



Waste Management 2030 +

The future of waste management sector

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DIRECTION

EAST SOUTHEAST SOUTH SOUTHWEST WEST

Global view of Waste Management by Antonis Mavropoulos

This is a blog dedicated to address waste management issues on a global perspective. Antonis Mavropoulos is a waste management consultant since 1994. He is calling for a discussion regarding the future of waste management as a complex social, technical and economical system. Antonis serves as ISWA STC Chair since November 2008.

Welcome

Welcome to this blog and feel free to post your comments for any of the issues that are published.

My intention is to contribute in a more sustainable way of waste management. I encourage the public debate regarding the solid waste management options and solutions available and I will be happy to answer questions and share ideas.

Greek readers may also read my greek blog:

<http://mavropoulos-gr.blogspot.com/>

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Waste Management 2030+

TAGS [BIODEGRADABLE](#), [ISWA](#), [LANDFILL](#), [MEGACITIES](#), [Politics](#), [SWM POLICY](#)

This is an article I prepared for the magazine Waste



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Scope of lecture



- To outline main forces that will shape the future of SWM
- To highlight their interaction
- To put major challenges for discussion

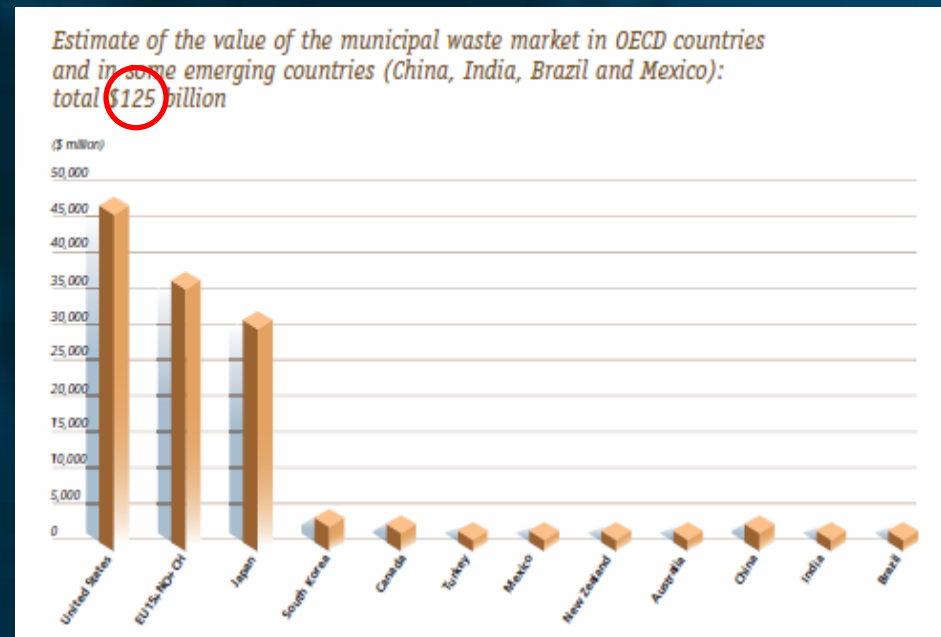
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0. Where do we stand today?

- There are islands of advanced SWM in an ocean of uncontrolled landfills
- There are technologies to face the problem
- Broad recognition of the disposal problem
- Broad recognition of recycling
- Initiatives for waste reduction

300 billions \$ - 2009

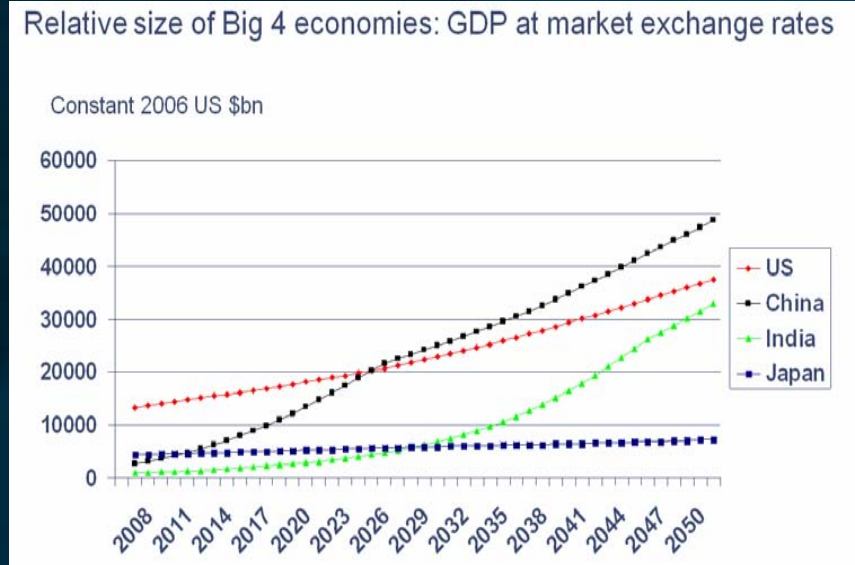
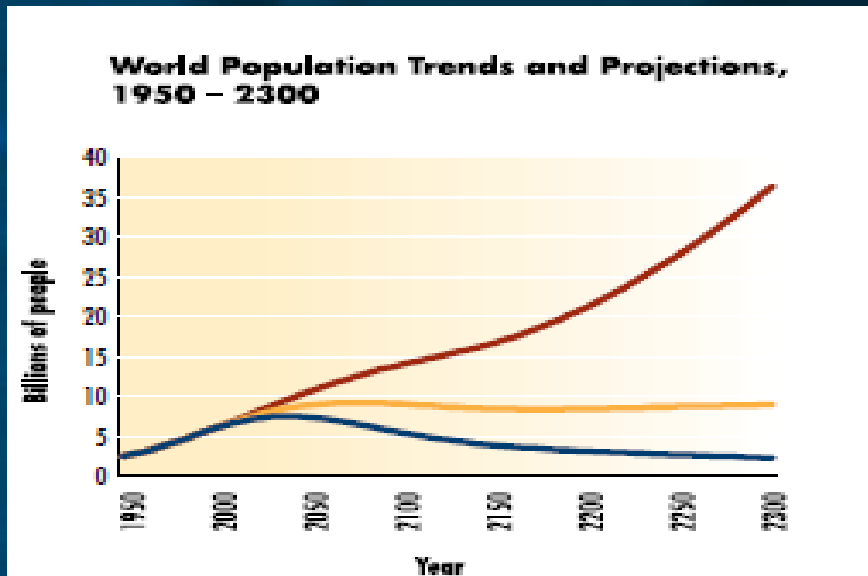


Source: From Waste to Resource, 2006 Waste Survey, Veolia

1. Waste volume will increase



- **GDP 2050 = 4 X GDP 2010** - *Still no evidence for decoupling*
- Population 2050 = 1,5 X Population 2010
- **Environmental footprint will be 6th fold**
- 1% rise of GDP/c → 0,69% rise of waste production



Source: John Hawksworth, PWC, *The world in 2050*, 2008

Cities growth 2007 - 2025



The City 600 today ...*

1.5 billion

people live in these 600 cities—
22 percent of global population

\$30 trillion

of GDP in 2007—more than half of
global GDP

485 million

households, with average per capita GDP of

\$20,000

The top 100 cities generated

\$21 trillion

of GDP in 2007—38 percent
of the global total

... and tomorrow

2.0 billion

people will live in these 600 cities in 2025—
25 percent of the global population

