =	**6.6**

**** 'Expected' in this sense refers to "statistically expected value", which can be expressed mathematically as:***

$$\sum_{k=1}^{n} probability\ (k)\ x\ outcome\ (k)$$

Certain of the values listed above will require explanation, including:

- (Expected) minimum cumulative cash flow: the significance of this is that, given the possible ranges of (i) discarded appliance throughputs, (ii) new appliance sales volumes, and (iii) prices achieved in the sale of recyclables, the statistically expected minimum cumulative cash flow will be approximately R57 million. This is important as it indicates that it is unlikely that funds will need to be borrowed in order to set up the recycling system and/or sustain its operation (see also section 7.4). However, it does not mean that such eventuality can be completely ruled out, as the corresponding cumulative probability chart below indicates.

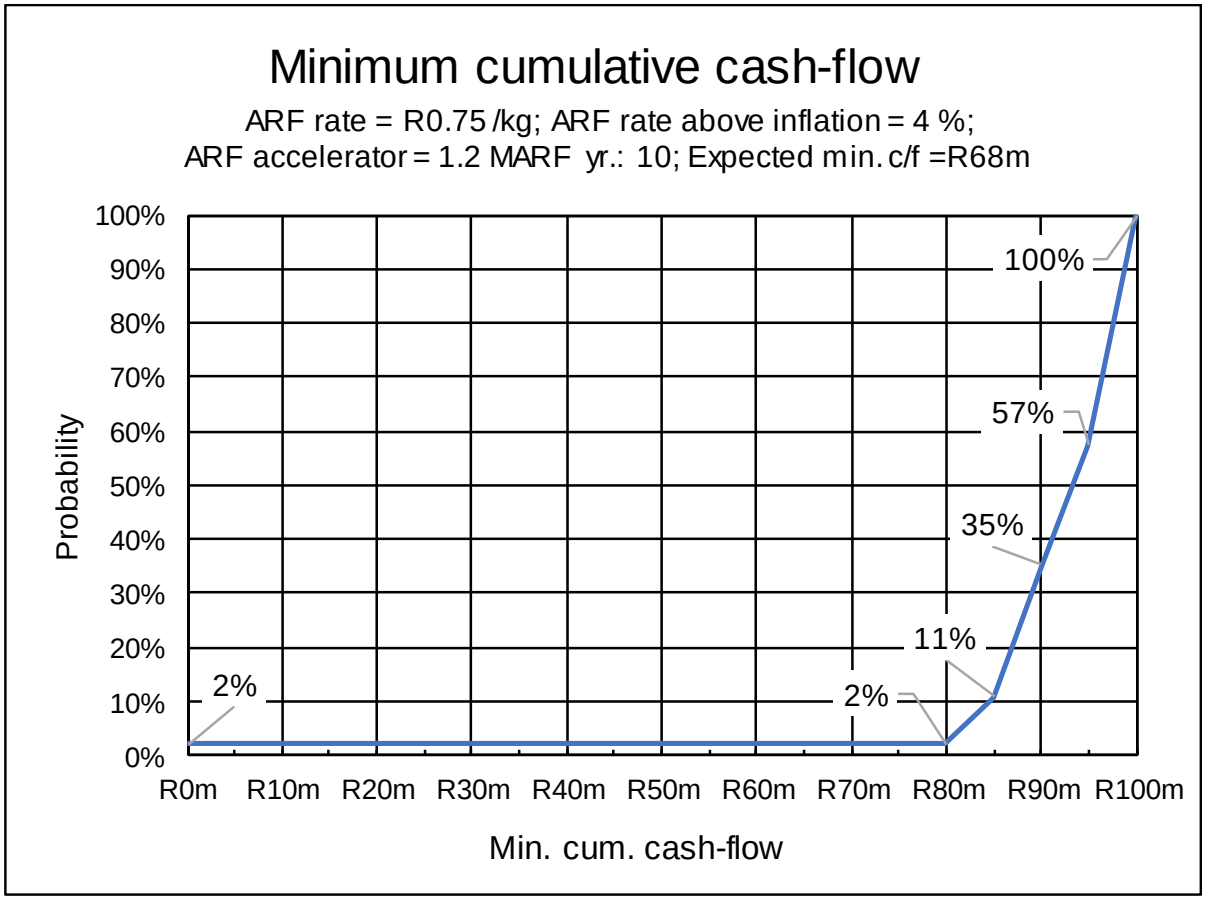

Figure 7-2: Minimum cumulative cash flow

This chart (Figure 7-2), derived from the relevant Monte Carlo simulation, shows the cumulative probability of a minimum cumulative cash flow. As may be seen from this chart, there is 2% probability that the minimum cumulative cash flow could be zero or less (i.e. negative). Conversely, there is 98% probability that the minimum cumulative cash flow will be greater than zero (in fact greater than R80 million). It can also be deduced from the chart that the probability of a minimum cumulative cash flow greater than R100 million is zero.

- (Expected) NPV (net present value) of 20-year cash flows at 25%: NPV is a mechanism used to determine the present value of future cash flows. A positive value indicates that the proposed project has a positive monetary value (i.e. is financially sustainable over the project period), even at the relatively high discount rate of 25% applied here. (Note that the use of a lower rate would yield a higher NPV, and conversely.)
- (Expected) NPV of ARFs (advance recycling fees) at 10%: this metric has been included for comparative purposes between the various recycling models under consideration (see section 7.5). It represents the statistically expected present value of future ARFs collected from manufacturers and importers. Expressed differently, it is the amount that would need to be invested today at an interest rate of 10% per annum to yield all the ARF contributions required to sustain the scheme over the 20-year model horizon. The significance of this is that the higher the value, the greater the financial burden placed on manufacturers and importers over the 20-year model horizon.

- (Expected) annual effective ARF escalation: This is the statistically expected annual rate at which ARF amounts (per kilogram and per appliance) will need to increase over the 20-year model horizon.
- The metrics relating to the (expected) numbers of appliances passing through the system and to the (expected) employment numbers[36] are self-explanatory.
- In the case of total person-years – all employees (depots + MARF), it can be seen from the above that the (statistically) expected value is 4 700 person-years. For illustrative purposes, a histogram reflecting the probabilities associated with total person-years is presented below.

