WTERT 2014 Bi-annual Meeting, Columbia University, Oct. 9-10

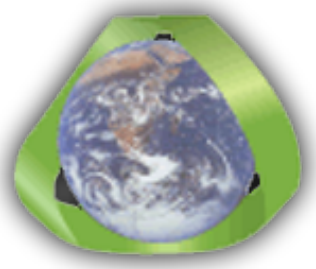
Highlights of WTERT activities 2012-2014

Prof. Nickolas J. Themelis, Director

COLUMBIA UNIVERSITY

EARTH ENGINEERING CENTER

Chair, Global WTERT Council (GWC)



The IPCC 2011 Assessment Report

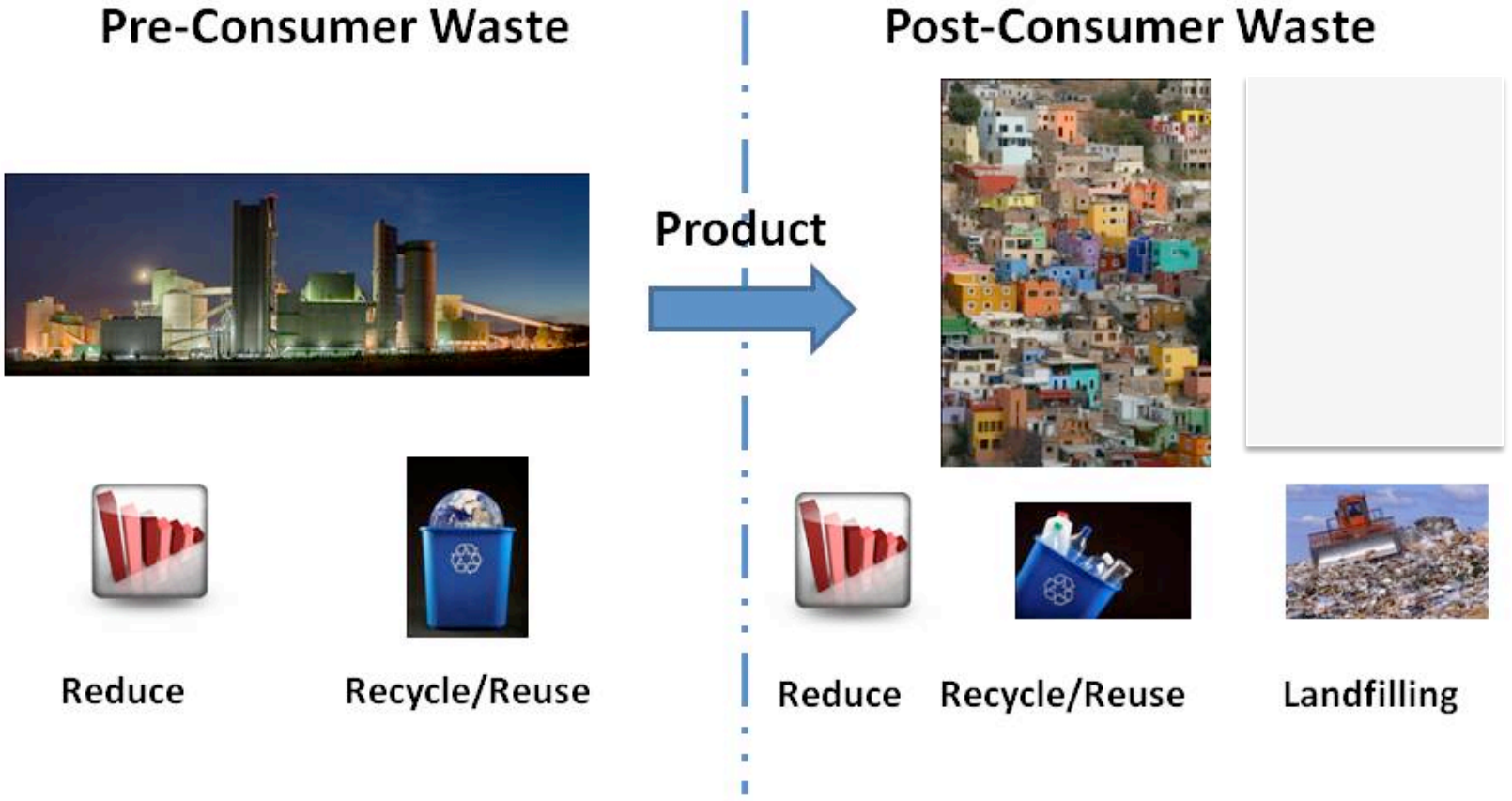


Figure 10.11. Illustration of waste mitigation options at pre-consumer and post-consumer stages
Need to add composting and (other technologies e.g. anaerobic digestion to be consistent with the text)

“Surprising” new information in the IPCC 2014 Report

Figure 10.11. Illustration of waste mitigation options at pre-consumer and post-consumer stages
Need to add composting and (other technologies e.g. anaerobic digestion to be consistent with the text)

Objectives of 2013 Columbia national urvey

- To satisfy EPA and others asking "when is the next Survey coming up"?

