

WTERT 2016 Conference
Columbia University in the City of New York
October 6, 2016

Introduction to WTERT 2016

The onset of Anthropocene and the disposition of municipal solid wastes (MSW)

Prof. Nickolas J. Themelis, Director

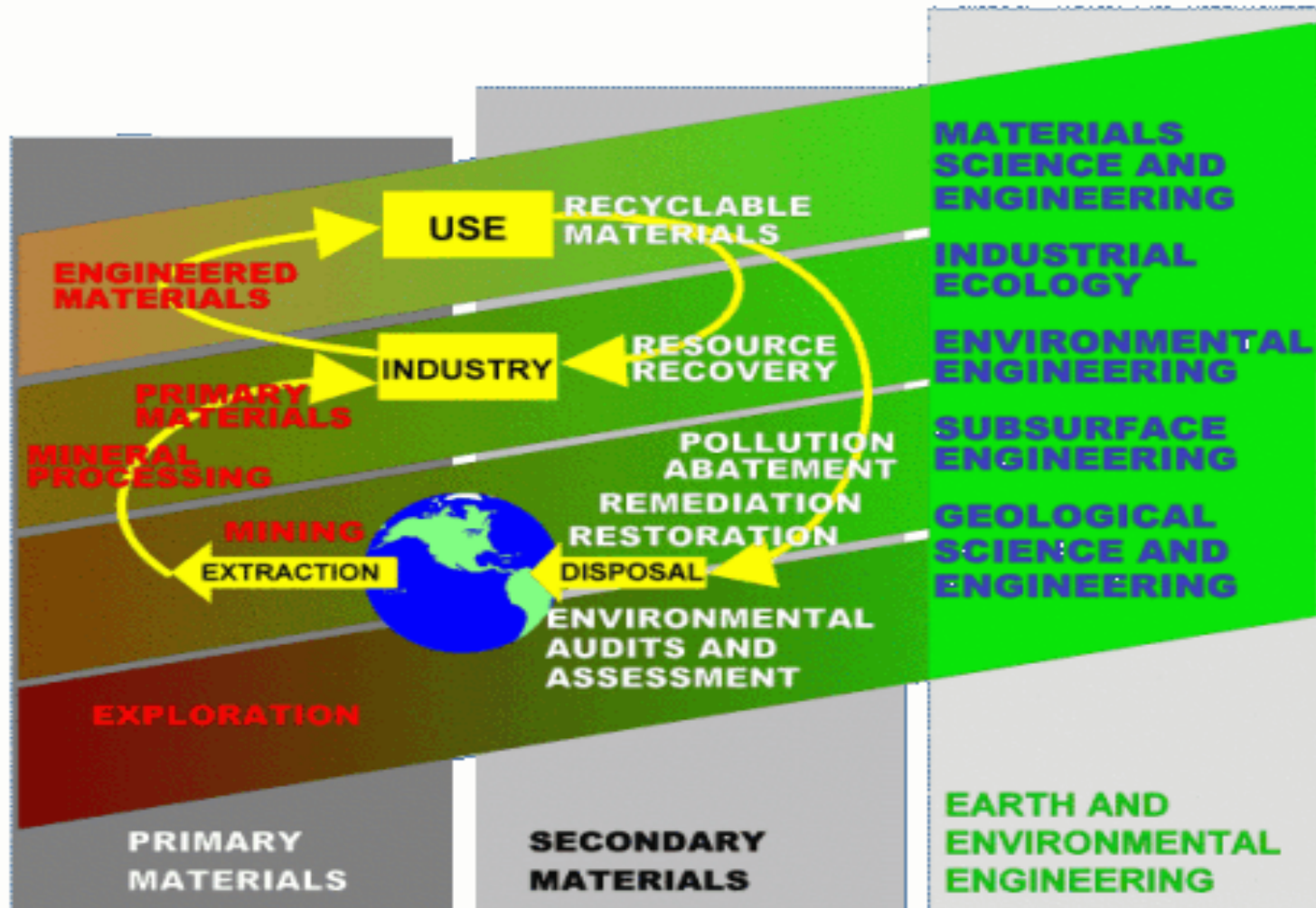
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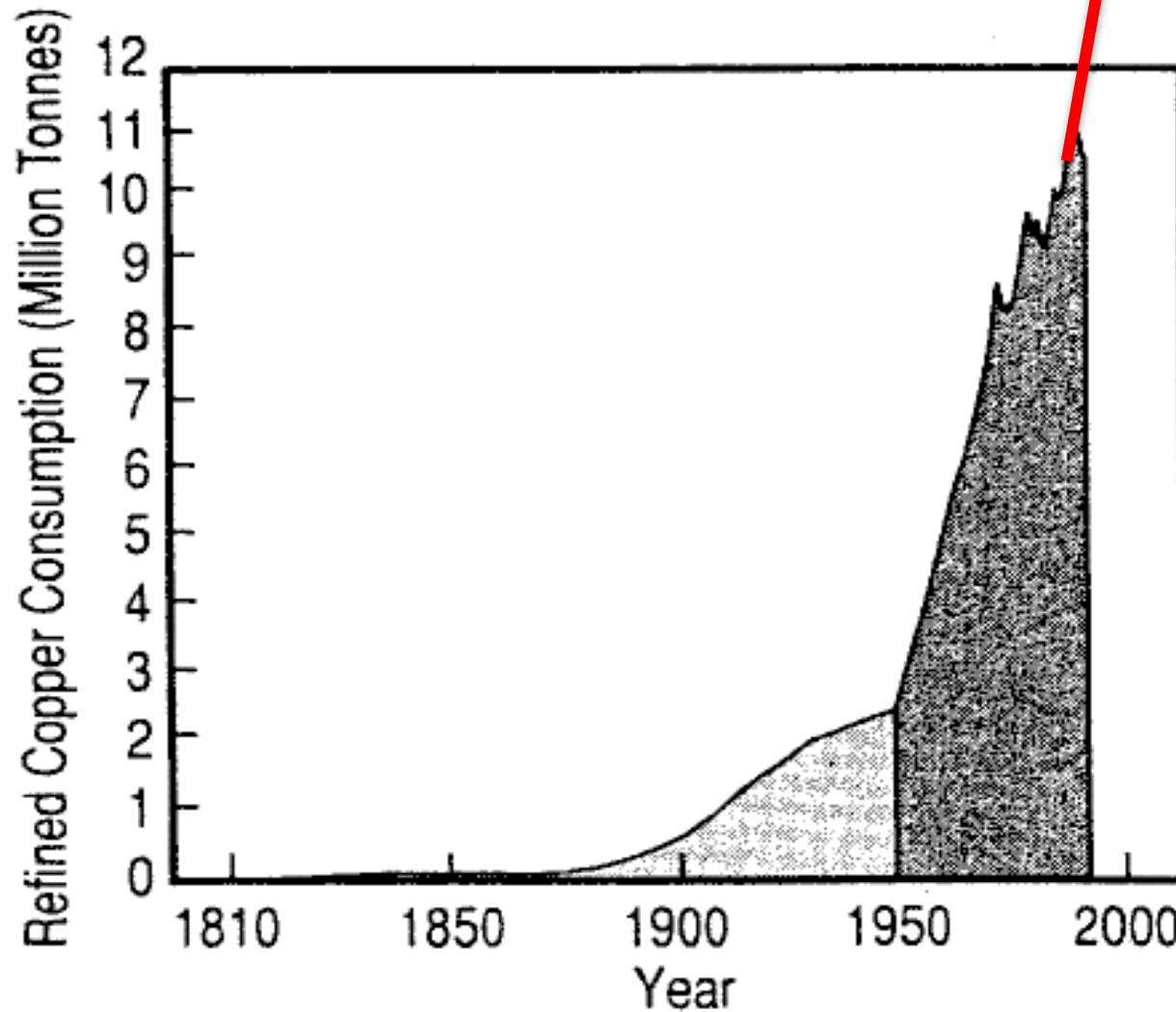
Chair, Global WTERT Council (GWC)



