

Comparing Solid Waste Management in the World's Cities

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DAKOFA/ ISWA
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Imperial College
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Scope of this presentation

PART 1

- Where are we now?
 - Comparing the status of solid waste management around the world



PART 2

- Where are we going next?
 - Future drivers and directions

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CBO collection in
Ouagadougou, Burkina
Faso

Modern landfill in
Hong Kong

Selling recycled bottles,
Dhaka

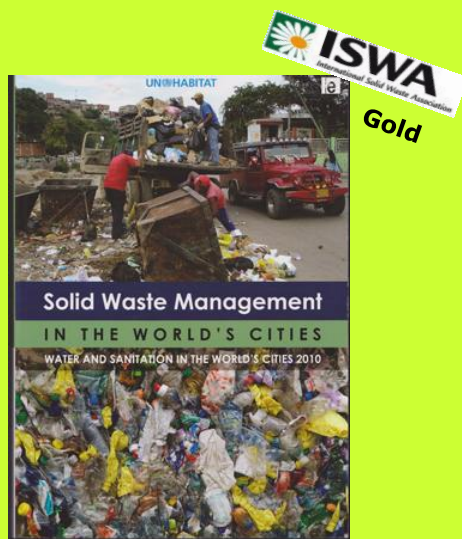
WHAT IS THE CURRENT STATUS OF SWM AROUND THE WORLD?

Photo credits: © Jeroen Ijgosse; David C Wilson; Mansoor Ali

Comparing SWM

- Good data have been hard to come by
- UN-Habitat book has changed that
- Reliable and consistent data for 20 cities
- Full data analysis published March 2012

Book: Scheinberg, A., Wilson, D.C. and Rodic L. (2010). *Solid Waste Management in the World's Cities*. Published by Earthscan for UN-Habitat, March 2010.



Analysis: Wilson, D.C., Rodic L., Scheinberg, A., Velis, C.A. and Alabaster, G. (2012). Comparative analysis of solid waste management in 20 cities. *Waste Management & Research*, 30, 237-254.

The 20 reference cities

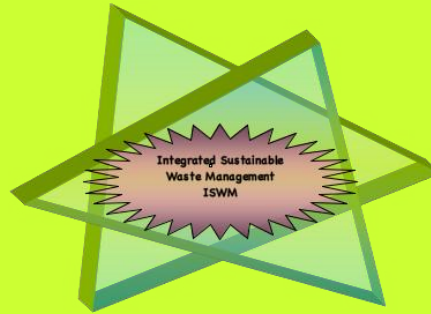


Integrated and sustainable waste management (ISWM)



For further information: www.waste.nl

Analytical Framework (1)



3 key physical elements - each related to a driver

- Public health - collection
- Environmental protection - disposal
- Resource value - recycling

The old paradigm – up to early 1990s – stopped there

- *Focus on technical solutions*
- *Each municipality acting on its own*

New Analytical Framework



3 key physical elements - each related to a driver

- Public health/ collection
- Environmental protection/ disposal
- Resource management

3 key governance strategies

- Inclusivity, of both users and service providers
- Financial sustainability
- Sound institutions and proactive policies

Source: Scheinberg A, Wilson D.C. and Rodic L. (2010). *Solid Waste Management in the World's Cities*. Published for UN-Habitat by Earthscan, London

One way of categorising the cities

- by income level of the country (GDP/capita/year)

High-income	Upper-middle	Lower-middle	Low-income
Rotterdam, Netherlands	Belo Horizonte, Brazil	Sousse, Tunisia	Lusaka, Zambia
San Francisco, USA Tompkins County, USA	Curepipe, Mauritius Varna, Bulgaria	Kumming, China Quezon City, Philippines	Nairobi, Kenya Bamako, Mali
Adelaide, Australia	Canete, Peru	Bengaluru, India Delhi, India Managua, Nicaragua	Dhaka, Bangladesh Moshi, Tanzania Ghorahi, Nepal
<i>Over \$11,500</i>	<i>\$3,700 - \$11,500</i>	<i>\$970 - \$ 3,700</i>	<i>Less than \$ 970</i>