- Identify the causes of data discrepancy with EPA

- Develop/suggest improved landfill and recycle estimation methodology

DATA DISCREPANCY

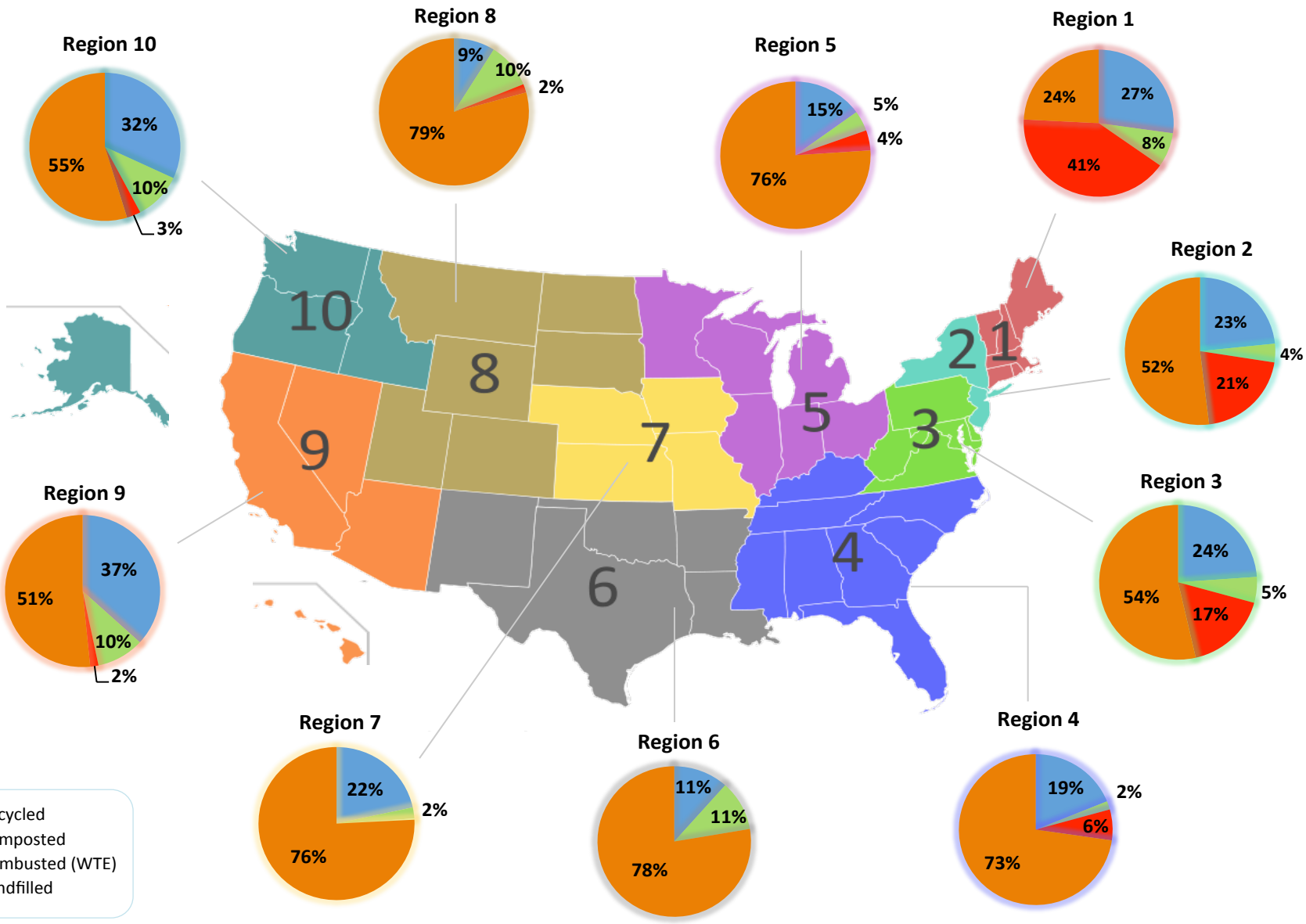
2011 Data

Disposal Method	EPA/ Franklin* (mil tons)	Columbia University	Difference tons/year
MSW Generated	250	389	+139
Recycled	66.2	87.8	+21.8
Composted	20.7	24.7	+4
Landfilled	134	247	113
Combusted	29.3	29.3	0

*http://www.epa.gov/osw/nonhaz/municipal/pubs/msw2008rpt.pdf

Breakdown by EPA Regions

Recycling, composting, combusting, and landfilling rates by regions



Some of the international activities of Global WTERT Council

- 14 national groups including Brazil, Canada, China and India
- Research on beneficial use of WTE ash- Imperial College
- Three India workshops
- WTE Guidebook for Latin America and the Caribbean

International activities of Global WTERT Council

- "Be Waste Wise" web medium bridges the information gap between world expertise/ practice and the public/policymakers (www.waste.be)

. International activities of Global WTERT Council

-2014 planning grant by Columbia's Global Initiative Fund to develop WTERT-Latin America
-August-Sept. 2014: Workshops on sustainable waste management in Rio de Janeiro and Santiago of Chile.
_ Participation in InterAmerican Development Bank conference of Caribbean waste management leaders, October 2014

WTERT contributed locations and capacities of all known WTE plants around the world

www.atlas.d-waste.com

Waste Atlas

- **Annual MSW generation 1.9 billion tonnes (30% not-collected =. 600 million tons of solids**

- Collected MSW:
  - **70%** to landfills and dumpsites,
  - **19** or recovered and,
  - **11%** is led to energy recovery facilities.