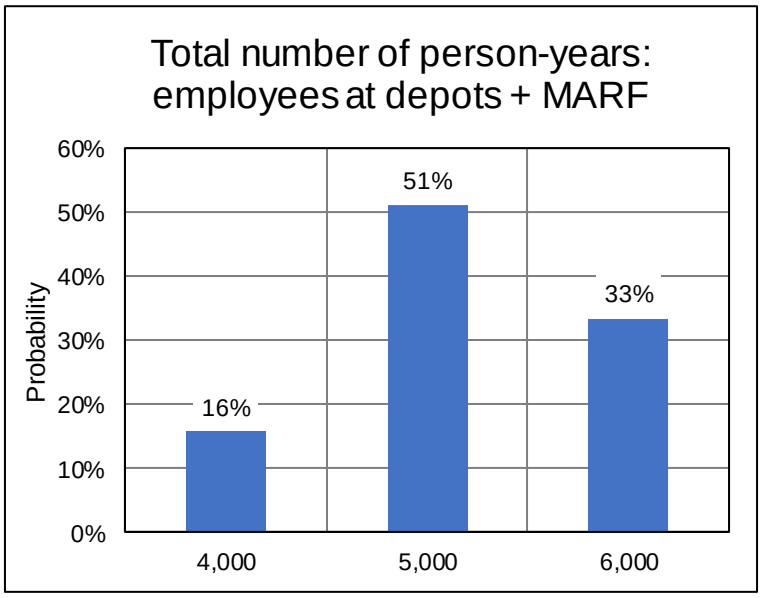

Figure 7-3: Total number of person-years: employees at depot and MARF

This chart, which is a histogram of the results of the relevant *Monte Carlo* simulation, indicates that there is a 16% probability that total person-years will be 4 000 or less, a 51% probability that the value will lie between 4 000 and 5 000, and a 33% probability that the value will lie between 5 000 and 6 000.

7.5 COMPARISON OF RESULTS

Results were computed for Models A and B, both with and without a MARF. Comparative results are shown in the table below.

[36] This only includes employees at the depots and the MARF (if present). If the MARF included, heavy vehicle drivers associated with the transport of F+F's from depot to MARF, and with the transport of recyclables to processors, are included. The numbers exclude employees in the ARCO and PRO offices. SMME numbers (which assume that each SMME appliance collector employs one assistant) are shown separately.

Table 7-2: Comparative results from financial model

Comparative results from financial model

		MODEL A			MODEL B		
		No MARF	MARF yr. 5	MARF yr. 10	No MARF	MARF yr. 5	MARF yr. 10
Model inputs	***ARF / kg: year 1***	**R0.67**	**R0.76**	**R0.75**	**R0.80**	**R0.90**	**R0.88**
	ARF per appliance year 1: F+F	R34.17	R38.76	R38.25	R40.80	R45.90	R44.88
	ARF per appliance year 1: A/C	R29.48	R33.44	R33.00	R35.20	R39.60	R38.72
	ARF per appliance year 1: Non-cold	R24.12	R27.36	R27.00	R28.80	R32.40	R31.68
	Buy-back amounts offered in year 1:						
	F+F per average appliance	R170.00	R170.00	R170.00	R170.00	R170.00	R170.00
	A/C per average appliance	R215.00	R215.00	R215.00	R215.00	R215.00	R215.00
	Non-cold per average appliance	R80.00	R80.00	R80.00	R80.00	R80.00	R80.00
	Payments to SMME collectors in year 1:						
	F+F per average appliance	R150.00	R150.00	R150.00	R240.00	R240.00	R240.00
	A/C per average appliance	R100.00	R100.00	R100.00	R160.00	R160.00	R160.00
	Non-cold per average appliance	R100.00	R100.00	R100.00	R160.00	R160.00	R160.00
Model outputs	***Statistically expected values from Monte Carlo simulations:***						
	Total number of appliances treated over 20-year period	9.6m	9.5m	9.5m	9.4m	9.4m	9.5m
	Number of depots operating in year 20	11.5	6.6	6.6	n/a	n/a	n/a
	Total person-years: all personnel	5,600	4,500	4,700	3,800	3,500	3,500
	Total person-years: Semi- and un-skilled personnel	4,500	3,300	3,500	3,500	2,900	3,000
	Total person-years: SMME collectors + assistants	6,800	6,700	6,700	9,400	9,400	9,500
	Total person-years: all personnel + SMME collectors & assts. =	12,400	11,200	11,400	13,200	12,900	13,000
	Annual ARF escalation rate required	**10.1%**	**10.2%**	**10.3%**	**10.1%**	**10.2%**	**10.3%**
	Minimum cumulative cashflow	R55m	R69m	R57m	R51m	R67m	R53m
	NPV @ 25%	R350m	R290m	R370m	R440m	R390m	R440m
	NPV of ARFs	R2,270m	R2,630m	R2,590m	R2,730m	R3,110m	R3,030m

Significant conclusions from the comparative results:

- In terms of the level of ARFs required to sustain recycling operations, Model A (no MARF) offers the best alternative, both in terms of the ARFs required in year 1 (R0.67/kg), and in terms of the required annual ARF escalation rate required (10.1%).
- In terms of numbers of staff employed (at the depots and MARF), Model A (no MARF) also offers the highest total expected person-years over the 20-year model horizon, both overall and in respect of semi-skilled and unskilled staff (5 600 and 4 500, respectively). (Note that if person-years for SMME collectors + assistants are included, the totals for Model B are between 6% and 14% higher than those for Model A.)
- The introduction of a MARF in Model A increases the required year-1 ARF above the level required for a no-MARF scenario (the increase is R0.08 per kilogram [~12%] for a MARF in year 10, and R0.09 per kg [~13%] for a MARF in year 5). The introduction of a MARF also marginally increases the required annual ARF escalation rate. The overall

effect of an increase in year-1 ARFs and required annual escalation rate means that the net present value (NPV) of the ARFs paid by manufacturers and importers increases by ~14% and ~16% for MARFs constructed in year 10 or year 5, respectively, over that for the no-MARF alternative.

- The year-1 ARFs required for Model B are all higher than the highest year-1 ARF of Model A. The required year-1 ARF for Model B (no MARF) is ~19% higher than that required for Model A (no MARF). ARFs required in Model B (with MARF) are ~17% and ~18% higher than those required for Model A, at 10 and 5 years, respectively.
- Similar to the case with Model A, the ARFs required in Model B (including MARF) are higher than those required for Model B (no MARF), by respectively ~10% (MARF in year 10) and ~13% (MARF in year 5).

It is important to remember that the analysis and conclusions above are based on the imposition of ARFs on national sales, while the formalised recycling system only relates to Gauteng. Expansion of formalised recycling to other provinces will increase the overall costs, and therefore inevitably necessitate an increase in the ARFs imposed.