*Based on GDP/capita data for 2007 (taken from 2009 UNDP Human Development Report)
Categorisation follows that of the World Bank*

1st driver: Public Health – Focus on Collection



Burning uncollected waste, Venezuela

Direct: Increased incidence of sickness among children living in households without a waste collection service:

Data from Demographic and Health surveys:

- Diarrhoea – rate x 2 or more
- Acute respiratory infections – rate x 6



Dengue fever clean-up campaign, Quezon City

Indirect: water-borne disease via blocked drains and flooding

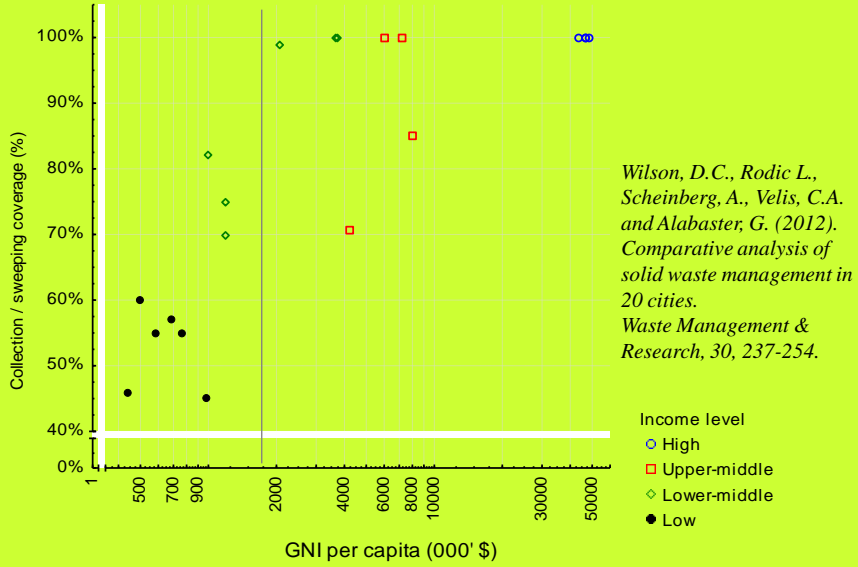


Waste blocking a storm drain.
Bamako, Mali

Photo credits clockwise from top left: © Jeroen Ijgosse; Erica Trauba; SWAPP

Public health – collection coverage

World Bank website: 30-60% in low & middle income countries



2nd driver:
Environment –
Focus on open
dumps



Top: On Nooch,
Bangkok, 1983
Bottom: Jam Chakro,
Karachi, 2001

Photos: David C Wilson;
Jonathan Rouse

Environmental control – waste disposal

1990s baseline: open dumping still dominant
in middle and low-income countries

Income Level	State of the art disposal	Simple controlled disposal	Uncontrolled Disposal
High	100%	0%	0%
Upper-middle	75%	20%	5%
Lower-middle	61%	32%	7%
Low	29%	24%	47%

Substantial progress has been made, particularly in middle-income countries

Data source: Scheinberg A, Wilson D.C. and Rodic L. (2010). *Solid Waste Management in the World's Cities*. Published for UN-Habitat by Earthscan, London

Resource value – recycling rates

Income Level	Minimum %	Maximum %	Average %
High	30	72	54
Upper-middle	7	27	15
Lower-middle	6	39	27
Low	6	85	27

A lot of variation between countries

Rates in high-income countries have regrown since 1980s

Rates still relatively high in the lower income countries

Data source: Scheinberg A, Wilson D.C. and Rodic L. (2010). *Solid Waste Management in the World's Cities*. Published for UN-Habitat by Earthscan, London



Moshi – the ‘cleanest city in Tanzania’

