



 **waste**
swiss e-waste programme



E-Waste Management in Developing Countries – with a focus on Africa

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ITU Symposium on ICTs and the Environment & Climate Change

Cairo, 2-3 November 2010

Fast growing consumption of e-products (~1 billion mobile phones, ~1/4 billion note books 2008)

Fastest growing household waste in EU = e-waste
Important % of scarce metals ends in e-waste

Developing and emerging countries are seriously affected since ...

- ... they produce a growing amount of e-waste by themselves
- ... some of them receive e-waste from industrialised countries
- ... they have many cheap and unskilled workers
- ... they face a lack in suitable laws and their enforcement

Since 20 years Empa assists e-waste management systems in Switzerland and abroad (e-Waste Team 8 / 800):

- Audits and R&D for Swiss system operators SENS, SWICO, (SLRS & INOBAT)
- represents Switzerland in the European WEEE Forum
- founding member StEP-Initiative
- Managing e-waste projects in e.g. China, India, South Africa, Peru, Colombia, Morocco, West- East Africa etc.
- Current e-waste research topics
 - flame retardants in plastics
 - no-emission recycling for LCD-displays
 - modelling of long term stocks and flows (crt-glass etc.)
 - recycling business models for informal sector
 - compare eco efficiency in recycling strategies
 - ...



A global programme resting on 2 pillars

Capacity Building:

cooperate with five countries: China, India, South Africa, Colombia and Peru to facilitate the development of sustainable e-waste management systems

Knowledge Management:

connect national stakeholders internationally to stimulate knowledge and knowhow exchange on e-waste management (e.g. StEP Initiative)



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Department of Economic Affairs FDEA
State Secretariat for Economic Affairs SECO

Empa's recent and current activities in Africa



Morocco

e-Waste Management in Africa

Assessment Study
Feasibility Study

Funding Agency: HP, GTZ
Project Partner: DSF, CMPP
Time Frame: 2007 - ?



Uganda & Tanzania:

Refurbishment Centre Initiative

Assessment Study
Funding Agency: Unido, Microsoft
Project Partner: UCPC, CPCT
Time Frame: 2007 - 2010



Senegal



e-Waste Management in Africa

Assessment Study

Funding Agency: DSF
Project Partner: SENECLIC
Time Frame: 2007 - 2008

Kenya:

e-Waste Management in Africa

Assessment Study

Funding Agency: HP
Project Partner: DSF, KICTANeT
Time Frame: 2007 - 2008



South Africa:



Swiss e-Waste Programme

Facilitating the development of a national e-waste management strategy

Funding Agency: SECO
Project Partner: ITA, EWASA
Time Frame: 2003 – 2009

Benin, Côte d'Ivoire, Ghana, Liberia, Nigeria:

The Basel Convention e-Waste Africa Project

Assessment Study
Training Pilot

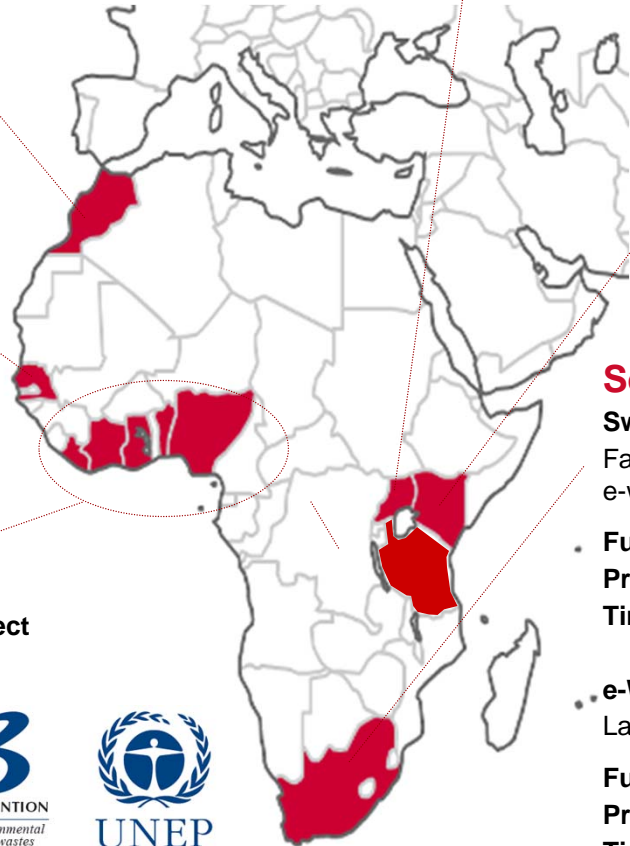
Funding Agency: SBC, EU
Project Partner: African BCRCs, IMPEL, Öko-Institut
Time Frame: 2009-2011



