



e waste



Technical report on the assessment of e-waste management in Morocco

- July 2008 -

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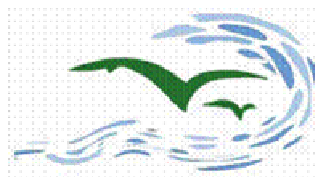


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Preface

Abbreviations

ANPME	National Agency for the Promotion of Small and Medium Enterprises
ANRT	National Telecommunications Regulatory Agency
APEBI	Federation of Information Technologies, Telecommunications and Offshoring
IBRD	International Bank for Reconstruction and Development
CGEM	General Confederation of Moroccan Enterprises
CMPP	Moroccan Centre for Clean Production
UNCTAD	United Nations Conference on Trade and Development
WEEE	Waste Electrical and Electronic Equipment
EEE	Electrical and Electronic Equipment
EMPA	Swiss Materials Science and Technology Research Institute
ESITH	Higher School of Textile and Clothing Industries
FENELEC	National Federation of Electricity and Electronics
FODEP	Industrial Pollution Control Fund
DSF	global Digital Solidarity Fund
HACA	High Authority for Audiovisual Communication
HCP	High Commission for Planning
HP	Hewlett Packard
INDH	National Human Development Initiative
MEMEE	Ministry of Energy, Mines, Water and Environment
MICNT	Ministry of Industry, Trade and New Technologies
NICT	New Information and Communication Technologies
OFPPT	Office of Vocational Training and Labour Promotion
UNIDO	United Nations Industrial Development Organization
OTI	Information Technology Observatory
PC	Computer
GDP	Gross Domestic Product
GNB	Gross National Product
UNEP	United Nations Environment Programme
PP	Public-private
RDT	Technological Development Network
TOE	Tonne of oil equivalent
ICT	Information and Communication Technologies
MP	Mobile phone
TV	Television set

Executive Summary

The present "e-waste Assessment in Morocco" was conducted within the framework of the "e-Waste Management in Africa" project launched by HP in London on September 18th 2007, in collaboration with Empa and DSF. The objective of the project is to assess the current e-waste management situation in Kenya, Morocco and Senegal, with regard to each country's specificities. Based on the assessment methodology developed by Empa, this study offers an analysis of the local context, a stakeholder analysis, a mass flow analysis as well as an evaluation of social, economic and environmental impacts resulting from the current e-waste management practices.

The goal of this paper is to provide the necessary elements for drafting a road map, which would allow to implement a proper e-waste management system, and to identify opportunities to create and improve employment in Morocco. In this sense, a National e-Waste Strategy group was constituted under the coordination of the State Secretary for the Ministry of Energy, Mines, Water and Environment.

The scope of the study covers the entire country, with a special focus on the great Casablanca, Fez and Meknes, where field visits were conducted. In addition, surveys were conducted with companies, government agencies and households in several regions.

The equipments studied in this project are computers (desktop and laptop), mobile phones and televisions.

E-waste related legislation

There is currently no specific legislation for WEEE in Morocco. Nevertheless, law #28-00 relative to waste management and disposal allows to produce application decrees for specific types of waste such as e-waste.

Besides that, the Moroccan legal system comprises a whole set of laws that apply to e-waste management:

- Law n°28-00 relative to waste management and disposal.
- Law n° 10-95 on water
- Law n°13-03 on air pollution
- Law n°12-03 environmental impact studies
- Law n°11-03 on the protection and valorisation of the environment

In addition, Morocco has adopted the concept of sustainable development and ratified several international agreements concerning environment, especially:

- Ozone depletion: the Montréal protocol in 1992, the Vienna convention and the amendments in London and Copenhagen in 1995 ;
- The convention on Climate Change in 1995 followed by the adhesion to the Kyoto protocol in 2002 ;
- the Basel Convention transboundary movements of hazardous wastes in 1995
- The Stockholm convention on persistent organic pollutants (POPs)
- The protocol on the prevention of the Mediterranean sea's pollution in 1999.

Moreover, within the framework of the association agreement, Morocco and the European Union cooperate actively in the domains of soil and water quality, consequences of industrial development and the control and prevention of marine pollution (article 48).

Finally, the Investment Charter (1995) and the Royal letter dated 9th January 2002 mention environmental concerns.

Institutional framework

The ICT sector evolves in the framework of a broad strategy called e-Morocco, elaborated by the government in partnership with both public and private stakeholders represented in the strategic committee for ICT. This strategy not only aims at promoting the ITC sector and positioning Morocco on the international market, but also at better structuring and regulating the sector through institutional programs and actions. In this context, the government particularly cares for the WEEE problem, the State Secretary for the Ministry of Energy, Mines, Water and Environment being the present study's national coordinator.

Mass flows

The stock of televisions, computers and mobile phones is estimated at 222'000 tonnes in 2007. Mass wise, computers have the largest share with 68 % of the total, followed by televisions with 30 %, while mobile phones only account for 2 % of the stock. On the other hand, mobile phones constitute 81 % of the stock in term of numbers. This difference is explained by the very low average weight of phones (0.1 kg) compared to televisions (30 kg) and computers (25 kg).

The resulting e-waste flow amounts to 30'300 tonnes. Mass wise, televisions and computers account for 95 %, with respectively 15'200 tonnes/year and 13'500 tonnes/year. Mobile phone waste generate 1'700 tonnes/year.

Households hold the largest share of all equipments, with 81 % of the stock, while companies possess 18 % and government agencies 1 %. This unbalanced distribution of EEE is mainly explained by the high penetration rate of televisions. The related e-waste flow generated yearly is also dominated by households, who generate 73 % of the flow, followed by companies and government with respectively 26 % and 1 %.

Considering all three sectors, the 5 most important regions (Casablanca, Souss, Marakech, Tangier/Tetouan and Rabat) generate 54 % of WEEE, resulting from the high density of population and economic activity in these regions.

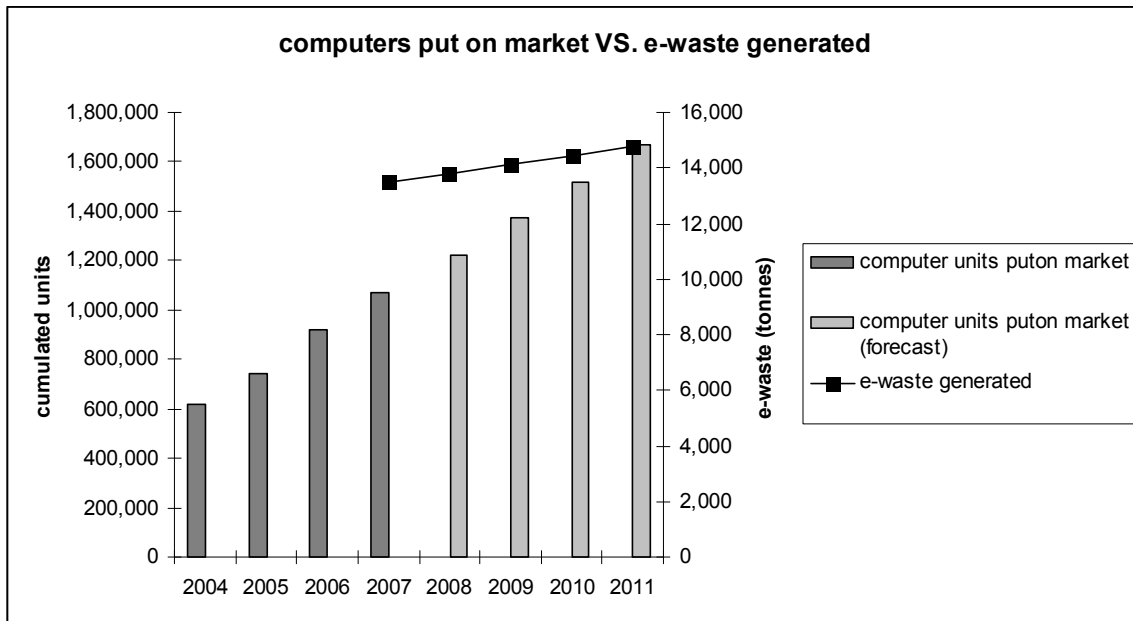


Figure 1: Installed IT park, Internet connections and penetration rate in the Moroccan population (source: OTI 2008).

Recycling infrastructure

90 % of collection activities for metal scrap in general are assumed by the informal sector. A large share of these collected metals are exported to foreign smelters, while the local metallurgical industry needs to import costly raw material. It is estimated that this costs 286 million US\$ to Morocco, which corresponds to the value that would be added by the 274'000 tons of metals exported every year if they were processed locally.

The largest Moroccan metal processing units comprise SONASID, Tube et profil, Maghreb Steel, or Comptoirs métallurgiques. Several small and medium smelting units exist, especially in Casablanca, Rabat and Kenitra. The informal sector is not very active in this industry, regarding the technical know-how and the investments that are required. The recovery of precious and special metals, such as those found in printed circuit boards, doesn't exist in Morocco, excepted for the metallurgical complex of Guemassa, specialised in some metals like copper, lead, zinc and cobalt.

Table 1: Recycling options in Morocco for different waste streams generated by PCs, TVs and cell phones

Material fraction	Recycling in Morocco	Possible downstream partners
Plastic	partially	Valorisation in construction; patent taken out by ENIM/ECOTECHNO "waterproof polymer" on June 2008
Ferrous metals	yes	Sonacid et others
Aluminium	partially	Traditional industry
Copper	partially	Macz et others / traditional industry
Printed wiring boards (precious metals)	At its beginning	Recycling plants in implementation process / export to Europe
CRT tubes (containing lead, beryllium, phosphor, etc.)	No	CNEDS or controlled landfills
Hazardous fraction (PCB in capacitors, mercury in backlights, batteries)	No	CNEDS or controlled landfills

Conclusion

There is currently no organised e-waste management system in Morocco for the 3 studied equipments. The situation regarding e-waste is therefore concerning, but not yet alarming.

The Moroccan legal background, especially with Law 28-00, presents a favourable legal framework, though currently insufficient. A specific application decree for WEEE would definitely contribute to a better e-waste management, as long as the appropriate channels and infrastructure are implemented.

Moreover, both the government and the private sector have elaborated ambitious strategies for the development of the ITC sector. Though the question of sustainable management of WEEE hasn't been explicitly raised, both parties are active with environmental protection initiatives: the Environmentally Sustainable Industrial Development for the government, and the Social Responsibility Charter of the CGEM for the private sector. In order to translate these commitments into action, the existing conventions and strategies (progress contract, e-gov, etc.) need to be amended, taking WEEE management into account for the following initiatives.

The financing of the present study by the private sector, and its coordination by a governmental agency, show the determination of both parties of being actively involved of the implementation of a sustainable e-waste management system

Also, the high motivation of the informal sector to participate to the project presents a strong potential for employment creation and improvement.

Finally, Morocco could take advantage to position itself as a leading regional platform for the treatment and valorisation of e-waste, as long as the principles of the Basle Convention are respected.

1 Introduction

1.1 General context

It is estimated that approximately between 40 to 50 million tonnes of WEEE is produced each year worldwide (European Environment Agency, UNEP); this figure is increasing three times more quickly than all other types of domestic waste. Were we to load this e-waste onto trucks and line those trucks up, they would stretch half-way around the Earth.

Increasingly short product lifetimes, particularly for information and communication technologies (ICT), are resulting in accelerated growth of WEEE. Indeed, the Organisation for Economic Cooperation and Development (OECD) estimated that in 2004 the turnover generated worldwide by ICT trade was equivalent to 7.7% of the global gross social product. Meanwhile, one in every two German households owned a computer in 2004, with this figure rising to 75% of households by the end of 2006. In Japan, computer ownership is equally high, while only 0.07% of households have one in Niger, 1.2% in India, 2.3% in Bolivia, 4.1% in China and 16.3% in Morocco. The African continent offers great opportunities for ICT development, with high rates of growth. In 2006, this sector accounted for 3.5% of the GNP of the African continent.

Although electrical and electronic equipment (EEE) does not pose any danger to users while in working order, it can present certain risks when it reaches the end of its useful life. The dismantling and recycling of this waste in an unprofessional manner in poor and developing countries poses serious threats to health and the environment. Moreover, regulations designed to protect the health of dismantling workers in these countries is often limited, or non-existent.

According to the UNEP, the illegal export of WEEE to developing countries sometimes occurs under the guise of charitable donations. Export to these countries is prompted by regulations that are often lax or not adhered to, and by very low labour costs (US\$1.50 a day, in China). A recent report by Toxics Link (2004) reveals that 70% of WEEE disposed of in New Delhi (India) was imported from industrialised countries.

According to a study of the volume of solid waste (Department of the Environment, 2000), Moroccan industry produces approximately 1 million tonnes of industrial waste a year, 120,000 tonnes of which is classed as hazardous. Waste from the mechanical, metallurgical, electrical and electronic sectors accounted for more than 70,000 tonnes (8% of industrial waste).

1.2 Products studied

According to the European directive, electrical and electronic equipment comprises any device that requires electrical current or electromagnetic fields in order to operate correctly. Given the huge number of existing devices (see Appendix I), this study focuses on desktop and laptop computers, television sets and mobile phones. These three types of equipment will serve as tracers for this assessment study, as they are widely used among both the Moroccan population and Moroccan businesses. The composition of these categories of equipment in terms of weight and materials is provided in Appendix II.

1.3 Objectives of the study

This study for the “Assessment of WEEE Management in Morocco” is part of the “e-Waste Management in Africa” programme launched by HP on 18 September 2007 in London, in collaboration with the DSF and EMPA. Depending on the specific situation in each country, its aim is to prepare a diagnosis of current WEEE recycling conditions in Kenya, Morocco and Senegal. This study includes analyses of the local context, actors, and current and future WEEE stocks and flows, as well as an evaluation of the social, economic and environmental impacts of the current management system.

The objective of the project is to provide the information required to prepare a roadmap for the implementation of a specific structure for the processing of WEEE and identify opportunities for the creation of jobs locally. For this purpose, a national WEEE-management strategy committee was established under the coordination of the State Secretariat to the Ministry of Energy, Mines, Water and Environment.

Although the scope of this study encompasses the whole of Morocco, the site visits focused on three regions (Greater Casablanca, Fez and Meknes). In addition, surveys of businesses, public sector bodies and households were conducted in several regions.

2 Methods

2.1 Data gathering

The data underpinning this study was gathered in various manners and from various sources:

2.1.1 Documentary analysis

- Of studies directly or indirectly addressing NICT and WEEE (public-private strategies, evolution of household sizes and consumption, electrification programme, illiteracy, micro credit, etc.).
- Consultation of Moroccan (HCP, MICNT, APEBI, etc.) and international (IBRD, UNIDO, etc.) databases.

2.1.2 Interviews with partners

More than 40 interviews were conducted with institutional partners, private firms, professional associations, development organisations, etc., in order to obtain more detailed information about the markets of the 3 types of EEE selected (TVs, Computers and MPs), their consumers, second-hand markets and recycling practices.

2.1.3 Surveys

In the field

Field visits were made to Casablanca, Meknes, Fez and their regions. The fact that the IVSEP project, which has been selected as a pilot case for the action plan that will follow publication of this study, is located in Meknes prompted the choice of Meknes and Fez for the surveys. Furthermore, the two cities have two different models for the recovery of solid waste in general, and WEEE in particular.

The survey questionnaire is 11 pages long and covers technical, economic, financial and social questions. Approximately fifteen survey questionnaires were completed.

In addition, several visits were made to scrap metal wholesalers, informal recycling centres (Sidi Bennour, Tit Mellil, etc.) and the uncontrolled dump in Casablanca.

In households

This task was carried out in collaboration with the ESITH (Masters in Health, Safety and Environment), covering 202 households (represented by ESITH students).

In institutions and companies

A two-page survey questionnaire was sent by fax and email to companies in the technology, primary, industry/construction and services/transport sectors. More than 1,200 questionnaires were sent out, but only 25 were completed and returned: 7 public sector bodies, 7 large companies (more than 200 employees), 6 small companies (fewer than 200 employees) and 5 NGOs. The directory of the SME Federation and the directory of CGEM members were the databases used for sending out the survey questionnaires.

Visits to exhibitions

- ELECEXPO2007 organised by the FENELEC from 23 - 27 October 2007;
- EnviroMaroc 2007, from 24 to 26 October 2007, the 4th edition of the Morocco-German environmental protection and management conference;
- Telecomp Maroc 2008, the 6th International Telecommunications Exhibition and Conference for Morocco, from 1 to 4 April 2008, in Casablanca.

2.2 Material flow analysis

The methodological approach adopted to estimate the amount of equipment and flows of waste was primarily based on:

- Interviews with professionals in the sector (producers, retailers, etc.)
- Analysis of data from the “Moroccan Economic Census” study (HCP, 2002)
- Analysis of data from the “Moroccan Housing and Population Census” study (HCP, 2004)
- Analysis of OTI data (2007)
- Analysis of statistical data from the Ministry of Tourism (2006/07)
- Analysis of data from the MMSP (results and analysis of Operation Intilaka, 2005)

The consumption and use method was applied to estimate the flow of WEEE generated (Bureau B&G, 1993), according to the following equation:

$$\text{WEEE generated per year} = (m_n * hh * r_n) / ls_n$$

m_n : average weight of equipment n

hh : number of households

r_n : penetration rate of equipment n

ls_n : average lifetime of equipment n

2.3 Limitations

The survey conducted within the framework of this study highlighted the difficulty of performing an exhaustive, accurate assessment of the quantities of waste generated, particularly for the following reasons:

- This type of waste is not specified in detail, let alone the management methods (sorting, storage, transportation, processing, disposal);
- The difficulty of accessing data held by manufacturers, suppliers and users;
- The low response rate of companies to the questionnaire.