A new engineering discipline (1997): Earth and Environmental Engineering at Columbia



Themelis' lecture to Metallurgical Society of Finland (1996)



23 million tons

2015

Some conclusions from the previous slide:

- **1996:** Humanity used much more copper in the period of 1950-1995, than it had been used in 6,000 years before that
- **2016:** Consumption of copper has nearly doubled from 1995 to 2015
- **2016:** If it had not been for recycling of copper, the world would have run out of copper (too expensive for many)

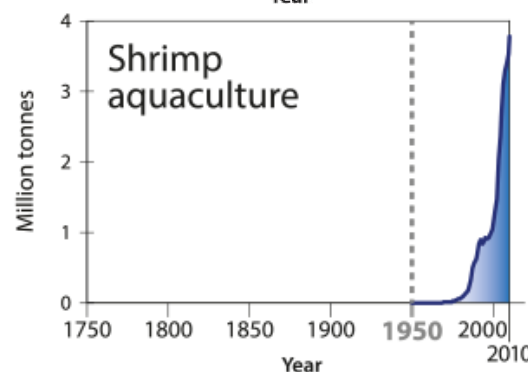
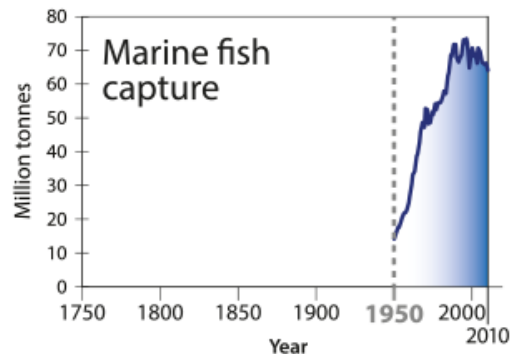
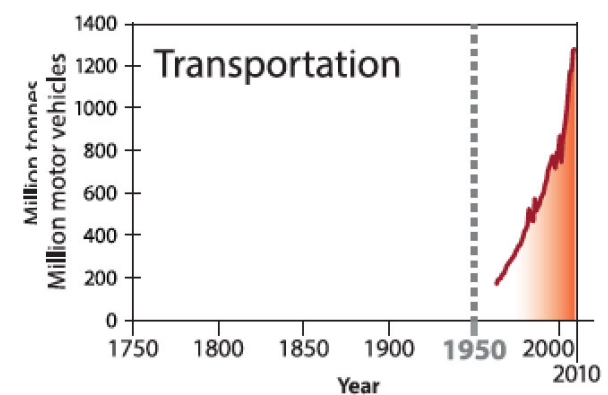
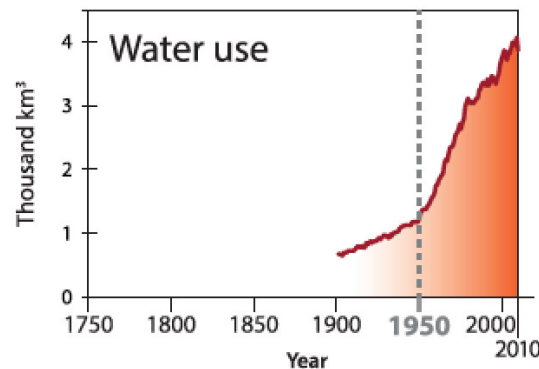
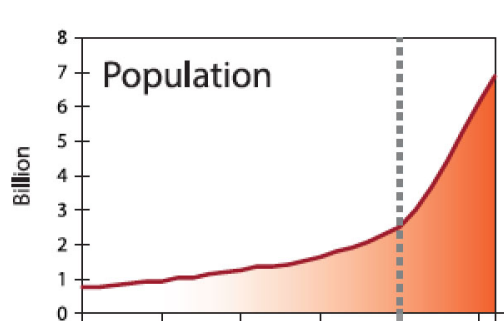


So what copper has to do with Waste Management?