e-Waste Management in Africa

Launching an e-waste recycling unit in Cape Town

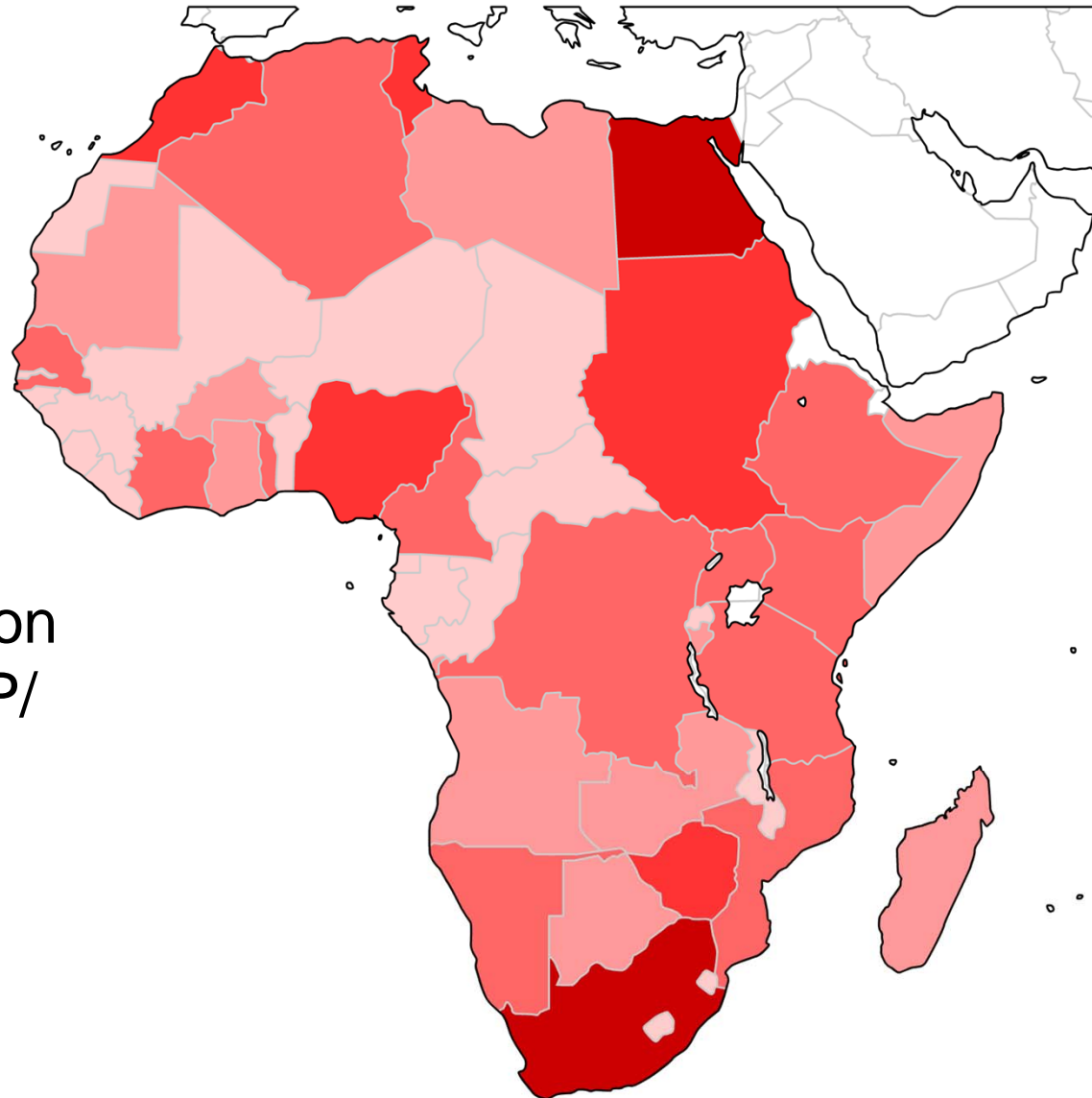
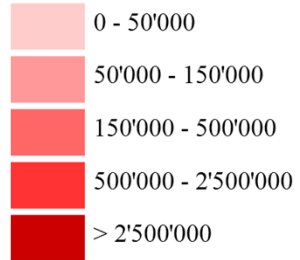
Funding Agency: HP
Project Partner: DSF, Recover-e-Alliance, EnviroSense
Time Frame: 2007 - 2008