We based our estimate of current landfill sizes on data from reliable sources (OTI, HCP, etc.), and therefore the results are reliable. However, the reliability of the estimates of the quantities that will be generated between 2008 and 2012 should be qualified as medium and, finally, the results of the surveys should only be treated as indicative.

3 Definition of the system

3.1 Development indicators

3.1.1 Population

The various indicators concerning the population of Morocco are presented in the following tables.

Table 1: Moroccan population (source: HCP, 2004)

Indicators	In millions
Total population	29.9
Urban population	16.4 (55%)
Rural population	13.5 (45%)
Projected population in 2015	33.5
Projected population in 2030	37.9 (13.5 rural population)

Approximately 1.8 million Moroccan residents have foreign backgrounds, coming mainly from France (575,000), Italy (200,000) and Belgium (120,000). Part of this population brings second-hand EEE into Morocco for trade or private use. However, it is difficult to estimate the quantities, as no customs statistics are available, because these are individual (undeclared) imports.

Table 2: Moroccan population and household projections by residential setting (HCP, 2004)

No. households in 2004	6.2 million
No. households in 2030 (estimated)	10 million (growth rate of 62%)
Increase in No. urban households	74%
Increase in No. rural households	40%
Size of households in 2004	5.9 people
Size of households in 2015	4.2

According to the World Bank, among its young population Morocco has one of the highest unemployment rates: nearly 16%, compared with 11% for the working-age population as a whole.

In addition, the table below shows informal employment as a proportion of national employment by sector of the economy (1999/2000).

Table 3: Employment surveys, National Statistics Office, Rabat

Economic sector	Volume of informal jobs (in thousands)	Informal employment as a proportion of total non-agricultural employment (%)
Industry and crafts	476.4	36.8
Construction	132.8	23.6
Trade and maintenance	917	91.2
Other services	375.7	18.8
Total	1,901.9	39

It can be observed that the informal economy represents a labour market segment equivalent to two out of every five jobs.

Finally, in 1994, the year of the last census, 55% of the population was recorded as illiterate. The distribution by setting has not changed significantly: inhabitants of rural areas tend to be less educated than those in urban areas. Although the school enrolment rate has risen from 62% in 1994 to 80% in 2004, more than 27% of the population that attends school does not continue beyond primary education.

3.1.2 Environment

Morocco has a National Strategy for Environmental Protection and Sustainable Development, which was adopted in 1995. This strategy has been turned into a National Environmental Action Plan, prepared through a participatory process involving all the stakeholders concerned by environmental and sustainable development issues.

Table 4: Environmental indicators (various sources)

Surface area	710,550 km ²
Estimated cost of environmental degradation in 2004	13 billion dh (1.1 billion euros / 3.7% of GDP) Source: MEMEE
Estimated polluting emissions in 2003	72 tonnes BOD/day Source: World Bank
Energy consumption	0.4 TOE/inhabitant (2004) Source: World Bank

Table 5: The main Moroccan cities (source: www.diplomatie.gouv.fr)

City	In millions
Casablanca	3.6
Rabat/Salé	1.8 combined
Marrakech and Fez	1 each
Meknes, Tangier, Agadir	0.5 each
Kenitra, Oujda and Safi	Less than 0.25 each

3.1.3 Economy

Table 6: Economic indicators (source: World Bank)

Average growth rate 2001/06	5%
GDP (2006)	65.4 billion USD
% GDP from agriculture	16.6
% GDP from industry and mining	28.9
% GDP from services	54.4
Purchasing power parity	3.29

Today, Morocco is classed as an emerging country, like India and Turkey, and has a liberal market economy governed by the laws of supply and demand. The country's economic system is characterised by great openness to the outside world. In this respect, the free trade agreements that Morocco has ratified with its main economic partners are:

- The free trade agreement with the European Union, with the aim of joining the free trade area in 2012;
- The Agadir agreement, signed with Egypt, Jordan and Tunisia, within the framework of establishing the Arab Free Trade Area;
- Free trade agreements with the United Arab Emirates, Turkey and, more recently, the free trade agreement with the United States, which has been in force since 1 January 2006.

3.2 Politics and Legislation

3.2.1 Politics and legislation relating to the management of e-waste

- **Laws on environmental protection**

The main laws concerning environmental protection are:

- Law No. 28-00 on the management and disposal of waste
- Law No. 10-95 on water

- Law No. 13-03 on air pollution control
- Law No. 12-03 on environmental impact studies
- Law No. 11-03 on the protection and enhancement of the environment

A summary of the laws, decrees and orders linked to WEEE management that have been enacted, are pending or are currently being drafted is presented in Appendix III.

- **International environmental conventions**

Morocco has also embraced the concept of sustainable development and has ratified numerous environmental treaties. Recent conventions include:

- Protection of the ozone layer: the Montreal Protocol in 1992, the Vienna Convention and the London and Copenhagen Amendments in 1995;
- The Convention on Climate Change in 1995 and then ratification of the Kyoto Protocol in 2002;
- The Control of Transboundary Movements of Hazardous Wastes and their Disposal: the Basel Convention in 1995 as well as the Protocol on the Prevention of Pollution of the Mediterranean Sea linked to the convention in 1999, etc.;
- The Stockholm Convention on Persistent Organic Pollutants (POPs);
- The Protocol on the Prevention of Pollution of the Mediterranean Sea by Transboundary Movements of Hazardous Wastes and their Disposal.

It is also worth noting that, within the framework of the association agreement between the European Union and Morocco, the parties agree to cooperate in the areas of soil and water quality, the consequences of industrial development, and the control and prevention of marine pollution (Article 48).

With regard to investment rules, the Investment Charter (1995) and the Royal Letter of 9 January 2002 refer to environmental concerns.

- **Laws on social aspects**

Concerning social legislation, freedom of association is recognised by the Constitution. Indeed, Article 9 of the Constitution guarantees all citizens freedom of expression and the freedom to join the trade union of their choice. With regard to collective bargaining, Article 3 of the Constitution states that “unions and trade chambers shall participate in the organisation and representation of citizens”.

To give concrete form to the principles set out in the Constitution, Article 2 of the Dahir of 16 July 1957 establishes the right of persons practising the same profession, similar trades or related occupations that contribute to the production of specific products, or the same liberal profession, to freely form organisations of their choice.

The right to organise and bargain collectively is also recognised by virtue of international instruments ratified by Morocco, in particular:

- Convention No. 98 on the Right to Organise and Bargain Collectively, 1949;
- The International Covenant on Economic and Social Rights;
- ILO Convention No. 11 on Collective Bargaining.

For workers and employers in the private sector, there are no exclusions or restrictions regarding the right to form or join trade unions, or the right to engage in collective bargaining.

An association of waste collectors in Casablanca is currently being set up by a WEEE recovery operator (ECODECHET).

3.2.2 Specific legislation on e-waste management

At present, there is no specific legislation on WEEE. However, law No. 28-00 on the management and disposal of waste could lead to a decree specifically applicable to this type of waste.

3.2.3 Institutional framework

The ICT sector is developing within the framework of the strategy christened e-Maroc, prepared by the government in consultation with the public and private actors represented on the ICT strategy committee. This strategy aims to not only develop the ICT sector and secure a place for Morocco in the international arena, but also improve its structure and regulation through various actions and programmes organised by different institutions. The government is giving special attention to WEEE. Indeed, the State Secretariat to the Ministry of Energy, Mines, Water and Environment, which is responsible for water and the environment, is the national coordinator of this study.

3.2.3.1 Bodies active in the promotion of ICT

Supervision of the ICT sector is carried out by the following institutions:

- National Telecommunications Regulatory Agency (ANRT)
- Ministry of Public Sector Modernisation (MMSP)
- Department of Post, Telecommunications and Information Technologies (DEPTTI)
- Strategy Committee for the development of Information Technologies (CSTI)
- E-government committee

On the whole, the ICT sector is strongly supported by the Ministry of Industry, Trade and New Technologies (MICNT), as well as the Ministry of Public Sector Modernisation (MMSP). The MICNT develops strategic orientations for the trade and industry sectors, encourages wealth-creating investments and quality innovation, and promotes the spread of information technologies. The MMSP, meanwhile, strengthens and drives the process of modernising Morocco's public sector through the preparation of digital content and the promotion of electronic exchanges between government bodies and citizens.

- National Information Technology Observatory
- Moroccan Industrial and Commercial Property Office (OMPIC)

A description of the role of each body is provided in Appendix IVa.

3.2.3.2 Organisations active in technical support

- Moroccan Centre for Clean Production (CMPP)
- National School of the Mineral Industry (ENIM)

- Moroccan Association of Waste and Environment Experts (AMEDE)
- The ministry responsible for employment

A description of the role of each organisation is provided in Appendix IVb.

3.2.3.3 Organisations active in financial support

- The Industrial Pollution Control Fund (FODEP) is involved in the financing of pollution control projects through grants twinned with loans provided by banks;
- The main role of the ANPME is to develop and implement advice and support programmes geared towards the creation, promotion and modernisation of enterprises by bearing part of the expenses incurred by SMEs within the framework of such programmes;
- The objective of the Technology Dissemination Network (RDT) is to assist SMEs with identifying and articulating their needs in terms of innovation projects or technological development;
- The aims of the Hassan II Fund for Economic and Social Development include providing financial assistance for:
 - Programmes for the creation of structures to receive industrial investments and IT development investments,
 - Employment promotion initiatives by micro-credit associations,
 - Any project that contributes to promoting investment and employment;
- The National Human Development Initiative (INDH) places the fight against poverty, exclusion and insecurity at the centre of the country's economic and social policy priorities and aims to give new, decisive momentum to the social development strategy.

A description of the role of each organisation is provided in Appendix IVc.

3.3 Stakeholders

3.3.1 Manufacturers and importers

Within the framework of the 2006-2012 Progress Contract, the APEBI is working towards goals that will enable the sector to increase its turnover from the 26 billion dirhams recorded at the end of 2004 to nearly 60 billion dirhams by 2012, i.e. a potential average annual growth rate of around 18%.

Computers

The main computer manufacturers have a commercial and marketing presence in Morocco, enabling them to promote their products and provide their representatives with technical support. That is the case for HP, IBM, FUJITSU SIEMENS COMPUTER and DELL, which have subsidiaries in Morocco.

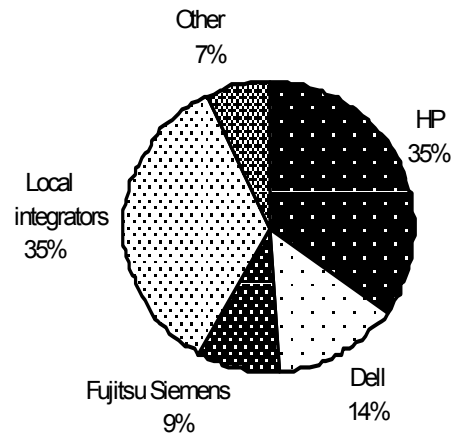


Figure 1: Market share of computer manufacturers in Morocco in 2006 (Matel PC Market SA, 2007)

HP also dominates the national printer market, with a market share of more than 75%; the remainder is split between the LEXMARK, EPSON, CANON and BROTHER brands.

The Moroccan authorities have introduced a customs code that encourages the import of IT products and consumables. Thus, within the framework of the Morocco-European Union association agreement, computer equipment and software of European origin has been exempt from customs duty since March 2000. With regard to consumables, imports of ink cartridges of European origin have been exempt from customs duty since March 2003, following the association agreement between Morocco and the European Union. However, imports of cartridges from non-European countries are taxed at the rate of 2.5%.

Mobile phones

The first phase of liberalisation in 1999, with the award of the second GSM licence to a foreign operator, was a big step forward for Morocco in the democratisation of new information technologies. This first step was followed, in 2005, by a second phase of liberalisation of all services linked to fixed and mobile telephony.

The spectacular increase in the number of mobile phone subscribers illustrates this perfectly: mobile telephony penetration rose from 1% in 1999 to 65% in 2007. According to the most recent joint report published by ITU and UNCTAD in May 2007, Morocco had the fastest digital opportunity index (DOI) growth worldwide between 2004 and 2006, and currently has the most developed telecommunications infrastructures on the continent, together with South Africa.

The manufacturers that have a strong presence in Morocco are Nokia, Samsung, Sony Ericsson, Motorola and LG. Although Moroccan market share statistics are not available, the chart below shows an overview of the global market.

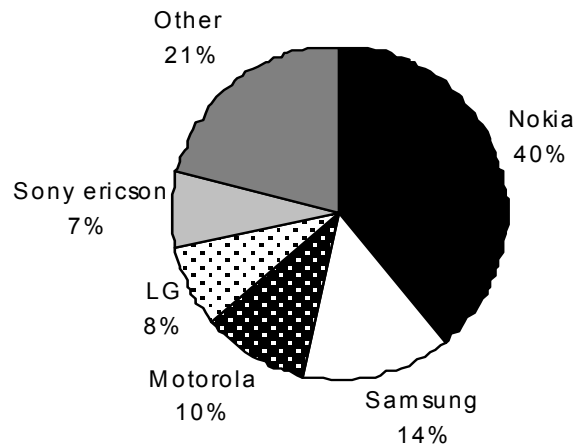


Figure 2: Market share of mobile phone brands in the global market (Gartner Group, 2008)

Television sets

As there is no body responsible for compiling statistics, it is difficult to give an exact breakdown of the market. However, according to the market research company GFK, Samsung controls 45% of the market, followed by LG with 15% and Sony with 10%. The other brands (Philips, Sierra, etc.) share the remaining 30%. Television sets are still sold in the informal market.

Manufacturers and WEEE management

Few manufacturers/importers (IBM, HP and Philips, among others) entrust the management of their WEEE to specialised firms. The majority make charity donations to local associations, rural schools, etc.

Furthermore, a number of manufacturers and/or importers (PC, TV and GSM) have social promotion programmes, one of the largest being the Maroc Telecom Association for the Creation of Enterprises and the Promotion of Employment. More details about this programme are provided in Appendix V.

3.3.1.1 Professional associations

- Professionals in the ICT sector are represented by the *Federation of Information Technologies, Telecommunications and Offshoring* (APEBI). Founded in 1989, today it has more than 150 members, representing 95% of turnover in the sector.

The 2006-2012 Progress Contract, signed on 20 September 2006 between the APEBI and the government, defines the main areas for the development of information technologies for all actors, both private and public. The APEBI projects that, by 2012, Morocco will have generated more than 30,000 direct new jobs in the ICT industry, in addition to the 100,000 forecast for offshoring activities (Emergence programme). It is estimated that the turnover of 30 billion dirhams generated by the sector in 2005 will rise to more than 60 billion dirhams, 1.8 billion of which will be from exports (excluding offshoring activities). However, the question of WEEE has not been addressed. In 2007, this Federation signed the United Nations Global Compact on human rights, labour rights, protection of the environment and the fight against corruption.

- The Moroccan Centre of Information and Communication Technologies for Enterprises (CETIC) was created in July 2004 with the support of the Ministry of Industry, within the framework of the MEDA II programme financed by the European Commission. It is organised as a not-for-profit association, chaired by the APEBI and managed by the various enterprise support organisations (ANPME, OFPPT, CGEM, etc.). This centre, based in Casablanca, identifies and proposes appropriate measures to promote the use of ICTs in enterprises and helps businesses develop solutions.

- The FENELEC, *National Federation of Electricity and Electronics*, represents a sector comprising over 200 structured enterprises, 196 of which are members of the Federation. They employ more than 52,000 people and generated total turnover in the region of 2.5 billion euros in 2005. This Federation brings together professionals from the electricity and electronics sector in the form of four associations (association of manufacturers, association of installers, association of electrical equipment distributors and the association of the electronics sector).

- The FIMME, *Federation of Metallurgical, Mechanical and Electrical Industries*, is made up of 12 professional groups covering all the branches of activity.

3.3.2 Distributors

In Morocco, nearly all manufacturers have adopted the approach of indirect distribution through wholesale distributors. Some manufacturers such as Xerox and Dell have a strategy based on the direct model (presence established through the creation of subsidiaries). However, in the African market, and in the majority of emerging countries in general, manufacturers have recently been forced to adopt the indirect model. The main reasons for this decision are related to expanding distribution networks and winning greater market share.

Table 7: Distribution of suppliers by region (source: InfoMagazine – directory of IT and telecommunications suppliers, 2007)

City	Number of suppliers	Percentage
Casablanca	380	66
Rabat	82	14
Other cities	111	20
Total	573*	100

*Suppliers may sell ICT equipment without having the status of authorised dealer.

Casablanca is the focus of the bulk of the activity of IT and telecoms suppliers (66%). 14% of suppliers are based in Rabat. The remaining operators are distributed between the country's other cities.

Furthermore, according to the MICNT, in December 2006, Morocco had 49 “superstores” (hypermarkets with a surface area greater than 2,000 m² or supermarkets with a surface area of between 400 m² and 2,000 m²).

Hypermarkets and supermarkets have enjoyed sustained growth, which has picked up pace in the last three years. Turnover, which is rising by an average of 30% a year, reached 10 billion dirhams in 2006. These retailers sell food and non-food products (EEE, furniture, etc.). Experts predict that around fifty hypermarkets and supermarkets will emerge in the medium term.