Finally, please note that the slight differences (~2%) in the total numbers of appliances processed over the 20-year project for the various options (ranging between 9.4m and 9.6m) can be ascribed to the randomizing process within the simulation, and to rounding-errors.

7.6 CONCLUSION

The financial model was developed in order to quantify the financial implications of adopting any of the recycling models proposed herein.

It became clear from an early stage that, in addition to income derived from the sale of recyclables, the environmentally-sound recycling of appliances would require substantial additional operational funding by means of advance recycling fees (ARFs), to be paid by appliance manufacturers and importers on their current unit sales volumes. Determination of the level of ARFs necessary to sustain operation of the proposed recycling system, and the rate at which ARFs would need to rise over time to accommodate the increasing number of appliances entering the recycling system, therefore became a key objective in the modelling process.

The model was created to provide a 20-year forecast of the cash flows associated with each of the proposed recycling models. A 20-year period was considered prudent, in view of the capital investment required to establish the appliance recycling depots, and more particularly the mechanized appliance recycling facility (MARF), in the event of that being viable.

The model confirmed that, due to the high appliance sales volumes and the income arising from the imposition of ARFs, incoming cash flows would be substantial. Accordingly, if depots are constructed on a phased basis, for e.g. only one or two per year during the early stages of implementation, the funds necessary for CAPEX can be generated internally, i.e. it should not be necessary to source outside funding by way of borrowings, grants, etc.

In order to ensure that all necessary CAPEX could be funded internally, it would be necessary to ensure that cumulative cash flow was positive through the 20-year modelling period. This therefore became another important objective when determining the required ARF levels.

Comparison of results for the two recycling models (Models A and B) demonstrated that ARFs associated with Model A (multiple, distributed recycling depots) were lower than those associated with Model B (single, centralised recycling depot), both with and without a MARF (mechanised appliance recycling facility). Note that a lower ARF implies a lower cost to appliance manufacturers and importers, and by extension to customers purchasing new appliances

Model A (without MARF) offered the lowest overall ARF level (R0.67 per kilogram in year 1). The ARF would need to escalate at a rate of 10.1% per annum (i.e. 4.1% above nominal inflation of 6%) to ensure long-term sustainability of the proposed recycling system.

In terms of employment opportunities, Model A (distributed depots, no MARF) offers a total of 5 600 person-years of employment over the 20-year time horizon. Of this total, 4 500 person-years represent semi-skilled and unskilled opportunities.

Over and above these opportunities, a further 1 200 person-years of employment are projected for SMME appliance collectors and their assistants.

Other than the possible need for nominal funding to support administrative activities during the first few months of operation of the proposed recycling system, all necessary CAPEX and OPEX can be funded internally.

From the financial model, it is thus concluded that the initial phase of Model A is the preferred option, should no donor funding be available.

8 PROPOSED LEGAL FRAMEWORK FOR APPLIANCE RECOVERY AND RECYCLING SYSTEM

This section of the report discusses the proposed legal framework for the appliance recovery and recycling system under the following headings:

- Delicensing
- National Norms and Standards
- Regulation.

8.1 DELICENSING

Following the above discussion and in light of the precedent set with respect to waste from the scrapping or recovery of motor vehicles and tyres, it is recommended that the Minister delicenses the treatment, recycling and recovery of WEEE, subject to registration with the DEA and compliance with national norms and standards for WEEE operations and a new WEEE regulation to be gazetted.[37]

8.2 NATIONAL NORMS AND STANDARDS

It is proposed that the Minister publish as a schedule to the WEEE regulations (proposed below), *National Norms and Standards for the Collection, Storage, Treatment, Recycling, Recovery and Disposal of WEEE* (Norms and Standards) in terms of section 19(3)(a) of NEMWA. The Norms and Standards will provide technical uniformity and legal certainty for the design, construction, operation and decommissioning of WEEE facilities. This will enable the responsible collection, storage, treatment, recycling, recovery and re-use of WEEE and reduce environmental pollution and degradation. The Norms and Standards discussed below focus primarily on the WEEE recycling of appliances in Gauteng as discussed in this report and can be expanded to provide for IT and Telecommunication or other categories of WEEE.

8.2.1 MINIMUM ENVIRONMENTAL REQUIREMENTS FOR THE DESIGN, PLANNING, LOCATION, CONSTRUCTION OR UPGRADING OF A WEEE FACILITY

It should stipulate the minimum requirements for the design, planning, location, construction or upgrading of –

- Low volume WEEE recycling facilities that are used for the initial collection, storage and pre-treatment of WEEE (for example depots).
- Large volume WEEE facilities for treatment and recovery of such as the proposed MARF in Gauteng.

8.2.2 MINIMUM ENVIRONMENTAL REQUIREMENTS FOR THE OPERATION OF A WEEE FACILITY

- WEEE recycling during collection, storage and pre-treatment of WEEE

[37] Section 19(2)(b) and (3)(a) of NEMWA.

- Specify extent of pre-treatment for different types of WEEE to be recycled to address the potential impact of hazardous substances.
- For example, as indicated in this report, pre-treatment is required for non-cooling appliances (removal of loose items, removal of printed circuit boards (PCBs) as well as removal of switches and globes containing hazardous metals like mercury). Refrigerants, oils as well as motors and condensers must be removed for non-cooling like loose items.
- WEEE recycling by a mechanised recycling facility (such as the MARF envisaged for appliance recycling in Gauteng) for the treatment and recovery of WEEE
- Where a MARF is provided, pre-treatment of cooling appliances must be undertaken at the recycling facility itself, with insulation materials only removed as part of the mechanised recycling process. Insulation materials can only be removed manually where the necessary measures are taken to prevent release of blowing agents, or ignition of flammable insulation materials.
- Other recycling facilities e.g. scrap metal dealers (SMDs), plastic recyclers, smelters and waste disposal facilities will not be addressed by the proposed Norms and Standards as they must comply with other legal instruments.[38]

8.2.3 MINIMUM REQUIREMENTS FOR THE STORAGE, TRANSPORTATION AND SHIPMENT OF WEEE

- Storage: Require compliance with the National Norms and Standards for the Storage of Waste[39] in terms of NEMWA that apply to delicenced listed activities[40].
- Transportation: With the exception of small WEEE loads transported by SMMEs by road, it requires compliance with the minimum technical requirements or standards for road, marine or air transportation of WEEE containing hazardous materials (where the minimum thresholds are met). For example, refer to SANS 10228[41] for road transport by the National Road Traffic Regulations[42].
- Shipment: Stipulate documentary requirements to distinguish between EEE and WEEE e.g. for the shipment of second hand EEE or the shipment of defective EEE for repair or root cause analysis to the producer, supplier or another third party within, or from (export) or to (import) South Africa. Refer to the exports and import documentation for EEE and WEEE by the International Trade Administration Act (No. 71 of 2003) and the NEMWA Regulations regarding the Import and Export of Waste[43] (thereby

[38] These are specific environmental authorisations (EA), waste management licences (WML) and waste management plans (WMP) for each facility and in general the provisions of NEMWA, Waste Classification and Management Regulations (GN R634 of 23 August 2013), National Norms and Standards for the Assessment of Waste for Landfill Disposal (GN R635 of 23 August 2013) and the National Norms and Standards for Disposal of Waste to Landfill (GN R636 of 23 August 2013).