Personal Computer penetration in Africa



Number of Personal Computers
in Pieces



Estimated based on
ITU data and GDP/
PPP correlations

PC penetration in Africa compared to the world

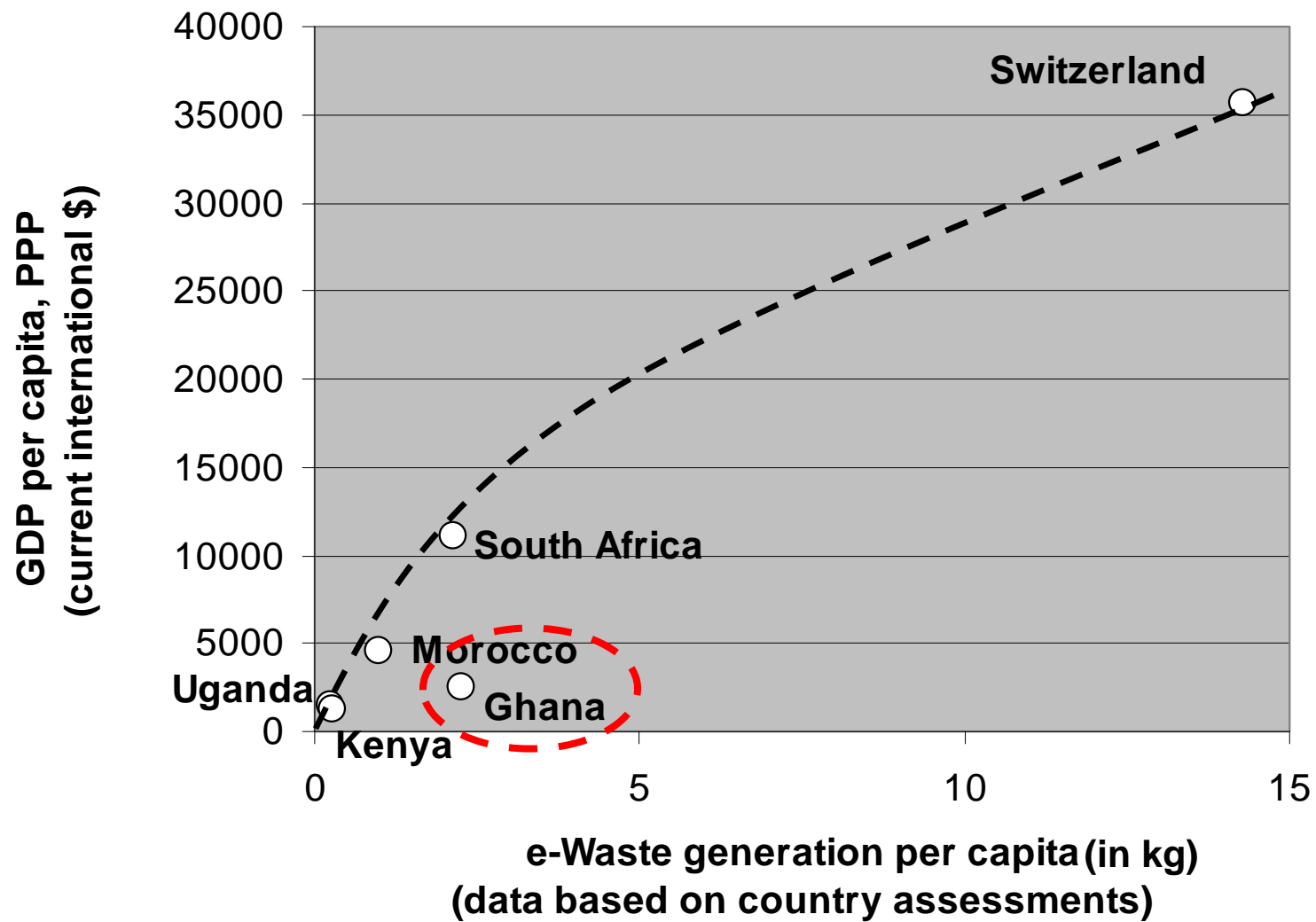


In 2005 Africa generated approx. 2% of the worlds PC waste

Region	Mio Pieces	kTonnes
North America	36,7	807
Latin America & Caribbean	5,9	137
Europe	24,8	549
Middle East	2,0	45
Africa	1,6	39
Central Asia	0,9	22
East Asia	25,7	595
Total	97,7	2194

Presented at R'09: Mueller E., Schluep M. et al.(2009). Assessment of e-waste flows: a probabilistic approach to quantify e-waste based on world ICT and development indicators. R'09 Twin World Congress, Davos/ Switzerland and Nagoya/ Japan, 14-16 September .

Correlation GDP / PPP with e-waste generation



New imports **(64'000 tons)**

Second hand imports **(149'000 tons)**

- Formal business importers
- Small scale / informal importers (e.g. by family members/relatives abroad)
- Imports of untested EEE (Grade D)
- It is estimated that around 30% already arrives as unsellable devices / e-waste **(44'000 tons)**

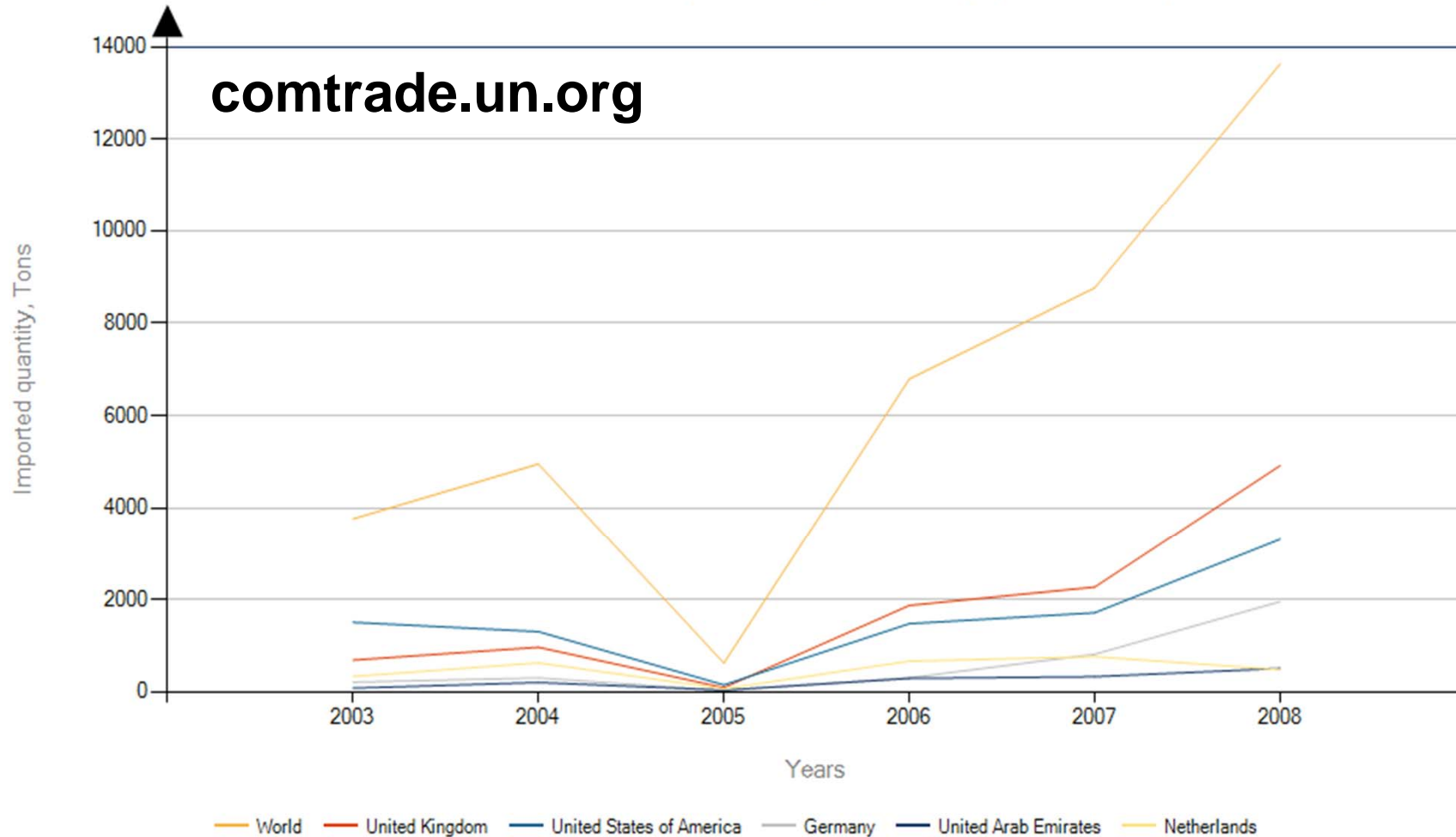
Private imports of new/second hand EEE **(1'300 tons)**