- I don't brag, usually, but as of 1996, I was the first scientist to point out that **the use of copper had entered a radically new phase in 1950.**
- I am delighted that by now *Nature* and the earth science community have recognized that the same phenomenon applies to all other materials used by humans.

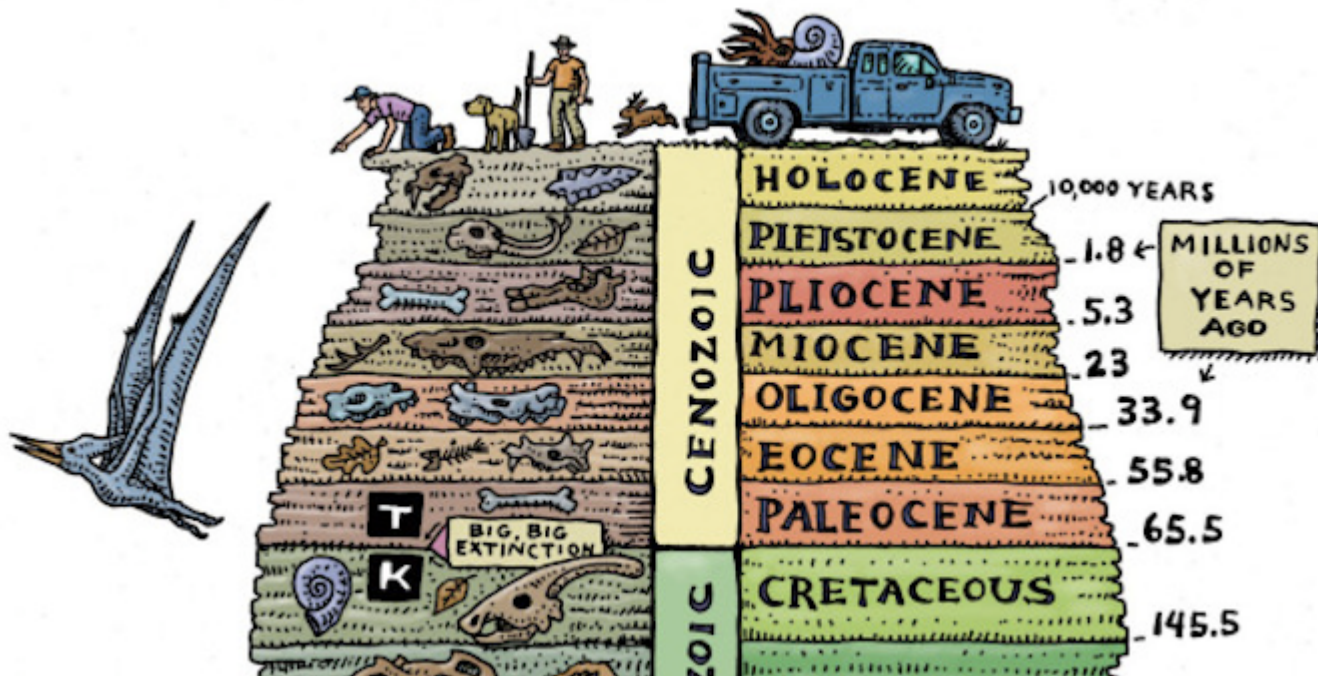
The growth of copper consumption is similar to all materials

- The use of all minerals, metals, water, the construction of buildings, dams and roads, etc. etc., has increased manifold (See “The Human Age”, *Nature*, March 12, 2015, p. 144-147)



1950: The beginning of Anthropocene

- Since 1950, the effects of mining, construction, water use, and atmospheric effects on the planet Earth have been so dramatic, that many earth scientists have already designated **1950** as the start of a new geological age
- **Anthropocene: The Human Age**



But so far they have overlooked: The impacts of disposing the wastes generated by humanity

Estimated global disposition of one class of collected (i.e. recorded) post-recycling municipal solid wastes:

- Combustion with energy recovery (WTE): 230 million tons
- Sanitary landfill, partial CH₄ recovery: 250 million tons
- Landfilled without CH₄ recovery: >800 million tons

MSW generation has tripled since 1950 and is projected to double by 2030

Some serious and still overlooked impacts of humanity at the beginning of Anthropocene

- However, there is one class of human activities that remains to be recognized by scientists, government, and the general public as a very worrisome part of the human impacts on the planet Earth.