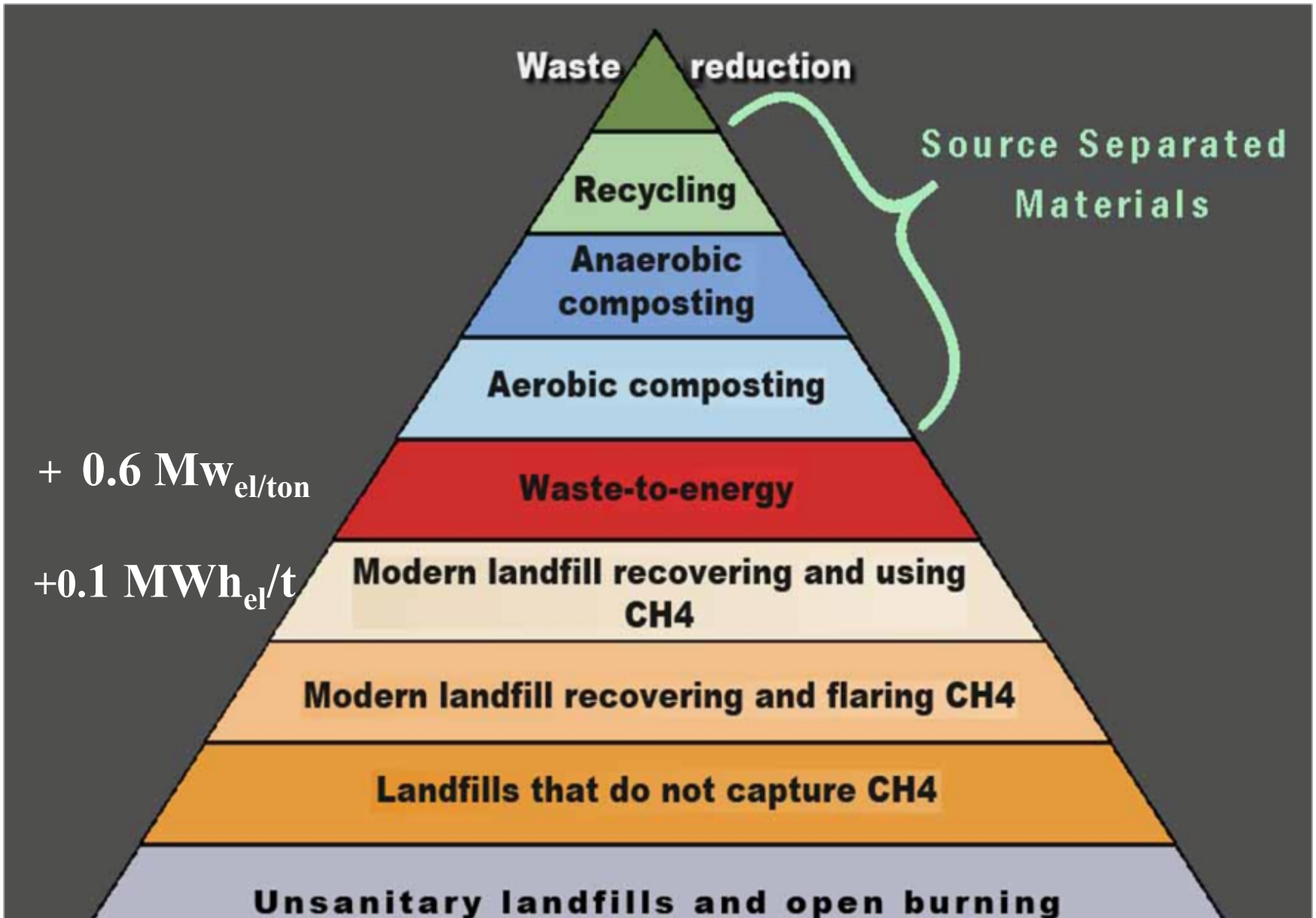
Source: http://www.atlas.d-waste.com/

Upper Citarum River, west Java, Indonesia.

A. Padilla

Citarum River downstream, west Java, Indonesia.

