

WTERT 2012 Conference, October 19, 2012

GDP per capita, sustainable waste management, and the role of the WTERT national organizations

Prof. Nickolas J. Themelis, Director

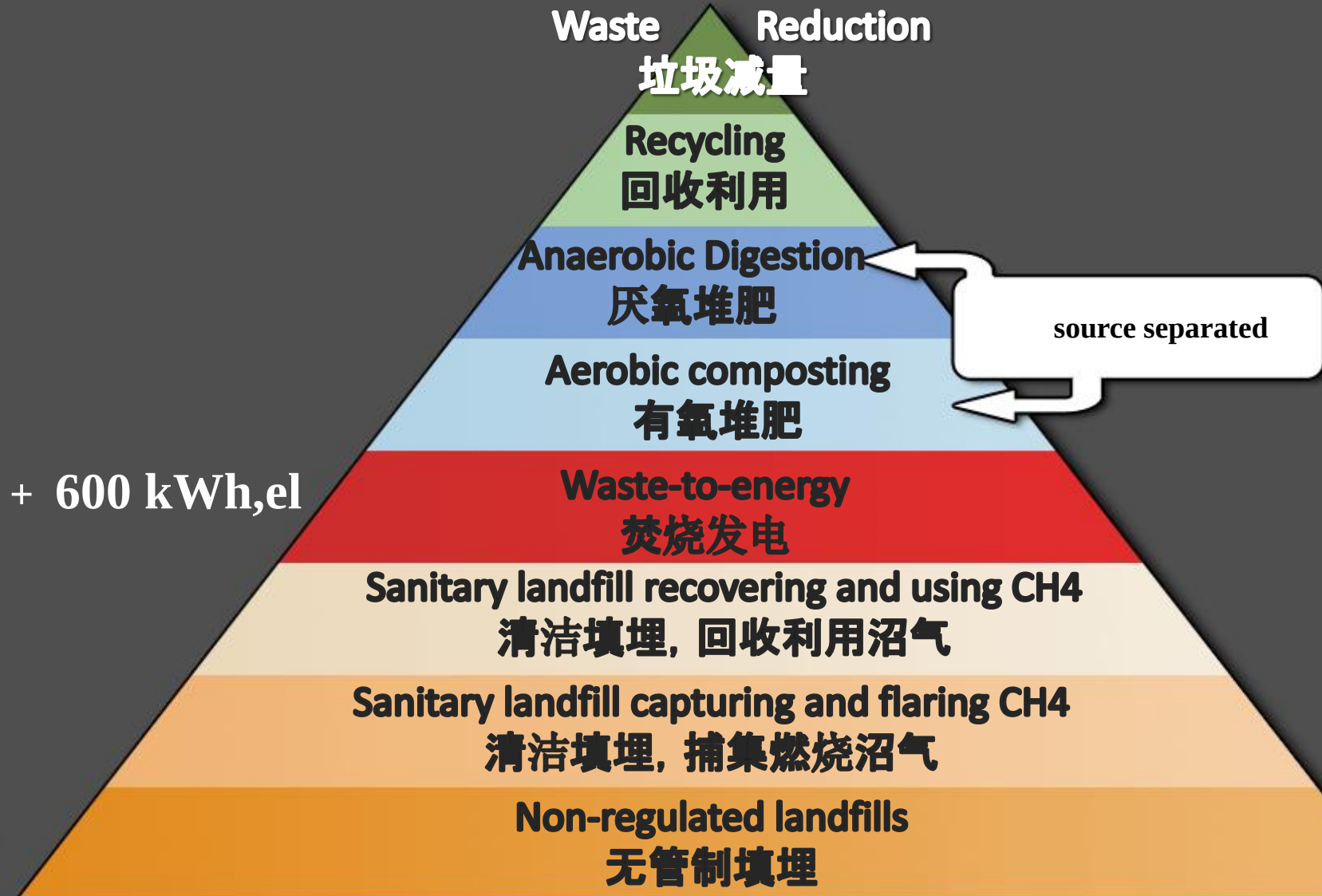
COLUMBIA UNIVERSITY

EARTH ENGINEERING CENTER



The Hierarchy of Waste Management (EEC)