\$64 trillion

of GDP in 2025, nearly
60 percent of global GDP

735 million

households will live in these cities, with
average per capita GDP of

\$32,000

... of which

235 million

households in developing world
cities will have income above
\$20,000 per annum

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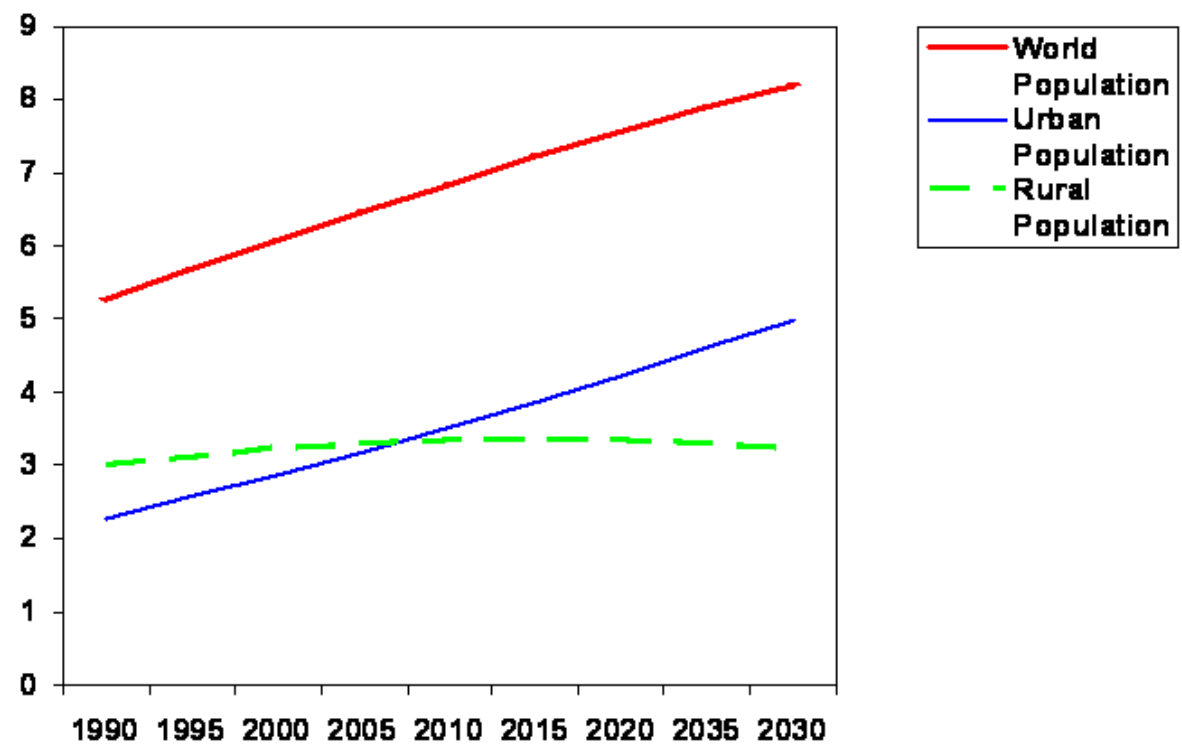
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21st century will be:

- Urban
- Asian
- Overcrowded

Figure 1. World, Urban, and Rural Population Change (Billions)



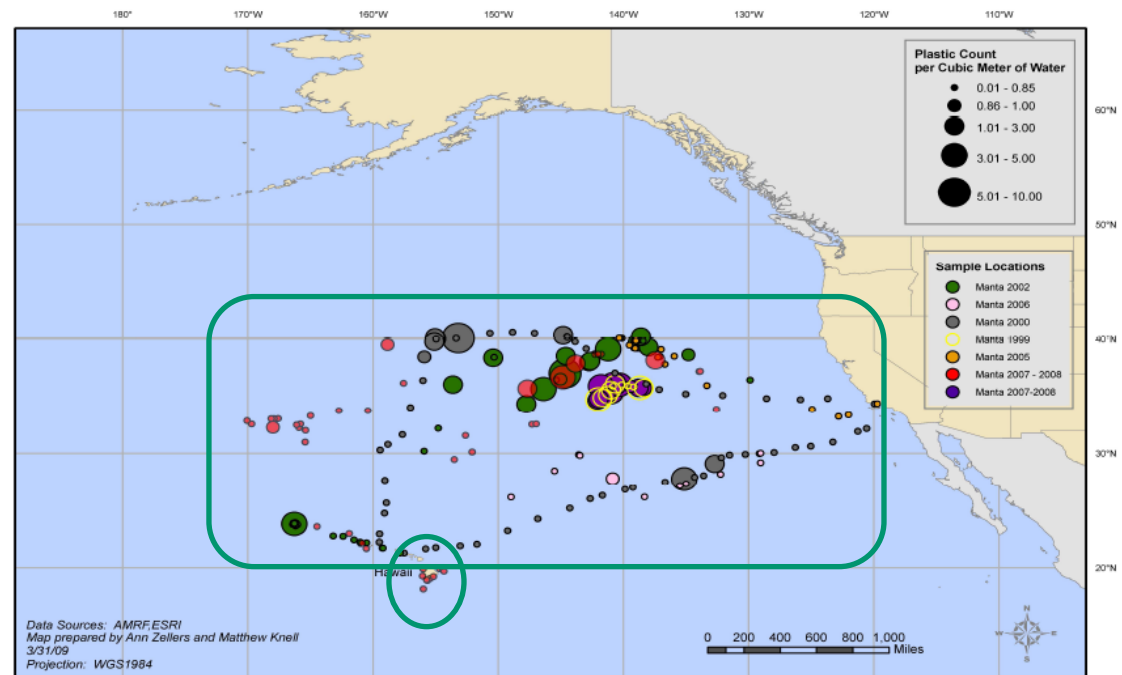
Source: Based on data by UN Population Division, *World Population Prospects: The 2004 Revision, Population Database*. Medium variant.



- Good news: MBT and Thermal treatment will be globally expanded
- Are our systems capable to receive those amounts of waste?
 - In developing countries
 - **In developed countries**

Example 1

- 46.000 plastic pieces/ sq. mile
- 6 kg of marine litter/ kg of plankton
- 5-10 m plastic layers
- 7.000.000 tons floating around Hawaii



Count Densities of Plastic Debris from Ocean Surface Samples
North Pacific Gyre 1999 - 2008



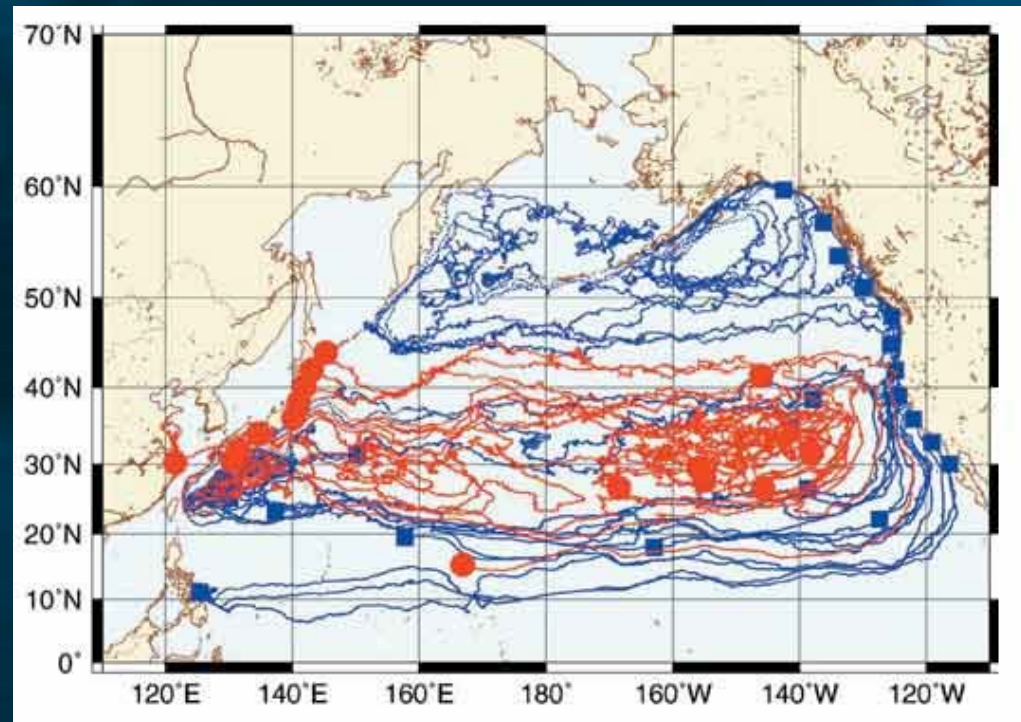
Source: Algalita Marine Research Foundation, 2009

The plastics are coming from...