The EEC Hierarchy of waste management



Checking the EEC: estimate of 0.1 MWh/ton landfilled vs U.S. national numbers

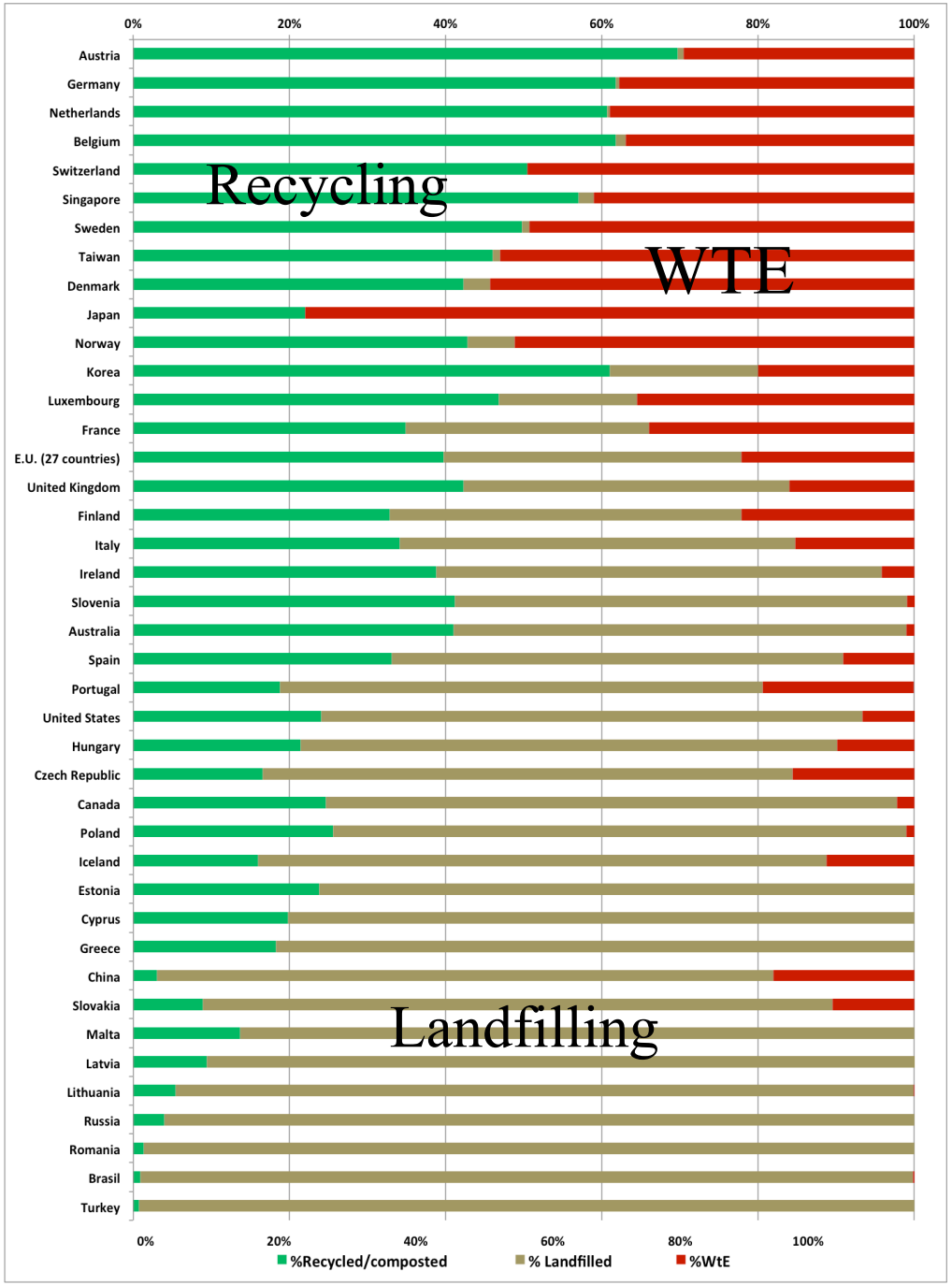
- 250 million tons MSW landfilled in U.S.A. (Columbia Survey)
- Electricity potential at 0.1 MWh/ton = 25 million MWh
- Actual production 2013 = 16 million MWh*
  (2/3 of estimated potential)