Computers

To provide a clearer picture, the local computer market can be segmented into several categories that are characterised by different demands and needs. There are three main market segments:

- *The “major accounts” segment*, which is primarily made up of government agencies and public bodies (Ministries and Offices), as well as major private actors (banks, insurance companies, industrial companies, multinationals). This segment attracts a specific category of competitive resellers with sufficient capacity to handle major contracts, thanks to their high technical competence and their logistical and financial capacity. These resellers are also solution integrators and generate high turnover, running to hundreds of millions of dirhams a year. There are currently about 20 such resellers. In the event that their wholesale suppliers have insufficient stock, the “major accounts” reseller obtains supplies directly from the manufacturers.
- *The SME SMI segment*: Demand for IT products in this sector has long depended on the degree of modernisation of the firm. The positive effects of modernisation programmes and the vital need to integrate new technologies (Internet) are currently generating high demand. The SME SMI market mainly consists of dealers and retailers. The need for geographical proximity and the small size of the firms explains the high number of dealers in this category (more than 1,000 dealers at present).
- *The home segment (private individuals)*: Following the example of more mature markets, development of the Internet and multimedia technologies combined with the constant lowering of prices has led to strong growth in domestic demand for products such as computers, laptops, printers, digital cameras, MP3 players and video projectors. This demand is essentially met by specialist outlets, which have stores located close to the customers. National store chains and mass retailers (hypermarkets) are the most active in this segment, where marketing plays a key role. Around a dozen chains dominate this market.

Television sets

The distribution of television sets is split between traditional resellers, which are the most numerous, mass retailers and specialist chains, particularly Le Comptoir de l’Electroménager, Cramer, Le Tangérois and Batam. For the moment, these are small- and medium-scale stores, usually smaller than 2,000 m².

Mobile phones

The market is currently split between three mobile phone operators: Maroc Telecom (66.41% of the market), Méditel (33.59% of the market) and WANA (launched in 2007). Each operator has a national network of dealers (exclusive or not) that sell their products to private consumers and businesses. In June 2008, these three operators set up MATI (*Moroccan Association for the Telecoms Industry*) to promote the sector and create a forum for dialogue with their environment.

3.3.2.1 The informal sector

For the 3 types of EEE studied, the informal sector is active and, according to experts, does not exceed 20% of the market. It is difficult to ascertain the number of operators due to the lack of official data (see statistics for the Derb Ghallef informal market in Casablanca for an example: Repairers chapter). The informal sector is found throughout

Morocco, with prices up to 30% cheaper than the formal sector for new equipment and much cheaper for second-hand EEE.

3.3.3 Consumers

Consumers are presented here separately, depending on whether they belong to households, companies or the public sector. Equipment penetration rates and habits in the management of WEEE differ between these 3 groups.

3.3.3.1 Households

The survey of households shows that they mainly purchase new equipment, although the second-hand market remains active. 89% of households that own a desktop computer bought it new, compared with 11% from the second-hand market (85% new vs. 15% second-hand for laptops). The proportion of new purchases is even higher for television sets.

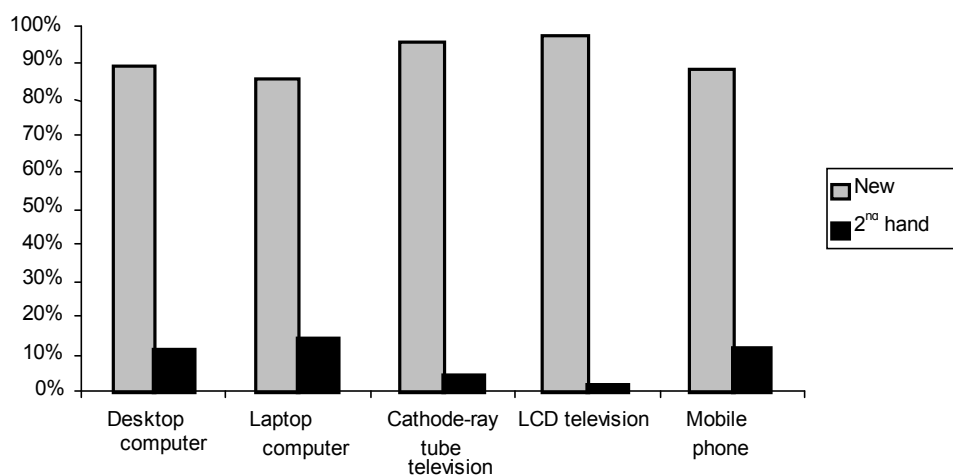


Figure 1: Purchases of new and second-hand equipment by Moroccan households

Computers

An OTI estimate places the number of computers in Morocco in 2006 at around 920,000, up 23% on the previous year. By the end of 2007 this figure was in excess of one million, compared with 620,000 in 2004 and 745,000 in 2005. The penetration rate in households reached 19.6% in 2007, compared with 13.2% in 2005 and 16.3% in 2006.

According to the ANRT, only 18.1% of people living in rural areas had a computer in 2006 (only marginally more than in 2005). The situation is different in urban areas, where nearly 24% of people have at least one computer in their home. The presence of a child is also significant, due to their tendency to become familiar with using computers at school. Thus, in 2006, nearly 15% of people whose home is equipped with a computer belong to a household with one or more children under 16 years of age, up 1.2% compared with 2005. Furthermore, at the end of 2007, the number of Internet subscribers totalled 526,080, representing an increase of 31.6% compared with 2006 (399,720 subscribers) and 100.5% compared with 2005 (262,324).

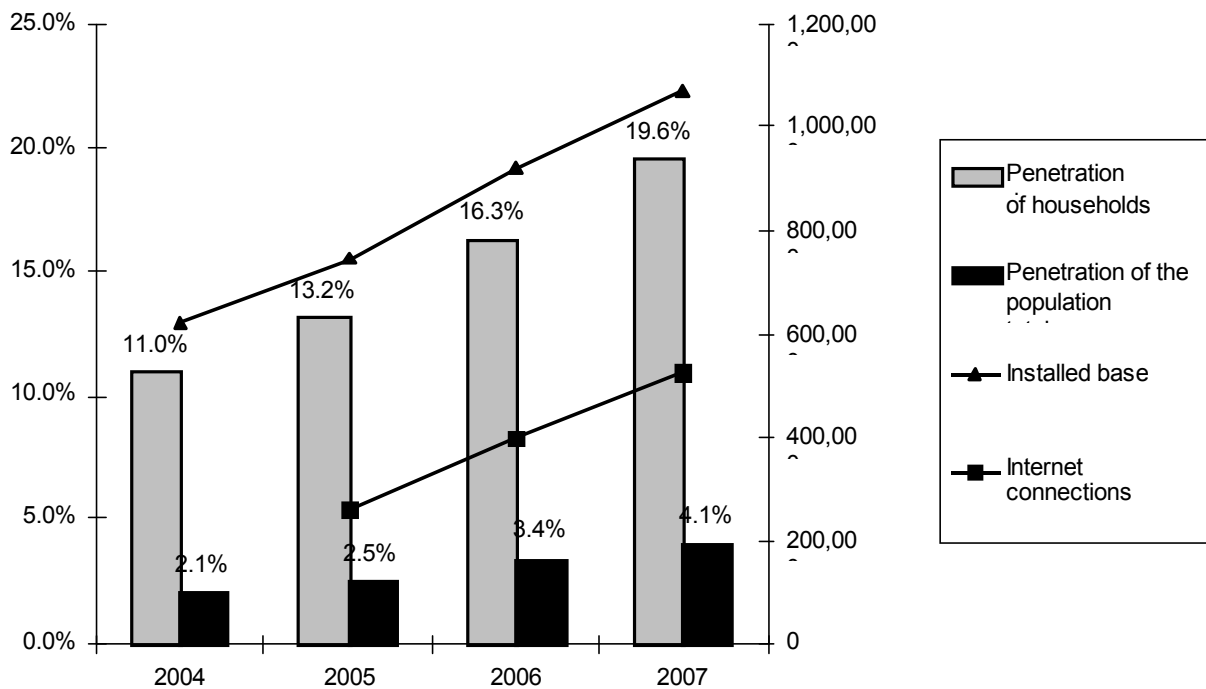


Figure 2: PC installed based, Internet connections and penetration rate in the Moroccan population (source: OTI 2008)

Moreover, in March 2005, the government adopted a strategy designed to increase the presence of ICT in public school teaching with the GENIE programme. This initiative had already equipped 2,824 teaching establishments with computer equipment in 2007, and plans to provide all schools and colleges (8,600) with equipment by 2008, benefiting more than 6 million pupils (i.e. 20% of the Moroccan population).

According to the same source, 74% of computers in homes were less than 1 year old in 2006, and the remainder (26%) was between 1 and 4 years old; this suggests that households will generate considerable volumes of obsolete equipment in the coming years.

Telephones

At the end of 2007, the number of mobile subscribers reached 20,029,300, reflecting annual growth of just over 25% (16,004,731 subscribers at the end of 2006). Thus, the penetration rate rose 12% in one year, recording 65% at the end of December 2007 compared with 53% in 2006 and only 41% in 2004.

Oversupply continues to rise, with 68% of people having more than one mobile phone in their household (compared with 61% in 2005 and 53% in 2004).

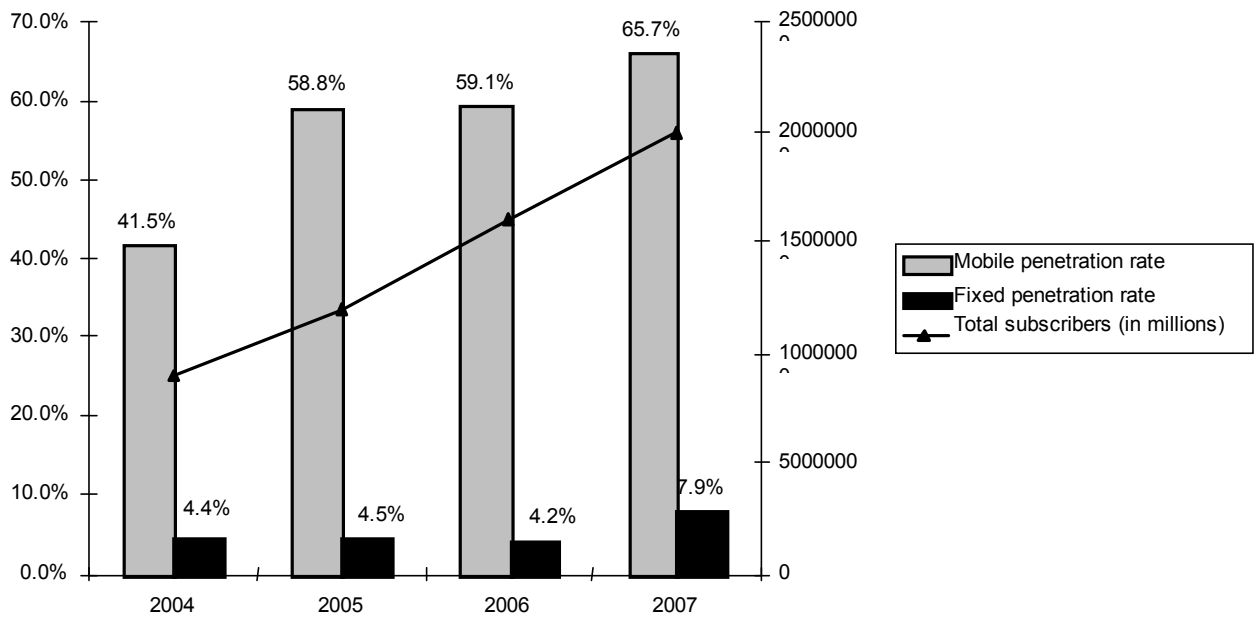


Figure 3: Population penetration of fixed and mobile telephony equipment in Morocco (source: OTI 2007)

This increase is due to the development of services and the lowering of tariffs thanks to the State's mobile network liberalisation policy, which has also resulted in a predominance of mobile telephony over fixed telephony.

Finally, the government has launched the PACTE programme, which aims to spread access to telecommunications to all regions of Morocco. This is a 4-year programme that is due to end in 2011. A census of all the areas not served by telecommunications networks reveals that approximately 9,200 villages are not yet covered, i.e. some 2,000,000 Moroccans do not have access to telecommunications services.

Television sets

According to the general population and housing census conducted by the HCP in 2004, there were 4.3 million television sets in Morocco, with a household penetration rate of around 76.4%. The urban population owns the majority of this equipment with 3 million sets (70%) and a penetration rate of 88.5%.

According to sector experts, the number of television sets reached 5 million in 2007 (8% average annual growth) and of the 500,000 sets sold in 2007, 70,000 (14%) were flat screens (mostly LCDs), while in 2006, LCD and plasma screens accounted for just 2%. In 2008, these operators expect to sell at least 150,000 flat screens. All indications suggest that Morocco is following the global trend of gradually replacing cathode-ray tube screens with flat screens, especially as LCDs become more affordable.

Management of WEEE in households

In the 202 households surveyed, mobile phones, cathode-ray tube televisions and desktop computers head the list of discarded equipment, while LCD television sets and laptop computers account for just 8% (Figure 6).

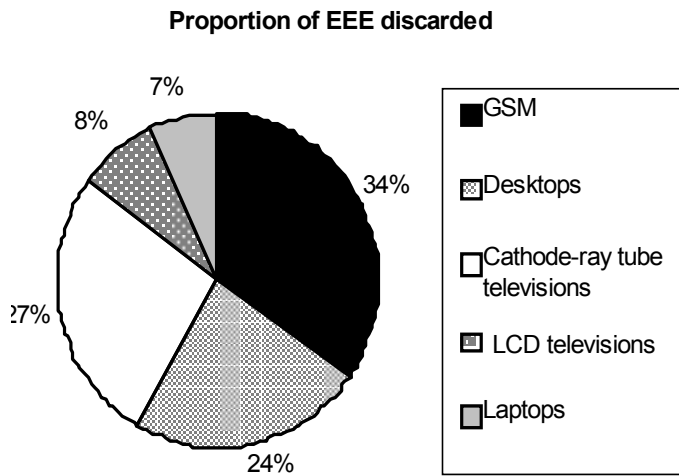


Figure 4: Proportion of equipment discarded by Moroccan households

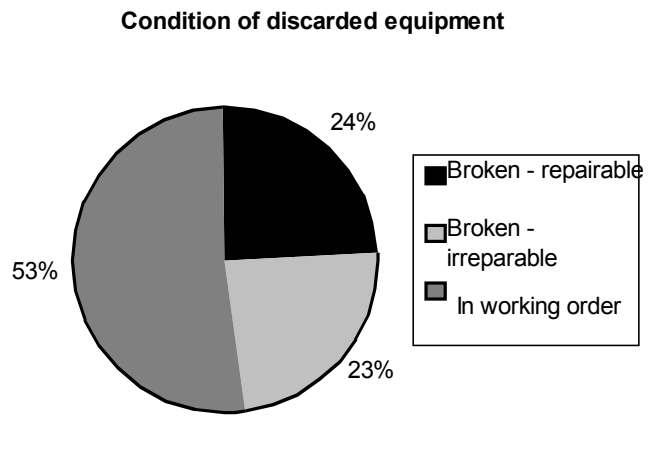


Figure 5: Condition of equipment discarded by Moroccan households

The survey also reveals that more than half of the equipment discarded by households is in working order, quarter is repairable and quarter irreparable (Figure 7); this equates to an equipment reuse potential of 75%.

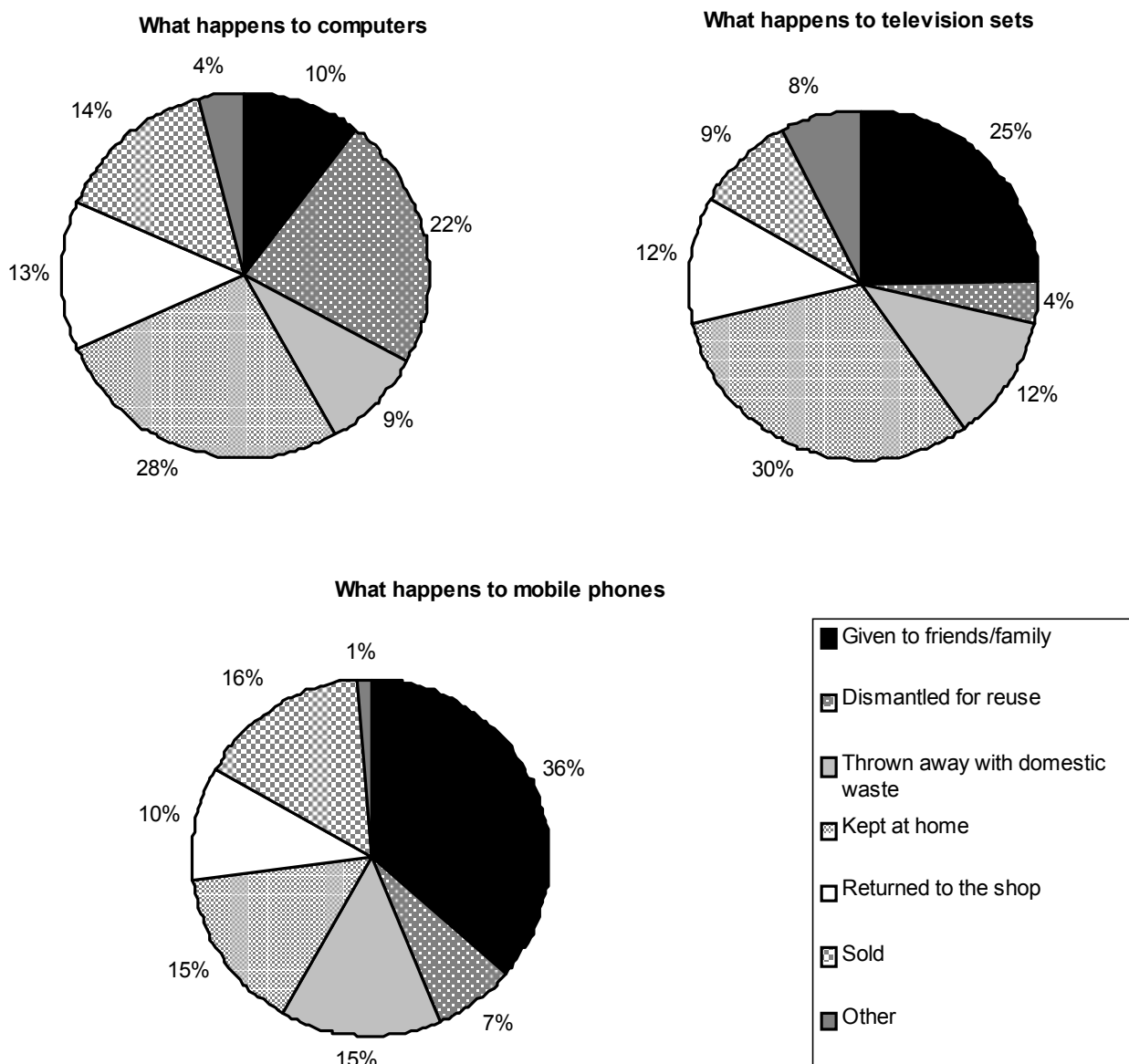


Figure 6: What happens to computers, television sets and mobile phones when they are discarded by Moroccan households

Figure 8 shows what happens to the 3 types of equipment studied when households discard them. 36% of mobile phones are given to friends or family, 15% are kept at home and 15% are sold. Only 14% of mobile phones are thrown away, ending up in landfills. Moreover, only 10% of EEE is returned to shops, being traded in against the purchase of new equipment.