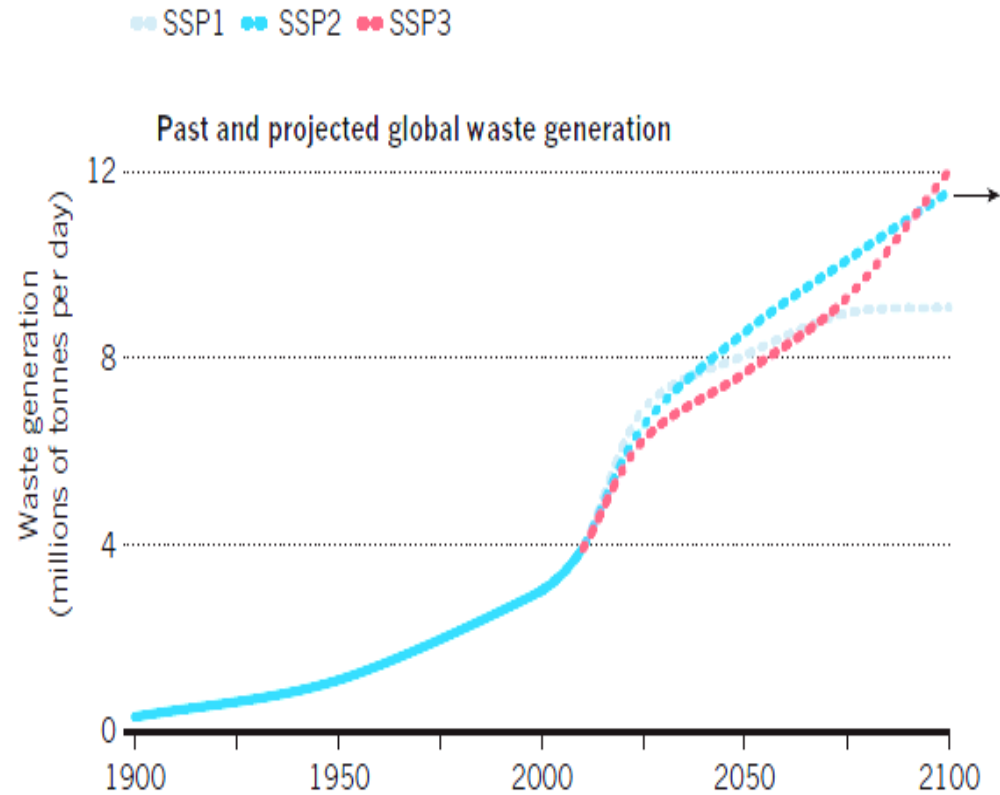
Projections of waste generation to 2100

Daniel Hoornweg, NATURE, October 2013, vol 502

Scenario SSP1 the 7-billion population is 90% urbanized, development goals are achieved, fossil-fuel consumption is reduced.

SSP2 : 'business-as-usual' forecast, with an estimated population of 9.5 million and 80% urbanization.

SSP3 : 70% of the world's 13.5 billion live in cities - pockets of extreme poverty and moderate w populations.



Global use of land for landfilling in one year

Estimated average ultimate use of land for proper (sanitary) landfilling of MSW: One square meter for every 10 tons of MSW

- Current global landfilling converts an estimated 100 square kilometers of greenfields to landfills
- If all landfilling were at one place, it would use up a land surface equal to metropolitan Paris (or nearly two Mannhattans) in one year
- At present rate of MSW generation, continued landfilling would use up **10,000 square kilometers in one century**

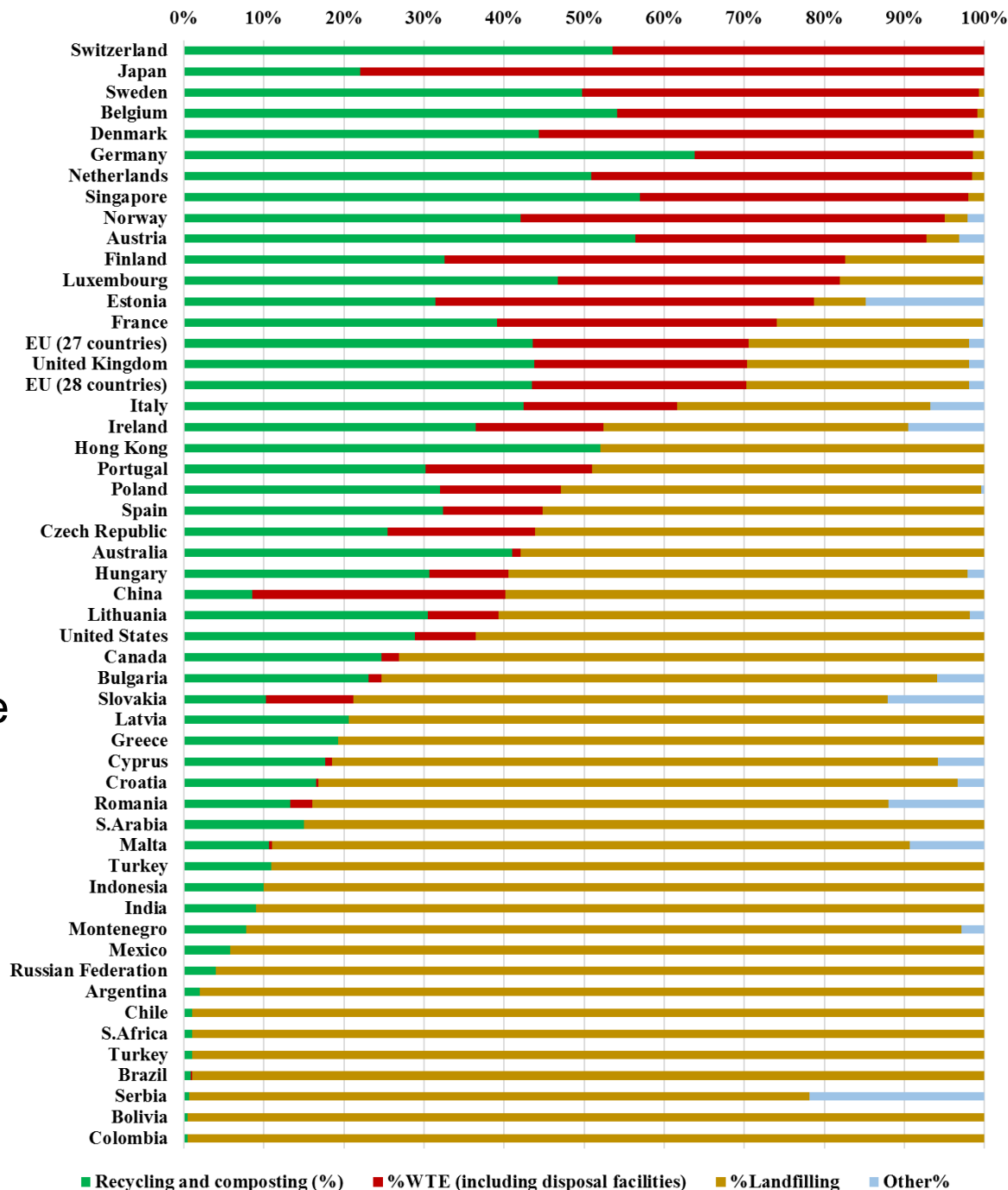
Colonizing Mars or Europe vs. doing away with landfilling