- Laptops, Cameras, DVD Players, Game Consoles, Mobile Phones and MP3 Players are privately imported (past customs) by people arriving at the airport

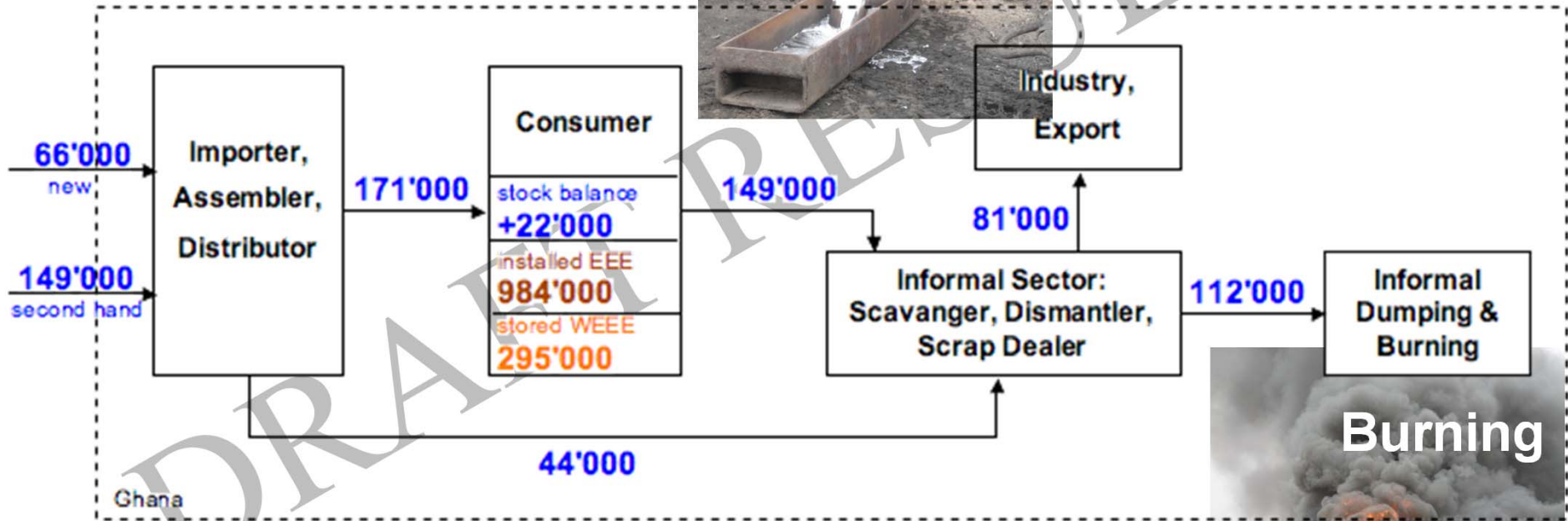
Ghana: Imports of W(EEE)



List of supplying markets for a product imported by Ghana
Product : 8471 Automatic data processing machines;optical reader, etc



Simplified massbalance Ghana all of (W)EEE (cat. 1-4)



Flow of (W)EEE (Tons/Year)
 Installed Base of EEE (Tons)
 Stored Base of WEEE (Tons)

————> Quantified Flows
 - - - - -> Not-Quantified Flows

~1000 tonnes / year burnt cables in Greater Accra Region

- Thereof is ~38% plastic = 400 tonnes / year
- Thereof is ~62% copper = 600 tonnes / year