- Map of current drift over 10 years
- Objects start near coasts and end in gyre

**A final sink for
10% of global
plastic
production!**



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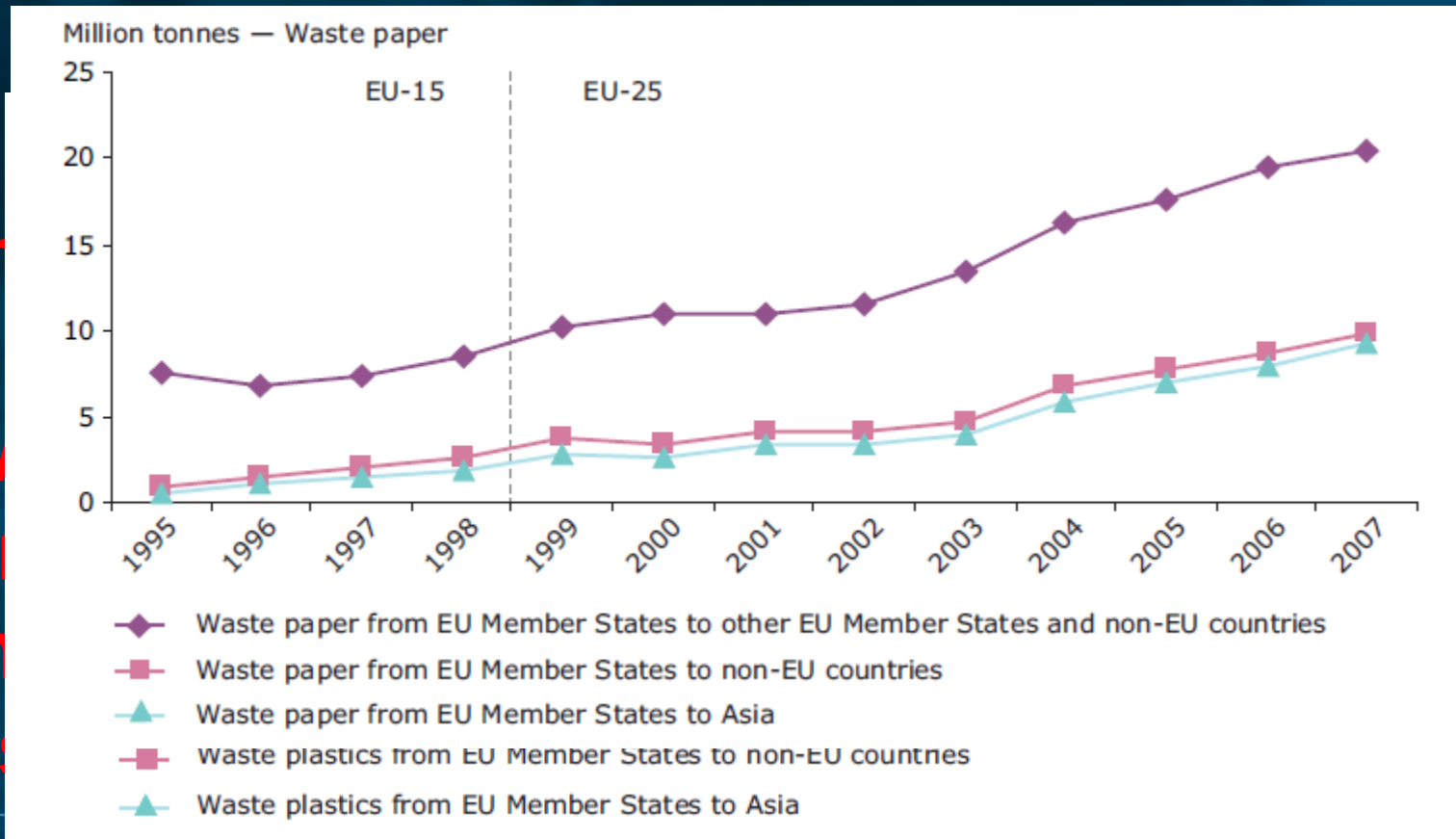
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Example 2



The results are:
20 million containers/ year to non –EU members

According
prices it
expensive
Netherlands
“recycling”
NY Times



The "China" syndrome

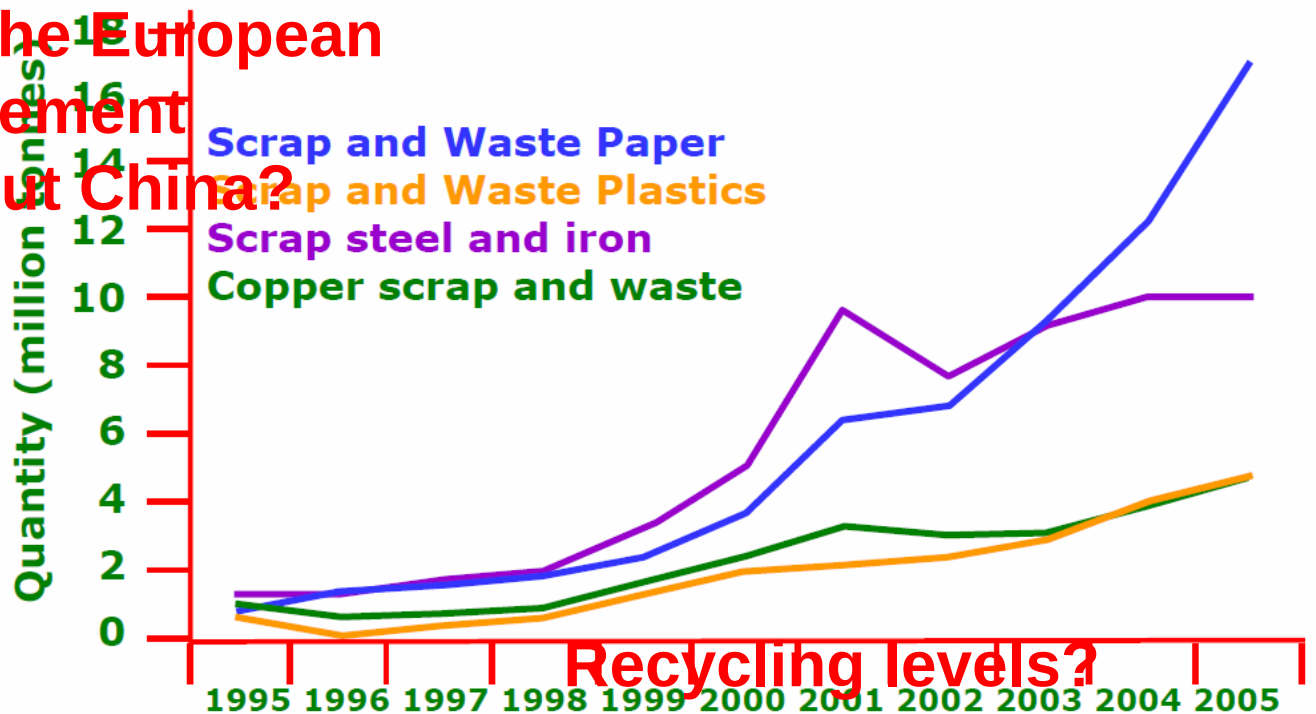


International

What will be the European Waste Management System without China?