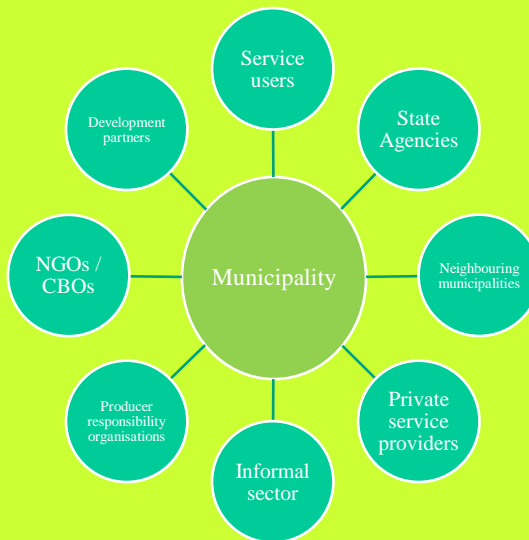
Waste & Citizenship Forum, Belo Horizonte

COMPARING GOVERNANCE ASPECTS

Photo credits: © Alodia Ishengoma, Sonia Maria Dias



Good governance – partnering with ALL stakeholders in an ISWM system



Inclusivity: Focus in Particular on Users & Service Providers



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Qualitative indicators: e.g. User inclusivity

Why partner with users?

1. SWM is a service – the users need to be satisfied
2. People want to live in clean neighbourhoods where their children are healthy
3. Changes in the service require participation from the users and often changes in their behaviour
4. New facilities cannot be sited without the buy-in of the people

Qualitative indicators*

1. Do laws require participation of stakeholders outside the bureaucratic structures?
2. Are there any procedures in place for citizens to participate in the siting of landfills or incinerators?
3. Is customer satisfaction with the waste management service measured at the municipal level?
4. Are there any feedback mechanisms between service users and service providers?
5. Are there any citizens committees in place which address waste management issues?

**As defined and used in the Habitat book*

Achieving user inclusivity

Citizens Committee

At Barangay level in Quezon City, Philippines

Participative planning

Catia La Mar, Venezuela



Photos: SWAPP; Jeroen IJgosse



Door-to-door informal collector, India

Collection

Some examples of diversity in service provision



CBO collection in Bamako, Mali

Bicycle cart delivering to small transfer station in Kunming

Curepipe, Mauritius

Adelaide, Australia



Modernisation does not necessarily mean motorisation

Photo credits clockwise from top left: © WASTE; Erica Trauba; Justin Lang, Zero Waste South Australia; Curepipe Municipality; Ljiljana Rodic

Recycling rates- formal vs informal

Income Level	Average %	Formal %	Informal %
High	54	54	0
Upper-middle	15	1	15
Lower-middle	27	11	16
Low	27	1	26

Data source: Scheinberg A, Wilson D.C. and Rodic L. (2010).
Solid Waste Management in the World's Cities.
 Published for UN-Habitat by Earthscan, London

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Contribution of community / informal sector

- Systems entirely private sector, financed only from sale of recyclates
- Modern recycling systems have been rebuilt by municipalities as 'sinks' – cost them money but cheaper than landfill or waste-to-energy
- Reduce public sector costs – by millions of \$/year in a large city
- **Professional waste workers in the community/ informal sector are just one partner group, but they are often not recognised as such by the municipality**



Istanbul, 1993 (Photo: DCW)



Port Harcourt, 2006 (Photo: Kaine Chinwah, IC)

‘Working conditions are unacceptable’

- Yes, but why are their working conditions so dirty?
- Most sorting is in mixed waste
- Hand sorting is common in high income countries
- **Key: separate organics from dry recyclables at source**
- *At a stroke, improve working conditions for the recyclers AND provide the foundation for ‘zero waste’ to landfill*
- Separation at source already takes place – itinerant waste buyers (IWBs)



Clockwise from top: Delhi, India; Lichfield, UK; Siddhipur, Nepal; Sukkur, Pakistan

Photo credits: Enrico Fabian, Lichfield DC, Bhushan Tuladhar, Mansoor Ali

ISWA Task Force on Waste & Globalisation

- Informal sector is one focus
- Preparing guidelines on how to select appropriate local actions to include the informal sector as part of a city’s SWM system



Photos: On Right top and bottom, Kaine Chinwah, Port Harcourt 2006. Middle David C Wilson, Yangshou, China, 2000. On left, Jeroen IJgosse, Quixeramobim, Brazil.