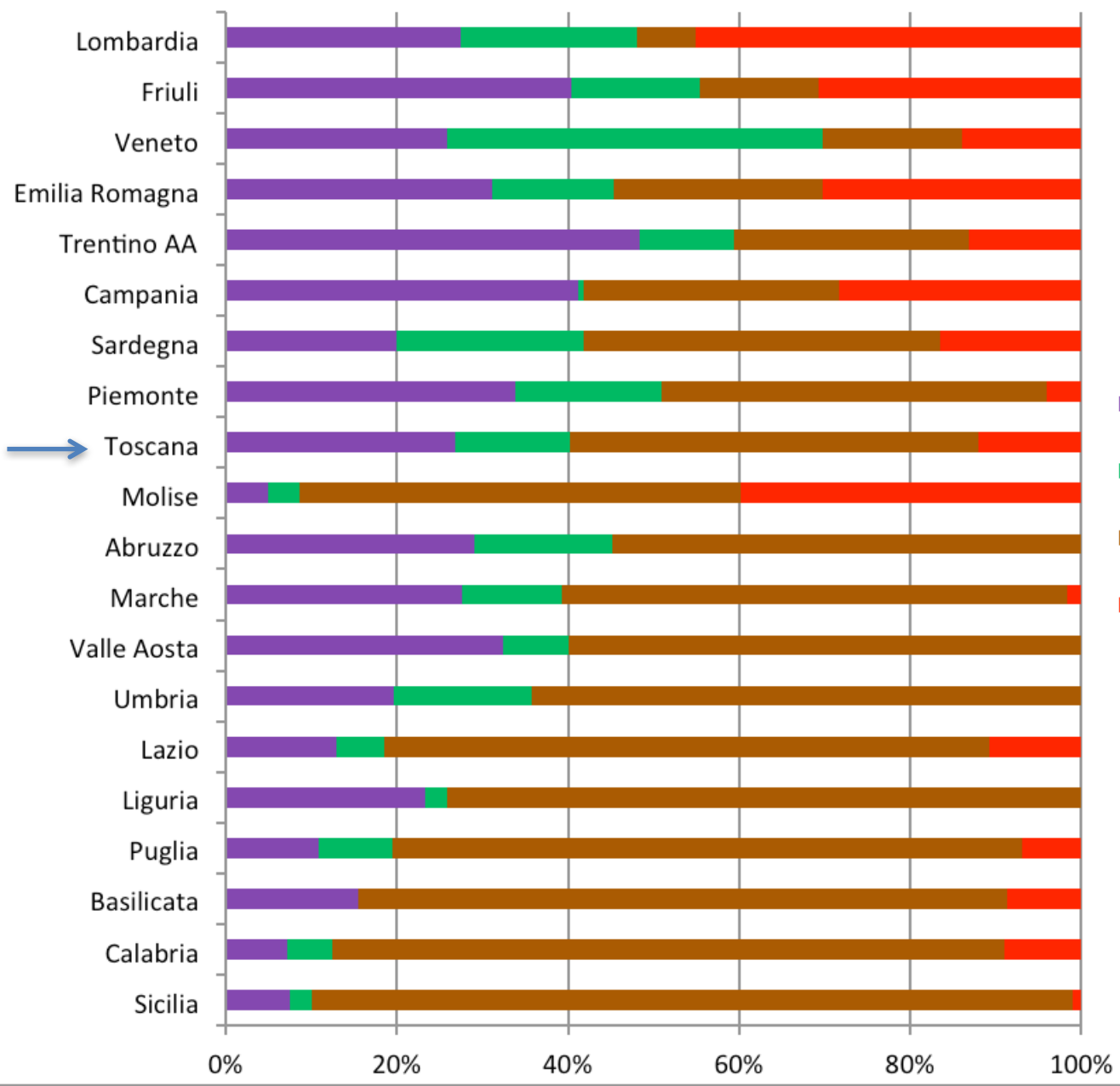
- Governments are spending billions in missions in the hope of developing living space in Mars, etc.
- How much would it cost to create 100 square kilometers of livable land on Mars?
- Which brings us to the goal of this Conference:

How best to advance Sustainable Waste Management on the planet Earth?