垃圾管理等级塔



WTERT CONTACTS, 2002-2012 ([alphabetically](#))

COUNTRY	GDP/cap	COUNTRY	GDP/cap	COUNTRY	GDP/cap	COUNTRY	GDP/cap
Argentina	\$17,700	China	\$8,500	Ireland	\$49,100	P. Rico	\$16,800
Australia	\$40,800	Costa Rica	\$12,100	Israel	\$31,400	Qatar	\$104,300
Austria	\$42,400	Cyprus	\$29,400	Italy	\$30,900	Russia	\$17,000
Azerbaijan	\$10,300	Czech Rep.	\$27,400	Jamaica	\$9,100	Serbia	\$10,800
Bahamas	\$31,400	Denmark	\$37,600	Japan	\$35,200	Sierra L.	\$900
Barbados	\$23,700	Ecuador	\$8,600	S. Korea	\$32,100	Singapore	\$60,500
Belgium	\$38,200	Egypt	\$6,600	Lebanon	\$15,700	Sweden	\$40,900
Bermuda	\$69,900	Finland	\$36,700	Malaysia	\$15,800	Switzerland	\$43,900
Botswana	\$16,200	France	\$35,600	Mauritius	\$15,100	Taiwan	\$38,200
Brazil	\$11,900	Germany	\$38,400	Mexico	\$14,800	Thailand	\$9,500
Bulgaria	\$13,800	Greece	\$26,600	Nigeria	\$2,600	Turkey	\$14,700
Canada	\$41,100	Hong Kong	\$49,800	Norway	\$54,200	U.A.E.	\$48,800
Cayman Isl.	\$43,800	Hungary	\$19,800	Panama	\$14,300	U.K.	\$36,600
Chile	\$17,400	India	\$3,700	Portugal	\$23,700	U.S.	\$49,000

WTERT CONTACTS, 2002-2012 (by GDP per capita)

COUNTRY	GDP/cap	COUNTRY	GDP/cap	COUNTRY	GDP/cap	COUNTRY	GDP/cap
Qatar	\$104,300	Germany	\$38,400	Greece	\$26,600	Panama	\$14,300
Bermuda	\$69,900	Taiwan	\$38,200	Portugal	\$23,700	Bulgaria	\$13,800
Singapore	\$60,500	Belgium	\$38,200	Barbados	\$23,700	Costa Rica	\$12,100
Norway	\$54,200	Denmark	\$37,600	Hungary	\$19,800	Brazil	\$11,900
Hong Kong	\$49,800	Finland	\$36,700	Argentina	\$17,700	Serbia	\$10,800
Ireland	\$49,100	U.K.	\$36,600	Chile	\$17,400	Azerbaijan	\$10,300
United States	\$49,000	France	\$35,600	Russia	\$17,000	Thailand	\$9,500
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Australia	\$40,800	Czech Rep.	\$27,400	Turkey	\$14,700	Sierra L.	\$900

WTERT CONTACTS, 2002-2012 (by GDP per capita) (one or more WTEs)

COUNTRY	GDP/cap	COUNTRY	GDP/cap	COUNTRY	GDP/cap	COUNTRY	GDP/cap
Qatar	\$104,300	Germany	\$38,400	Greece	\$26,600	Panama	\$14,300
Bermuda	\$69,900	Taiwan	\$38,200	Portugal	\$23,700	Bulgaria	\$13,800
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Global disposition of urban post-recycling municipal solid wastes (total MSW: 1.2 billion tons):

- **Thermal treatment (WTE): 200 mill. tons**
- **Landfilled, partial methane recovery: 200 mill. tons**
- **Landfilled without methane recovery: >800 mill. tons**