As for computers, 27% of households keep their PCs at home and 22% reuse them. 14% prefer to either sell them on the second-hand market or exchange them with suppliers. 9% of families thrown their faulty computers away.

Regarding television sets, 30% of households keep their old TVs (the majority of which are cathode-ray tube TVs) at home, while 25% are given to friends or family and 12% are thrown away.

Finally (Figure 9), the majority of WEEE sold by households is done so on the second-hand market, 24% is bought by ragpickers and 13% is acquired friends and family.

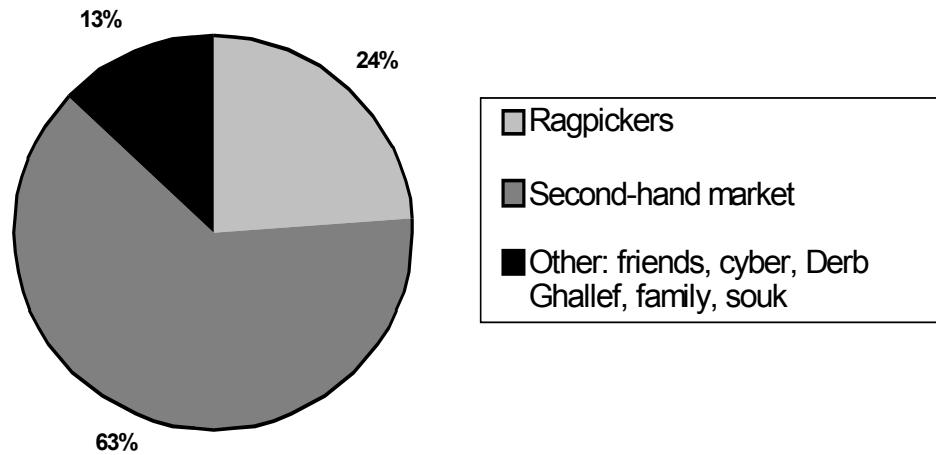


Figure 7: Breakdown of the sale of equipment discarded by Moroccan households

3.3.3.2 Companies

Computer equipment

According to the OTI, the computer penetration rate in companies is 37%. The authors of the survey believe that this low level of equipment is due to the high cost of computers.

Casablanca is home to a third of all Moroccan companies and five cities (Casablanca, Fez, Tangier, Rabat and Agadir) account for more than 60% of all companies. The technology sector represents more than 18% of companies, but only 3% of staff.

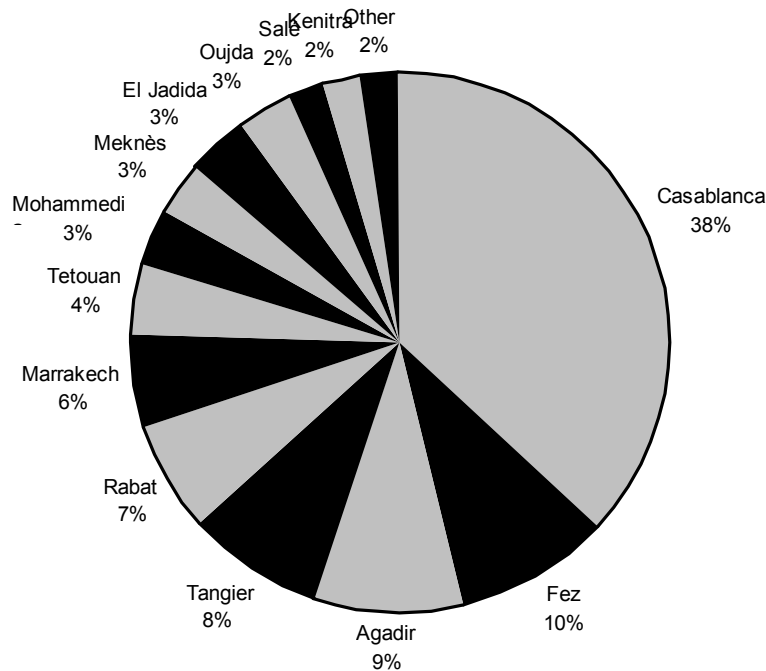


Figure 8: Geographical distribution of companies in Morocco (source: OTI 2007)

The 40,000 Moroccan companies listed in the Kompass directory have 40,000 computers. The average number of computers per employee in 2006 was 0.48 (0.40 in 2005), according to the OTI (Figure 11). However, this average ratio masks major differences from one sector to the next. Indeed, companies in the technology sector have the highest computer equipment rate (in 2006, this rate reached 80%), while companies in the primary sector and the services and transport sector come second with a level of equipment per employee of more than 50%. The construction and public works sector is the least equipped, with just 20%.

In 2006, 32% of computers in companies were less than 1 year old, 43% were between 1 and 3 years old, and 25% more than 3 years old. In households, computer equipment is relatively young, with high potential for the generation of WEEE in the short term.

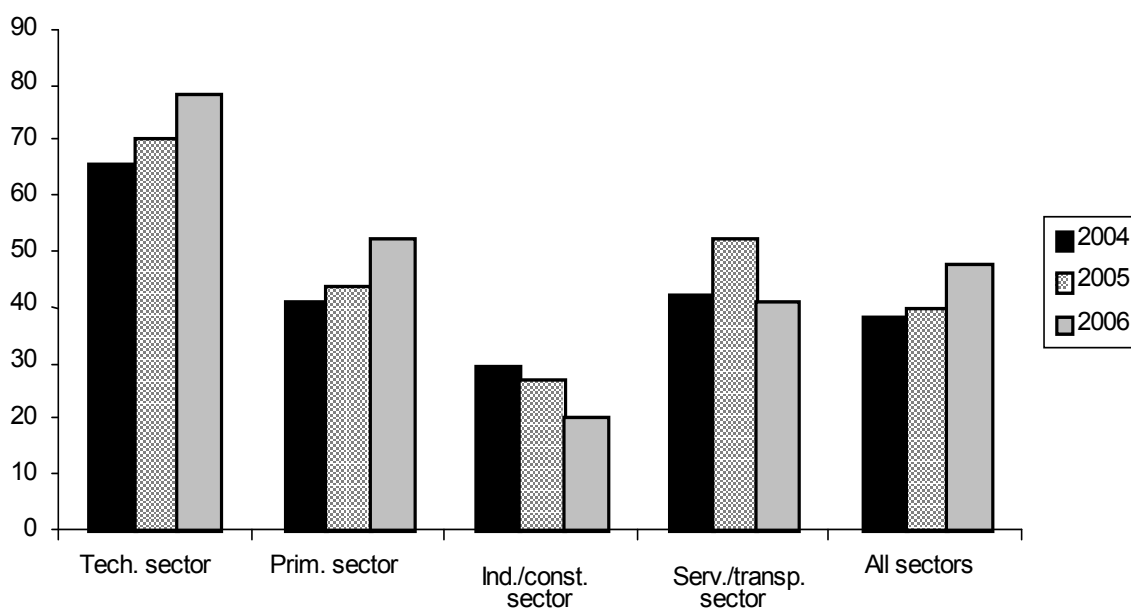


Figure 9: Number of computers vs. employees in each economic sector (source: OTI 2007)

PROTIC (the National Programme for the Promotion of ICT) has been set up to promote the use of ICT as a tool for competitiveness within companies. The CETIC is responsible for the implementation of this programme, which aims to increase the number of companies connected to the Internet to 50,000 by the end of 2008.

Management of WEEE in companies

The survey conducted and the various interviews carried out with companies show that the majority of businesses are aware of the environmental hazards linked to WEEE and that WEEE can be profitably recycled. The form of managing this waste differs according to the size of the company and how organised it is. SMEs generally sell their WEEE by auction, or dispose of it mixed up with other waste (plastic, wood, desks, etc.). The buyers are usually wholesale intermediaries or scrap metal dealers. These companies do not know the destination of their waste and pay little attention to this aspect, even after the publication of Law 28-00 on the management and disposal of waste. A number of companies in the technology sector (call centres, banks, etc.) return computer equipment to the reseller (usually after 2 or 3 years), trading it in against the purchase of new equipment, thus avoiding accumulating equipment while ensuring that they always have the most up-to-date equipment.

Large companies, meanwhile, usually store their WEEE until a solution for its reuse and/or sustainable disposal is found. Storage remains the best solution, although some companies have limited space and donate equipment to local charities, rural schools, etc. The fate of this equipment when it reaches the end of its useful life is not known. Very few companies in Morocco entrust the management of WEEE to specialist firms, either because of the high cost or unsatisfactory disposal methods.

3.3.3.3 Public sector

According to a study carried out by the SEPTI in 2002 on the use of ICT in the Moroccan public sector, there was only one PC for every 35 civil servant and the computer penetration rate within government agencies was just 3%. The “e-government” project christened IDARATI (Computerisation of Government Departments and their Networking via ICT), which was launched for the 2005/2008 period, should increase this rate by the end of 2008. During 2007, the MMSP approved and adopted 11 projects for the modernisation of administrative services through the integration of ICT, taking the number of online public administration portals from 15 to more than 190 in 2007. The MMSP plans to undertake a study to assess the use of ICT in the public sector and will present the results in the course of 2008.

The surveys and interviews conducted with the representatives of ministerial departments revealed that the management of WEEE depends on the status of the body. Indeed, public structures (depending on the general budget of the State) proceed in much the same manner: defective equipment which would cost more to repair than it is worth (old models that have been used for 4 to 5 years) is used by the technicians in the IT department for spare parts. Once there is no further use for it, equipment is stored with any other unwanted items, until the storage limit is reached. The body in question then informs the State Property Department (under the Ministry of Finance), which collects everything and auctions it without worrying about its destination or what happens to it.

For semi-public bodies with autonomous budgets, management is the same as for government agencies, except that WEEE can be sold directly, without going via the Ministry of Finance.

3.3.4 Collectors and recyclers

In Morocco, in terms of quantities of waste and numbers of people involved, the bulk of WEEE collection and recycling is performed by the informal sector. In fact, the formal sector is in its infancy, with several initiatives beginning recently.

3.3.4.1 The informal sector

WEEE (PCs, TVs and mobile phones) collection and recycling activity basically consists of the dismantling and recovery of metals/scrap. Generally, an income hierarchy exists within this sector, where those at the bottom of the collection chain are the most numerous and earn the least (Figure 12).

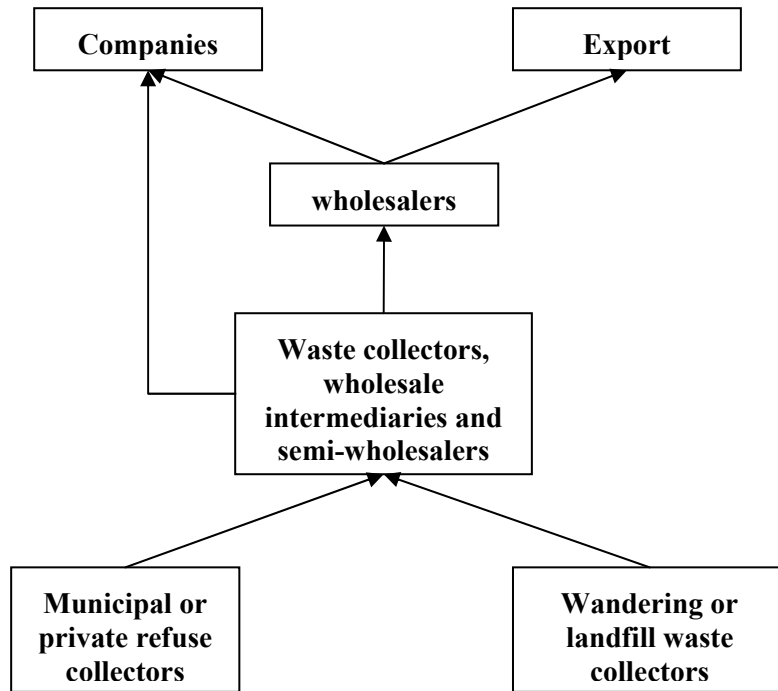


Figure 10: Simplified diagram of the WEEE collection chain

Refuse collectors

Some refuse collectors working for municipalities or private firms separate recyclable waste in the refuse truck and then sell it on to wholesale intermediaries. The proportion of WEEE is low and mainly consists of remote controls, radios and other small, broken household appliances. This activity supplements their income; surveys conducted in Fez with these operators show that up to 30 dirhams a day can be made from this sorting.

Landfill waste collectors

These are collectors who sort through dumped waste, in order to recover as much recyclable material as possible. During the survey of the uncontrolled dump in Meknes, it emerged that WEEE was not recovered due to a lack of demand. During the survey, an agreement regarding the price per kilo was reached between the representative of a new formal recycling company and the informal manager (wholesale intermediary) of the dump, whereby the waste accumulated by the end of 2008 will be used for the start-up tests for the new plant. 150 waste collectors, including 16 children (aged between 9 and 16) work on this dump and sell what they have collected to the wholesale intermediary on the site. A landfill waste collector can earn an average of 60 dirhams a day (between 35 and 150 dh/day).

A new sanitary landfill is currently being prepared in the district, and will replace the current dump in 2009. The fate of the waste collectors who work on the dump is not yet known.



Figure 11: WEEE in the uncontrolled dump in Meknes is not of interest to the collectors as there is no market for it

Mediouna landfill in Casablanca is the largest in Morocco, covering 76 hectares and attracting around 500 ragpickers (including 40 women and a few children). These do not collect WEEE either, due to the lack of buyers. This landfill has only received one recycling request from an industrial pollution control company: 800 kg of crushed plastic from computers.

An agreement was signed in 2008 for the creation and operation of a new public sanitary landfill, as well as for the rehabilitation of the current dump, with a view to its definitive closure in two years' time. The project also addresses the reuse of waste, for both electricity production (an eventual output of 5 megawatts) and the recovery of recyclable materials. 40 permanent jobs will be created in relation to the running of the landfill, and at least 200 jobs will be created in manual sorting. If the WEEE currently contained in the uncontrolled dump is not recovered, it will be buried once and for all, with all the ensuing consequences (loss of raw materials for recyclers and pollution risks).

The set-up is different in Fez, which already has a privately managed sanitary landfill. Consequently, there are no on-site waste collectors. However, recovery takes place at the transfer stations. Once the waste reaches the landfill, it is buried, with no possibility of being reused.

Although it is difficult to estimate the amount of WEEE in the landfills, the managers say that it is limited compared with ordinary domestic waste (less than 5%).

Wandering waste collectors

Also called ragpickers, they scour the city with a cart and collect recyclable waste from public rubbish bins, factories and dumps. There are no wandering waste collectors that specialise in WEEE as, according to them, the product is difficult to sell on. Some go from house to house, offering to buy EEE (old models sold at very low prices, or sometimes given away). These operators sell what they have collected to wholesale intermediaries for an average of 1 dirham per kilo, giving them a daily income of roughly 70 dirhams (between 20 and 100 dh/day).



Figure 12: Some waste collectors burn WEEE to recover the metals (especially copper)



Figure 13: Manual dismantling to recover metals from WEEE

In the city of Fez and the surrounding regions, according to the wholesale intermediaries, there are some 3,000 ragpickers, including 50 children under 13 years of age, and 1,000 over 50 years of age. 20% are reportedly tramps and 80% waste collection professionals, according to the same sources.

Wholesale intermediaries

Usually located in working-class districts and on the edge of cities, they store, sort and/or wash recyclable waste purchased from waste collectors and small intermediaries. They also take part in auctions held by companies in the region and some public authorities. The purchasing strategy consists of making a visual diagnosis of the WEEE (which is often mixed with other items, particularly office furniture), and offering a price on the tonnage (1 dh/kg), taking into account the fact that the equipment is not in working order, which enables them to make a profit.

Some operators sell WEEE on directly, without processing it in any way, while others dismantle it first. Desktop computers and printers are broken apart with clubs, then the metal parts are sold as scrap and the electric cables are burned in the open air to recover the copper. Cathode-ray tube monitors and television sets are broken apart to recover the metal components (copper is sold at 45 dh/kg), or simply to avoid implosion when loaded onto the collection truck.

The recovered materials are sold to wholesalers (usually in Casablanca) for a price of between 1.25 and 5 dirhams per kilo, depending on the content.



Figure 14: WEEE mixed with other waste on the premises of a semi-wholesaler



Figure 15: A semi-wholesaler stores WEEE from the district

Materials that cannot be sold on, such as plastic stands, are simply abandoned if they cannot be used for something else (e.g. cow milking stools). Glass, which has a high lead content, is simply dumped as it cannot be sold on.