The WTERT “ladder” of sustainable waste management

Some nations are
doing better than
others

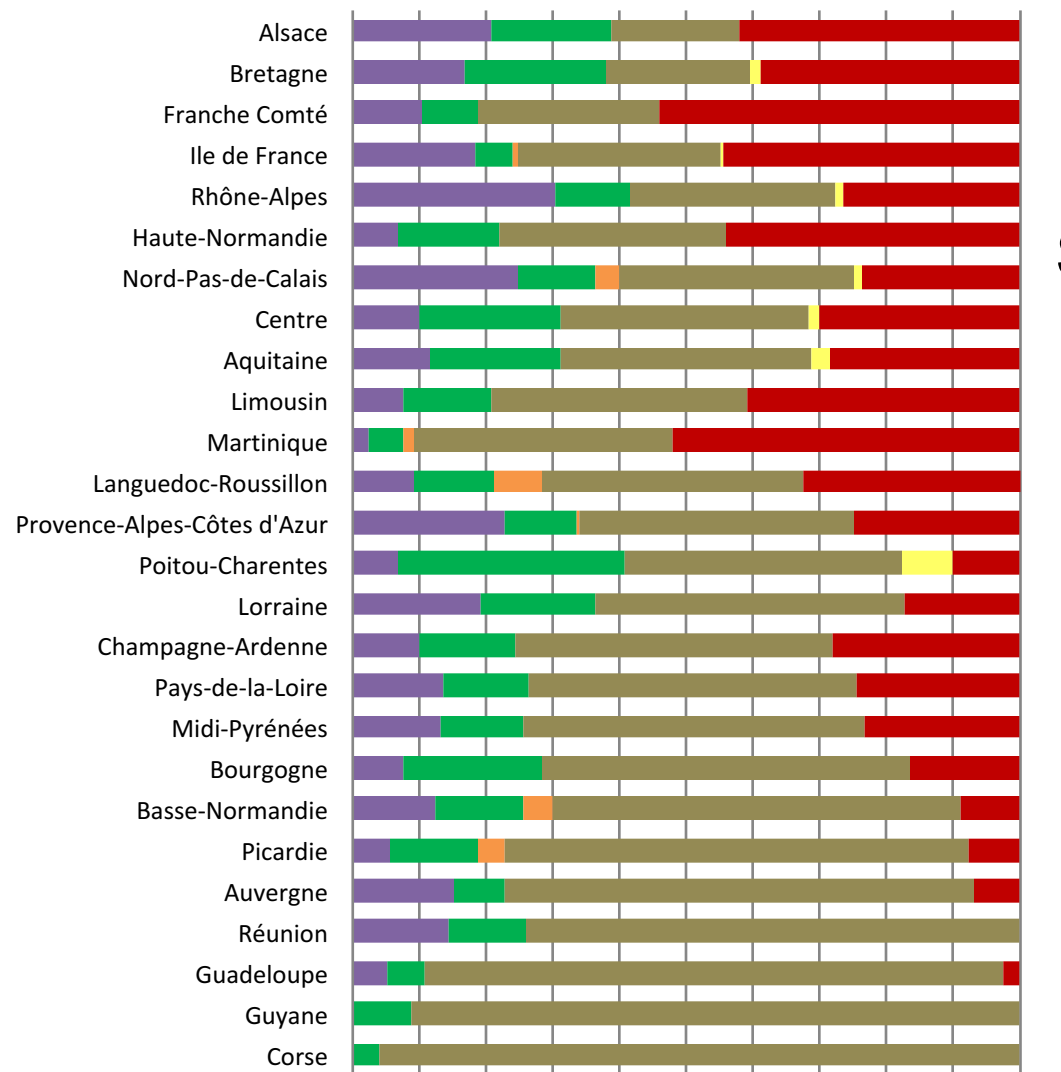




Some provinces are doing better than others

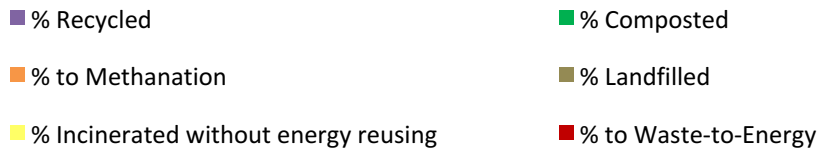
“Ladder” of sustainable waste management for the Provinces of Italy
(Grazie Leonzio)