The global picture of global landfilling

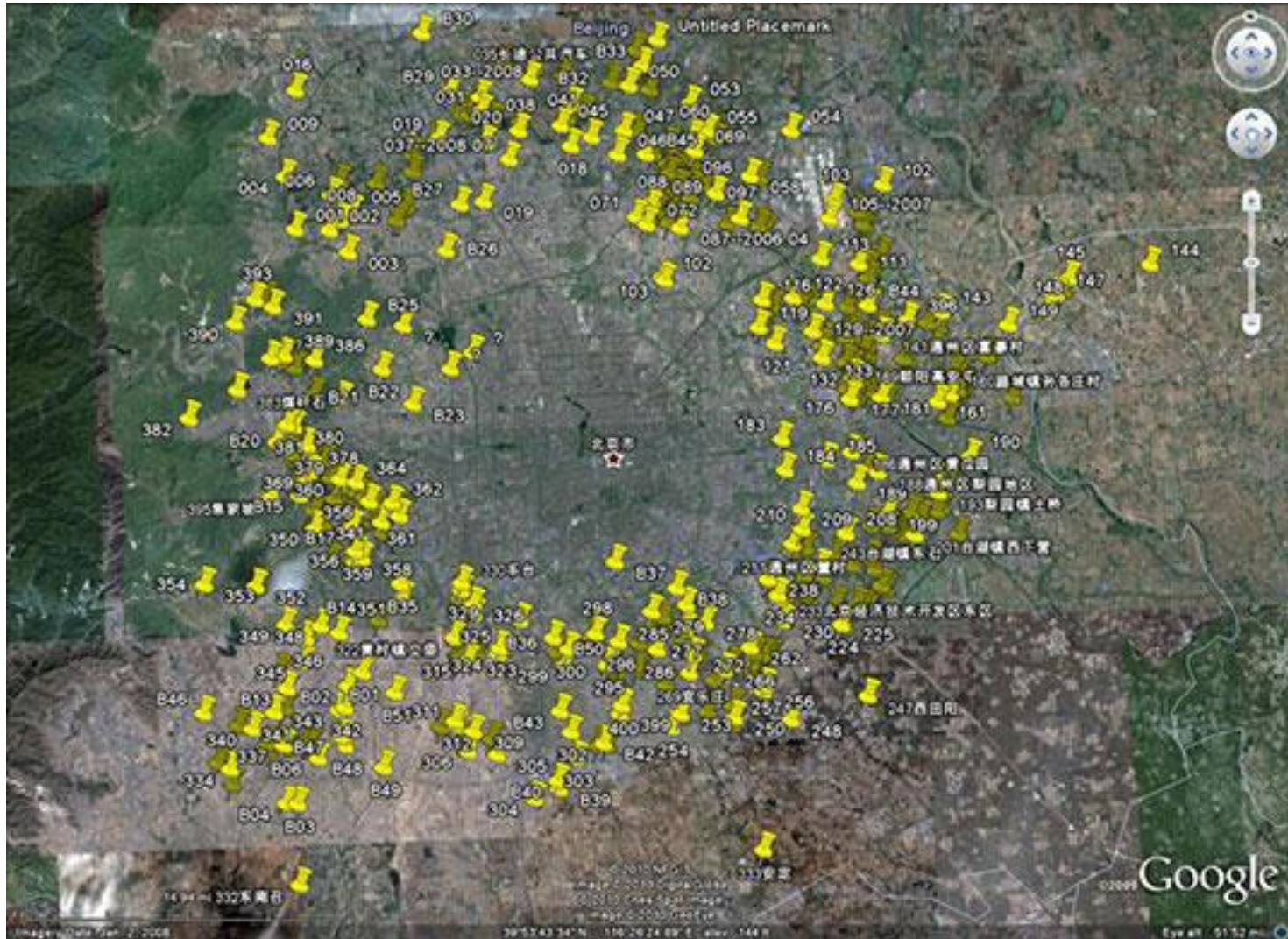
*(N.J. Themelis and P. Ulloa, "Methane generation in landfills",
Renewable Energy 32 (2007) 1243-1257*

- | | |
|-------------------------------------|---|
| • MSW to global landfills: | 1 billion tons/year |
| • Landfill Gas (LFG) generation: | 50 million tons CH₄ |
| • LFG collected and used or flared: | 6 million tons CH₄ |
| • LFG emitted globally: | 44 million tons CH₄ * |