*www.epa.gov/lmop/documents.pdfs/overview.pdf

The EEC “ladder” of Sustainable Waste Management

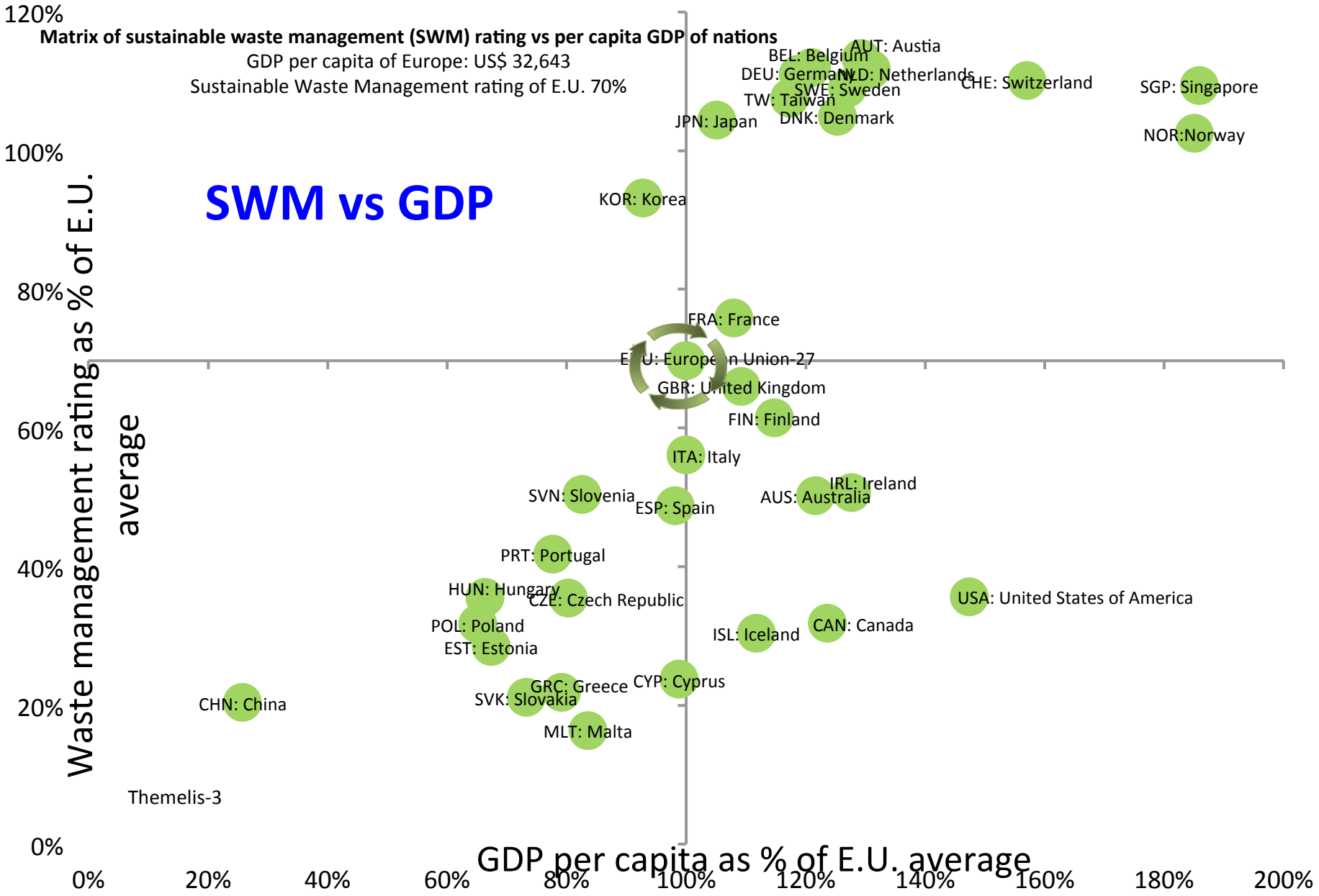
In the following slide, we have added tons recycled plus tons composted as “Recycling’

Anything left after recycling and composting, we will call ‘post-recycling’ MSW



Expanding the EEC Ladder of Sustainable Waste Managementto North America, Asia, and Australia:

Nations can be rated as to their attainment of sustainable waste management


Matrix of sustainable waste management (SWM) rating vs per capita GDP of nations
GDP per capita of Europe: US$ 32,643
Sustainable Waste Management rating of E.U. 70%
SWM vs GDP
Waste management rating as % of E.U. average
GDP per capita as % of E.U. average
120%
100%
80%
60%
40%
20%
0%
0%
20%
40%
60%
80%
100%
120%
140%
160%
180%
200%
AUT: Austia
BEL: Belgium
DEU: Germany
NLD: Netherlands
SWE: Sweden
CHE: Switzerland
SGP: Singapore
TW: Taiwan
DNK: Denmark
JPN: Japan
NOR:Norway
KOR: Korea
FRA: France
E U: European Union-27
GBR: United Kingdom
FIN: Finland
ITA: Italy
IRL: Ireland
SVN: Slovenia
AUS: Australia
ESP: Spain
PRT: Portugal
HUN: Hungary
CZE: Czech Republic
USA: United States of America
POL: Poland
ISL: Iceland
CAN: Canada
EST: Estonia
CYP: Cyprus
GRC: Greece
CHN: China
SVK: Slovakia
MLT: Malta
Themelis-3

Global Trend of WTE dioxin emissions (WTERT-US studies)

Country	Year measured	MSW Combusted (Million tons)	Average Dioxin Emissions iTEQ (ng/Nm3)	Total Dioxins Emitted g TEQ/year
USA	2012	25.9	0.027	2.90
France	2010	13.8	0.013	0.79
China	2009	26.0	0.348	40.50
Korea	2010	3.9	0.007	0.11

Stack gas/ton MSW Combusted Factor[1]:

Short ton	4075 dscsm/ton
Metric ton	4483 dscm/ton

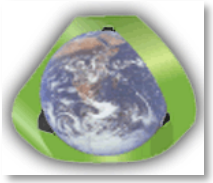
Sponsored by:

Inter-American Development Bank

GUIDEBOOK

FOR THE APPLICATION OF WASTE TO ENERGY TECHNOLOGIES IN LATIN AMERICA AND THE CARIBBEAN

NICKOLAS J. THEMELIS, MARIA ELENA DIAZ BARRIGA,
PAULA ESTEVEZ, AND MARIA GAVIOTA VELASCO



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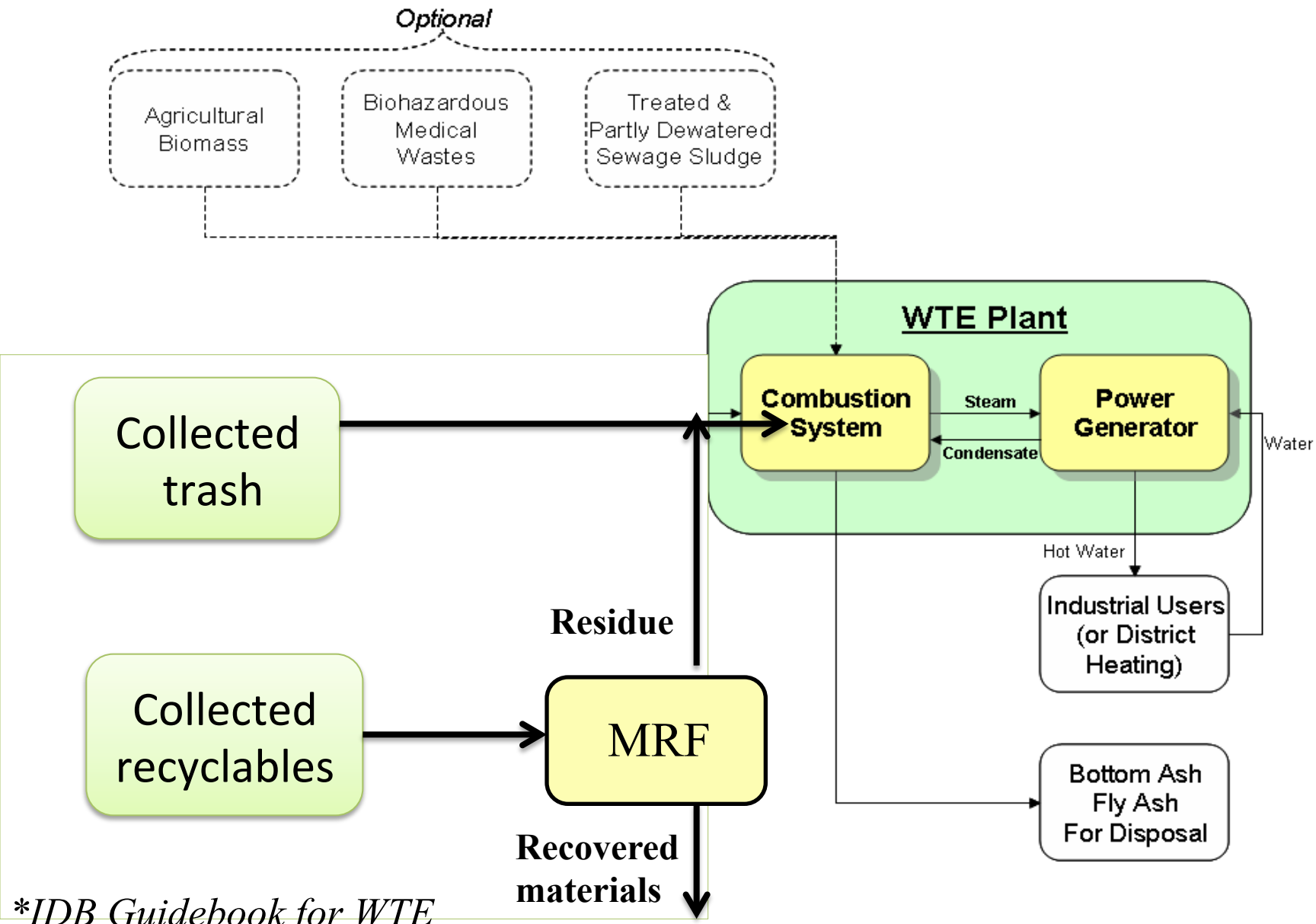
MARCH 2012

Google "wte guidebook"[1]

Complementary WTE plant and adjacent Materials Reeovery Facility (MRF)*



*IDB Guidebook for WTE

Guidebook conclusion: Waste management must be placed at the top of environmental priorities of cities and nations*

- Need for sustainable waste management, same as for potable water, electricity and wastewater treatment.
- Developing nations need to invest in prototype waste management facilities (it cannot be left only to municipalities)

**The EEC-IDB Guidebook for WTE in Latin America (in press)*

Major problem in growth of WTE in developing world: Required gate fee

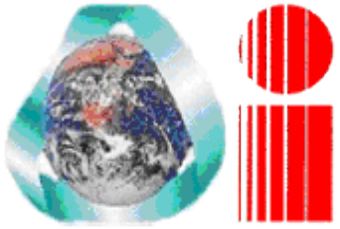
- Modern WTE plants, equipped with Air Pollution Control systems that meet the E.U./U.S. standards cost over $600/ton of annual capacity.
- To repay this amount over a period of 20 years (usual contract) requires a capital charge of about $60/ton (10% of capital investment/ton).
- Communities who pay a “gate fee” of $20/ton MSW, or less, cannot afford a WTE plant.
- Unless government subsidizes part of the capital cost (e,g, Azerbaijan) or provides economic incentives (e.g. China)

Emerging WTE technology: Circulating Fluid Bed

Developed and used mostly in China: Suitable for high organic, high moisture, lower heating value MSW, similar to that in developing countries

Nearly 50 such plants have been built in China in the last fifteen years at a lower capital cost than traditional WTE plants

WTERT



Waste-To-Energy Research and Technology Council