Some regions are doing better than others

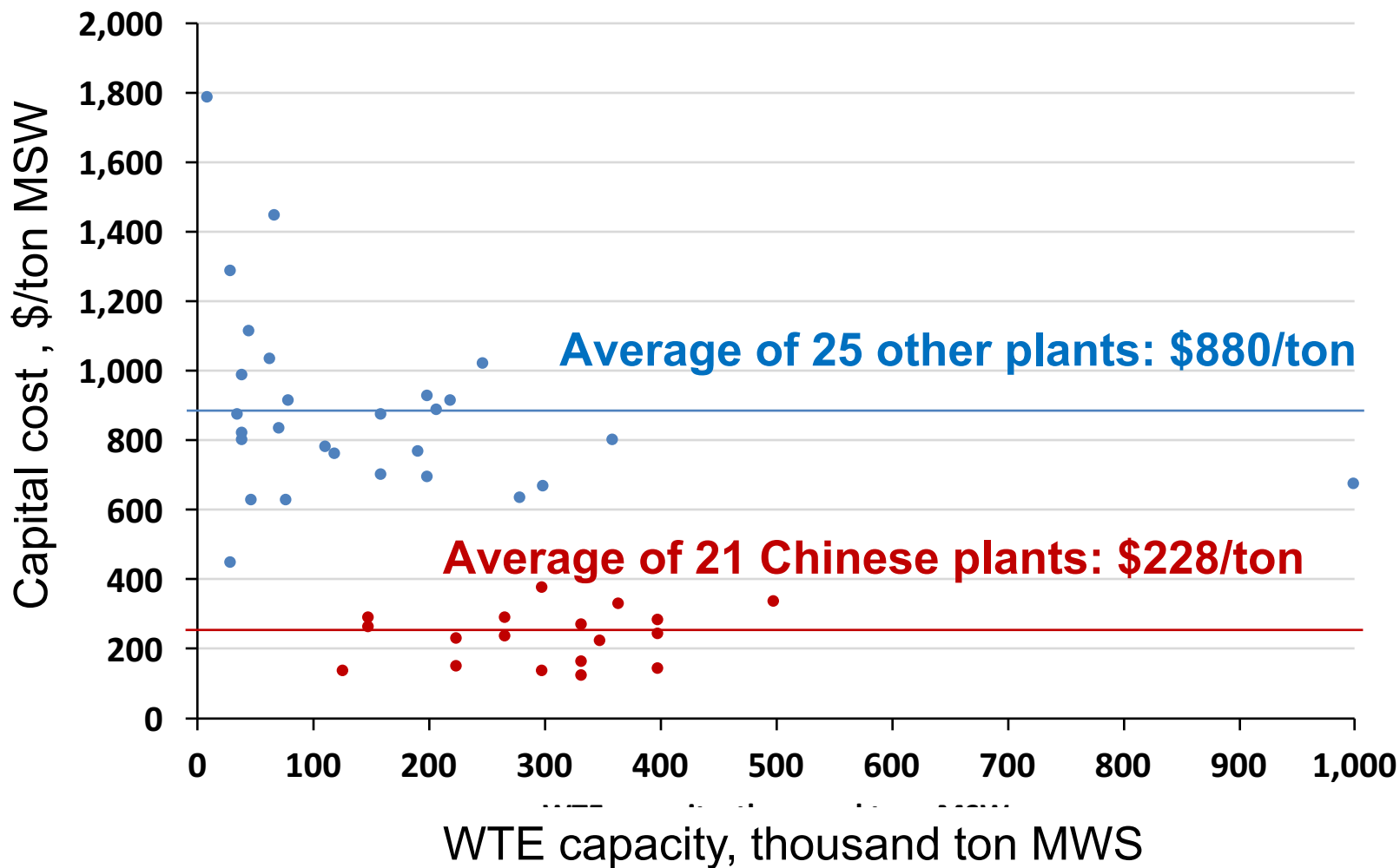
The “Ladder” of sustainable waste management for the Regions of France



Landfilling and WTE and landfilling gate fees estimated by Columbia University for the U.S. and Latin America

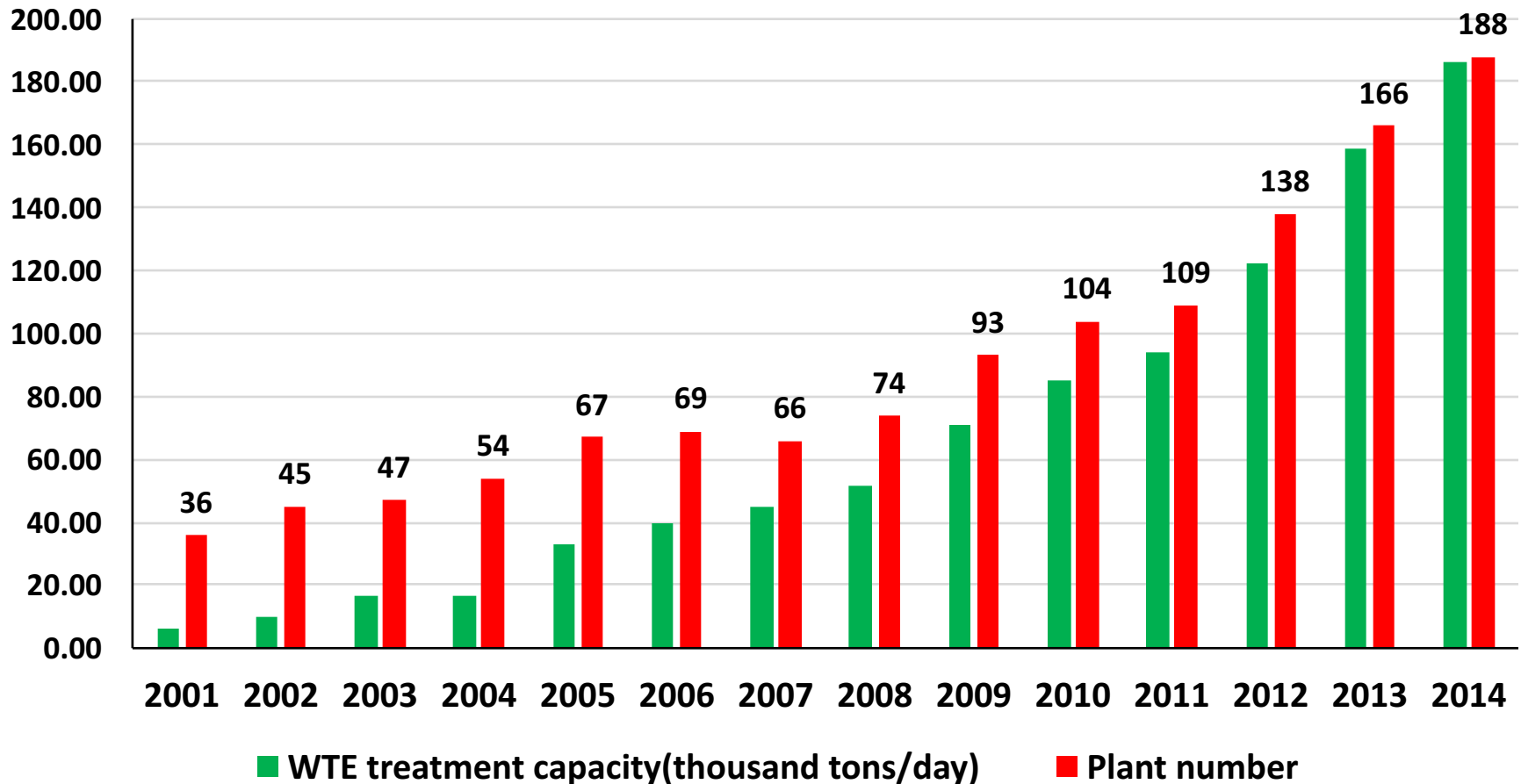
- **Gate fee difference** between sanitary landfills and WTE, **in the U.S.**, about \$20/ton MSW more for WTE
- In **Latin America**, the additional gate fee of \$20/ton required for WTE would disappear if the CAPEX of WTE plants could be reduced from \$600 per annual ton of capacity to \$400 (i.e., reduce CAPEX charge by about \$20/ton MSW).