Mobile phones are of no interest to either wandering waste collectors or wholesale intermediaries, given that WEEE is sold by weight and mobile handsets are rarely found in public rubbish bins.

Wholesalers

The majority of wholesalers are based in Casablanca, and there are none specialising in WEEE. They are supplied by semi-wholesalers from around the country, and also take part in public auctions (WEEE and other materials) as well as buying directly from companies. WEEE is rarely exported, given its limited volume compared with ferrous and non-ferrous metals. The places where informal dismantling has traditionally taken place (the scrap yards of Tit Mellil, Ahl Loghlam, etc.) have started to give way to dismantling operators located in Sidi Bennour (province of El Jadida). Consequently, the wholesalers in Casablanca are merely becoming intermediaries, performing little or no processing.

3.3.4.2 The formal sector

The actors active in the collection of WEEE (PCs, TVs and mobile phones) can be categorised as follows:

- *Associations and/or NGOs* that collect computer equipment (which may or may not be in working order) from companies to repair and distribute it to other associations, rural schools and other organisations. Non-repairable equipment is reused in other areas, with the WEEE resulting from these activities being stored until recycling facilities are created.
- *Companies specialising in industrial pollution control.* Their services are sometimes engaged by organisations to destroy WEEE and provide a certificate. Some of these companies do not have a waste recovery unit and are therefore unable to ensure the traceability of the waste, preventing them from providing this service. Others have denaturation units (industrial grinders). These companies can play an important role, providing an interface between the generators of waste and recyclers.

- Companies that *sell computer equipment*. Many offer their customers the possibility of trading in their computer equipment after a period of use (between 2 and 5 years), giving them a discount (of 10% to 30%) on the new equipment. The old traded-in equipment is upgraded and resold to other users, who are less demanding in terms of configuration and aesthetics (cyber cafés, private individuals, etc.).
- *Companies specialising in collection, dismantling and recovery*. This is a new phenomenon in Morocco, and a number of initiatives are already operational in the market. They operate independently, collecting waste from companies and separating the various components that they sell on the national or international market.

A detailed presentation of these main actors is provided in Appendix VI.

3.3.5 Repairers / reconditioning

EEE repairers represent an important link in the overall organisational chain of this sector. The waste generated comes from recycling, changing faulty parts, etc. However, the management of WEEE differs between the formal and informal sectors.

Some retailers provide the after-sales service themselves and either store WEEE, discard it together with ordinary waste, or export it to be recycled. Some entrust their WEE to industrial pollution control companies for denaturation (especially when the brand name is visible). Other retailers sub-contract the after-sales service to specialist firms, which store the WEEE or sell it by weight to waste collectors. Few retailers give their WEEE to processing companies, as the offer is very limited and the cost is high.

With regard to the informal sector, most repairers learn the trade on the job, and the majority work with households. Part of the WEEE comes from equipment that the repairer abandons due to a lack of spare parts or the prohibitive cost of repairing it. Another part is bought from customers who find the cost of repair too high. WEEE with no further use is usually discarded in public rubbish bins, while operators in second-hand markets sell their unwanted equipment to waste collectors for 1 dirham per kilo. To give an example, the Derb Ghallef informal market in Casablanca has 218 stalls for the sale and repair of mobile phones, 186 stalls for the sale and repair of computers and 135 stalls for the sale and repair of household appliances. The informal market in Meknes has approximately 30 sale and repair stalls.

3.3.6 Outlets for materials

Metallurgy experts estimate that 90% of metal waste collection activities are informal. The majority of this metal is sold abroad, while local metallurgists import raw materials that are more expensive.

Soaring commodity prices have favoured the export of Moroccan scrap. In 2006, some 274,000 tonnes of scrap (all types of metal) was sold abroad, compared to 130,000 in 2002. These sales represent a loss for Morocco of 2 billion dirhams, i.e. the added value of the 274,000 tonnes of metal exported each year if it were processed in the country, estimates the FIMME, which is calling for restrictions on the export of scrap over a period of 3 to 5 years. On 28 April 2008, Note 0604/1313 from the Facilitation Office introduced new provisions for the export of ferrous and non-ferrous metals, particularly metal debris, scrap metal and others. Since then, exporters of these materials must produce documents proving the origin of their cargoes in order to obtain customs release.

Iron scrap represents the majority of this metal waste, with 250,000 tonnes. However, non-ferrous metals are more remunerative for exporters. According to the FIMME, 5,000 tonnes of copper scrap, 6,000 tonnes of brass, 10,000 tonnes of aluminium and 3,000 tonnes of lead are exported annually. The main markets for scrap are Europe and

Southeast Asia. In 2000, Southeast Asia only absorbed 5% of non-ferrous metals; by 2006 this figure had shot up to 95%.

The largest Moroccan manufacturing plants are run by the companies SONASID, Tube et Profil, Maghreb Steel and Comptoirs Métallurgiques. Several small- and medium-sized foundries operate in different cities, notably Casablanca, Rabat and Kenitra. The informal sector is not active in this industry, given the level of technical expertise and investment required.

Foundries turn ferrous and non-ferrous metals into ingots for steel construction, manhole covers, hand-made articles and other items. In Morocco, there is no industry for the recovery of the precious and special metals contained in WEEE, with the exception of the Guemassa hydrometallurgy complex, which specialises in a few metals, including copper, lead, zinc and cobalt.

The scrap that interests wholesale waste collectors is metal from car carcasses, steel construction and, to a lesser extent, WEEE.

Table 8: Structures for the reuse of materials produced from the recycling of WEEE in Morocco

Type of material	Recycling possible in Morocco	Potential structures
Plastic	Yes, partially	Recycling by construction and public works sector; patent filed by ENIM/ECOTECHNO “impermeable polymer”, in June 2008
Ferrous metals	Yes	SONASID and others
Aluminium	Yes, partially	Craft industries (manufacture of pans and other items)
Copper	Yes, partially	Macz and other firms / craft industries
Printed circuit boards (precious metals)	Partially, in its infancy	Industrial recyclers currently setting up / export to Europe
Cathode-ray tubes (containing lead, beryllium, phosphorus, etc.)	No	Hazardous waste treatment plant (CNEDS) or landfill centres
Hazardous materials (PCB in capacitors, mercury in lamps, batteries, getter pills, etc.)	No	Hazardous waste treatment plant (CNEDS) or landfill centres

3.3.7 Final treatment

The presence of WEEE in waste represents a threat to the environment and health, particularly in uncontrolled dumps. Law 28-00 on the management and disposal of waste prohibits the mixing of hazardous waste with other types of waste. Moreover, it establishes rules for the organisation of existing dumps and calls for their replacement by sanitary landfills, defining three different landfill categories. This categorisation depends on the type of waste they are authorised to receive. Of 150 landfill sites studied by the *Direction Générale de l’Hydraulique* (Water Resources Department), only 20% are located on non-vulnerable land.

The Department of the Environment is currently drafting a decree regarding the adoption of a National Hazardous Waste Master Plan. A detailed feasibility study of the CNEDS hazardous waste treatment plant is currently being conducted by this Department. This initiative is being undertaken within the framework of the cooperation between the Kingdom of Morocco and the *Land* of North Rhine-Westphalia in Germany. This plant would be a suitable solution for the disposal of WEEE components that cannot be reused, particularly lead-rich glass, plastics containing flame retardants, and other toxic wastes. However, the question of profitability will be raised, as there will be a charge for the services of this plant.

Finally, the ECOVAL platform (and soon ECOCIM) offers a specialist service for the incineration of waste in cement plant furnaces, guaranteeing safe and strictly controlled disposal. It gives the client a tracking sheet to ensure the traceability of hazardous waste and its disposal in accordance with best practices. However, WEEE is not accepted by these companies as it contains heavy metals above the acceptable limits and because of the flame retardants contained in the plastics.

3.3.8 Other actors

It is interesting to note that some artists use WEEE to create works of art. In May 2008, the CGEM headquarters hosted an exhibition of the work of the artist Mohammed Tayert entitled “Traces and Totems”, with 56 paintings and statues, ten of which were made using electronic waste. The price of these works varies from between 2,000 and 7,000 dirhams (200 and 700 euros).



Figure 16: Artworks made from e-waste

4 Material flow analysis

4.1 System flow diagram

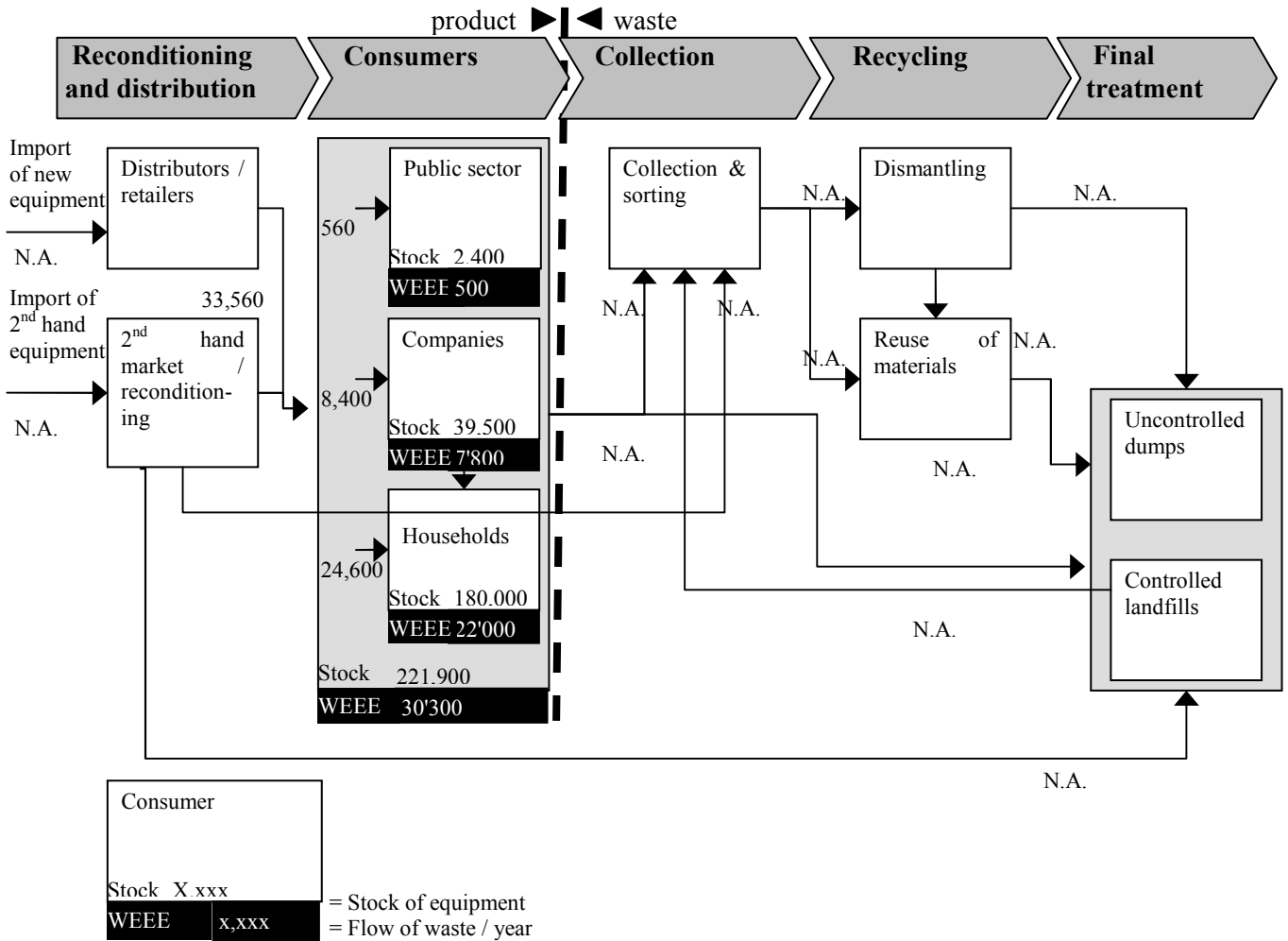


Figure 17: Material flow diagram in tonnes and tonnes/year for 2007 (N.A. = not available)

4.2 Current material flows

A summary of the results for the 3 types of equipment studied, all sectors taken together (households, companies and public sector), is provided in the table below:

Table 9: Quantities of waste generated per equipment type, all sectors together

Equipment	Estimated units (2007)	Stock of equipment (2007)		Flow of waste/year	
		Weight in tonnes	%	Weight in tonnes	%
TVs	5,035,000	151,000	68	15,120	50
Computers	2,700,000	67,500	30	13,500	45
Mobile phones	33,650,000	3,400	2	1,700	5
Totals		221,900	100	30,300	100

The stock of television sets, computers and mobile phones, which represents the potential volume of WEEE, was estimated to be 221,900 tonnes in 2007. In terms of mass, television sets account for 68% of the total stock, followed by PCs with 30% and finally mobile phones, which only account for 2%, even though they comprise 81% of total WEEE in terms of units. This is due to the low average weight (0.1 kg) of mobile phones compared with television sets (30 kg) and PCs (25 kg).

Furthermore, the flow of waste generated per year is 30,000 tonnes. In terms of mass, television sets and PCs account for 95%, with 15,200 tonnes/year and 13,500 tonnes/year respectively, and mobile telephones only account for 5% of mass with 1,700 tonnes/year.

The table below shows the distribution of waste per sector for the 3 types of equipment studied:

Table 10: Quantities of waste generated by sector

Actors	Equipment type	Stock of equipment (2007)		Lifetime	Flow of waste/year	
		Weight in tonnes	%	Years	Weight in tonnes	%
Households	Television sets	150,000	67	10	15,000	50
	Computers	26,600	12	5	5,300	17
	Mobile phones	3,400	2	2	1,700	6
	Total households	180,000	81		22,000	73
Companies	Television sets	1,000	1	10	100	1
	Computers	38,500	17	3 to 5	7,700	24
	Total companies	39,500	18		7,800	25
Public Sector	Total public sector	2,400	1	5	480	2
Total (rounded)		221,900	100		30,300	100

It is clear that households hold the bulk of the stock of equipment with 81% of the total mass, followed by companies with 18% of the installed base, while the public sector only accounts for 1%. This uneven distribution is due to the fact that households dominate in number, and tend to possess the heaviest equipment (television sets). The flows of waste generated per year are also dominated by households, which generate 73%, followed by companies with 26% and finally the public sector with 1%.

A detailed analysis for each sector is presented in Appendix VII.

4.3 Geographical distribution

Taking all sectors together (households, businesses and public sector), it emerges that the top 5 regions (Casablanca, Souss, Marrakech, Tangier-Tétouan and Rabat) generate 54% of waste for the three types of equipment studied (Figure 20). This is due to the fact that these regions have a high concentration of inhabitants, businesses and public sector bodies. However, the Greater Casablanca region stands out with a waste rate twice as high as the other 4 regions in the group. At the other end of the spectrum, the regions of Guelmim, Laayoune and Oued Ed-Dahab generate the least waste, with rates of less than 1.5%. Finally, the other regions have rates varying between 4.1% and 6.1%.

Stock et flux de déchets des équipements
selon les régions du Royaume du Maroc

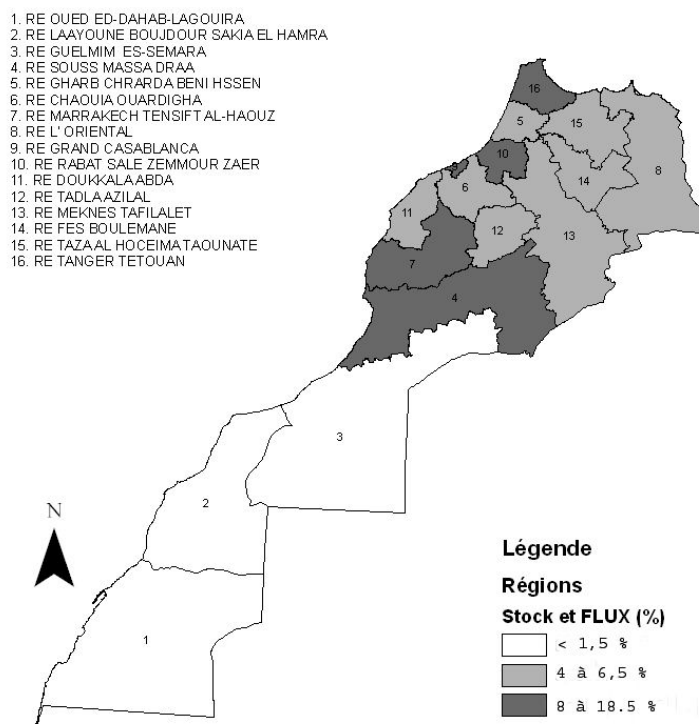


Figure 18: Distribution of the concentration of WEEE in Morocco

A detailed analysis of the flows of waste by region and sector is presented in Appendix VIII.

4.4 Trends for future material flows

It is difficult to estimate the evolution of quantities of waste in the long term, for several reasons:

- Absence of forward studies on the change in the penetration rates of the 3 types of equipment studied;
- Difficulty of anticipating the change in the number of businesses, public sector structures and households;
- Technological developments that could affect several factors (for example the gradual replacement of cathode-ray tube TVs by LCD TVs).

However, in the medium term (5 years), the following hypotheses have been used to ensure the reliability of the projections:

- The lifetimes of the 3 EEEs remain unchanged;
- The change in the number of EEE units will be based on arithmetic sequences whose coefficients are the average annual sales;
- The proportion of WEEE currently processed by the formal or informal sector is insignificant in relation to the total volume;
- The estimate of the volumes of waste that would be produced between 2008 and 2012 is obtained by adding the waste resulting from the average annual sales to the stock from the previous year. For example,

the stock of equipment in 2008 (household PCs) would be equal to the stock of equipment in 2007 (26,750 tonnes) plus the average annual increase in waste (750 tonnes), i.e. 27,500 tonnes. Similarly, to estimate the stock of equipment in 2009, we add the average annual increase in waste to the stock in 2008;

- In order to estimate annual sales of TVs (hotel sector) and PCs (public sector), it has been considered that purchases of new equipment are equivalent to the waste generated in the year, obtained by dividing the total stock by the lifetime of the equipment in question.