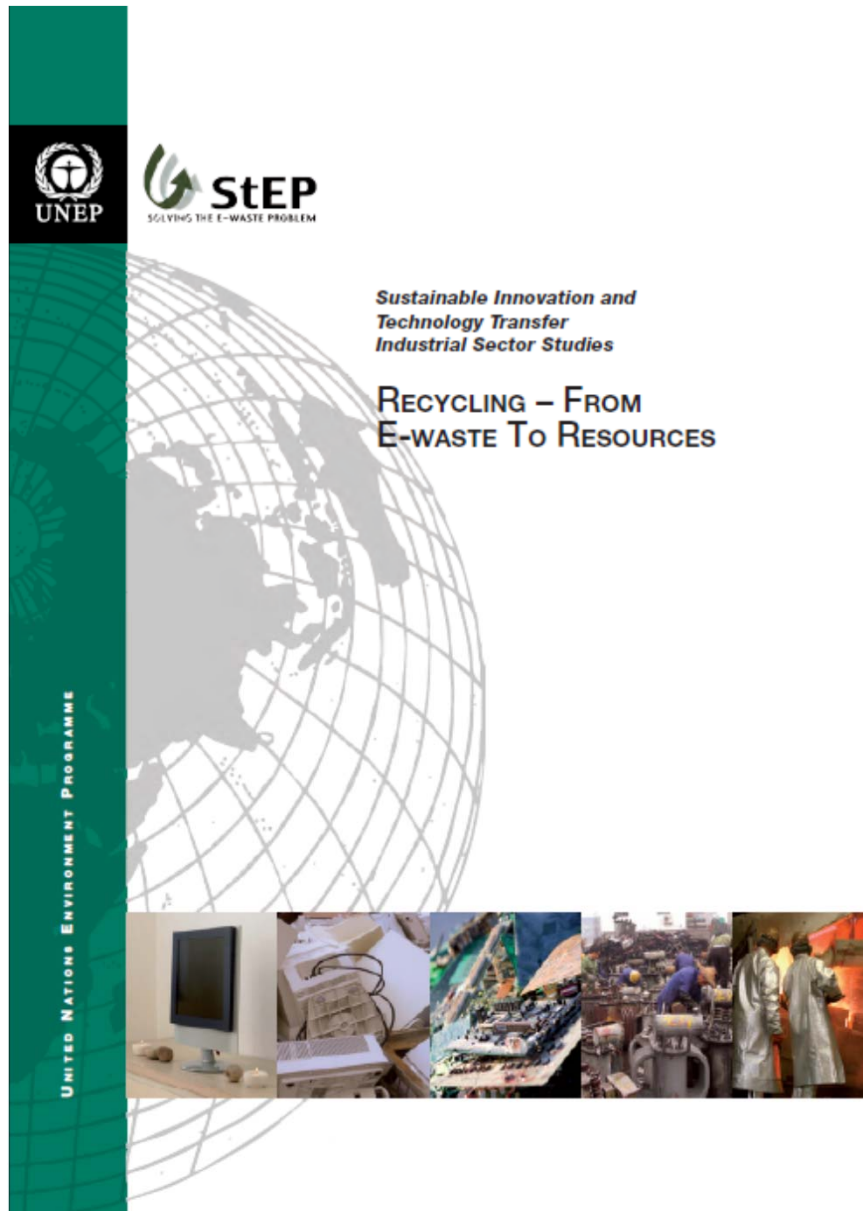
Preliminary estimation of total dioxin (PCDD/F) emissions to air from open cable burning in the Greater Accra Region:

- Source Strength = ~5 g / year

Compared with the European dioxin air emission inventory for 2005 (EU15 + Norway + Switzerland, Quass et al. 2004) this equals to:

- 0.25 – 0.5 % of total dioxin emissions
- 2.5 – 5 % of dioxin emissions from municipal waste incineration
- 15 – 25 % of dioxin emissions from industrial waste incineration

Ref: Quass et al. 2004: The European dioxin air emission inventory project – final results. Chemosphere 54, 1319–1327.



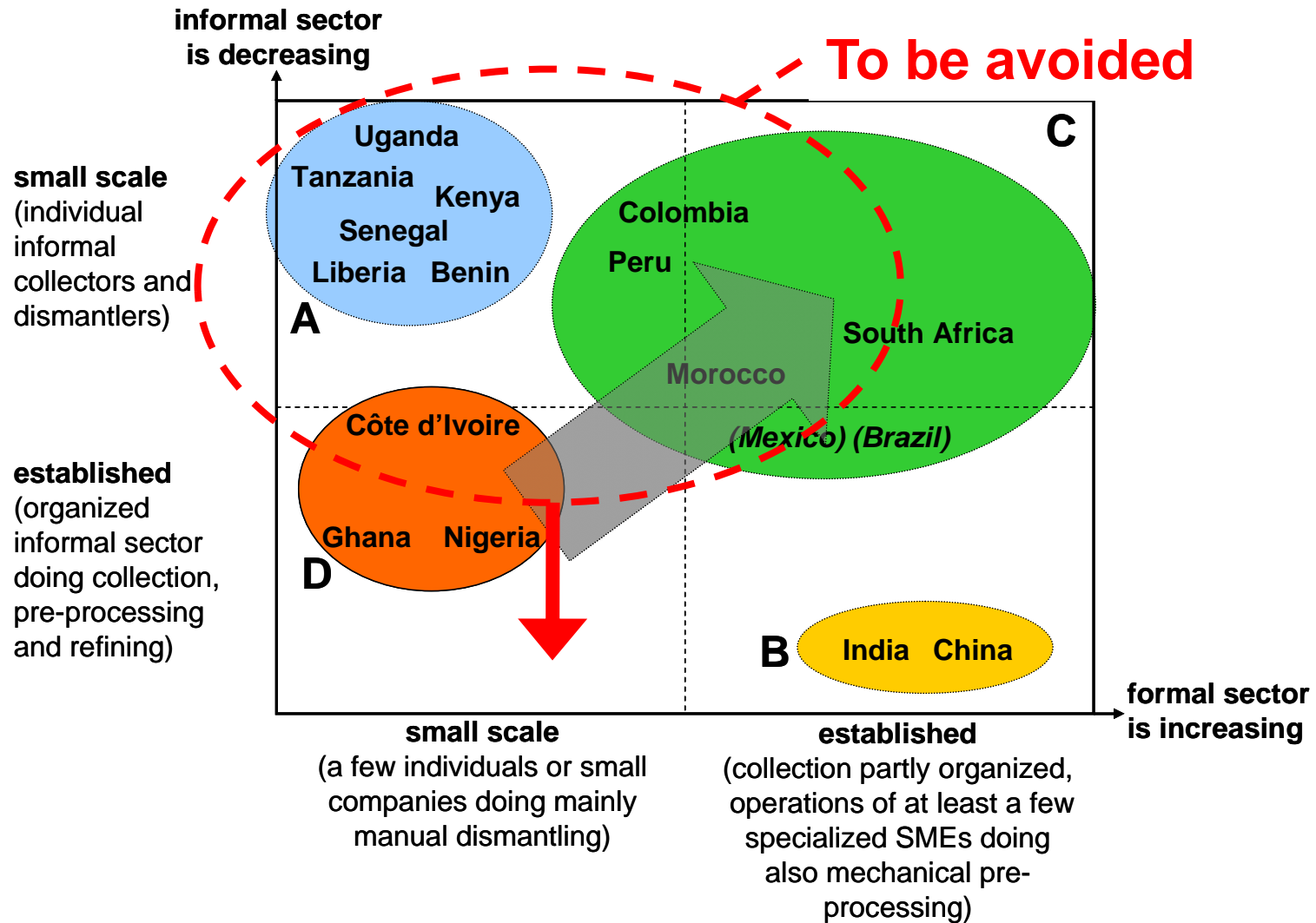
- Analysis of the market potential of innovative technologies for the e-waste recycling sector in selected developing countries.
- Classification of countries according to their current market situations and framework conditions.
- Application of the UNEP Framework Technology Transfer Activities in Support of Global Climate Change Objectives
- Identification of innovation hubs