Comparing qualitative governance indicators

Income Level	User Inclusivity Rating	Provider Inclusivity Rating	Institutional coherence
High	High	Medium	High
Upper-middle	Medium	Medium	High
Lower-middle	Medium	Medium	Medium
Low	Medium	Medium	Medium

Source: Scheinberg A, Wilson D.C. and Rodic L. (2010). *Solid Waste Management in the World's Cities*. Published for UN-Habitat by Earthscan, London

Financial sustainability - affordability

Income Level	City SW budget per capita	City SW budget per capita as % of GDP per capita	
		range	average
High	\$75	0.03 - 0.40%	0.17%
Upper-middle	\$33	0.14 - 1.19%	0.59%
Lower-middle	\$10	0.40 - 1.22%	0.69%
Low*	\$1.4	0.14 - 0.52%	0.32%

* Data only available for 3 of the 6 low-income cities (for 16 out of 20 cities in total)

Affordability is a key issue in the lower income countries

- Fees < 1-2% of household income

Data source: Scheinberg A, Wilson D.C. and Rodic L. (2010). *Solid Waste Management in the World's Cities*. Published for UN-Habitat by Earthscan, London

People are willing to pay – when they can see the benefits

- which is often for primary collection,
to improve the living conditions of their children

*Raising awareness
amongst citizens to
pay for waste
collection goes
hand in hand with
collection service
improvement*

Maputo,
Mozambique

Photo: Joachim Stretz



Success factors for improving SWM

- *No one size fits all – every city needs to develop its own local and sustainable solution*
- *Commitment does more than money: several poor cities with good systems*
- *Building on what you have works*
- *Including the informal sector improves the performance of the overall SWM system*
- *Technical ambitions need to be modified to achieve affordability: e.g. a sanitary landfill is worth nothing if the city can't afford to run it as intended*

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Kerbside sort in Rotterdam

Bring bins in Varna, Bulgaria

Exchanging recyclables for onions Siddhipur, Nepal

A diversity of approaches to separate collection for recycling

FUTURE DRIVERS & DIRECTIONS

Photo credits: © City of Rotterdam; Kossara Bozhilova-Kisheva; Bhushan Tuladhar



Three key drivers

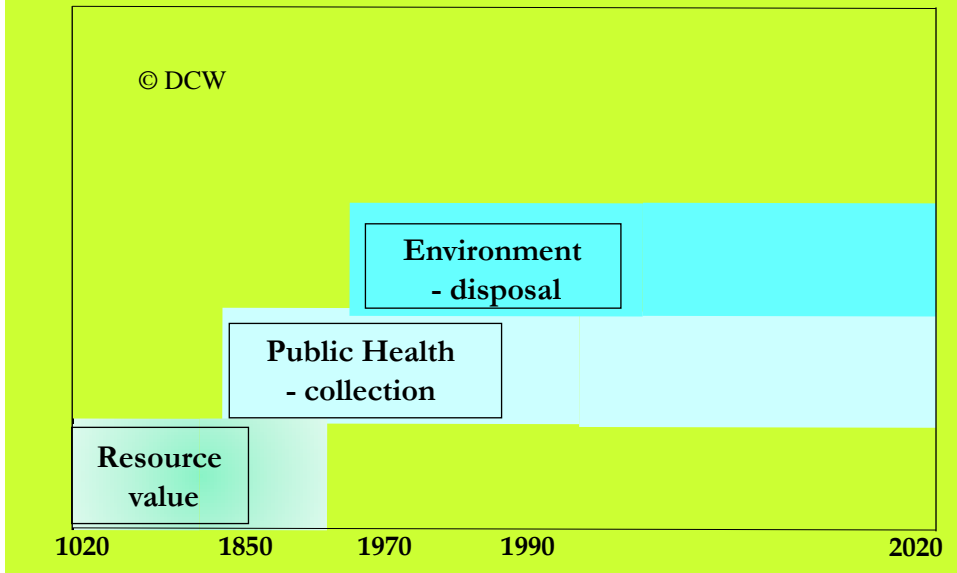
1. Public health
2. Environment
3. Resource value