Recycling in China



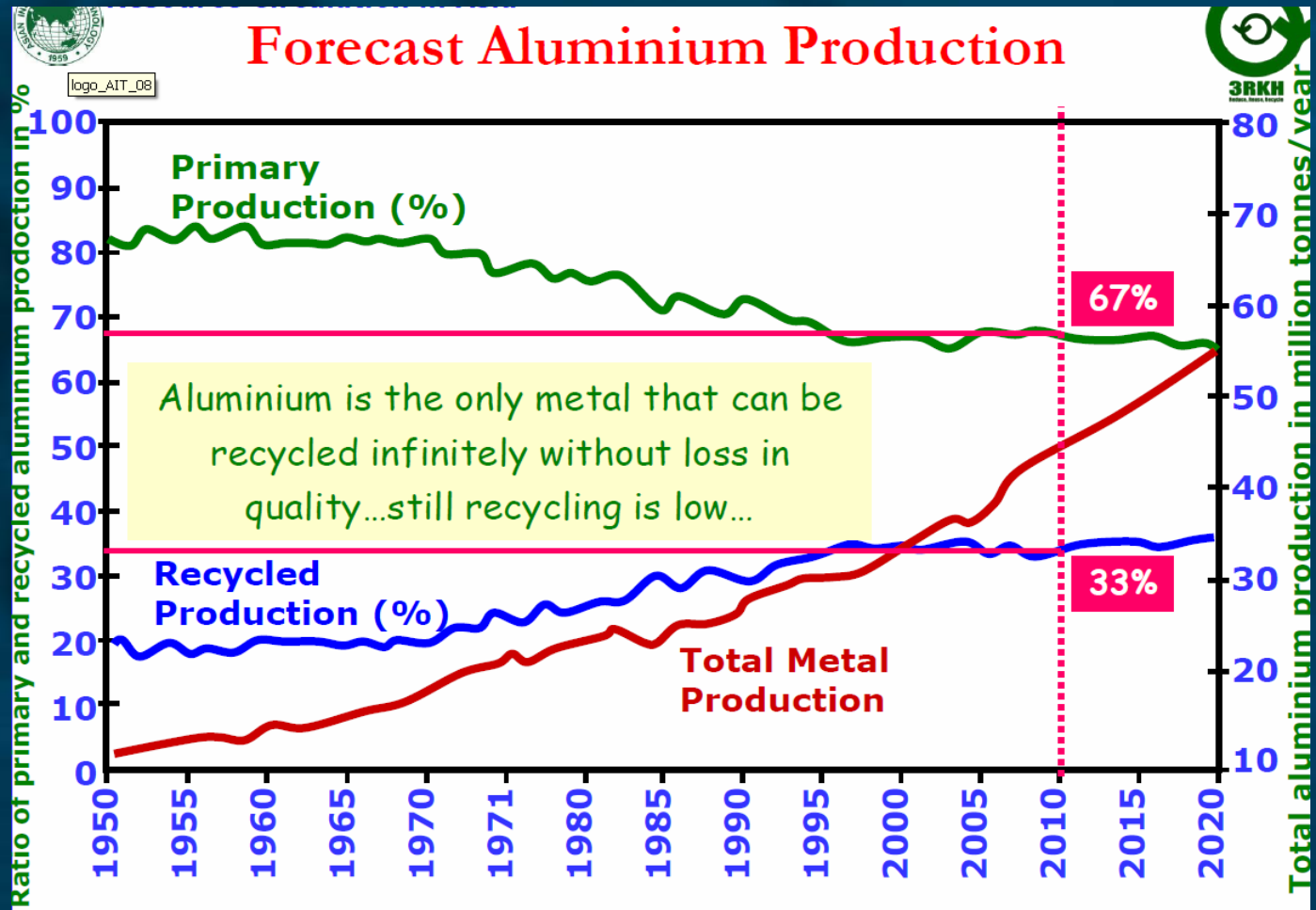
Recycling levels?

Self-efficient?

Can we afford termination of waste shipment?

Import of recyclables in China
China is in the forefront of the recycling industry !!!

The best we can...



Source: C. Visvanathan *Resource Circulation in Asia: Practical Challenges in Setting up Recycling Industries*, 2009

Comments



- Even our best systems are not self-capable and they have certain limits
- Increasing volumes and increasing collection rates will create disposal crisis in certain countries or cities
- New uncontrolled landfills will be created
- New landfills will be the dominant method worldwide – their importance is underestimated
- Waste trafficking will be a major problem
- Uncontrolled sinks will be a crucial issue

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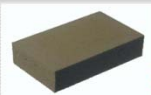
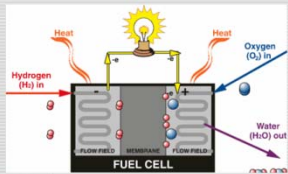
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2. Composition will keep changing

- Biotechnology
- Nanotechnology
- Combination of IT with them
- New energy products for home, personal use
- New IT products

Fuel Cell Batteries

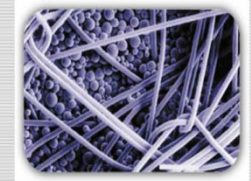
- ➔ Distributed Power
- ➔ Electric Motors
- ➔ Hydrocarbon based membranes
- ➔ Ink-jet printed membranes
- ➔ Nanoscale catalyst design
- ➔ High surface area 'sponges'
- ➔ Refill vs, recharge
- ➔ Energy Appliances



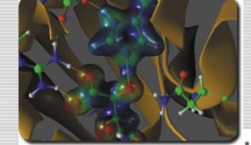
to futures

Nanoscale Science meets the age of Biological Energy Solutions

- ➔ Reinvention of everyday objects and materials
- ➔ Nanoscale machines
- ➔ Energy: Enzymes that produce hydrogen or nitrogen
- ➔ Moving beyond combustion based energy conversion and conventional alternatives



Nano-scale design 1/1,000,000,000 meter



Source: Derek Woodgate, Future frequencies, 2008

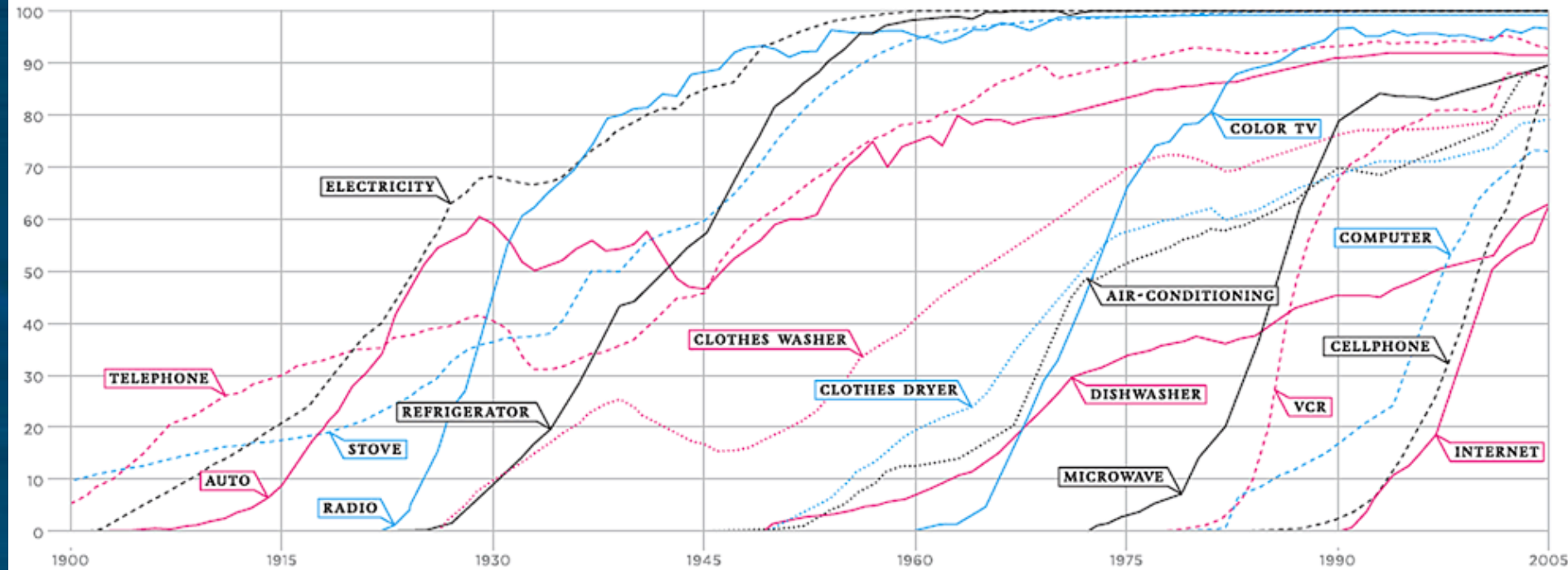
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PERCENT OF
U.S. HOUSEHOLDS