Table 11: Breakdown of future stocks of equipment according to sector and type of equipment

				Projection of stocks of equipment (tonnes)				
	Equipment	Average annual sales (units)	Average annual increase in waste (tonnes)	2008	2009	2010	2011	2012
Households	PCs	150,000	750	27,500	28,250	29,000	29,750	30,500
	Mobiles	3,564,000	178	3,543	3,721	3,899	4,078	4,256
	TVs	500,000	1,500	151,500	153,000	154,500	156,000	157,500
	Subtotal	-	2,428	182,543	184,971	187,399	189,828	192,256
Companies	PCs	144,792	724	39,094	39,818	40,542	41,266	41,990
	TVs (hotel)	3,431	10	1,040	1,050	1,060	1,070	1,081
	Subtotal	-	734	40,133	40,868	41,602	42,336	43,070
Public Sector	PCs	18,877	94	2,454	2,548	2,643	2,737	2,832
Totals	PCs	313,669	1,568	69,048	70,616	72,184	73,753	75,321
	Mobiles	3,564,000	178	3,543	3,721	3,899	4,078	4,256
	TVs	50,3431	1,510	152,540	154,050	155,560	157,070	158,581
Totals			3,257	225,130	228,387	231,644	234,901	238,158

We note that annual sales of mobile phones are 7 times higher than sales of television sets and 11 times higher than computers. However, in terms of the increase in the weight of waste generated per year, television sets and computers account for 94% of the stock, with 1,510 t/y (46%) and 1,568 t/y (48%) respectively. The waste generated by mobile phones only accounts for 6%, with just 178 t/y (8 times less than computers and television sets). We also note that television sets would account for 65% of waste by 2012 and PCs 32%, while mobile phones would represent just 3%.

Between 2008 and 2012, the stock of equipment in Morocco would increase by around 5.7%, rising from 225,130 tonnes to 238,158 tonnes.

Furthermore, the estimate of annual flows of waste that would be produced between 2008 and 2012 is obtained by dividing the stock in the year concerned by the lifetime of the equipment in question.

Table 12: Projection of future flows of WEEE/year by sector and by type of equipment

		Projection of waste flows (tonnes / year)				
	Equipment	2008	2009	2010	2011	2012
Households	PCs	5,500	5,650	5,800	5,950	6,100
	Mobiles	1,772	744	780	816	851
	TVs	15,150	15,300	15,450	15,600	15,750
	Subtotal	22,422	36,994	37,480	37,966	38,451
Companies	PCs	7,819	7,964	8,108	8,253	8,398
	TVs (hotel)	104	105	106	107	108
	Subtotal	8,027	8,174	8,320	8,467	8,614
Public Sector	PCs	491	510	529	547	566
Totals	PCs	13,810	14,123	14,437	14,751	15,064
	Mobiles	1,772	744	780	816	851
	TVs	15,358	30,810	31,112	31,414	31,716
Totals		30,835	30,272	30,773	31,273	31,773

Between 2008 and 2012, the flow of WEEE/year would increase by around 3%, rising from 30,835 tonnes to 31,773 tonnes.

5 Impacts

As no specific arrangements are in place yet for the management of WEEE in Morocco, it is difficult to estimate the social, environmental and economic impacts directly linked to WEEE. Nonetheless, the following chapters describe the potential risks that could result from uncontrolled development of this sector, as well as the impacts already observed in processes linked to the recycling of WEEE.

5.1 Social impact

WEEE accounts for part of the income of some ragpickers, semi-wholesalers and wholesalers, but usually no more than 20%. However, some informal recyclers are beginning to depend entirely on this work, particularly in Sidi Bennour, Tit Melil in Casablanca, and Rabat. The majority of these recyclers were formerly rural workers.

The wholesalers, semi-wholesalers or scrap metal dealers who process the WEEE (dismantling cathode-ray tubes, burning electrical cables or aerials, etc.) are exposed to risks, as are their neighbours. Indeed, these operators do not even wear the most basic personal protective clothing; some work at night (in summer), using solvent- and paint-based fuels for lighting, further worsening their working conditions. The use of masks, gloves and safe dismantling techniques would greatly reduce the risks. The most alarming finding is that the dismantlers do not consider the serious consequences of their actions on their health and the environment; above all, awareness needs to be raised. Contrary to the practices observed in India and China, the extraction of precious metals by wet-chemical processes involving acids, mercury and/or cyanide salts is not practised in Morocco for the time being.

There are no employment contracts binding collection and recycling operators to their associates. Waste collectors have chosen this job for the advantages it offers (flexible hours, no pressure to achieve results, independence, etc.) over construction or agriculture, which are much more physically demanding. However, these people suffer from a lack of recognition of and/or contempt for their occupation by society in general.

5.2 Environmental impact

The UNEP estimates that WEEE constitutes more than 5% of municipal waste worldwide, and is the fastest growing category of waste. The environmental impacts are related to the toxic substances contained in WEEE, and certain unsafe recycling practices.

5.2.1 The toxic content of WEEE

WEEE is composed of a variety of materials containing toxic substances that could contaminate the soil and groundwater when disposed of. These include heavy metals such as mercury, lead, cadmium and chrome, flame inhibitors such as polybrominated biphenyl (PBB) and polybrominated diphenylethers (PBDEs).

Indeed, leaching from a site or warehouse containing WEEE can affect the chemical quality of water, which then seeps into the soil, finally reaching the groundwater. Soil contamination can be considered:

- In the short-term: if heavy metals are mobile and do not build up in the soil, they will be transferred to the groundwater and plants, thus contaminating the population.
- In the long-term: if the heavy metals are not mobile, they do not pose an immediate risk to the population, but lead to long-lasting – sometimes irreversible – contamination of the soil.

5.2.2 Unsafe recycling practices

Unsafe recycling practices include the open-air burning of cables, printed circuit boards and other electric wires, with the aim of getting rid of the PVC sheath or epoxy support to recover the copper or aluminium. The low-temperature incineration of PVC under such conditions carries a high risk of producing dioxins and furans, organic pollutants with high carcinogenic potential. Studies conducted by the EMPA in India (2003) on uncontrolled cable incineration sites revealed high concentrations of dioxins in the soil.

There are also certain practices for extracting precious metals, particularly gold, silver and palladium, and electronic circuits, using wet-chemical processes. These processes, which are widely practiced in the informal sectors in India and China, involve the use of acids, mercury and/or cyanide salts, and produce large quantities of chemical effluents. It has been proven by the EMPA (2007) that, as well as being extremely dangerous for the environment and the health of the workers performing them, these processes are also ineffective, only resulting in the recovery of a fraction of the precious metals.

For the time being, only open-air incineration has been observed in Morocco; the case that has received most media coverage is the Ahl Loughlam scrap in Casablanca. Some waste collectors burn electrical cables, tyres and batteries. Some incineration points start burning at the end of the day, to recover the copper and other burned products the next morning. As a result, those living nearby often find themselves in clouds of black smoke during the night. In the morning, their homes are covered in a layer of greasy dust, causing coughing fits and asthma. According to the members of the Al Hadika association, which represents the victims of this pollution, one in three households has at least one person suffering from asthma, with children being particularly vulnerable. The association has organised several sit-ins at the incineration sites, and formal notices have been issued by the Health and Safety Division at Sidi Moumen to each of the offenders known to the authorities, but without effect.

Wet-chemical processes have not yet been observed in Morocco. However, based on experience acquired in other emerging countries, these dangerous metal recovery processes could appear and quickly spread in the informal sectors.

5.3 Economic impact

As there is no sector specialising in the management of WEEE (with the exception of dismantling operations and a few industrial recycling initiatives), it is difficult to evaluate the economic impact of this activity. Nonetheless, it may have positive economic impacts if it is organised and operates according to best practises. Indeed, given the quantities of WEEE in terms of the stock of equipment and annual growth, all operators in this sector could benefit on a lasting basis.

6 Conclusions

6.1 Main conclusions of the study

To conclude, we must note the absence of an organised WEEE management sector (for the 3 types of EEE studied). Although the management of this waste in Morocco is worrying, it is not yet alarming. Worrying, because the danger posed by this equipment when processed is not yet taken seriously, or is even unknown, and informal recycling is on the rise at several sites, such as Sidi Bennour. Not alarming, as these operators have not yet begun extracting precious metals using wet-chemical processes. If the WEEE sector is not organised in the medium term, the situation could quickly escalate out of control, making it difficult to bring it back on track, as shown by experiences in other countries such as India and China.

The Moroccan regulatory framework, with Law 28-00, is a good start but is insufficient. A specific decree regulating WEEE management would help improve practices as processing structures are set up. This applies particularly to the collection and transportation system, recycling/reuse units, waste landfill centres, the hazardous waste treatment plant (CNEDS), etc.

The government and the private sector (APEBI) have devised ambitious strategies for the development of NICT. However, the question of sustainable WEEE management has not been addressed. Both of these partners are involved in initiatives focusing on environmental protection: the government has an Ecologically Sustainable Industrial Development programme (among others), while in the private sector there is the Global Compact and the CGEM's Social Responsibility Charter. To translate these commitments on the ground, a central place must be given to the environmental and social dimensions. In other words, existing conventions and strategies (progress contract, e-Gov, etc.) must be adapted, and WEEE management must be taken into account in the preparation of forthcoming initiatives.

In practical terms, this means establishing a sustainable WEEE management structure. The fact that this study has been funded by the private sector and coordinated by a State agency demonstrates the determination of both parties to implement a solution for sustainable waste management. The other strong point is the motivation of the informal sector to get involved in the project. Morocco could take advantage of this opportunity to position itself as a regional (MENA) platform for the treatment and recycling of waste (provided that the principles of the Basel Convention are respected).

To that end, Moroccan technical and financial support organisations (CMPP, ANPME, INDH, etc.), as well as some international bodies (EMPA, DSF, etc.), could oversee organisation of the sector, while protecting the jobs of operators in the informal sector and improving their living conditions.

In 2007, the installed stock of the 3 products studied was in excess of 220,000 tonnes, generating some 30,000 tonnes/year, with uneven distribution throughout the country (5 regions generated more than half of waste). Television sets account for 68% of the weight, followed by computers with 30% and finally mobile phones with 2%. Households generate 81% of waste, companies 18% and finally the public sector 1%. Given the predominance of households in the production of waste, a practical collection system needs to be set up, to ensure that the WEEE generated by Moroccan households is channelled into an appropriate management structure. Finally, it is estimated that the stock of EEE will grow by an average of 1.6% per year, exceeding 238,000 tonnes in 2012.

The following recommendations serve to guide the work of the Strategic Steering Committee in the preparation of an action plan for the establishment of an appropriate WEEE management sector in Morocco.

6.2 Recommendations

6.2.1 Recommendations for regulation

The Strategic Steering Committee should be extended to include the key actors (DEPTTI, APEBI, etc.), which would make it possible to define and distribute the responsibilities of each link in the WEEE management chain. This enlarged committee would act as unifying body, bringing together all the stakeholders concerned by the issue, and could lay the foundations for the drafting of a specific decree concerning the management and disposal of WEEE. In particular, the committee would need to define the duties and responsibilities of each stakeholder with regard to the collection, transportation, recycling or surveillance of the sector.

Until this decree is introduced, it would be useful for the government to set an example of good management by issuing an interministerial circular authorising the Ministry of Finance to entrust collected WEEE to recycling/reuse companies (either for a fee or free of charge). Public sector organisations could also practise green procurement, by introducing environmental criteria into their tender specifications (possibility of collecting old equipment, ISO 14001-certified suppliers, etc.).

6.2.2 Recommendations for the infrastructure needs of the sector

The aim is to strengthen the necessary infrastructure in order to add value throughout the recycling chain: from collection to recovery of metals (precious or not) and disposal of materials that cannot be reused.

Table 13: Proposals for establishment of the necessary infrastructure at each stage of the WEEE recycling chain

Process	Proposals
Collection	<ul style="list-style-type: none"> - Organise B2B collection circuits for companies and government agencies and a B2C circuit for households, with door-to-door collection, district waste collection centres, etc. - Before the transition from uncontrolled dumps to sanitary landfills, it would be wise to remove any WEEE by purchasing it from ragpickers or by other mechanisms (case of Casablanca, Meknes, etc.)
Transport	<ul style="list-style-type: none"> - Encourage the acquisition of means of transportation by operators in the sector (ragpickers/motorcycles, semi-wholesalers/vans, etc.) through loans at subsidised interest rates, payment facilities, etc.
Storage	<ul style="list-style-type: none"> - Facilitate the acquisition of land for the construction of sheds for companies, wholesalers and semi-wholesalers operating in this area, in order to improve storage conditions (more space, specialised zones, attractive prices, etc.). This would make it possible to avoid open-air storage (rain/leaching)
Dismantling	<ul style="list-style-type: none"> - Encourage existing initiatives and improve their environmental quality - Organise the informal sector through dismantling cooperatives and offer operators technical and financial support (training, professional equipment, personal protective clothing, etc.)
Crushing / mechanical sorting	<ul style="list-style-type: none"> - Develop and disseminate the ECOTECHNO/ENIM process (dry process), improving its environmental quality - Promote the Moroccan metallurgy sector or export to specialised firms. Examine each WEEE outlet, case by case - Perform a technology watch; the switch to LCD televisions will generate a large volume of unwanted cathode-ray tube television sets. Processing technology should be upgradable, in order to prepare for the processing of LCDs
Management of hazardous substances	<ul style="list-style-type: none"> - Study the possibility and cost of having these substances treated by the hazardous waste treatment plant (CNEDS) or at sanitary landfills - Promote initiatives for the recycling of WEEE by-products, such as plastic (impermeable polymer developed by the ENIM/Ecotechno)

6.2.3 Recommendations for information, awareness-raising and education

There are many ways of raising the awareness of the population and companies to an environmental problem. Here, we propose:

- Conduct information and awareness-raising campaigns, targeting specific products and sectors, backed up with leaflets and booklets. Raising the awareness of households could be facilitated by the Mohammed VI

Foundation for the Protection of the Environment; raising the awareness of companies by the CGEM through the Environment Commission and the CMPP; and raising the awareness of the public sector by the MMSP and the MICNT, among others.

- Develop training courses targeting pupils and students, so that they become vectors of best practices in relation to the management of WEEE within their homes.
- Provide the necessary technical support for any WEEE management chain (from waste collectors to industrial recyclers, via semi-wholesalers and wholesalers), with the aim of optimising the reuse of materials and, especially, reducing the impacts on health and the environment.
- Make an awareness-raising documentary film adapted to the Moroccan context (information, technical aspects, impacts), in order to reach a broad audience and convince national and international technical and financial support organisations to get involved in projects to improve the standard of WEEE management.

6.2.4 Recommendations for information gathering and surveillance of the system

The Strategic Steering Committee should look into procedures for monitoring the sector, namely where control should begin, where to gather data (should surveillance be limited to recyclers or cover the whole chain?) and how. These questions will be addressed in the sector management strategy adopted. Although there is no ideal model to follow, Morocco could draw inspiration from control systems implemented in other countries, particularly in Europe. The aim will be to clarify the following aspects:

- Although the OTI monitors changes in the number of mobile phones and computers, there is not a body in place to monitor changes in television sets. It is important for a structure to address this aspect (HACA, ANRT, etc.) in order to anticipate the resultant waste in terms of quantity and particularly quality (cathode-ray tubes, LCDs).
- Create an accreditation system for WEEE treatment and recycling firms, or at least encourage them to certify their environmental management systems according to ISO 14001, EMAS, or other standards.
- Charity donations from abroad should be entrusted to organisations that will ensure their traceability, so as to ensure that when it reaches the end of its useful life, donated equipment is channelled into the WEEE management sector. A charter for charity organisations could be drawn up.

6.2.5 Recommendations for the responsibility of EEE producers

Here, producer is understood to mean any entity that produces and markets a product. According to this definition, importers of products are considered producers.

The principle of *extended producer responsibility (EPR)* is based on the ‘polluter pays’ principle, and stipulates that the manufacturer of a consumer good is responsible for its product throughout its life cycle. This principle is often applied to products that generate waste that is difficult to treat and presents too great a burden for the local authorities. The objective of EPR is twofold:

- EEE producers are responsible for making appropriate arrangements for WEEE. By that, we understand that they must provide consumers with the possibility of returning their used equipment to an appropriate structure, and the structure in question must be economically viable. This does not necessarily mean that

producers must manage the structure themselves, as they may sub-contract their responsibility to a third party.

- Being responsible for the end-of-life of their products motivates producers to make cleaner products, designed to be easily recycled. Given that responsibility for the economic viability of the structure lies with the producers, it is in their interest to optimise their products with a view to reducing the cost of their end-of-life management.

There are different ways for EEE producers to fulfil their extended responsibility, just as there are different ways of ensuring the economic viability of the structure. Here too, it would be wise to study the different systems implemented abroad, with the aim of developing a tailor-made system for Morocco.

7 Appendices

Appendix I – List of products considered waste electrical and electronic equipment according to the European WEEE Directive (this list is not exhaustive)

1. Large household appliances

Large cooling appliances, Refrigerators, Freezers, Other large appliances used for the refrigeration, conservation and storage of food, Washing machines, Clothes dryers, Dish washing machines, Cookers, Electric stoves, Electric hot plates, Microwave ovens, Other large appliances used for cooking and other processing of food, Electric heating appliances, Electric radiators, Other large appliances for heating rooms, beds and seating furniture, Electric fans, Air conditioning appliances, Other fanning, exhaust ventilation and air conditioning equipment.