Schluep M. et al.(2009). Recycling - from e-waste to resources, Sustainable innovation and technology transfer industrial sector studies. United Nations Environment Programme, Paris, France.

http://www.ewasteguide.info/UNEP_2009_eW2R

Classification of countries by 'informality'

Without proper measures in African countries it is likely that informal activities will increase



Group A (e.g. Benin, Kenya, Liberia, Senegal; Tanzania , Uganda) -> mainly “small” African country

- classified as promising for the introduction of pre-processing technologies with a strong support in capacity building.

Group B (India, China) -> no African country

- classified as having a significant potential for the introduction of pre- and end-processing technologies with a strong support in capacity building in the informal sector

Group C (e.g. South Africa, Morocco) -> **mainly African country with “stronger” economies**

- classified as having a significant potential to adapt pre- and to some extent end-processing technologies to their own needs, following a technology and knowledge exchange.

Group D (e.g. Côte d’Ivoire, Ghana, Nigeria) -> **mainly larger countries in West Africa**

- classified as promising for the introduction of pre-processing technologies with a strong support in capacity building in the informal sector, following a technology and knowledge exchange.

Informal collection and manual dismantling activities can be included in a formalized e-waste management framework

- Formalizing informal sectors is often not realistic, but connecting it to a formal system can be the first step
- The informal collection system is efficient in countries like India and China
- Deep-level manual dismantling in formal or informal environments is preferred over semi-automatic processes due to the abundant workforce and low labour costs
- All other informal activities such as wet-chemical leaching bear great adverse environmental and social impacts and are also often less attractive from an economical point of view than innovative technologies as identified above.

See also: Rochat D., Rodrigues W., et al. (2008) India: Including the Existing Informal Sector in a Clean e-Waste Channel. In: Proceedings of the Waste Management Conference (WasteCon2008), Durban, South Africa.
Sepúlveda, A., M. Schluep, et al. (2010) A review of environmental fate and effects of hazardous substances released from electrical and electronic equipments during recycling: examples from China and India. Environmental Impact Assessment Review, 30, 28–41.
Wang, F. (2008). Economic conditions for developing large scale WEEE recycling infrastructure based on manual dismantling in China - the learning experience from the setup of a pilot plant. Master Thesis, Universiteit Leiden, Delft University of Technology, The Netherlands.

Informal sector Bangalore



- only $\approx 20\%$ gets recovered
- $> 60\%$ loss due to the manual dismantling process
- $> 50\%$ loss due to the wet-chemical leaching process
- Emissions are dramatic: up to 400x European thresholds

State of the art smelter



- Recovery rate of up to 95%
- Plus other metal, e.g. palladium, silver, copper etc,
- High – tech off-gas control and treatment system

- **Having a market potential for e-waste recycling technologies doesn't necessarily mean that an operation can be run in a self-sufficient way (paid by the sales of recycling output fractions or materials).**
- **Sustainable recycling of e-waste will always demand for a proper managed framework and a financing scheme.**
- **Support in e-waste management in Africa has to follow a holistic approach (e.g. Durban Declaration)**