CONSUMPTION SPREADS FASTER TODAY

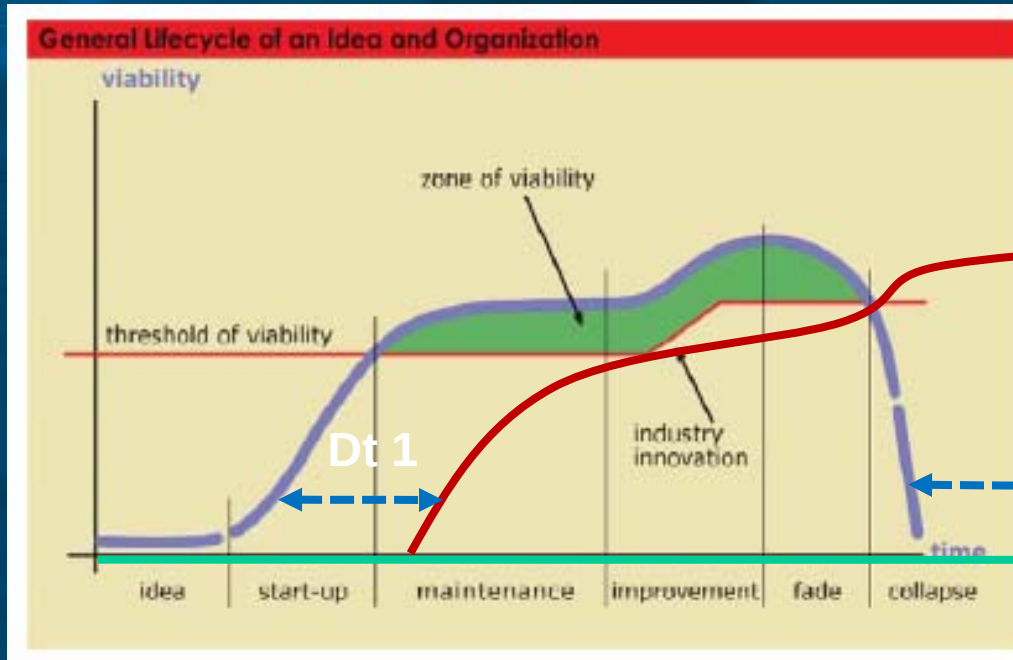


**New products will be rapidly consumed
and create new waste globally**

A more general problem



Product cycle



**Waste
management
cycle**

Dt 2

It starts later, when there are waste (Dt1)
It keeps much more (Dt2)

Targets

Dt1 → 0

Dt2 → 0

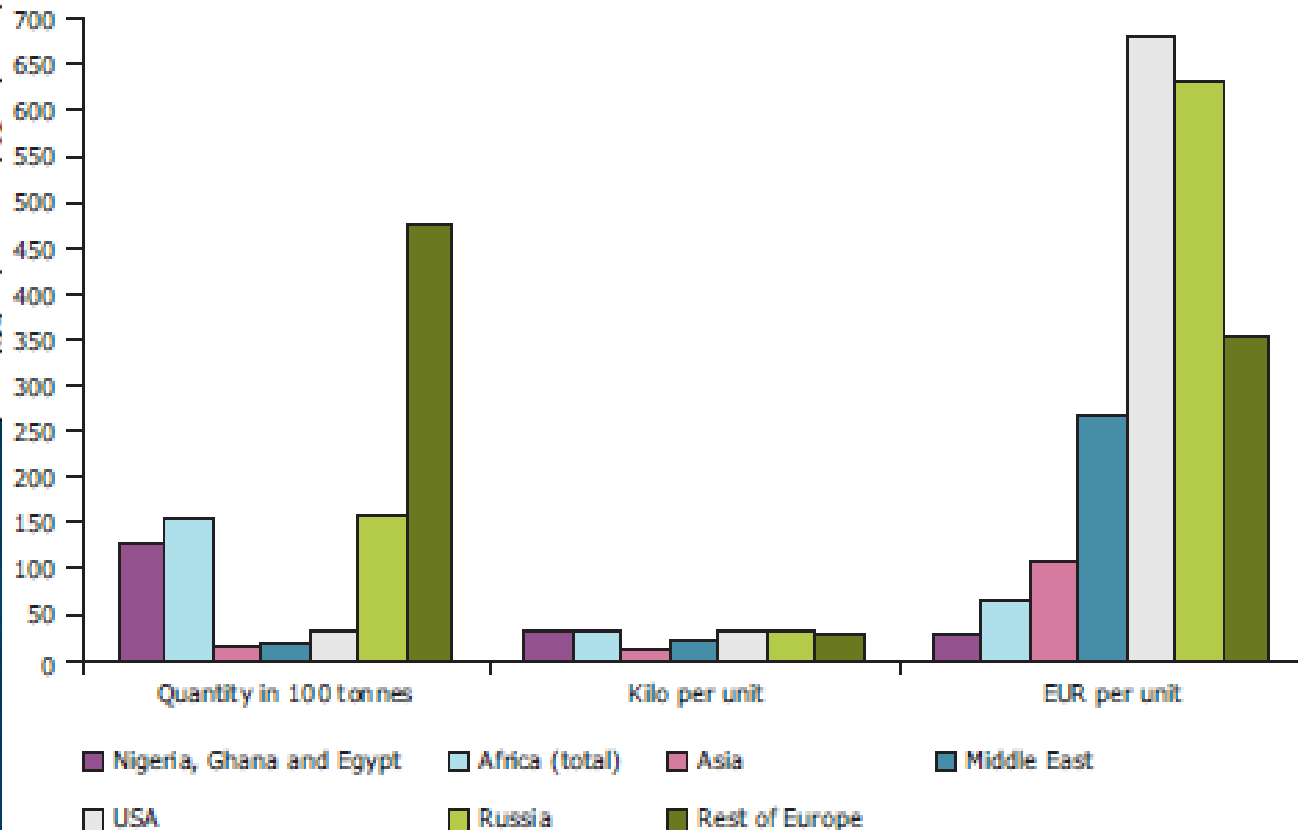
Build in obsolescence

The e-waste example



Global sales of e-waste market

Figure 5 Export of all colour television sets from the EU to Africa, Asia, the Middle East, United States and other European countries in 2005



Recycled Metals
 Recycled Plastic
[Recycled Silica](#)
 Other Technology
 Total

Source: EEA Report 1/2009, Waste Without Borders

Comments



- New products come faster than their sound management as waste
- More waste streams must have separate management for 3R purposes
- Waste Prevention & Eco-design are key - issues
- SWM Complexity will increase exponentially
- Differences between countries will be the driving force for waste trafficking
- Current market conditions are not capable to face the problem

3. Resource scarcity



Table 1: Predicted peak and depletion of different fuels and metals, and main area of usage

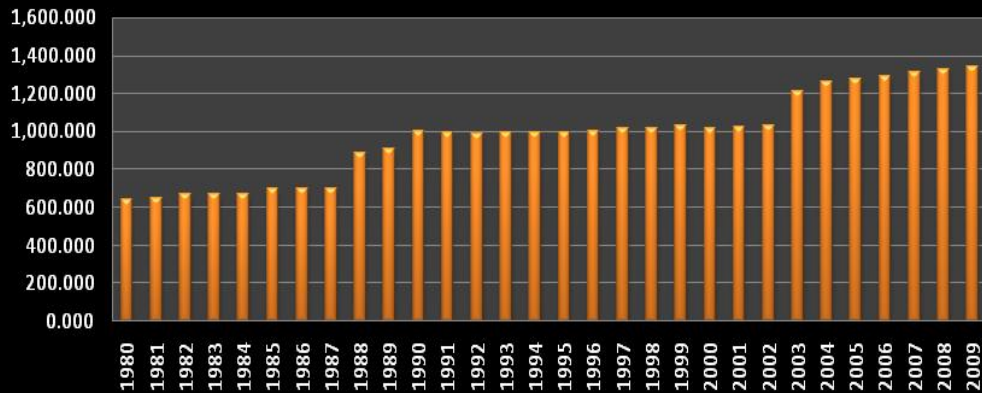
Commodity	Peak	Depletion	Main area of usage
Oil	2006-2026	2055-2100	Energy generation Chemical industry and pharmaceuticals Construction
Natural gas	2010-2025	2075	Energy generation
Coal	2100	2160-2210	Energy generation
Antimony	-	2020-2035	Metal alloys
Copper	-	2040-2070	Energy transport Piping Electronics
Gallium	may have passed	-	Electronics (mobile phones, solar cells)
Indium	-	2015-2020	Electronics (LCDs, solar cells)
Lead	Passed	2030	Automobile industry Chemical industry
Platinum	-	2020	Electronics (printer, etc) Industry (plug, catalyser, glass production) Medicine (pacemaker)
Silver	-	2020-2030	Electronics Pharmaceuticals
Tantalum	-	2025-2035	Electronics (mobile phone, automobiles) Pharmaceuticals Chemical industry
Uranium	-	2035-2045	Energy generation
Zinc	-	2030	Anticorrosives Energy storage (batteries)