D.C. Wilson (2007) . Development drivers for waste management. Waste Management & Research 25: 198–207



Photo credits: clockwise from top left - Delhi, Enrico Fabian; Nepal, Bhushan Tuladhar; Nairobi, UN-Habitat; Lusaka City Council/ Jan G Tesink

Waste Management Drivers in what is now the developed world: 1020-2020



1990 MSW progress review in the 12 EU Member States

Collection coverage

- Only 7 MS >99% population served
- 4 in range 75-85%

Uncontrolled disposal

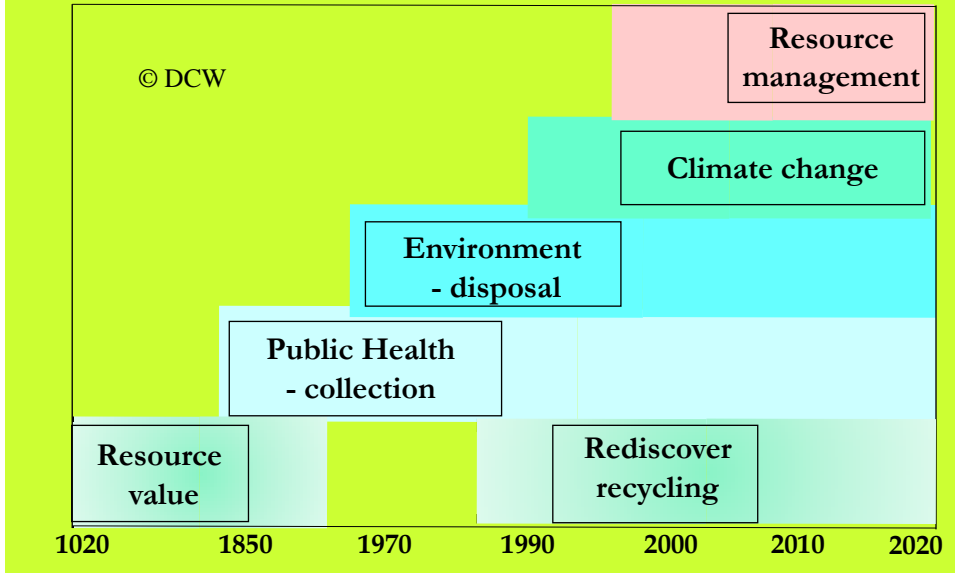
- Only 4 MS claimed 0%
- France 3%
- 3 MS above 50%