***Equivalent to about 900 million tons of CO₂**

Equal to about 3% of global CO₂ emission

Landfilling consumes land: Beijing is surrounded by hundreds of landfills

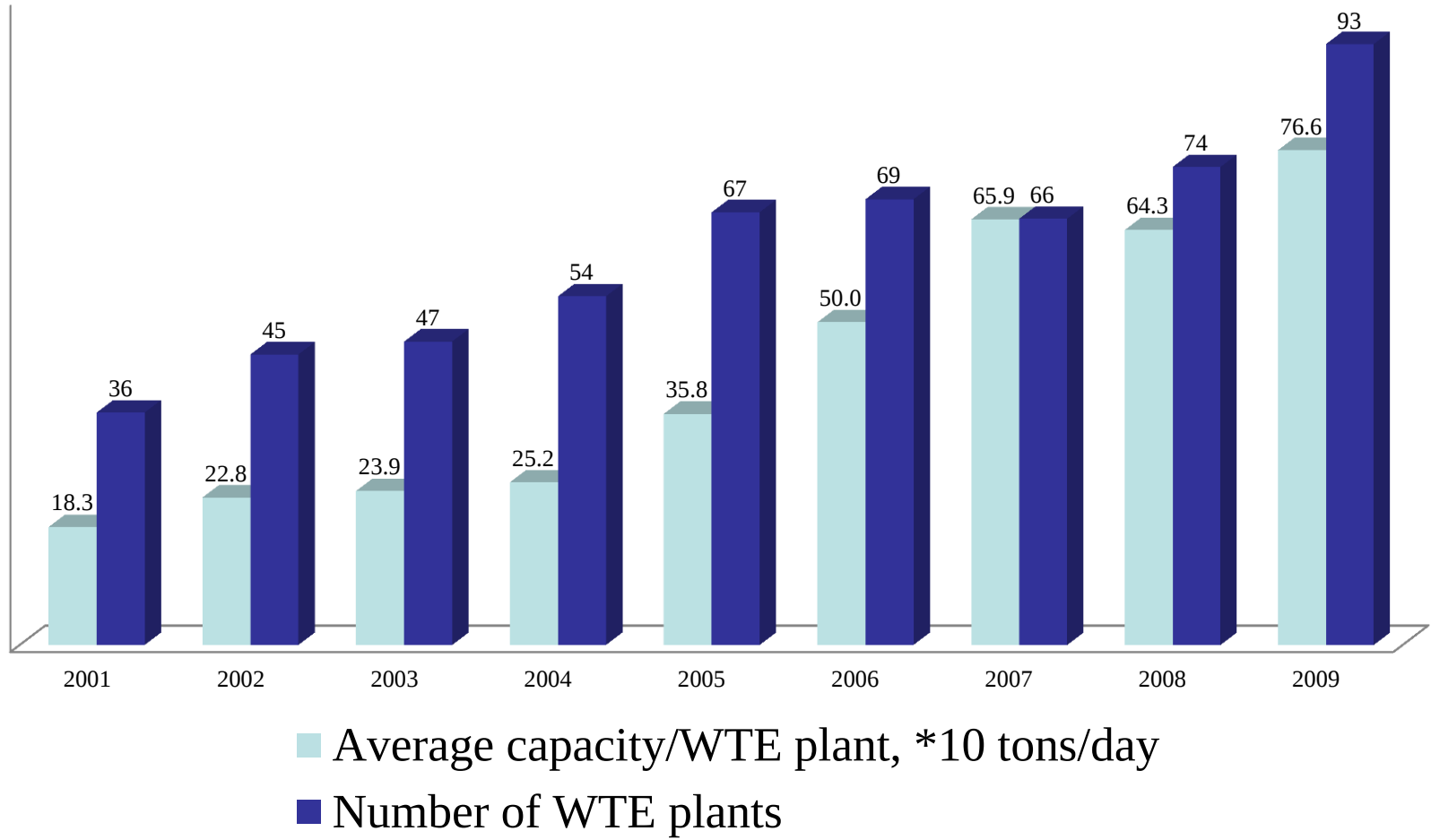


Source: Extraordinary film by Wang Julien

- Regrettably, Wang Julien ended his excellent film without giving an answer to the question: If not landfilling, then What??
- Fortunately for China, the national and regional governments have started to provide the answer:

A massive increase in WTE capacity since the year 2000

Growth in number and average capacity of WTE plants in China



(EEC/WTERT Thesis of Yani Dong, 2011)

Why landfilling remains dominant

- The main reason for the global dominance of landfilling is short-term low cost. In fact, the worst landfills cost nothing.
- A truly sanitary landfill costs over \$40/ton (CAPEX + operation) but the initial investment is low: <\$250/per annual ton.
- In contrast, the initial investment for a WTE plant, except in China, ranges from \$500 to \$800 per annual ton.

A recent study by the Earth Engineering Center (EEC)



- WTE Guidebook for Latin America and the Caribbean (For: InterAmerican Development Bank; five MS grads were involved)
- *Case studies: Buenos Aires, Valparaiso (Chile), Toluca (Mexico)*

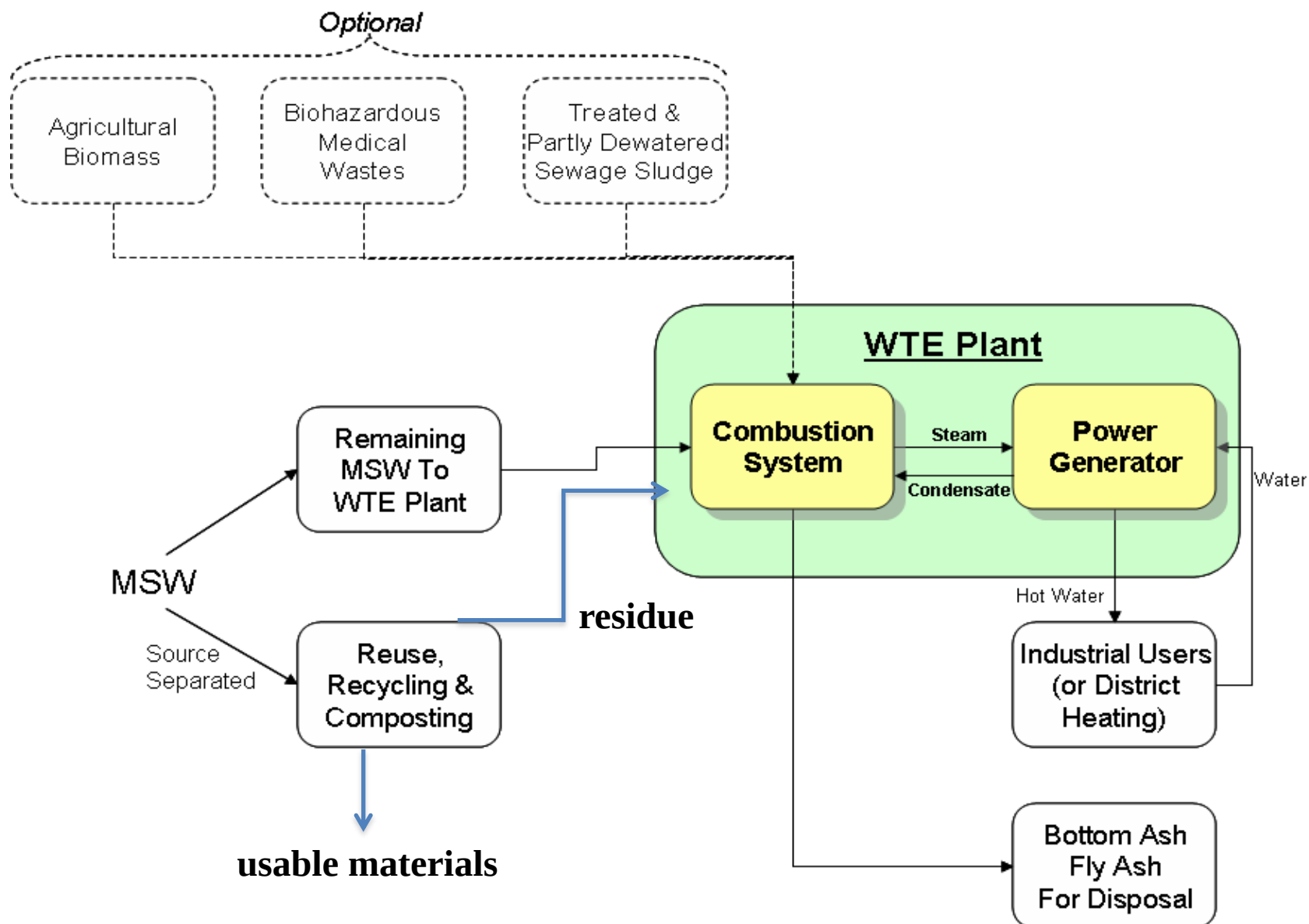
Some findings of WTE Guidebook study



- Major cost of managing MSW is collection. For example, in Valparaiso, collection cost is as high as \$100/ton; landfilling cost as low as \$10/ton
- There is no way, at low gate fees, that a WTE plant can be economic without a substantial financial support from government (PPP)