2. Small household appliances

Vacuum cleaners, Carpet sweepers, Other appliances for cleaning, Appliances used for sewing, knitting, weaving and other processing for textiles, Irons and other appliances for ironing, mangling and other care of clothing, Toasters, Fryers, Coffee grinders, coffee machines and equipment for opening or sealing containers or packages, Electric knives, Appliances for hair-cutting, hair drying, tooth brushing, shaving, massage and other body care appliances, Alarm clocks, watches and equipment for the purpose of measuring, indicating or registering time, Scales.

3. IT and telecommunications equipment

Centralised data processing: Mainframes, Minicomputers, Printer units, Personal computers (CPU, mouse, screen and keyboard), Laptop computers (CPU, mouse, screen and keyboard), Notebook computers, Notepad computers, Printers, Copying equipment, Electrical and electronic typewriters, Pocket and desk calculators and other products and equipment for the collection, storage, processing, presentation or communication of information by electronic means, User terminals and systems, Facsimile machines, Telex, Telephones, Pay telephones, Cordless telephones, Cellular telephones, Answering systems and other products or equipment of transmitting sound, images or other information by telecommunications.

4. Consumer equipment

Radio sets, Television sets, Video cameras, Video recorders, Hi-fi recorders, Audio amplifiers, Musical instruments and other products or equipment for the purpose of recording or reproducing sound or images, including signals or other technologies for the distribution of sound and image than by telecommunications.

5. Lighting equipment

Luminaires for fluorescent lamps with the exception of luminaires in households, Straight fluorescent lamps, Compact fluorescent lamps, High intensity discharge lamps, including high pressure sodium lamps and metal

halide lamps, Low pressure sodium lamps, Other lighting or equipment for the purpose of spreading or controlling light with the exception of filament bulbs.

6. Electrical and electronic tools (with the exception of large-scale stationary industrial tools)

Drills, Saws, Sewing machines, Equipment for turning, milling, sanding, grinding, sawing, cutting, shearing, drilling, making holes, punching, folding, bending or similar processing of wood, metal and other materials, Tools for riveting, nailing or screwing or removing rivets, nails, screws or similar uses, Tools for welding, soldering or similar uses, Equipment for spraying, spreading, dispersing or other treatment of liquid or gaseous substances by other means, Tools for mowing or other gardening activities.

7. Toys, leisure and sports equipment

Electric trains or car racing sets, Hand-held video game consoles, Video games, Computers for biking, diving, running, rowing, etc., Sports equipment with electric or electronic components, Coin slot machines.

8. Medical devices (with the exception of all implanted and infected products)

Radiotherapy equipment, Cardiology equipment, Dialysers, Pulmonary ventilators, Nuclear medicine equipment, Laboratory equipment for in-vitro diagnosis, Analysers, Freezers, Fertilization tests, Other appliances for detecting, preventing, monitoring, treating, alleviating illness, injury or disability.

9. Monitoring and control instruments

Smoke detectors, Heat regulators, Thermostats, Measuring, weighing or adjusting appliances for households or as laboratory equipment, Other monitoring and control instruments used in industrial installations (e.g. in control panels).

10. Automatic dispensers

Automatic dispensers for hot drinks, Automatic dispensers for hot or cold bottles or cans, Automatic dispensers for solid products, Automatic dispensers for money, All appliances which deliver automatically all kinds of products.

Appendix II – Weights of the main types of equipment studied

Item	Weight (kg)	Source
Desktop computer	9,931	Eugster
Laptop computer	3.51	SWICO 2006 / Ecoinvent
Cathode-ray tube screen	14.07	Laffely / Zumbuehl
LCD screen	5.72	SWICO 2006 / Ecoinvent
Mouse	0.05 (estimate)	Estimate + Ecoinvent
Keyboard	1 (estimate)	Estimate + Ecoinvent
Printer	6.53	Laffely
Cathode-ray tube television	31,631	Zumbuehl
Mobile phone	0.1 (+ 0.04 charger)	Estimates

Appendix III – Overview of regulations and voluntary initiatives with an impact on WEEE management in Morocco

Law, regulation, declaration or charter	General content	Influence on WEEE management	Status / date
Enacted laws, decrees and orders			
Law No. 11-03 on the protection and enhancement of the environment	<ul style="list-style-type: none"> - Sets out the guiding principles for environmental protection and management - Lays down the overall legislative framework for environmental conservation 	Treatment/recycling units are responsible, even in the absence of proof, for any direct or indirect bodily injury or damage to property linked to the pursuit of their activities	Enacted by Dahir No. 1.03.59 of 10 Rabii I 1424 (12 May 2003), published in Official Gazette No. 5118 of June 2003
Law No. 12-03 on environmental impact studies	<ul style="list-style-type: none"> - Adoption of preventive measures designed to protect the environment - Makes approval of a project submitted for an EIS subject to an environmental acceptability decision - Grants the public the right to access the content of EISs, with the exception of information deemed confidential 	Any new project or extension of an existing project for the recycling or disposal of WEEE is subject to an EIS	Enacted by Dahir No. 1-03.60 of 10 Rabii I 1424 (12 May 2003), published in Official Gazette No. 5118 of June 2003
Law No. 13-03 on air pollution control	<ul style="list-style-type: none"> - Prevents, reduces and limits emissions of pollutants into the atmosphere - Establishes the general principle of banning the emission, dumping, release or discharging into the atmosphere of pollutants, in excess of the regulatory limits - Establishes reduction and control measures (by decree) 	<ul style="list-style-type: none"> - Ban on burning WEEE in the open air - WEEE treatment projects must incorporate technical solutions to ensure compliance with the standards (filters, etc.) 	Enacted by Dahir No. 1-03.61 of 10 Rabii I 1424 (12 May 2003), published in Official Gazette No. 5118 of June 2003

<p>Law No. 28-00 on the management and disposal of waste</p>	<ul style="list-style-type: none"> - Defines the different types of waste, specifying waste management procedures and the level at which waste is treated (local, regional or national) - Clearly regulates the management of hazardous waste - Establishes rules for the organisation of existing dumps and calls for their replacement by sanitary landfills, classing them in three different categories depending on the type of waste they are authorised to receive - Provides for the establishment of three sorts of master plan, at three different territorial levels, for three different categories of waste - Establishes a system for monitoring and detecting offences, together with penalties 	<p>WEEE is classed as hazardous waste:</p> <ul style="list-style-type: none"> - System of licences at every stage of WEEE management – collection, transportation, storage and disposal - Bans the mixing of hazardous waste with other categories of waste - WEEE must be accompanied by a tracking sheet containing information about the shipper, carrier, consignee, the type and quantity of waste, the mode of transport and the procedures for its disposal 	<p>Enacted by Dahir No. 1.06.153 of 30 Chaoual 1427 (22 November 2006), published in Official Gazette No. 5480 of 7 December 2006</p>
<p>Law No. 10-95 on water</p>	<ul style="list-style-type: none"> - Quantitative and qualitative protection and conservation of water - Establishment of the user pays principle and the polluter pays principle - Direct or indirect discharge, run-off, effluent or deposits in surface water or groundwater are subject to prior authorisation, granted by the basin agency - Introduce limit values for general or specific discharges - Effluent charges 	<ul style="list-style-type: none"> - WEEE recycling or treatment undertakings that release effluent into surface water must apply for a discharge licence from the basin agency - Obligation to pay the pollution charge (depending on whether organic matter, suspended matter or liquid matter is involved), without exceeding the waste limit values. 	<p>Official Gazette No. 4324 24 Rabii II 1416 (20 September 1995)</p> <p>Published in Official Gazette No. 5292 of 17 February 2005</p>
<p>Decree No. 2-04-553 of 13 Hija 1425 on direct or indirect discharge, run-off, effluent or deposits in surface water or groundwater</p>	<ul style="list-style-type: none"> - Includes measures designed to rationalise the consumption of energy and water, and protect the environment - Companies with important investment programmes, in terms of the funds to be invested, the number of stable jobs to be created, the region of implementation, the technology to be transferred or the contribution to protecting the environment may conclude specific agreements with the State that give them additional benefits to those stipulated in this charter 	<p>Industrial WEEE recycling/reuse projects could receive additional benefits, such as partial exemption from the following expenses:</p> <ul style="list-style-type: none"> - Expenses related to purchasing the land required to make the investment; - External infrastructure expenses; - Vocational training expenses. 	<p>Enacted on 8 November 1995</p>
<p>Dahir No. 1-95-213 promulgating the framework law No. 18-95 forming the investment charter</p>	<p>The municipal council oversees health, safety and environmental protection (Article 40)</p>	<p>Once WEEE is disposed of (public bins and landfills), it becomes the property of the local council</p>	<p>Official Gazette of 21 November 2002</p>

Pending draft legislation

<p>Bill No. 31-06 on the protection and enhancement of the coast</p>	<p>Authorisation must be obtained from the administrative authorities before any effluent can be released into the sea, within the public domain</p>	<p>- WEEE recycling or treatment undertakings that generate effluent must apply for a discharge licence from the competent authority - This licence gives rise to the payment of effluent charges</p>	<p>(1st date of transmission to the SGG: 1 August 2006)</p>
<p>Draft decree setting the limit values for air-pollutant emissions from stationary sources and procedures for monitoring such emissions</p>	<p>- Sets the LVs for emissions of particulate matter, vapours and gases, and defines procedures for monitoring such emissions - Sets the general LVs and refers to joint orders for the setting of specific LVs - Specifies emission monitoring and self-checking procedures and establishes deadlines for the operators of existing facilities to comply with the new legislation before it comes into force</p>	<p>- The operator must comply with the emission LVs, taking all necessary measures to ensure said compliance</p>	<p>(1st date of transmission to the SGG: 11 April 2005)</p>
<p>Bill No. 2-07-253 on the classification of waste and defining the list of hazardous waste</p>	<p>- Adoption of the international nomenclature, including the list of hazardous wastes, for the purpose of internal management of hazardous waste - Defines hazardous waste - Discarded electronic equipment (such as printed circuit boards) and other discarded electronic equipment is not considered hazardous waste by the Moroccan Waste Catalogue and can be disposed of in household waste landfills and similar</p>	<p>If, during the treatment of WEEE, any harmful or toxic substances are released, the waste in question may become hazardous. A separate order will define such cases.</p>	<p>Ratified by the Council of Ministers in July 2008</p>
<p>Legislation currently being drafted</p>			
<p>Bill on the right of the public to access environmental information and decision-making in environmental matters.</p>			
<p>Draft joint order of the minister responsible for land management, water and the environment and the minister responsible for health in relation to vigilance thresholds, information thresholds, alert thresholds and emergency measures.</p>			
<p>Draft decree regarding the National Hazardous Waste Master Plan.</p>			
<p>Draft decree on sanitary landfills.</p>			
<p>Draft decree relating to the incineration and co-incineration of waste.</p>			

Draft decree on transboundary movements of hazardous waste.

Voluntary initiatives

<p>International declaration on cleaner production</p>	<p>Encourages the continuous application of a preventive strategy integrated into all processes, products and services, with a view to achieving progress in the economy, social life, health, safety and environment</p>	<p>Adopting this strategy would enable WEEE recycling/reuse firms to continually improve their environmental performance</p>	<p>Adopted in January 2003</p>
<p>Social Responsibility Charter of the CGEM (voluntary)</p>	<ul style="list-style-type: none"> - Protection of the natural environment, with a particular focus on improving environmental performance, communication and cooperation with local and public authorities, etc. - Reduce consumption of water, energy and raw materials and reduce emissions of pollutants and greenhouse gases - Assess and minimise the environmental impacts of investment projects - Define emergency plans for the prevention and containment of accidental damage to the environment, health and safety 	<ul style="list-style-type: none"> - Firms operating in the field of WEEE that want to adhere to this charter must comply with its content, particularly the environmental aspects - Firms may request the CGEM seal of approval, based on a managerial assessment carried out by an independent, third-party expert accredited by the Confederation 	<p>Adopted by the National Business Council (December 2006)</p>
<p>StEP Initiative</p>	<p>A UN initiative to improve the recycling of electronic waste</p>		<p>Officially launched on 7 March 2007</p>

Appendix IVa – Bodies active in the promotion of ICT

Supervision of the ICT sector is carried out by:

- The main role of the National Telecommunications Regulatory Agency (ANRT) is to monitor compliance with the provisions of the Telecommunications Act. It ensures fair competition between players in the sector and approves equipment used for telecommunications and networks.
- The Ministry of Public Sector Modernisation (MMSP) works to drive the process of modernising public establishments by simplifying procedures and digitalising exchanges between government agencies and the public.
- The Department of Post, Telecommunications and Information Technologies (DEPTTI), which is affiliated to the Ministry of Industry, Trade and New Technologies, is responsible for implementing the government's strategy on post, telecommunications and information technologies.
- The Strategy Committee for the development of Information Technologies (CSTI), which is attached to the Ministry of Economic and General Affairs, is charged with preparing a national information society development programme and implementing electronic government.
- The e-Gov Committee, established by the prime minister, is responsible for interministerial coordination in relation to the deployment of services to citizens via an Internet platform.

On the whole, the ICT sector is strongly supported by the Ministry of Industry, Trade and New Technologies (MICNT), as well as the Ministry of Public Sector Modernisation. The MICNT develops strategic orientations for the trade and industry sectors, encourages wealth-creating investments and quality innovation, and promotes the spread of information technologies. The MMSP, meanwhile, strengthens and drives the process of modernising Morocco's public sector through the preparation of digital content and the promotion of electronic exchanges between government bodies and citizens.

- National Information Technology Observatory (OTI): The OTI was established in 2005, jointly by the APEBI and the ANRT. It helps the ANRT fulfil its role as a driver of change among decision-makers, thanks to its knowledge of the market which will enable it to identify the strengths and weaknesses of the ICT sector in Morocco.

This body periodically publishes studies and surveys about ICT (mobile phones and PCs), which are very useful for estimating the volume and evolution of WEEE.

- The Moroccan Industrial and Commercial Property Office (OMPIC): The OMPIC is a public establishment whose responsibilities include the registration and management of industrial property rights such as patents, industrial designs and trademarks. To that end, the company ECOTECHNO has filed a patent for a WEEE treatment process that consists of recovering metals, metallic salts (steel, copper, gold, lead, etc.) and plastic materials.

Appendix IVb – Organisations active in technical support

- The **Moroccan Centre for Clean Production (CMPP)**, a public-private partnership between the **MICNT** and the **CGEM**, is part of an international network of clean production centres created jointly by the UNIDO and the UNEP. This organisation is the national reference centre in terms of cleaner production. Its main aim is to provide Moroccan enterprises with technical assistance for the adoption of cleaner technologies and environmental management systems that enable them to improve both their economic performance (productivity and competitiveness) and their environmental performance. The CMPP is helping the company IVSEP (recycling of WEEE) with its technological choices, as well as with putting together the technical file to support its application for funding from the FODEP and finding financial and commercial partners nationally and internationally.
- The **National School of the Mineral Industry (ENIM)** has developed a WEEE recycling and recovery process. This patented process consists of recovering metals, metallic salts (steel, copper, gold, lead, etc.) and plastic materials from this waste.
- The **AMEDE** (Moroccan Association of Waste and Environment Experts), created in January 2005, brings together national experts involved in environmental and development issues in general and waste management in particular.
- The **ministry responsible for employment**: Morocco currently has 700 occupational health officers, yet it is estimated that 3,500 are needed. This ministry plans to create three new occupational health inspectorates in Marrakech, Tangier and Agadir, as well as recruiting more staff to the existing inspectorates. Moreover, there are plans to train 25 new workplace safety officers. Finally, several site visits will be carried out in sectors which are high risk in terms of occupational health and safety. The informal sector, particularly the collection and dismantling of WEEE, and new WEEE recycling plants should be included in this initiative.

Appendix IVc – Organisations active in financial support

- With the objective of encouraging industrial operators to invest in environmental projects, the Department of the Environment has set up the FODEP, in partnership with KfW Bankengruppe. This incentive mechanism aims to encourage industrial and artisanal manufacturers to invest in pollution control and resource saving, and introduce an environmental dimension into their activities so that they are prepared for the regulatory framework needed to respond to the new order of globalised trade.

The FODEP funds pollution control projects through grants, twinned with loans provided by banks. These grants are 20% for projects integrated into the industrial process that aim to both control industrial pollution and generate resource savings (water, energy, etc.), or 40% for projects downstream of the industrial process designed to reduce pollution by setting up facilities for the treatment of liquid and gas effluent and solid waste.

Resources	Downstream projects	Integrated projects
FODEP contribution	40%	20%
Bank loans	20% to 40%	20% to 60%
Self-financing	At least 20%	At least 20%

Industrial-scale WEEE recycling projects could benefit from this fund to finance up to 40% of their pollution control component (bag filters or electrostatic precipitators, etc.).

- The main role of the ANPME, created in accordance with the provisions of the SME Charter, is to develop and implement advice and support programmes geared towards the creation, promotion and modernisation of enterprises by bearing part of the expenses incurred by SMEs within the framework of such programmes. WEEE recycling firms could benefit from the services of this agency through the partial funding of studies and technical support.
- The objective of the RDT is to assist SMEs with identifying and articulating their needs in terms of innovation projects or technological development, guiding them towards appropriate skills and providing, where necessary, financial support for eligible services, such as technical feasibility studies and market research for new products or processes.
- The Hassan II Fund for Economic and Social Development is a public entity with a corporate personality and financial autonomy whose aims include providing financial assistance for:
 - Programmes for the creation of structures to receive industrial investments and IT development investments;
 - Employment promotion initiatives by **micro-credit** associations;
 - Any project that contributes to promoting investment and employment.