Source: European Parliament, *Eco-innovation - putting the EU on the path to a resource and energy efficient economy*, 2009

The example of oil

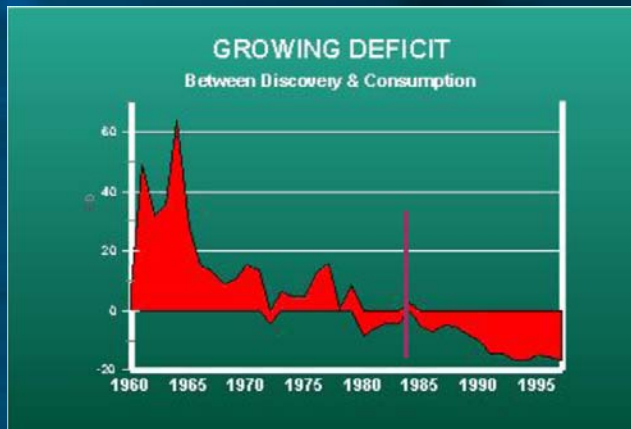


GLOBAL OIL RESERVES 1980 – 2009 (billions barrels)



Reserves were few
Prices grew exponentially
Poor oil fields became attractive
New extraction methods went feasible
Reserves doubled
They are going to be spent

Extraction costs went higher



Source: BP Statistical Review of World Energy June 2009

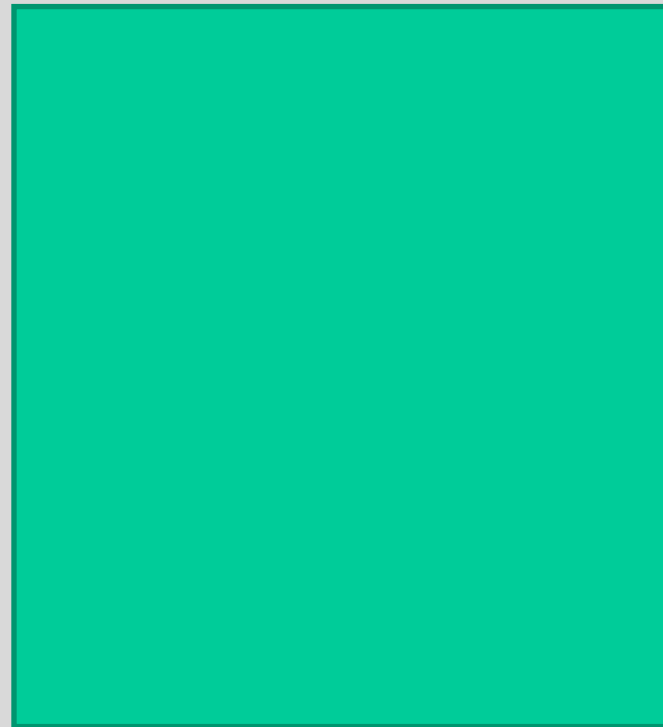
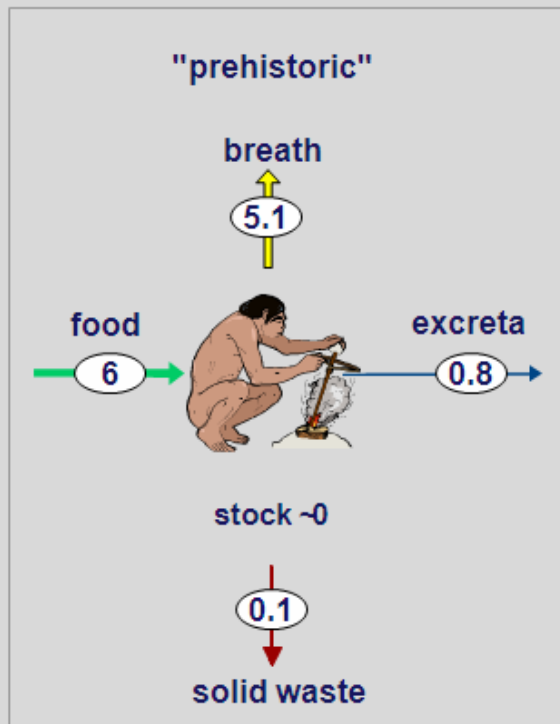
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Recycling and urban mining



Understanding anthropogenic metabolism

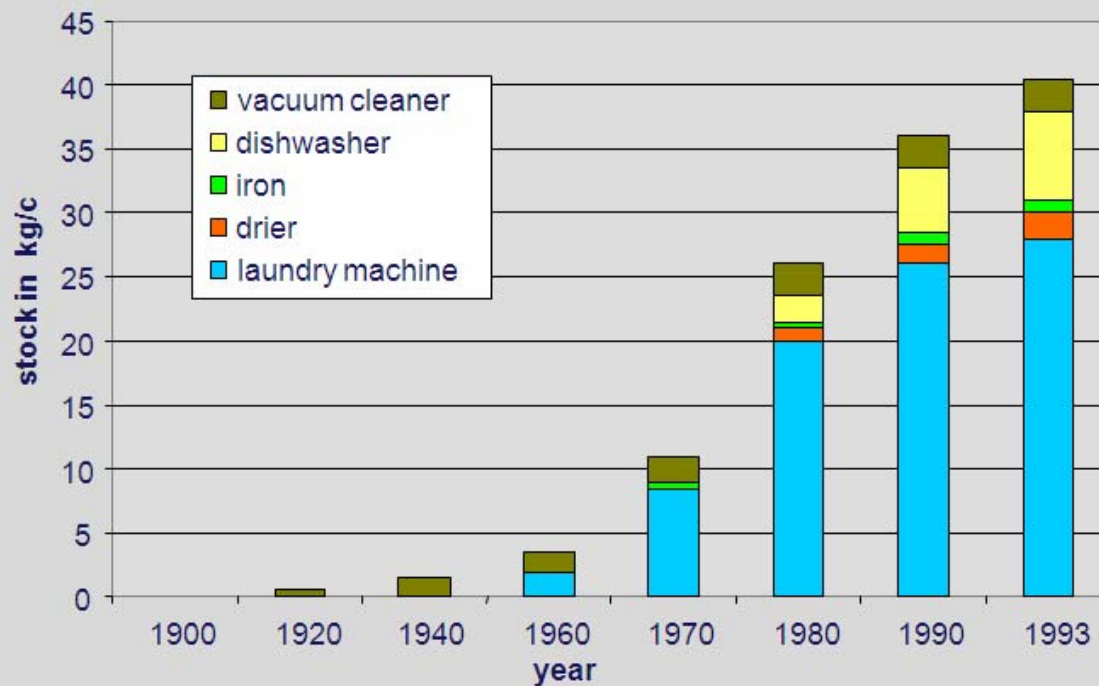
flows in t/c.y, stock in t/c



Where the materials are?