- Building a WTE plants should be coupled with building a more productive recycling system.
- At locations where there exists appreciable informal recycling, it should be incorporated in the new recycling system.

Recommendation in WTE Guidebook (InterAmerican Development Bank; EEC, 2012):

Combine WTE plan with recycling plan



Waste management should be at the top of environmental priorities of a nation

- National governments should place sustainable waste management high up on their list of essential infrastructure projects, as they have done in the past in providing potable water, electricity and wastewater treatment.



Some other recent EEC studies

- Environmental and economic impacts of Single vs Dual Stream Recycling (For: *Recycle America* unit of *Waste Management Inc.*)
- Means for beneficial use of flexible packaging wastes (FPW) (For: *Flexible Packaging Association*)
- Means for energy recovery from U.S. non-recycled plastic wastes (For: *Plastics Division of American Chemistry Council*)
- Prototype system for collection and mechanical processing of flexible packaging wastes (For: *FPA*)

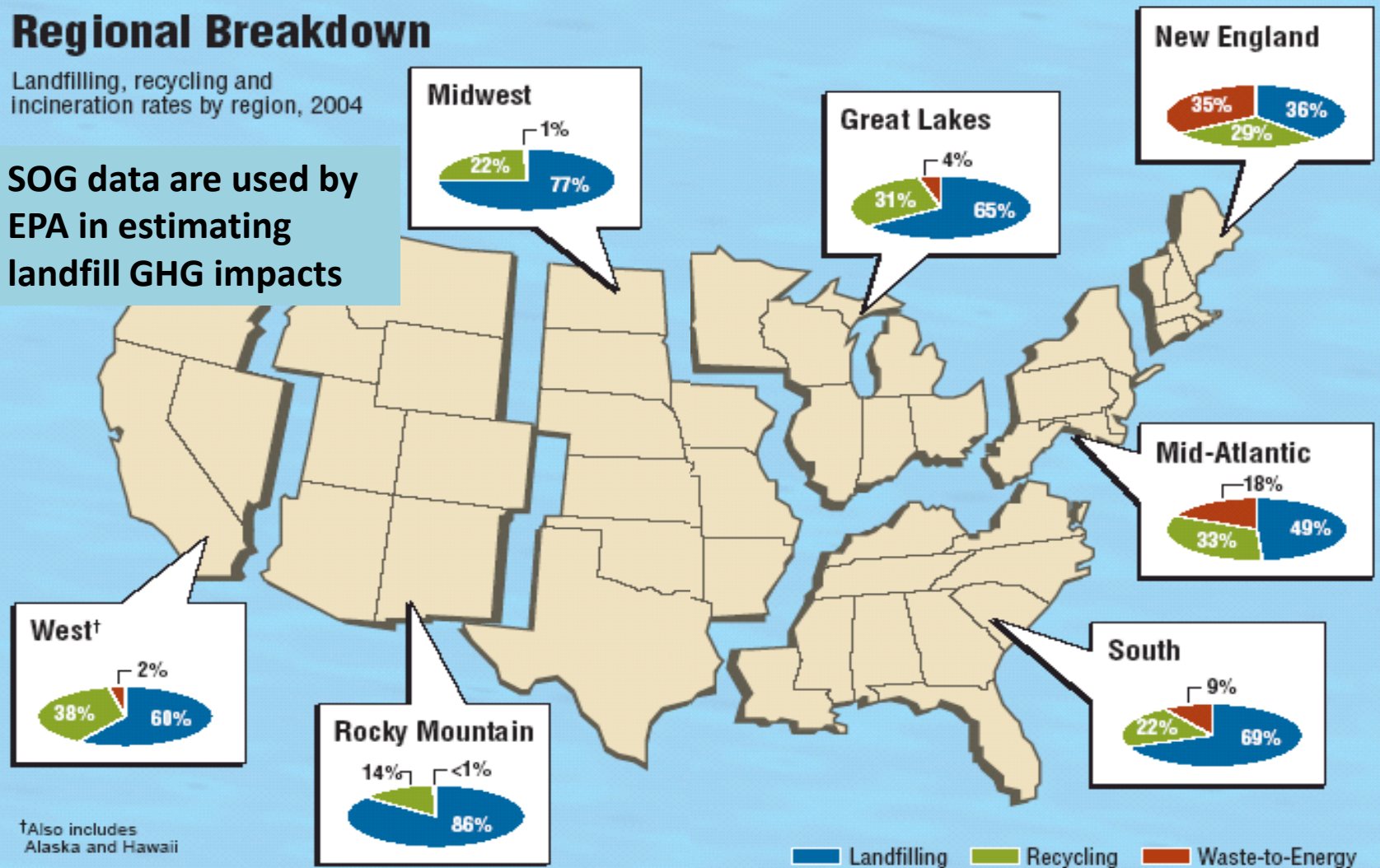
“State of the Garbage in America” (SOG)