Recycling rates

- Range <1-20%
- Mean 8%
- Median 6%

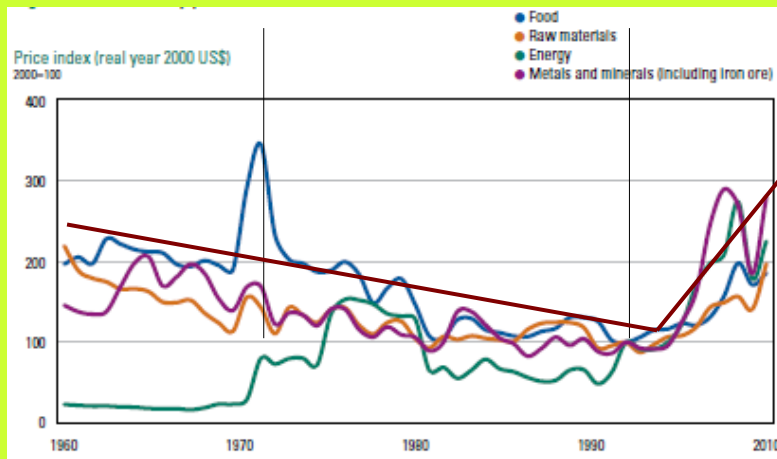
Environmental Resources Limited (1992). *Quantification, characteristics and disposal methods of municipal waste in the community – technical and economic aspects*. Report prepared by David C Wilson, Environmental Resources Limited (ERL) for the European Commission, August 1992.

Waste Management Drivers in what is now the developed world: 1020-2020



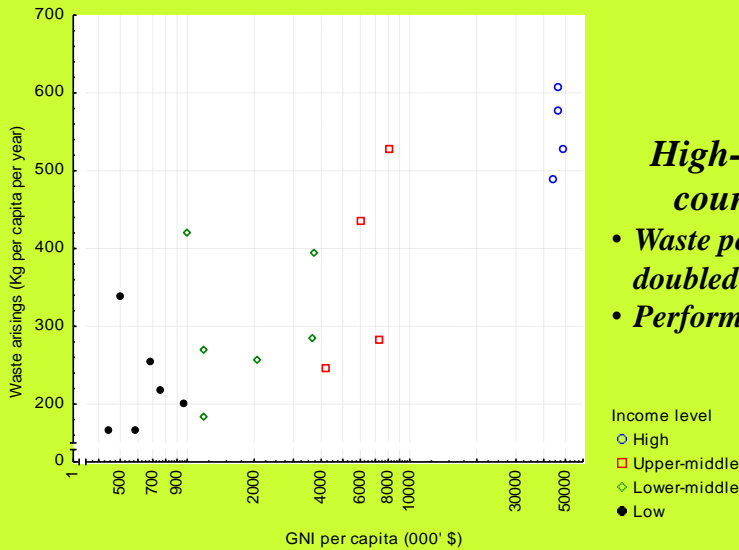
Why focus on resource management?

- Resource prices fell steadily through the 20th century
- Falls more than wiped out since 2000 – 147% increase



Source: World Bank Commodity Price Data (Pink Sheet)

Waste per capita increases with income level



- High-income countries:**
- *Waste per capita doubled since 1980*
 - *Perform worst*

Income level

- High
- Upper-middle
- ◇ Lower-middle
- Low

Source: Wilson, D.C., Rodic L., Scheinberg, A., Velis, C.A. and Alabaster, G. (2012). Comparative analysis of solid waste management in 20 cities. Waste Management & Research, 30, 237-254.



Key issue: waste prevention

- Need to look beyond end-of-pipe waste management
- Life-cycle thinking



Source: Bernie Thomas, ERM

- Focus on food waste as an example



The Business Case for Waste prevention

Waste costs the food supply chain in the UK **£5 billion** annually*

Company benefits:

- Labour efficiency and costs
- Financial Savings
- Competitive advantage
- Reputation

*Source: Waste arising in the supply of food and drink to households in the UK, WRAP (2010)



Prevention is the best carbon reduction strategy – food waste

Landfilling food waste generates 450 kg CO₂e/ tonne
 Net benefit of prevention – 4,000 kg CO₂e/ tonne

Prevention	Recovery (Combustion)	Recovery (AD)	Composting	Landfill
-3,590	-89	-162	-39	450

Source: The economics of waste and waste policy, DEFRA (2011)

All figures are CO₂e/tonne

Pig food	Pig food (displacing soya meal from newly cleared tropical forests)
-236	-11,600

Source: Tristram Stuart

Comparing organic waste generation

Income level	Waste generation	Organic fraction	Organic waste generation
	Kg/capita/ year	%	Kg/capita/ year
High	550	29	160
Upper-middle	370	52	190
Lower-middle	300	67	200
Low	225	71	160

Data source: Scheinberg, A., Wilson, D.C. and Rodic L. (2010).
Solid Waste Management in the World's Cities.
 Published by Earthscan for UN-Habitat, March 2010.