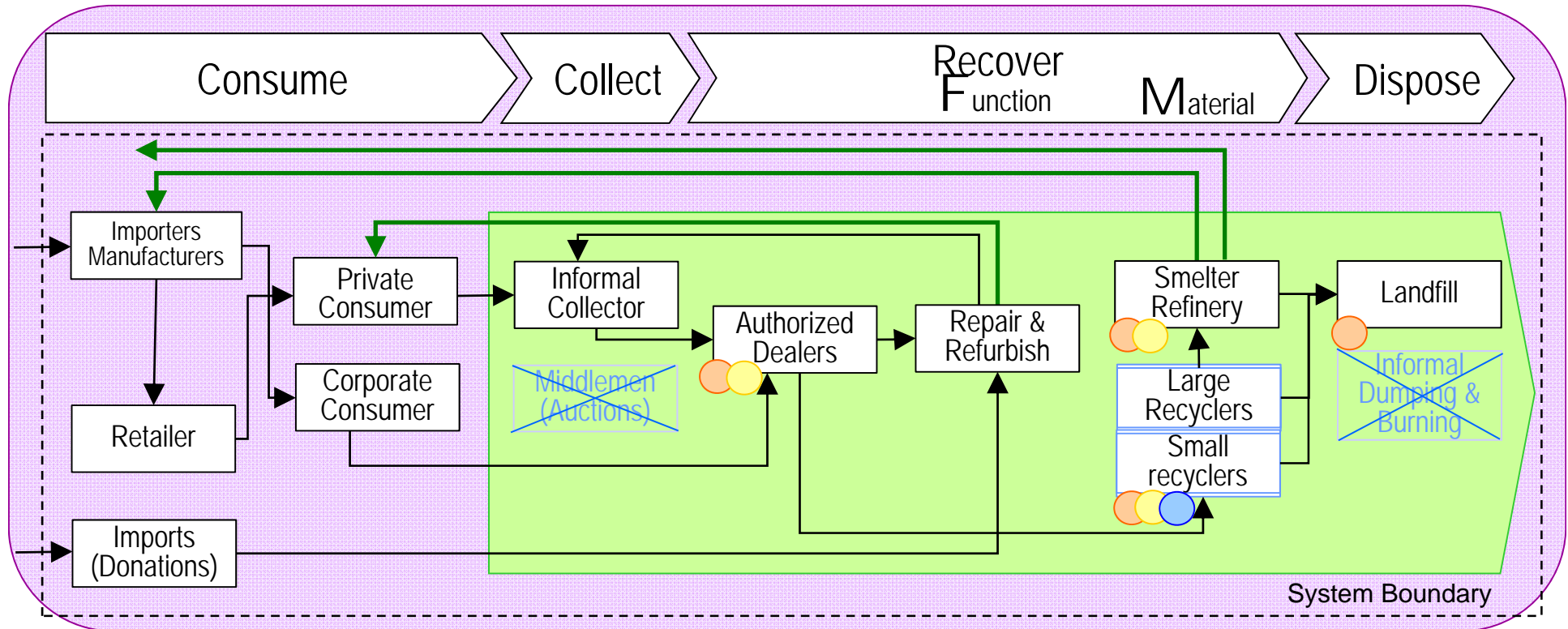
The Durban Declaration on e-Waste Management in Africa

The main issues related to an improvement of the current e-waste management practices encountered on the African continent and elsewhere were synthesized in the "**Durban Declaration on e-Waste Management in Africa**" during the WasteCon2008 in Durban, South Africa. It was agreed that every country requires its own process to define its specific roadmap, however, general recommendations were suggested:

The signatories, Durban 9 October 2008:

1. improve cooperation among stakeholders (3 recom.)
2. establish an institutional framework (2 recom.)
3. create awareness at all levels of governance & the general public (2 recom.)
4. support markets (3 recom.)
5. collect and manage data (3 recom.)
6. develop a legal framework (5 recom.)
7. develop a qualified and efficient e-waste recycling sector (5 recom.)

How to implement a holistic approach



Intervention Mechanisms:

- | | | | |
|--|--|--|---|
| Policy & Legislation <ul style="list-style-type: none"> • Licensing • Legislation | Business & Finance <ul style="list-style-type: none"> • Take back scheme • Technical control and fixed contracts • New business models | Technology & Skills <ul style="list-style-type: none"> • Knowledge and technology transfer • Formalizing the informal sector • Trainings | Monitoring and Control <ul style="list-style-type: none"> • Standards • Audits • Monitoring Massflows |
| | | | Marketing & Awareness <ul style="list-style-type: none"> • Information Campaigns on all levels |

Current progresses in Africa



Implementation	Country Assessment	South Africa, Kenya, Uganda, Tanzania, Nigeria, Benin, Ghana, Côte d'Ivoire, (Liberia), Senegal, Morocco, (Tunisia, Egypt)				
	National Strategy	South Africa, Kenya, Uganda, Nigeria, Benin, Ghana				
	Pilot			South Africa, Kenya, Morocco, Senegal, (Tunisia)		South Africa, Uganda, Kenya, Nigeria, Ghana; Morocco, (Tunisia, Egypt)
	Solutions shaping	South Africa, Uganda, Kenya, Nigeria, Ghana, (Tunisia)	South Africa		South Africa	
	Solutions established			South Africa (certain)		