[39] GN R926 of 29 November 2013.

[40] GN R921 of 29 November 2013, as amended.

[41] The identification and classification of dangerous goods for transport.

[42] GN R225 of 17 March 2000, as amended. See the SANS standards for the transportation of dangerous goods incorporated by regulation 273A.

[43] GN R22 of 21 January 2019.

indirectly to the requirements of the Basel Convention[44]) and waste transport manifest requirements in the Waste Classification and Management Regulations[45].

8.2.4 TRAINING OF PERSONNEL EMPLOYED AT THE WEEE FACILITY

- Provide training in occupational health and safety and environmental (SHE) risks and impacts as part of induction training and capacity building of staff and suppliers rendering a service such as informal WEEE collectors and SMMEs.
- Provision should be made for SMMEs to obtain assistance with registration by the DEA or provincial regulator.

8.2.5 HANDLING OF EMERGENCY SITUATIONS AT A WEEE FACILITY

WEEE facilities must develop an emergency plan for approval on a response procedure to safety, health and environmental emergencies and ensure implementation thereof.

8.2.6 MONITORING, AUDITING AND REPORTING OF A WEEE FACILITY

Daily inspection and monitoring of the facility and recording of environmental impacts and potential problems for corrective action must be performed.

Two formal internal audits per annum (bi-annually) must be performed by the facility and the report provided to the regulatory authority.

A biennial audit by an independent auditor must be performed with a formal report on the effectiveness of environmental impact management and compliance at the facility must be provided to the regulatory authority. The audit must be performed (with the necessary changes) in accordance with regulation 34 of the NEMA EIA Regulations[46].

8.2.7 MINIMUM ENVIRONMENTAL REQUIREMENTS DURING DECOMMISSIONING OF A WEEE FACILITY

It should describe the requirements for the closure and removal of a facility and the remediation of pollution, which must be reflected in the rehabilitation plan that must be approved by the regulatory authority. A basic assessment may be required to obtain Environmental Authorisation (EA) to decommission certain facilities in terms of section 24F of NEMA.

8.3 REGULATION

8.3.1 REGULATORY POWER

Certain aspects of the envisaged WEEE recycling process must also be addressed by enabling regulations to ensure the lawful and effective administration and management of WEEE

44 *Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposa*l, Basel, 22 March 1989 in force on 5 May 1992 (http://www.basel.int).

45 Regulation 11 of GN R634 of 23 August 2013.

46 GN R982 of 4 December 2014, as amended.

recycling in South Africa to realise the objectives of NEMWA and the constitutional environmental rights. This cannot be done only by WEEE policy and management documents such as the proposed National Norms and Standards and IndWMP but under the rule of law and legality principle of the Constitution, appropriate legislation is required.

Section 69(1) of NEMWA empowers the Minister to make regulations pertaining to different aspects of the WEEE recycling process[47], as discussed below.[48]

The proposed waste regulation is a law of general application and supersedes an IndWMP, which is subsidiary thereto and applies only to the specific industry for which it has been approved by the competent authority as a general management plan.

8.3.2 WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (WEEE) REGULATIONS

8.3.2.1 Definitions

The definition provision should provide the legal definition for important terms not defined in NEMWA for purposes of the WEEE regulations such as producers, distributors, EEE, WEEE, etc. For example, producer is defined in EU law to include natural or legal persons that are manufacturers, sellers, distance sellers, resellers (unless the brand of the producer appears on the product), importers and exporters of an appliance and some distributors[49] but not a financier in terms of a finance agreement that do not produce EEE.[50] The term EEE is defined with reference to the maximum voltage and the current of the product.[51]

8.3.2.2 Scope and Application

This provision should describe the different categories of EEE and types of EEE under each category that are covered by the Schedules to the regulations. For example, e.g. large

47 Section 69(1)(b), (c), (e), (i), (m), (o), (p), (t) and (ee) of NEMWA.

48 The failure of Government in the past to exercise its regulatory powers provided for in enabling legislation such as the Environmental Conservation Act 73 of 1989 was criticised by the High Court in *Verstappen v Port Edward Town and Other* 1994 (3) (SA 569 (D) at 573D: "*… the clear intention of the Legislature as expressed in s 20(1) of the Act cannot be overridden by the Minister's failure, whether inadvertent or intentional, to make the appropriate regulations."*

49 Section 1 of the CPA states that '***distributor'***, in relation to any particular goods, means *"a person who, in the ordinary course of business (a) is supplied with those goods by a producer, importer or other distributor; and (b) in turn, supplies those goods to either another distributor or to a retailer*" A '**retailer**' with respect to any particular goods, means "*a person who, in the ordinary course of business, supplies those goods to a consumer." Thus, under the CPA, a retailer is similar than a supplier*.

50 According to the EU definition in Article 3 of the Recast WEEE Directive (Directive 2012/19/EU (Recast)). Section 1 of the CPA stipulates that '***producer'***, with respect to any particular goods, means "*a person who (a) grows, nurtures, harvests, mines, generates, refines, creates, manufactures or otherwise produces the goods within the Republic, or causes any of those things to be done, with the intention of making them available for supply in the ordinary course of business; or (b) by applying a personal or business name, trade mark, trade description or other visual representation on or in relation to the goods, has created or established a reasonable expectation that the person is a person contemplated in paragraph (a)."*

51 EEE is defined by the EU in Article 3 of the Recast WEEE Directive (Directive 2012/19/EU (Recast)) as "*equipment which is dependent on electric currents or electromagnetic fields in order to work properly and equipment for the generation, transfer and measurement of such currents and fields and designed for use with a voltage rating not exceeding 1 000 volts for alternating current and 1 500 volts for direct current*."

household appliances (LHA), small household appliance (SHA), Information Technology (IT) and Telecommunication Equipment (TE), each with its types of appliances. The extent of the aforesaid lists is potentially very broad if international experience is followed and should be clarified to create legal certainty.