Edible food waste in the West

- WRAP data for the UK:
 - one third of all the food we buy
 - two-thirds of that is food that could have been eaten
 - £680/ 4-person family/ year
 - levels similar for rich and poor
- US:
 - 30% of food that is bought
 - \$48 billion/ year
 - about \$625/ family/ year
- FAO, EU data:
 - very similar



Photos: WRAP



Detailed data for Malaysia (%)

Organic waste category	High income group	Middle income group	Low income group
Food (consumed)	36.91	45.63	49.06
Food (not consumed)	1.9	1.58	0.32
Garden waste	11.26	8.64	5.94
Other organics	0.59	0.18	0.27
TOTAL	50.7	56.0	55.6

Source: Fauziah, S. H., Simon, C. and Agamuthu, P.
Malaysian Journal of Science, 23(2): 61-70 (2005)

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Does it matter that the 'West' wastes so much food?

- If everyone consumed at the UK's current rate, we would need three Earths, not one



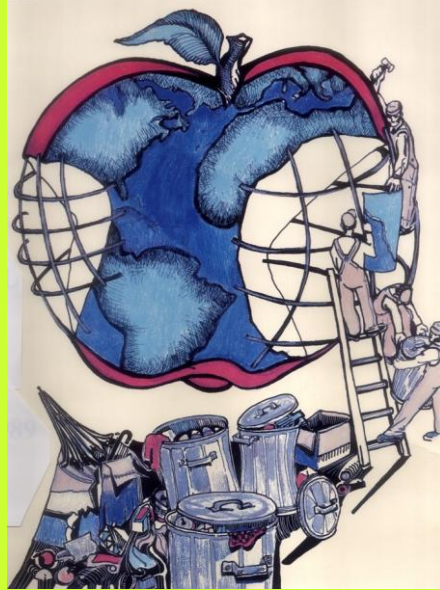
**ONE
PLANET
LIVING**

- The food we eat accounts for 20% of the UK's greenhouse gas emissions
- So the food we squander accounts for 5-10% of our total carbon footprint
- Total contribution to GHG of end-of-pipe waste management: 3-5%

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How do we move to more sustainable living?

- A very broad question...
- ... but behaviour change IS possible
- e.g. EU recycling rates
 - Increased from an average of 8% in 1990 to 42% in 2009
- And the tide is beginning to turn....



Source: 1979 ISWA Waste Minimisation Conference, Geneva

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Resource efficiency is moving into the economic mainstream

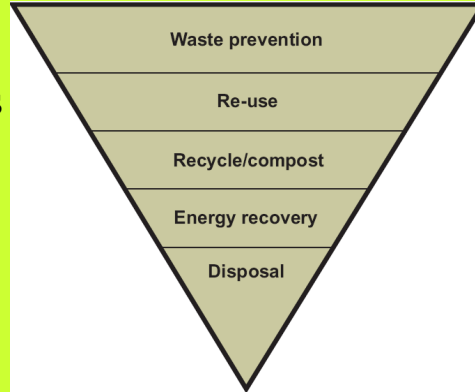
Three major reports since November 2011:

- *Ellen MacArthur Foundation: Towards the Circular Economy* - www.thecirculareconomy.org
- *Chatham House: A Global redesign? Shaping the Circular Economy*
- *McKinsey: Resource Revolution: meeting the world's energy, materials, food and water needs*

Net material cost savings in the EU \$340 – \$630 billion per year AND large carbon savings