EEC/BioCycle Survey of MSW Generation and Disposition in the U.S. (2004 data)

Regional Breakdown

Landfilling, recycling and incineration rates by region, 2004

SOG data are used by EPA in estimating landfill GHG impacts



SOURCE: BioCycle

Some good news:

In 2012-2013, EEC will resume its survey of waste management in the U.S.....

- It will be done with intellectual support of USEPA
- Emphasis: On actual, state-by-state, recycling figures
- It will be the M.S. thesis of Ms. Dolly Shin

Some more good news:

- The next GreenHouse Gas (GHG) global review of the *International Panel on Climate Change* (IPCC) will include waste-to-energy (WTE) in its Industry volume
- Prof. Themelis has been asked by IPCC to author the WTE section of the Industry volume.
- He will be asking for input/review by some people in this room.

And now: About WTERT

- The Global WTERT Council (GWC) consists of thirteen national groups
- The mission of the WTERT organizations is to bring together academia and industry in a nation.....
- ...with the objective of advancing sustainable waste management in the nation and worldwide

“Information paves the way to sustainable waste management”: The global WTERT network

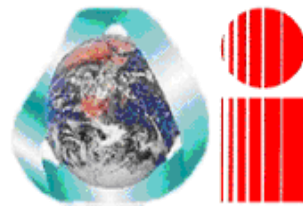
Founded by Earth Engineering Center in 2003:

Sister national organizations:

- **WtERT-Germany (www.wtert.eu)**
- **WTERT-China (www.wtert.cn)**
- **WTERT-Canada (CEFWC, www.wtert.ca)**
- **WTERT-Greece (SYNERGIA, www.wtert.gr)**
- **WTERT-Brazil (www.wtert.com.br)**
- **WTERT-France (Ecole des Mines d' Albi)**
- **WTERT-Italy (Politecnico di Milano)**
- **WTERT-U.K. (Imperial College, U. London)**
- **WTERT-India (Co-founder: NEERI, National Energy and Environment Institute)**
- **WTERT-Mexico (Universidad Autonoma del NorEste)**
- **WTERT-Singapore (Nanyang Technological University)**

Thank you!

WIERT



**Waste-To-Energy Research
and Technology Council**