Thank you



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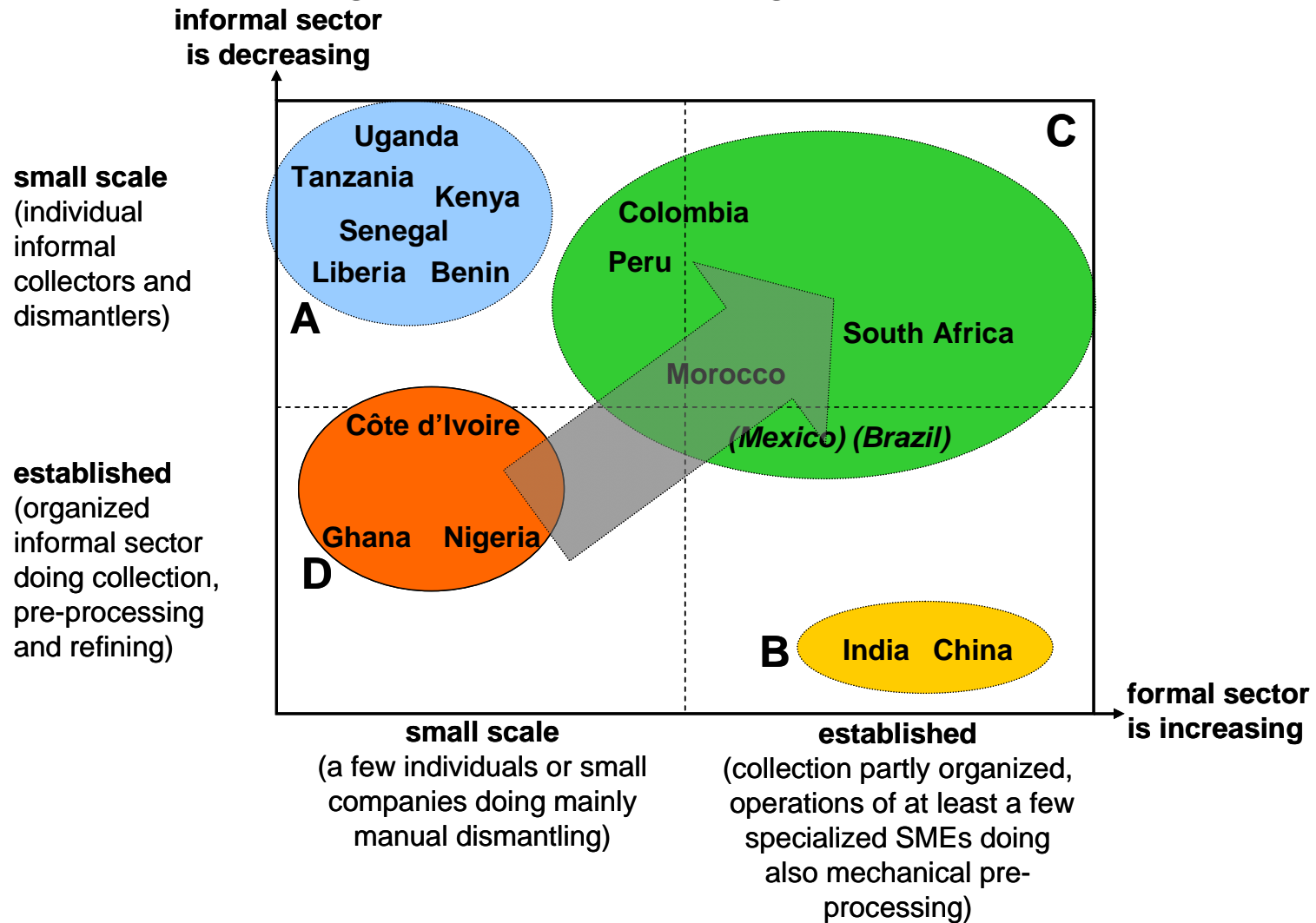
Technology & Society Lab:
www.empa.ch/tsl

Swiss e-Wast Programme:
www.ewasteguide.info

Swiss e-Waste Competence
www.e-waste.ch

Tentative classification of countries

Normally, a sustainable recycling system should grow towards the upper right corner of the graph



Group A (e.g. Benin, Kenya, Liberia, Senegal; Tanzania , Uganda) -> mainly “small” African country

- includes countries featuring the formal and informal sector on a small scale, if existent at all
- e-waste volumes were too small for the formation of informal or formal recycling activities
- as e-waste volumes also increase over time, those countries typically could move towards more informal activities if appropriate measures are not taken
- classified as promising for the introduction of pre-processing technologies with a strong support in capacity building.
- Pre-processing technologies include:
 - Manual dismantling/ sorting of fractions
 - De-gassing CFC, HCFC
 - Semi-automatic CRT cut and cleaning

Group B (India, China) -> no African country

- includes countries featuring an established informal and formal sector.
- e-waste volumes are large and in turn a well-organized informal sector was formed. The formal sector operates as a downstream partner and was not able to establish itself as a competitor for activities typically performed by the informal sector
- provided a better control of the informal sector, these countries would have the technological and economical capacity to adapt sustainable recycling technologies.
- classified as having a significant potential for the introduction of pre- and end-processing technologies with a strong support in capacity building in the informal sector

Group C (e.g. South Africa, Morocco) -> mainly African country with “stronger” economies

- includes countries featuring a currently developing or already established formal recycling sector, while informal activities remain on a small or medium scale
- Typically include politically “stable” emerging economies
- (Domestic) e-waste volumes were large enough to support pioneering entrepreneurs
- Group C is classified as having a significant potential to adapt pre- and to some extent end-processing technologies to their own needs, following a technology and knowledge exchange.
- Pre-processing technologies include:
 - Manual dismantling/ sorting of fractions
 - De-gassing CFC, HCFC
 - Semi-automatic CRT cut and cleaning
 - At a limited scale full-automated technologies (mid to long term)

Group D (e.g. Côte d'Ivoire, Ghana, Nigeria) -> mainly larger countries in West Africa

- includes countries featuring a currently established informal recycling sector, while formal activities remain on a small scale
- Informal activities seem to be triggered by waste and second-hand imports, while domestic e-waste volumes play increasingly an important role
- Group D is classified as promising for the introduction of pre-processing technologies with a strong support in capacity building in the informal sector, following a technology and knowledge exchange.
- Pre-processing technologies include:
 - Manual dismantling/ sorting of fractions
 - De-gassing CFC, HCFC
 - Semi-automatic CRT cut and cleaning
 - At a limited scale full-automated technologies (mid to long term)