Waste Prevention – its time has come

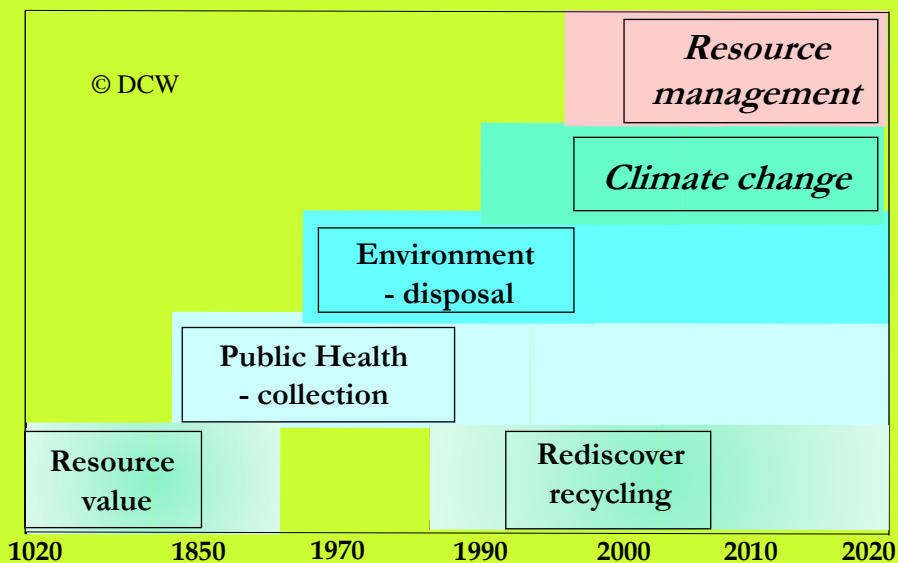
- Top of the hierarchy for more than 30 years
- We have paid lip service long enough
- Time to take it seriously



Source: Waste Strategy for England 2007. The hierarchy was first drawn in this format by Prof David C Wilson: 'Stick or carrot? The use of policy measures to move waste management up the hierarchy'. *Waste Management & Research* (1996) 14, 385-398

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Lets rise to the challenge and deliver on the new drivers for the 21st century



Thanks to ...

- *UN-Habitat for their leadership and funding for data gathering*
- *the global community of practice (CWG) who did the work behind the Habitat book*
- *My co-authors Ljiljana Rodic, Anne Scheinberg and Costas Velis*
- *and most of all to ...*



One size does not fit all – large and small composting plants in Adelaide and Canete, Peru

Photo credits: © Justin Lang, Zero Waste South Australia; Oscar Espinoza

... the millions of professional waste workers around the world



Clockwise from top left: Canete, Nepal, Delhi, Sousse, Cairo, Bengaluru, Dhaka, San Francisco, Rotterdam

Photo credits in same order: © Oscar Espinoza; Bhusan Tuladhar; Enrico Fabian; Verele de Vreede; David C Wilson; Jeroen Ijgosse; Waste Concern; Portia M. Sinnott; Rotterdam

Thank you for
listening!

*Full references and web links
provided in the presentation*

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References for city comparative work

- **BOOK:** Scheinberg A, Wilson D.C. and Rodic L. (2010). *Solid Waste Management in the World's Cities*. Published for UN-Habitat by Earthscan, London. Also available via www.waste.nl
- **DATA ANALYSIS:** Wilson, D.C., Rodic L., Scheinberg, A., Velis, C.A. and Alabaster, G. (2012). Comparative analysis of solid waste management in 20 cities. *Waste Management & Research*, 30, 237-254.
- **PAPER WITH FULL DATA TABLES:** Wilson *et al*, *Waste 2010 conference, Stratford* - <http://warrt.org/901/>
- **PAPER WITH QUALITATIVE COMPARISON OF CITIES:** Rodic *et al*, *IWSA 2010 Conference, Hamburg* - <http://www.iswa.org/fileadmin/galleries/General%20Assembly%20and%20WC%202010%2011%20Hamburg/Pr%C3%A9sentations/Rodic.pdf>

DcW