In-house stock of appliances for “cleaning” in Vienna



Source: Beschoner, St. 1996

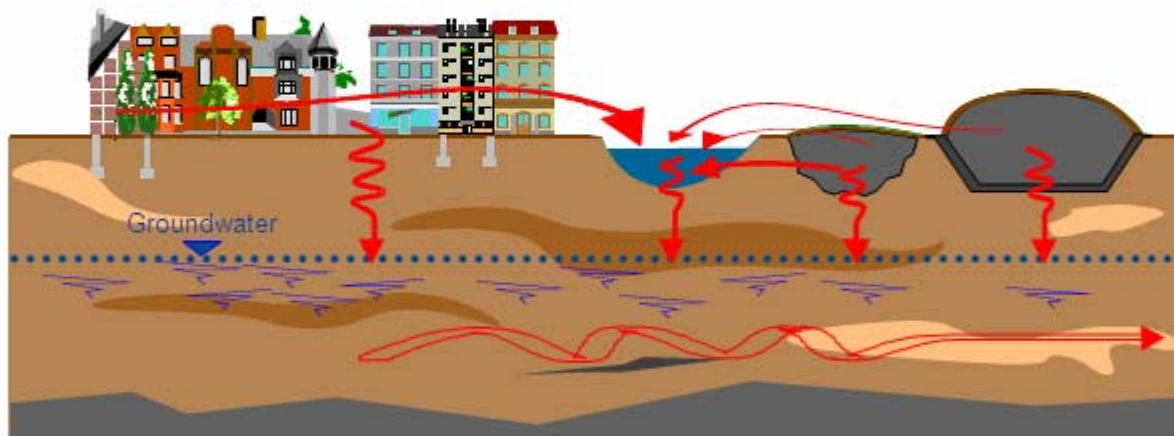
Urban mining - where are the recyclables?