The regulations should apply to any natural or legal person that generates, collects, stores, treats, recycles, recovers, imports, exports, re-uses or disposes of waste from EEE listed in the schedules to the regulations.

This provision should prohibit any contravention of or non-compliance with the regulations and the schedules.

8.3.2.3 Producers' Obligations

Pursuant to the EPR principle, all producers of EEE should join a Producer Responsibility Organisation (PRO) and must submit specified information on the specified forms indicated in a schedule to the regulations.

A PRO must register all producers on SAWIS and obtain a registration number for each producer in terms of section 60 of NEMWA or on a provincial information system.[52] The South African Waste Information System (SAWIS) may have to be adapted to capture information specific to the WEEE recycling process. The required information can be restated in a schedule for clarity.

The labelling requirements for WEEE[53] regulation should require producers to mark the EEE with the international symbol of a crossed-out wheeled bin and specify the manufacturing date as per illustration in a schedule to the regulation to prevent WEEE from being disposed of as domestic waste to landfill.

Product design requirements may be prescribed by notice in the Government Gazette. Producers must comply with specific eco-product design, manufacturing, material and/or packaging requirements to enable effective re-use, recycling and recovery of EEE.[54]

Producers should carry out life cycle assessments of the EEE that they produce in order to ensure WEEE management can take place according to the regulations, prescribed national norms and standards and approved IndWMP.[55]

8.3.2.4 Institutional Arrangements

The proposed corporate and commercial structures and institutional arrangements for WEEE recycling will be determined by the specific part of the EEE industry that is targeted and the

[52] Sections 6O and 61 of NEMWA, regulation 8 and Annexures 2-5 of the NWIR for the waste information to be reported on SAWIS.

[53] Section 69(1)(r) of NEMWA - under subsection (2) it requires prior consultation with the DTI.

[54] Section 69(1)(l) and (n) of NEMWA – under subsection (2) it requires prior consultation with the DTI.

[55] Section 69(1)(k) of NEMWA – under subsection (2) it requires prior consultation with the DTI.

geographical scope of operations as illustrated by the choice of Models A, B or C in this report for the recycling of WEEE appliances in Gauteng.[56]

The regulations provide for the establishment and roles of the following WEEE Institutions:

- A Producer Responsibility Organisation (PRO) that represents the producers of EEE and ensures producer compliance with the WEEE regulations.
- A PRO has the power to make its own financial arrangements to ensure financially sustainable functioning and adherence to strict financial and management standards. It determines the Advance Recycling Fee (ARF) payable by Producers to it. A PRO disburses funds for the operation of WEEE recycling facilities of a particular EEE recycling process such as the Depots and Appliance Recycling Company (ARCO) for the Gauteng appliance process in this report.
- A PRO may establish, own, manage and operate entities and operational facilities for the WEEE recycling process or it can hire independent parties to perform some of its functions such as the collection, bulk pre-treatment, transport of WEEE or operation of WEEE facilities.

8.3.2.5 Requirements for WEEE Operations

As stated above, the detailed requirements, roles, responsibilities and institutional arrangements for the collection, transport, pre-treatment, storage, recycling, recovery, re-use, export and disposal of WEEE will be formulated once consensus has been reached on the specific type of WEEE and extent of the recycling process.

WEEE facilities for WEEE recycling (such as depots, the MARF or the Centralised Manual Recycling Plant for the Gauteng recycling of WEEE appliances) must be registered with the DEA on SAWIS or with the provincial regulatory authority on the provincial waste information system, where available, and be provided with a registration number as a WEEE operator. Changes to SAWIS documentation may be required.

Persons transporting WEEE, including SMME collectors, must also register[57] on SAWIS by the DEA or on the provincial waste information system by the provincial regulatory authority and be provided with a WEEE transportation registration number. Presently, SAWIS does not provide for registration of WEEE transportation and it should therefore be expanded to cover transportation of WEEE.[58]

The regulation must indicate that the National Norms and Standards that specify the requirements for the location, planning, design and operation of WEEE facilities are provided in a schedule to the regulations or may be published in the Government Gazette.[59] The regulation should require an operator of a WEEE facility to comply with the norms and

[56] See Figure 6-6 for Model A and Figure 6-7 for Model B.

[57] Section 69(1)(t) of NEMWA.

[58] Regulation 5(1) and Annexure 1 of the National Waste Information Regulations (NWIR), GN R625 of 13 August 2012, only makes provision for the registration of the generation, recovery or recycling, treatment, disposal and exportation certain waste streams.

[59] Section 69(1)(s) of NEMWA.

standards in the schedule or as published in the Government Gazette[60] as well as any IndWMP that has been approved by the competent authority for that industry.

8.3.2.6 Financial Measures

- Each producer in South Africa or its authorised representative shall annually pay the prescribed Advance Recycling Fee (ARF) to the Producer Responsibility Organisation (PRO).
- The ARF shall be calculated according to a prescribed formula. When determining the ARF formula, it must be ensured that WEEE recycling is commercially viable and sustainable.
- A PRO must use the ARF for the following purposes –
- Operation of the WEEE recycling process
- Functioning of the PRO itself.

8.3.2.7 Information Reporting and Disclosure

- Reporting
- This regulation should specify in specific schedules the nature, type, time and format of WEEE data and information that must be submitted in terms of section 60 of NEMWA and the National Waste Information Regulations (NWIR).[61]
- A PRO will collectively report on behalf of producers on waste matters but not on manufacturing, importing or exporting.
- This information must be reported on SAWIS or a provincial information system by various responsible parties i.e. a PRO, operators of WEEE facilities, transporters of large volumes of WEEE, exporters of recyclable materials, etc.
- SAWIS may have to be expanded to capture information specific to the WEEE recovery process.[62]
- Disclosure
- This provision should confirm that information supplied by producers to the PRO, by the PRO, operators and other WEEE parties to the competent authority, including information on SAWIS or the provincial information system is confidential and may only be accessed subject to the Promotion of Access to Information Act, 2000 (Act 2 of 2000) (PAIA), as provided in section 64 of NEMWA.

8.3.2.8 Miscellaneous

- Enforcement notices, entry and inspection
- This regulation should specify the action that may be taken by a waste management officer (WMO) or an environmental management inspector (EMI) pursuant to section 66 of NEMWA read with section 34A-Q of NEMA to enforce these regulations.