This assistance is provided within the framework of agreements, and may take the form of equity investments, repayable advances or loans, or non-repayable grants.

- The INDH focuses on the following three core areas:
 - Reducing social deficits, particularly in poor urban districts and the most deprived rural areas (basic social services and resources, such as health care and education, etc.);
 - Promoting activities that generate stable income and jobs, adopting a more imaginative and resolute approach with regard to the informal sector;
 - Helping the most vulnerable members of society or those with specific needs.

This Royal Initiative places the fight against poverty, exclusion and insecurity at the centre of the country's economic and social policy priorities and aims to give new, decisive momentum to the social development strategy by implementing integrated public policies with a coherent, comprehensive approach and strong mobilisation across the board where the political, social, economic, educational, cultural and ecological dimensions come together and complement each other. Waste collectors (ragpickers) could benefit from this initiative through socio-economic and environmental improvements.

Furthermore, Morocco is the Mediterranean country where micro credit is most developed and where micro-credit institutions are most numerous. The first lending programmes to finance the activities of low-income borrowers began in 1993/94. The organisation of micro finance is supported by local NGOs, and encouraged and spurred on by the government and international partners. In April 1999, a law established the framework of micro-credit activities. According to the National Federation of Micro-Credit Associations (FNAM), by the end of December 2003, 307,532 micro-entrepreneurs had received micro credit; 75% of these recipients were women, making the Moroccan experience a reference for countries all around the Mediterranean.

Waste collectors (ragpickers) could benefit from this fund through micro credits and WEEE recycling operators through its other mechanisms.

Appendix V – Maroc Telecom Programme for the Creation of Enterprises and the Promotion of Employment

Maroc Telecom has signed a five-year framework agreement (2005-2010) with the government, committing to help unemployed young graduates get their careers off the ground. The young graduates distribute Maroc Telecom products and services and receive technical and commercial training. This agreement was signed in September 2005, and by 31 May 2006, 1,537 projects had been created and launched, creating 2,638 jobs.

Maroc Telecom and Vivendi, its parent company, created a joint fund for the creation of enterprises and the payment of scholarships. This fund is financed by a one million-euro contribution from each of the two parties. The association assists entrepreneurs throughout the process, from putting together their proposals to actually implementing their projects. It gives them interest-free loans to complement their personal contributions, and additional loans can, if necessary, be obtained from partner banks of the association. The members of the Maroc Telecom Supervisory Board have unanimously waived their attendance fees, instead paying them into the fund to give financial support to deserving Moroccan students from deprived backgrounds who want to study in fields related to the areas in which Maroc Telecom and Vivendi operate. As for ecological design, the new Maroc Telecom headquarters are scheduled to open in 2010. In September 2006, the architectural design received a special mention from the jury awarding the *grand prix* for very tall buildings at the Eco Building forum at Paris-Expo (a distinction in recognition of the environmental performance of the design). In the design, special attention was given to energy management (renewable energies for the production of hot water, natural lighting thanks to the glazing, etc.).

Appendix VI – Main actors in the formal recycling sector

- The Collectique association has been active in this field since 1998 and issues certificates to donor companies. It is not known what happens to the distributed computer equipment when it reaches the end of its useful life. Meanwhile, the not-for-profit association Ateliers Sans Frontières (Workshops Without Borders) collects, reuses and recycles second-hand IT equipment to help international solidarity projects. This association has set up workshops offering training in computer maintenance to deprived youngsters in Tangier, Casablanca and Salé, with further workshops soon opening in Oujda and Agadir. The waste produced by these workshops will be stored until an appropriate solution is found. That is why ASF, in partnership with another association, Al Jisr, plans to create a WEEE recycling unit in Casablanca in 2009.
- ECODECHET, a firm set up in Casablanca two years ago, works with different types of waste (wood, plastic, glass and WEEE) and employs 16 people. Waste is collected from companies, public institutions (mostly hospitals) and waste collectors (at the markets of Derb Ghallef in Casablanca, Souk el Had in Rabat, etc.). The criteria for purchasing WEEE are based on the functionality, content (with or without hard disk), model and weight. The position of the casing (vertical more expensive than horizontal) and its colour (black is more expensive than white) also influence the purchase price. Thus, the purchase price of a desktop computer varies between 50 and 100 dirhams, a laptop between 100 and 150 dirhams and a television set between 100 and 200 dirhams. Most of the WEEE purchased was manufactured between 1980 and 1990. After collection, the equipment is repaired; non-repairable units are dismantled and the components recovered. Recovered copper (extracted from electrical cables by burning or stripping, without any protection of either workers or the environment) and aluminium are sold to foundries for 40 to 55 dh/kg and 10 to 12 dh/kg respectively. Waste that cannot be reused is stored until a solution is found. Waste is transported by 4 trucks owned by the firm.
- ECOTECHNO: Within the framework of a project hatched at the Innovative Enterprise Incubation and Support Centre (CIAEI) of the National School of the Mineral Industry (ENIM), a Moroccan team has developed a process for the recycling and reuse of waste electronic and electrical equipment. This initiative, for which a patent has been filed with the OMPIC, consists of recovering metals, metallic salts (steel, copper, gold, lead, etc.) and plastic materials from this waste. The process begins with characterisation and collection, followed by storage and dismantling. The next stage consists of sorting and physical treatment, and finally chemical treatment to recover metals and salts. Metal powders are then sent to foundries and components containing gold will be treated by wet processes to separate the free gold. The firm is based in Casablanca, on a 2,830-m² site, and employs 20 people. Ecotechno is currently performing trials and seeking additional investors, and will be operational in 2009.
- VALDEM specialises in the recycling and export of scrap metal to Europe and Asia. This firm also treats WEEE for some Moroccan companies that pay for the service (e.g. ST Microelectronics and Philips). It processes an average of 500 computers a year. The recovered metal is sold locally and material that cannot be reused (particularly the lead-rich glass from monitors) is exported to France for treatment. This firm, a subsidiary of SOVAMEP, the French leader in the recovery of precious

metals, plans to invest more than 4 million dirhams to build a tailor-made structure and purchase various production facilities. The aim of this new structure will be to obtain ISO 14001 certification, in order to offer Moroccan manufacturers, companies and local authorities the same environmental guarantees as in Europe.

- IVSEP, a firm specialising in the treatment and recycling of WEEE, benefits from the support of the CMPP within the framework of the Ecologically Sustainable Industrial Development programme, in the following areas:
 - Technical support: choosing the process and pollution control devices (especially filters), and putting together the technical file to support its application for funding from the FODEP;
 - Seeking national (client companies) and international (R&D centres, purchasers of recycled products, etc.) partners, to optimise the investment;
 - Organisational support: assistance with the setting up of a regional WEEE collection network, in partnership with actors in the region (ragpickers, semi-wholesalers).

This firm will employ around fifty people and will be operational in 2009, with a treatment capacity of 2,000 tonnes of WEEE per year. A stock of raw materials is currently being built up for the start-up phase.

Appendix VII – Detailed analysis of material flows by sector

Quantities of waste generated by households

We based our calculations on the following elements:

- Average annual sales of computers and mobile phones are obtained by the following formula: $(2006 \text{ volume} - 2004 \text{ volume}) / 2$ (OTI).
- The estimated number of PCs in 2007 is obtained by adding the average annual sales to the 2006 volume; the number of mobile phones in 2007 is obtained by the following formula: the number of subscribers in 2007 x 1.68, as 68% of Moroccans have at least 2 mobile phones (according to the OTI, 2007). Finally, the number of television sets in 2007 is estimated by sector experts, based on data from the population census (HCP, 2004).
- The stock of equipment is calculated according to the formula: estimated units in 2007 x average weight.
- The flow of waste generated per year is calculated by dividing the total stock by the lifetime of the equipment in question.
- The lifetimes of TVs, PCs and mobile phones are considered to be 10, 5 and 2 years, respectively.

Equipment	Total units (2007)	Stock of equipment (T)	% of stock	Waste flow (T/year)	% waste flow
Computers	1,070,000	26,750	15	5,350	24
Mobile phones	33,648,720	3,365	2	1,682	8
Television sets	5,000,000	150,000	83	15,000	68
Subtotal		180,115	100	22,032	100

TVs account for 83% of the weight of equipment stored in households; PCs account for 15%, while mobile phones represent just 2%. The findings are similar for the annual waste flows generated: the majority (68%) consists of TV sets, followed by PCs (24%) and finally mobile phones with 8%.

Quantities of waste generated by companies

- The figure for average annual sales of computers is obtained by the following formula: $(2006 \text{ volume} - 2004 \text{ volume}) / 2$ (the volumes are obtained from the OTI survey).
- The number of television sets is estimated based on the number of hotels, according to category. For this estimate, it is considered that:
 - o 30% of 3-star hotels have a TV in each room,
 - o 4- and 5-star hotels have a TV in each room,

- Other categories of hotel have an average of three TVs per establishment.

	1 star	2 stars	3 stars	4 stars	5 stars	Other categories	Total TV sets
Hotels*	113	165	164	136	46	348	
Total No. rooms*	3,127	6,205	11,375	17,868	9,898	-	
Subtotal	565	825	3,413	17,868	9,898	1,740	34309

*Source: Ministry of tourism / statistics at 31/12/2006

- The stock of equipment is calculated according to the formula: estimated units in 2007 x average weight (OTI)
- The flow of waste generated per year is calculated by dividing the total stock by the lifetime of the equipment in question.

Equipment	Stock of equipment (T)	% of stock	Flow of waste (T/year)	% waste flow
Computers	38,370	97	7,674	99
TV sets (mainly hotels)	1,029	3	103	1
Totals	39,399	100	7,777	100

The majority of the stock of waste generated by companies each year, in terms of both volume and quantity, is made up of PCs, with 97% and 99% respectively.

Quantities of waste generated by the public sector

According to the MMSP (results and analysis of Operation Intilaka, 2005), there are 471,928 civil servants in Morocco following the voluntary retirement scheme. To estimate the total number of computers, we have considered the computers/civil servant ratio to be 0.2 (the same as the ratio within industrial/construction companies in 2006, which is the lowest of all sectors: OTI 2007).

Equipment	Average annual sales (units)	Lifetime in years	Average weight in tonnes	Weight of waste per year (tonnes)	Estimated units (2007)	Total waste in T (2007)	Total waste/year in T
Computers	NA	5	0.025	NA	94,386	2,360	472

The low number of computers and the low penetration of ICT within the public sector (with significant disparities between central and regional structures) explain the modest quantity compared with households and companies.

Appendix VIII – Detailed analysis of material flows by region

Distribution of WEEE by region, all sectors together

Region	Stock of equipment (2007)		Waste flow		Cumulative %
	Weight in tonnes	%	Weight in tonnes	%	
Greater Casablanca	36,522	16.5	5,563	18.4	18
Souss-Massa-Draa	22,155	10.0	2,964	9.8	28
Marrakech-Tensift-El Haouz	20,913	9.4	2,722	9.0	37
Tangier-Tétouan	19,419	8.8	2,713	9.0	46
Rabat-Salé-Zemmour-Zaer	17,635	7.9	2,411	8.0	54
Meknes-Tafilalet	14,276	6.4	1,850	6.1	60
Fes-Boulemane	12,798	5.8	1,812	6.0	66
Doukkala-Abda	13,298	6.0	1,724	5.7	72
Oriental	12,925	5.8	1,682	5.6	77
Taza-Al Hoceima-Taounate	12,647	5.7	1,675	5.5	83
Gharb-Chrarda-Beni Hssen	12,131	5.5	1,552	5.1	88
Chaouia-Ouardigha	10,820	4.9	1,386	4.6	93
Tadla-Azilal	9,594	4.3	1,234	4.1	97
Guelmim-Es Semara	3,345	1.5	467	1.5	98
Laayounee-Boujdour-Sakia El Hamra	2,233	1.0	329	1.1	99
Ouad Ed-Dahab-Lagouira	1,163	0.5	196	0.6	100
Total (rounded)	222,000	100	30,400	100	

Geographical distribution of waste generated by households

We quantified the waste produced in each of Morocco's 16 regions by:

- Establishing the geographical distribution of the population;
- Establishing the geographical distribution of public and private sector employees;
- Deducing the geographical distribution of waste, pro rata to the tonnages calculated previously.

Region	Population	Stock of equipment: households (T)	Flow of waste: households (T/year)	%
Greater Casablanca	3,615,903	21,943	2,684	12.2
Souss-Massa-Draa	3,094,985	18,782	2,297	10.4
Marrakech-Tensift-El Haouz	3,088,338	18,742	2,293	10.4
Tangier-Tétouan	2,460,220	14,930	1,826	8.3
Rabat-Salé-Zemmour-Zaer	2,349,202	14,256	1,744	7.9
Meknes-Tafilalet	2,125,608	12,899	1,578	7.2
Doukkala-Abda	1,978,189	12,005	1,468	6.7
Oriental	1,908,905	11,584	1,417	6.4
Gharb-Chrarda-Beni Hssen	1,849,776	11,225	1,373	6.2
Taza-Al Hoceima-Taounate	1,803,051	10,942	1,338	6.1
Chaouia-Ouardigha	1,646,051	9,989	1,222	5.5
Fes-Boulemane	1,567,846	9,515	1,164	5.3
Tadla-Azilal	1,448,155	8,788	1,075	4.9
Guelmim-Es Semara	425,211	2,580	316	1.4
Laayounee-Boujdour-Sakia El Hamra	245,562	1,490	182	0.8
Ouad Ed-Dahab-Lagouira	73,067	443	54	0.2
	29,680,069	180,115	22,032	100

Based on these results, three categories of regions can be distinguished:

- The 3 regions (Casablanca, Souss-Massa and Marrakech) in which a third of the waste generated by households is concentrated, with percentages in excess of 10%; these are Morocco's most densely populated regions;
- 7 regions (Tangier-Tétouan, Rabat-Salé, Meknes, Doukkala, Oriental, Gharb and Taza) that generate approximately half of the waste, with percentages of between 6% and 10%; and
- The 6 remaining regions, which produce 18% of waste, with percentages of less than 6%.

For the 3 types of EEE studied, the stock of equipment/inhabitant and waste flow generated/year/inhabitant ratios are roughly 0.74 kg/inhabitant and 0.09 kg/inhabitant/year, respectively. Given that there are 3,430,908 households in Morocco (HCP, 2004), these ratios are approximately 52.5 kg/household and 6.4 kg/household/year.

Geographical distribution of waste generated by companies

Region	No. private-sector employees	Stock of equipment: companies (T)	Flow of waste: companies (T/year)	%
Greater Casablanca	1,042,500	14,184	2,800	36
Doukkala-Abda	318,542	4,334	855	11
Souss-Massa-Draa	231,667	3,152	622	8
Marrakech-Tensift-El Haouz	231,667	3,152	622	8
Oriental	231,667	3,152	622	8
Tangier-Tétouan	144,792	1,970	389	5
Gharb-Chrarda-Beni Hssen	115,833	1,576	311	4
Rabat-Salé-Zemmour-Zaer	86,875	1,182	233	3
Meknes-Tafilalet	86,875	1,182	233	3
Fes-Boulemane	86,875	1,182	233	3
Chaouia-Ouardigha	57,917	788	156	2
Taza-Al Hoceima-Taounate	52,125	709	140	2
Tadla-Azilal	52,125	709	140	2
Guelmim-Es Semara	52,125	709	140	2
Laayounee-Boujdour-Sakia El Hamra	52,125	709	140	2
Ouad Ed-Dahab-Lagouira	52,125	709	140	2
TOTAL	2,895,833	39,399	7,777	100

With regard to companies, 5 regions (Casablanca, Doukkala, Souss-Massa, Marrakech and Oriental) generate 71% of waste, with percentages of between 8% and 36%. The other 11 regions produce just 29% of waste, with percentages ranging from 2% to 5%.

For the 3 types of EEE studied, the volume of waste/employee and weight of waste generated/year/employee ratios are roughly 4.90/employee and 0.97 kg/employee/year, respectively.

Geographical distribution of waste generated by the public sector

Region	Number of civil servants	Stock of equipment: public sector (T)	Flow of waste: public sector (T/year)	%
Greater Casablanca	78,958	395	79	16.7
Souss-Massa-Draa	45,400	227	45	9.6
Marrakech-Tensift-El Haouz	44,250	221	44	9.4
Tangier-Tétouan	40,304	202	40	8.5
Rabat-Salé-Zemmour-Zaer	39,025	195	39	8.3
Meknes-Tafilalet	31,688	158	32	6.7
Doukkala-Abda	30,935	155	31	6.6
Oriental	26,219	131	26	5.6
Gharb-Chrarda-Beni Hssen	25,760	129	26	5.5
Taza-Al Hoceima-Taounate	24,406	122	24	5.2
Chaouia-Ouardigha	23,474	117	23	5
Fes-Boulemane	22,251	111	22	4.7
Tadla-Azilal	19,302	97	19	4.1
Guelmim-Es Semara	11,028	55	11	2.3
Laayounee-Boujdour-Sakia El Hamra	6,793	34	7	1.4
Ouad Ed-Dahab-Lagouira	2,134	11	2	0.5
TOTAL	471,927	2,360	472	100

Government agencies in 5 of Morocco's regions (Casablanca, Souss-Massa, Marrakech, Tangier-Tétouan and Rabat) generate more than half (53%) of the WEEE studied, with percentages of between 8.3% and 16.7%. Guelmim-Es Semara, Laayoune and Oued Ed-Dahab are the regions with the lowest percentages, at between 0.5% and 2.3%. The other regions have percentages ranging from 4.1% and 6.7%, representing 42.8% of the total waste generating by the public sector.

The stock of equipment/civil servant and flow of waste generated/year/civil servant ratios are approximately 5/civil servant and 1kg/civil servant/year.