Vienna stock in use and hybernating

Lead	200	[kg/capita]
Iron	5,000	

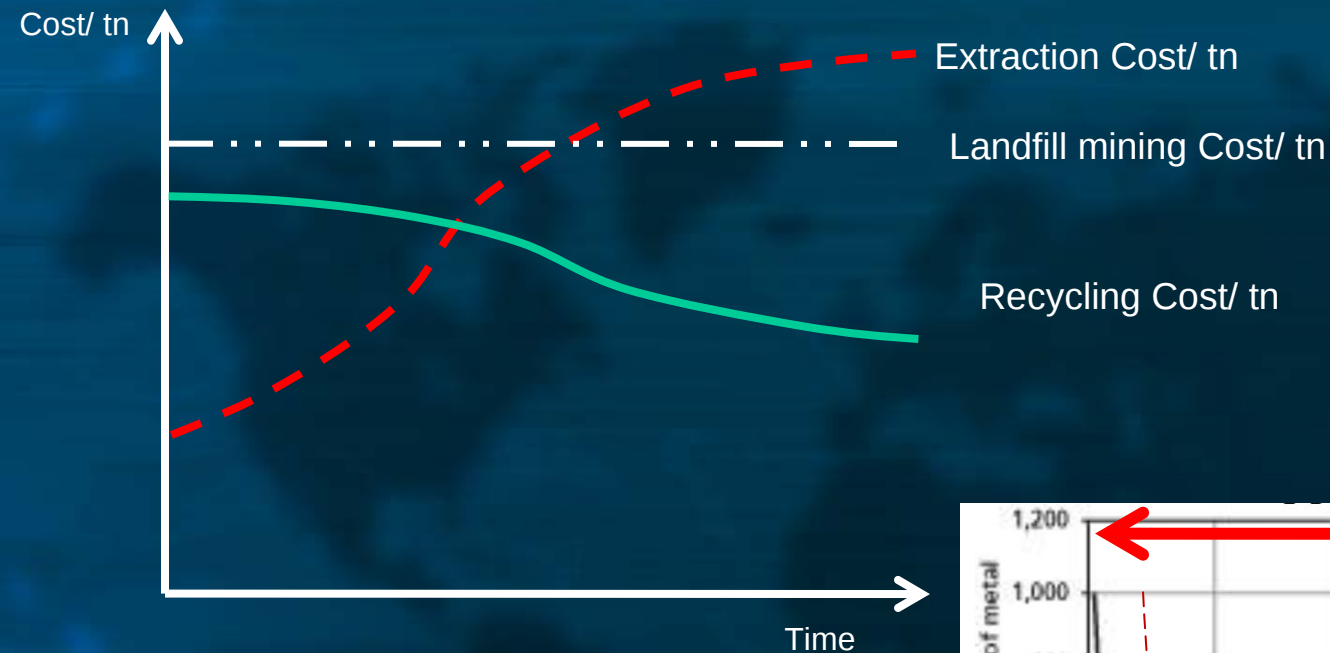
Stock in Vienna landfills

Lead	20
Iron	350

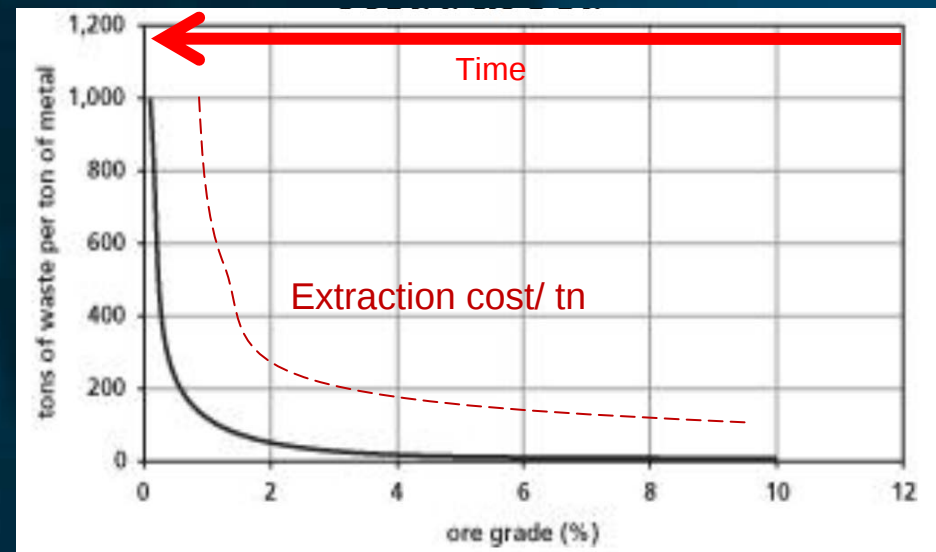


Source: R. Obernosterer et al, 1998

The break – even points

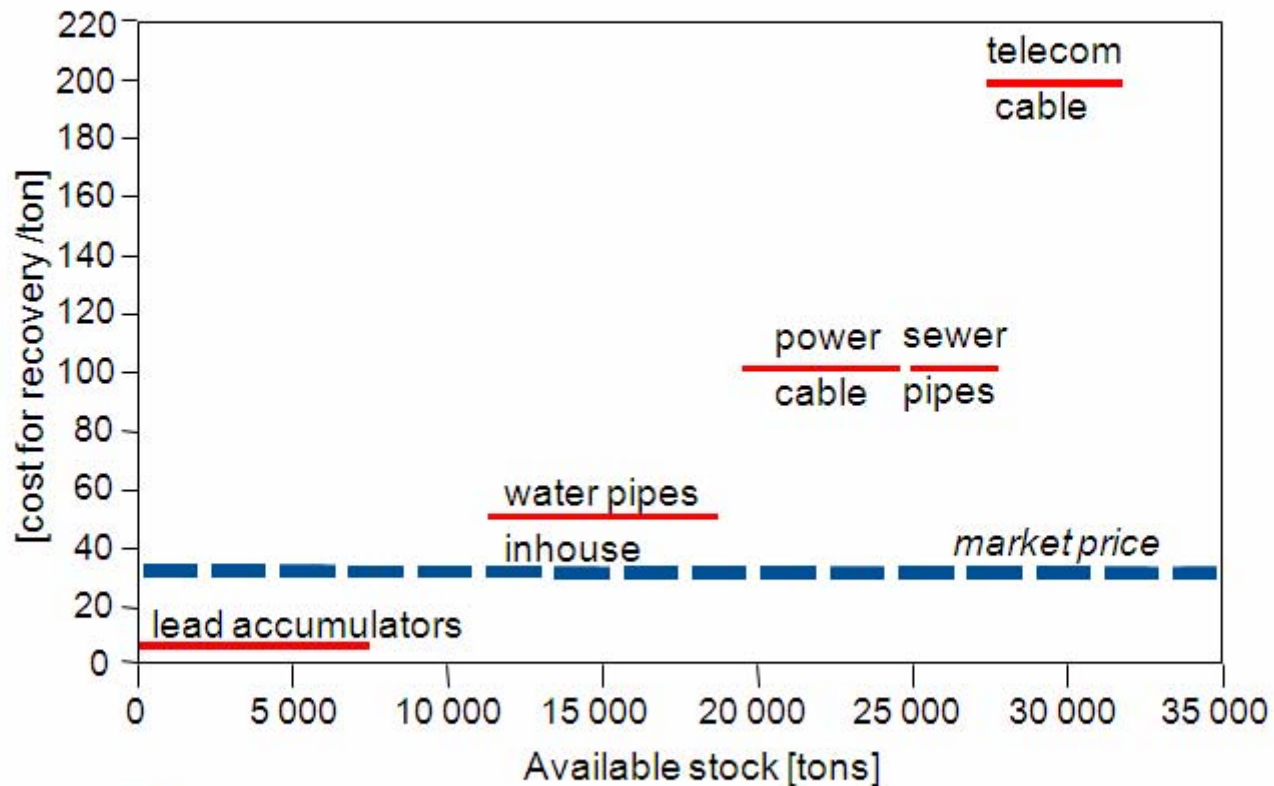


- **Economies of Scale**
- **Transboundary Movement**
- **Technology Transfer and Training**
- **Ensuring Markets**
- **Financing of Recycling Industries**



Source: Dennis Meadows, *Perspectives on Limits to Growth 37 Years Later*, 2009

What is the value of these recyclables? Ex. lead



Quelle: Lohm et al., 1998

Recycling and markets

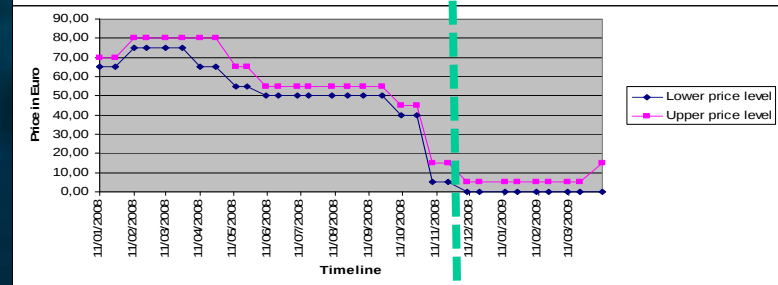
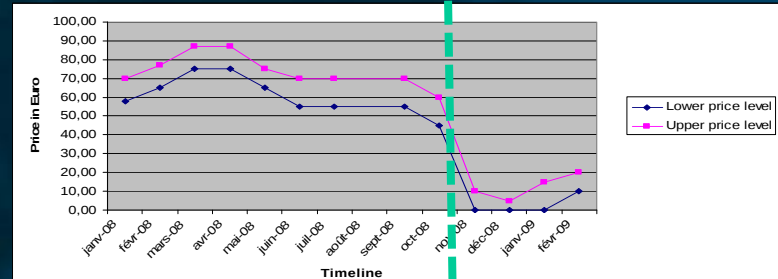
Production stopped
Prices dropped exponentially
Some recycling programs stopped
Stocks piled up

They went for disposal

Is it sustainable?

Recycled paper
price, France

Recycled paper
price, Germany



Comments



- Reuse, Recycling, Recovery (3R) will be more and more important for survival on Planet Earth
- New recycling & recovery technologies will be discovered - Current non feasible technologies will be feasible later (e.g. landfill mining)
- Market turbulences drive recyclables to landfills - they are going to be more
- Market tools are not enough to sustain a high level of recycling and resource conservation

Instead of conclusions



- SWM Complexity will exponentially increase
- Waste management is already part of the global economy
- Globalization of “waste” for “resource recovery” will be the rule as resource go more scarce
- The need for new type of final sinks is proportional with the complexity of SWM and the amount of new kinds of products

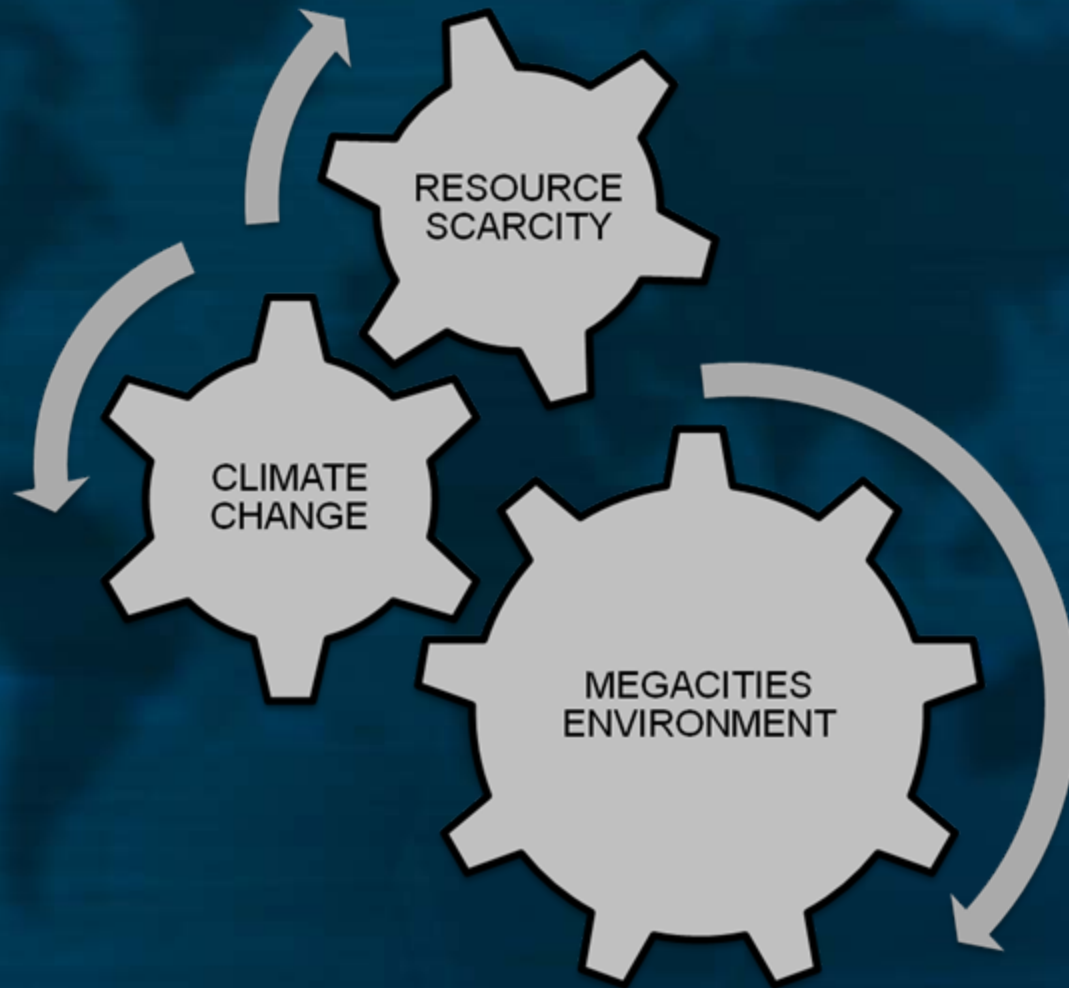
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- Waste will be more and more a global problem that is still managed with local regulations
- Waste will be more and more a local problem that will not be resolved without global regulations

SWM Science drivers





mavropoulos.blogspot.com

THANK YOU



References and suggested readings

1. *Solid Waste Management in the World's Cities*, UN HABITAT Book, 2010
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6. *Waste Management 2030+*, Antonis Mavropoulos, Waste Management World , December 2010
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9. *Urban World: Mapping the Economic Power of Cities*, Mc Kinsey, March 2011
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