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60 Section 71(1)(d) of NEMWA empowers the Minister to incorporate by reference any guideline, minimum requirements, code of practice or any national or international standard relating to waste management.

61 GN R.625 of 13 August 2013.

62 See section 61 of NEMWA, regulation 8 and Annexures 2-5 of the NWIR for the waste information to be reported on SAWIS.

- The regulation should specify any specific documentary requirements that may be required for the effective enforcement of the WEEE regulations e.g. providing officers with the valid original WEEE registration certificates, up to date copies of all prescribed WEEE information to be recorded and submitted on SAWIS, copies of internal and external audit reports.
- Offences and penalties
- According to the general regulatory powers in section 71(2) of NEMWA, this regulation should stipulate that contraventions of specific regulations will be criminal offences and any person who contravenes or fails to comply with a provision thereof commits an offence and is liable on conviction to imprisonment for a period not exceeding 15 years, an appropriate fine, or both a fine and imprisonment.
- Appeals and review

This regulation should make provision that any person may appeal to the Minister or the MEC, as the case may be, against a decision taken by the competent authority in terms of these regulations according to section 43 of NEMA and the National Appeal Regulations, 2014.[63]

[63] Regulation 3(1)(e) of the National Appeal Regulations, GN R993 of 8 December 2014.

9 PILOT PROJECT

The proposed pilot project will act as a short-term intervention to test cooling (fridges and freezers) appliance pre-treatment (similar to proposed activities at depots in Model A – Initial Phase). This section is discussed under the following headings:

- Physical flows of appliances
- Operations at DESCO
- Required facilities and equipment
- Capital cost.

9.1 PHYSICAL FLOWS OF APPLIANCES

There will be three main role players in the pilot project, including appliance manufacturers or importers, an existing WEEE recycler, and a SMD. Appliances will be provided by one or more manufacturers or manufacturers to an existing WEEE recycler (DESCO[64]). DESCO will pre-treat appliances for subsequent environmentally sound processing by a SMD (see Figure 9-1).

The roles of each party will be as follows:

- Manufacturer or importer(s)
    - Supply of discard appliances.
- DESCO
    - Collection of discards from manufacturers or importers
    - Pre-treatment of appliances
    - Stripping of motors, cables, etc. for recycling
    - Removal of lubricating oils, motors and capacitors, accessible cables and wires, mineral-wool insulation and ballast
    - Removal for safe treatment and disposal of refrigerant gases, lubricating oils and PUR foam.
    - Sell pre-treated appliance carcasses to SMDs
    - Sell other recyclable materials already recovered and sold by DESCO to existing off-take entities
- SMD
    - Sell metal to smelters
    - Sell recyclables e.g. plastic to appropriate recyclers

[64] Although no formal agreement was entered into at the time of submitting this report, DESCO indicated willingness to participate in the pilot project.

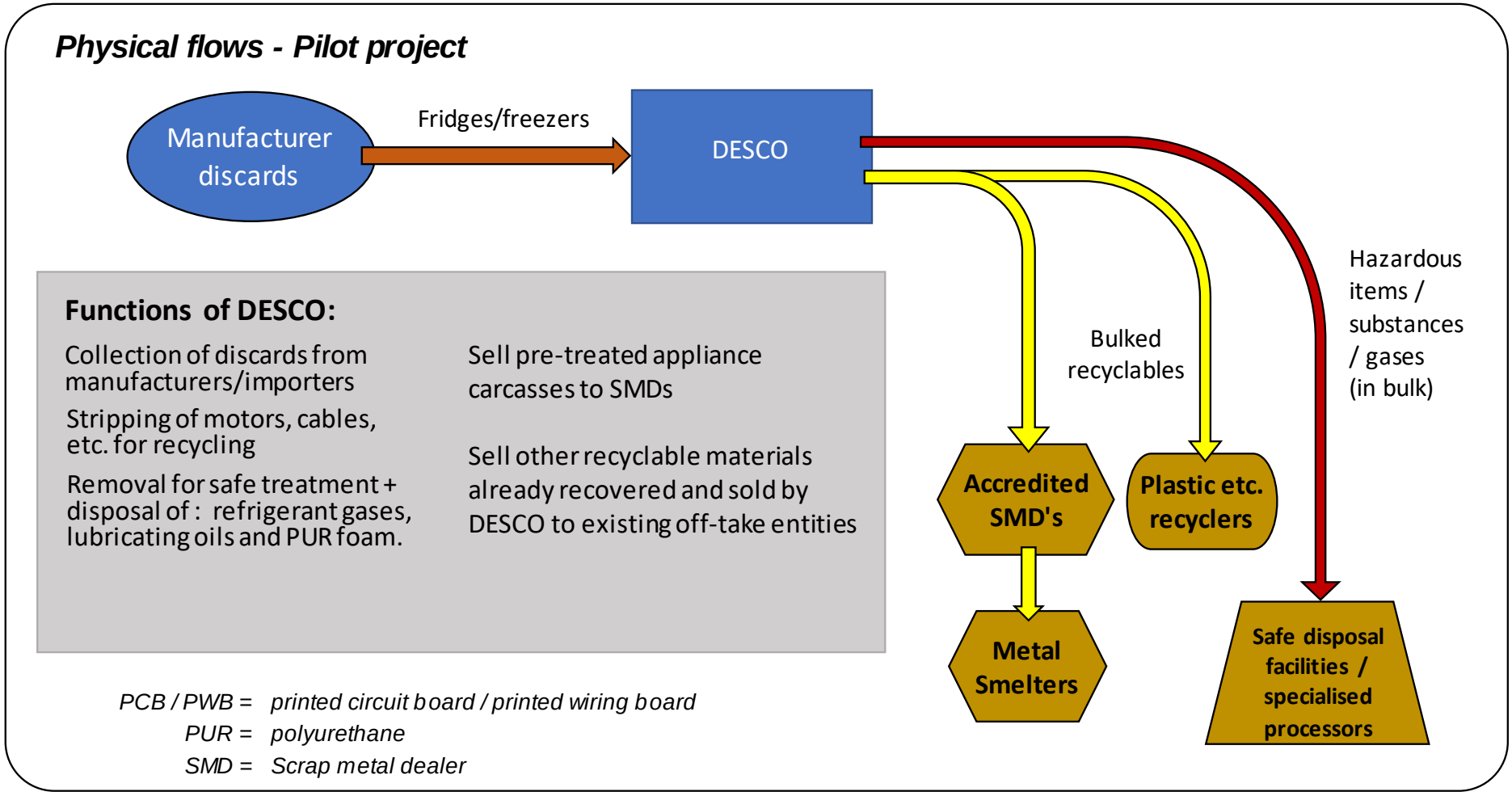

Figure 9-1: Physical flows of appliances (fridges / freezers) in pilot project

9.2 OPERATIONS AT DESCO

Appliances will enter DESCO for manual pre-treatment, due to the hazardous nature of some of the constituents of cold appliances, including:

- Most important critical refrigerants: CFC-12, HCFC-22, HFC-410A, HFC-32, ammonia solution containing chromium-VI
- Most important critical blowing agents: CFC-11, HCFC-141b
- Mercury in thermostats, sensors, relays, switches and lighting
- Printed circuit board components
- Lead
- Cadmium
- Hexavalent chromium and flame retardants
- Capacitors
- PBB and PBDE in plastics as flame retardants

The manual pre-treatment process entails the following:

- Removal of loose parts
- Extraction and containment of refrigerant and oil
- Separating oil from refrigerant
- Removal of hazardous components
- Removal of the compressor including attached components (and draining the compressor of oil)
- Removal of condensing unit
- Removal of PUR foam.

It is envisaged that the pilot project will treat an estimated 10 appliances cooling appliances per day.

9.2.1 REQUIRED FACILITIES AND EQUIPMENT

The following facilities and equipment will be required at DESCO, some of which already exist:

Table 9-1: Facilities and equipment required for the pilot project

FACILITIES/EQUIPMENT	EXISTING
Area for removal of loose parts	Yes
Area for storage of incoming appliances	Yes
Area for storage of pre-treated appliances and removed items	Yes
Small equipment for dismantling such as screwdrivers, cutters, hammers together with some specialised small equipment used to drain gases, oils, etc.	Yes (non-specialised only)
Gas testing equipment	No
Compressor for gas extraction	No

FACILITIES/EQUIPMENT	EXISTING
Refrigerant tanks	No
Mobile waste oil collector	No
Waste oil tank	No
Temporary container for negative pressure room	No
Hazardous particle extraction system	No
Trolleys	No
Tables	No

9.3 CAPITAL COST

The capital cost for the pilot project has been determined and is shown in Table 9-2 below.

Table 9-2: Capital cost for the proposed pilot project

NO.	ITEM	UNIT	QTY	RATE	AMOUNT
1	Small equipment	Sum	1	R 10 000.00	R 10 000.00
2	Gas testing equipment	No.	1	R 65 000.00	R 65 000.00
3	Compressor for gas extraction	No.	1	R 30 000.00	R 30 000.00
4	Refrigerant tanks	No.	2	R 30 000.00	R 60 000.00
5	Mobile waste oil collector	No.	1	R 5 000.00	R 5 000.00
6	Waste oil tank	No.	1	R 10 000.00	R 10 000.00
7	Temporary container for negative pressure room	No.	1	R 100 000.00	R 100 000.00
8	Hazardous particle extraction system	Sum	1	R 200 000.00	R 200 000.00
9	Trolleys	No.	1	R 2 000.00	R 2 000.00
10	Tables	No.	2	R 2 000.00	R 4 000.00
Total					**R 486 000.00**

10 FEEDBACK FROM INDUSTRY WORKSHOP

A workshop was held to engage with the industry regarding the models that had been developed on Thursday, 23 May 2019 at the Capital Empire Hotel in Sandton.

The proposed models, Model A and Model B, were considered and generally accepted but industry representatives raised the following points:

- The need for creating a 'new industry' to recycle large household appliances was questioned, as there already is a WEEE recycling industry. It was proposed that another model, Model C, be added that would entail pre-treatment (removal of ozone depleting gases and hazardous materials in an environmentally responsible manner) of appliances by authorised or accredited scrap metal dealers. Model C was subsequently added but then discarded as discussed in section 6.1.4.
- Industry representatives cautioned whether all industry players would commit to a plan unless it was mandated by government, and raised the implications of 'free riders' as a concern.
- Industry representatives noted that advanced recycling fees, which are currently estimated by the consultants to be in the order of R1.00 per kilogram, would ultimately be added to the prices paid by consumers for appliances.
- Industry representatives noted that calculating advanced recycling fees on a per-kilogram basis might not be appropriate for all appliances.

The proposed pilot project, envisaged to run for two years to establish the viability and cost of an appliance recycling facility, was in principle supported by industry. However, industry representatives raised certain concerns and queries, including:

- Whether it would be viable for retailers to deliver old appliances to the WEEE recycler through reverse logistics. A representative from Massmart indicated that their logistics system is outsourced, and that reverse logistics would not allow discarded appliances to be transported to WEEE recyclers.
- Whether WEEE recyclers are not already forced, by law, to pre-treat appliances. It was confirmed that the law does make provision for this through various acts and regulations but that it is not always rigorously enforced. However, there are no norms and standards dealing specifically with the management, recycling and disposal of discarded appliances.
- What the timeline for implementation of the pilot project is. It was confirmed that the pilot project would be rolled out as soon as possible after conclusion of the current feasibility study and subject to approval by the regulating authorities and industry.

The industry was informed that a suitable (existing) facility for the pilot project had already been identified and that the capital expenditure required for the setup of the project would be funded through grants. The industry was thus not called upon to provide facilities or funds but was invited to provide assistance by:

- Making appliances that have been made available to the project
- Transporting and delivering discarded appliances to the identified facility.

To date, no interest to become involved with the pilot project has been expressed by any of the parties represented at the workshop. The minutes of the workshop are attached to this report as Appendix F.

11 CONCLUSION

This study considered the feasibility of developing an integrated appliance recovery and recycling system in South Africa. The study presented three models, Models A, B and C for the recovery and recycling of large household appliances. Upon comparison of the models (with the financial model still to be developed), Model A and Model B were considered to be viable options but Model C was discarded, mainly due to the fact that regulation of SMDs would prove to be difficult.

The financial model was then developed and indicated that the most economical method for recovery and treatment of used appliances involved the establishment of a number of depots, geographically dispersed around Gauteng (as in Model A: Initial phase). Results from the financial model indicated that an advance recycling fee of R0.67 per kilogram (year 1) levied on national sales of new appliances would be adequate for the recovery, transport, safe and environmentally-sound pre-treatment of used appliances in Gauteng. To cope with the anticipated incremental volume of used appliances entering the recycling system over time, the financial model indicated that this fee would have to increase at a rate of 10.1% per annum, or approximately 4% above nominal inflation, during the first 20 years of operation of the system.

The financial model also showed that centralised pre-treatment (i.e. pre-treatment at a single location rather than a number of dispersed facilities) and/or the introduction of a MARF increase the overall costs of the system, and therefore the level of advance recycling fees necessary to sustain it. It should; however, be noted that if it becomes possible to secure some or all of the funding required for the establishment of a MARF from donors, the level of advance recycling fee could become much lower.

In terms of the legal framework required for the implementation of an appliance recovery and recycling system, this study found that an improved enabling legal framework for the recycling and recovery of WEEE is required to provide the requisite standard of legal certainty under the rule of law by the Constitution.

Firstly, National Norms and Standards for the Collection, Storage, Treatment, Recycling, Recovery and Disposal of WEEE (Norms and Standards) must be made in terms of section 19(3)(a) of NEMWA for the design, construction, operation and decommissioning of WEEE facilities. These Norms and Standards will ensure the responsible collection, storage, treatment, recycling, recovery and re-use of WEEE, and reduce environmental pollution, degradation, and public health impacts.

Secondly, section 69(1) of NEMWA empowers the Minister to make regulations to ensure the lawful administration and effective management of WEEE recycling in South Africa. The regulations must address different aspects of the WEEE recycling process such as producer obligations (financial obligations, labelling and product-design requirements, life cycle assessments), institutional arrangements (establishment and powers of Producer Responsibility Organisation (PRO)), requirements for WEEE operations, financial arrangements, information reporting and disclosure, enforcement notices, entry and inspection as well as offences and penalties.

Recommendations for the way forward are presented in the next section.

12 RECOMMENDATIONS

For an appliance recycling project to be initiated, it is recommended that the project be implemented on a pilot basis as a means of testing the technical feasibility and financial viability of the project. The pilot project would allow for testing the effectiveness with which:

1) Appliances can be collected from a range of sources in a cost-effective manner.
2) Appliances can be pre-treated for harmful gases and hazardous materials to be removed, treated and / or safely disposed of before the appliances are passed on to third parties for further processing and recycling.

Once the pilot project has been implemented and found viable, it is suggested that the initial phase of Model A be implemented. In short, this will entail the following (refer to section 6.1.1.1 above):

Drop-off depots (storage facilities) will be developed across Gauteng (Tshwane, Johannesburg, East Rand, West Rand and Southern Gauteng). SMME collectors will transport appliances to depots. SMME collectors will be linked to used appliance consumers whom require appliances to be collected by means of a mobile application.

SMME collectors (or consumers) delivering appliances to depots will be paid per appliance delivered, and payment may be based on the appliance type, capacity, mass and condition (non-functional or functional).

Prices paid to consumers for non-functional appliances will be determined by using prices at cash-for-scrap buyback centres (CSCs) as a yardstick, and prices paid for functional appliances will be determined by using prices paid for appliances at pawnshops as a yardstick.

In the initial phase (Refer to Figure 6-1), the depots will act as small appliance recycling facilities and will have the following functions:

- Interim storage of all incoming appliances.
- Pre-treatment of non-cooling and cooling appliances, *inter alia*, including safe removal of refrigerant gases, lubricating oils, motors and capacitors, PUR foam and other insulation, PCBs and PWBs, accessible cables and wires, most plastic components and other loose items.
- Bulking of pre-treated non-cooling and cooling appliances for more cost-effective transport to accredited SMDs.

The steel carcasses that remain after the above-mentioned components have been removed will be sent to accredited SMDs for final processing. Other recyclable materials will be sent to dedicated processing facilities with non-hazardous and hazardous residues sent to specialised facilities for safe treatment and/or disposal.

Financing of the appliance recycling system will be by means of advance recycling fees levied on the national sales of all appliances. Practically, this will necessitate the establishment of the PRO for the appliance industry and ARCO.

It will be necessary for the PRO to consult with industry participants and ARCO in order to develop and approve capital and operational budgets for the recycling operation. This in turn will facilitate the setting of advance recycling fee scales for each category of appliance, and (i) the amounts payable to consumers as trade-ins, and (ii) amounts payable to SMME collectors, per appliance.

Going forward, the PRO will need to collect the advance recycling fees from manufacturers or importers on a periodic (preferably monthly) basis, and remit funds to ARCO in accordance with the approved budget. Any surplus funds will be invested appropriately with a financial institution.

The PRO will also be responsible for promotion of used appliance recycling by means of appropriate marketing and communication activities.

As the commercial or operational entity, ARCO will perform crucial functions in the recycling operations including

- the establishment, capacitation and ongoing management of the appliance collection / drop-off depots;
- the recruitment, training, management and remuneration of all personnel employed at the ARCO head office and at the depots;
- the procurement, maintenance and securing of all fixed and movable assets associated with the recycling operations;
- the sourcing, capacitation and payment of SMME collectors;
- the accreditation of SMDs and the conclusion of off-take agreements with accredited SMD;
- the reconciliation of all used appliance stock received, treated, dismantled and sold to third-parties (accredited SMDs, etc.) including the recovery of monies from such third-parties;
- arranging for the safe disposal of all hazardous substances recovered from appliances; and
- environmental and safety auditing of the depots and SMME collectors, and the compilation of all statutory returns.

It is recommended that the Minister (DEA) take the following legal steps to clarify the enabling legal framework for the proposed WEEE recycling system, regardless of whether it is for the above stated initial phase or for a possible future mechanised phase:

- Firstly, make new WEEE Regulations in terms of section 69(1) of NEMWA
- Secondly, make the National Norms and Standards for the Collection, Storage, Treatment, Recycling, Recovery and Disposal of WEEE (Norms and Standards) as a Schedule to the WEEE Regulations in terms of section 19(3)(a) of NEMWA
- Thirdly, delicense the treatment, recycling and recovery of WEEE under section 19(2)(b) and (3)(a) of NEMWA, subject to registration thereof with the DEA and compliance with WEEE Regulations and the WEEE Norms and Standards.

APPENDIX A: REPORT: FINDINGS FROM LITERATURE REVIEW

APPENDIX B: INTERNATIONAL REGULATION OF WEEE

APPENDIX C: GOVERNMENT GAZETTE NO. 41303

APPENDIX D: CONSULTATION MINUTES

APPENDIX E: FINANCIAL MODEL

APPENDIX F: INDUSTRY WORKSHOP MINUTES