Recent WTE plants built in China, **both** by moving grate (MG) and CFB technologies, at a lower CAPEX

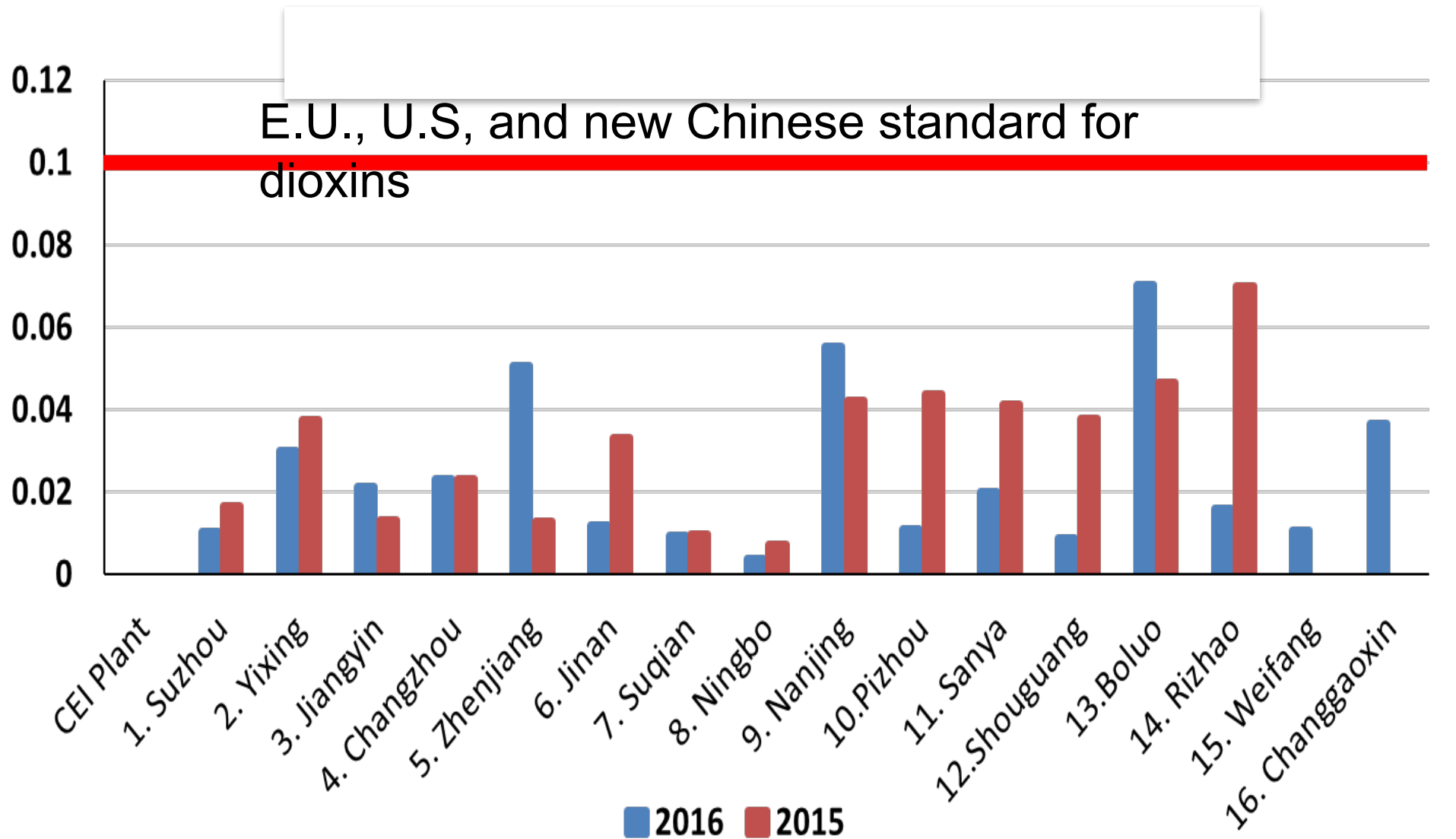


21st century growth of WTE industry in China

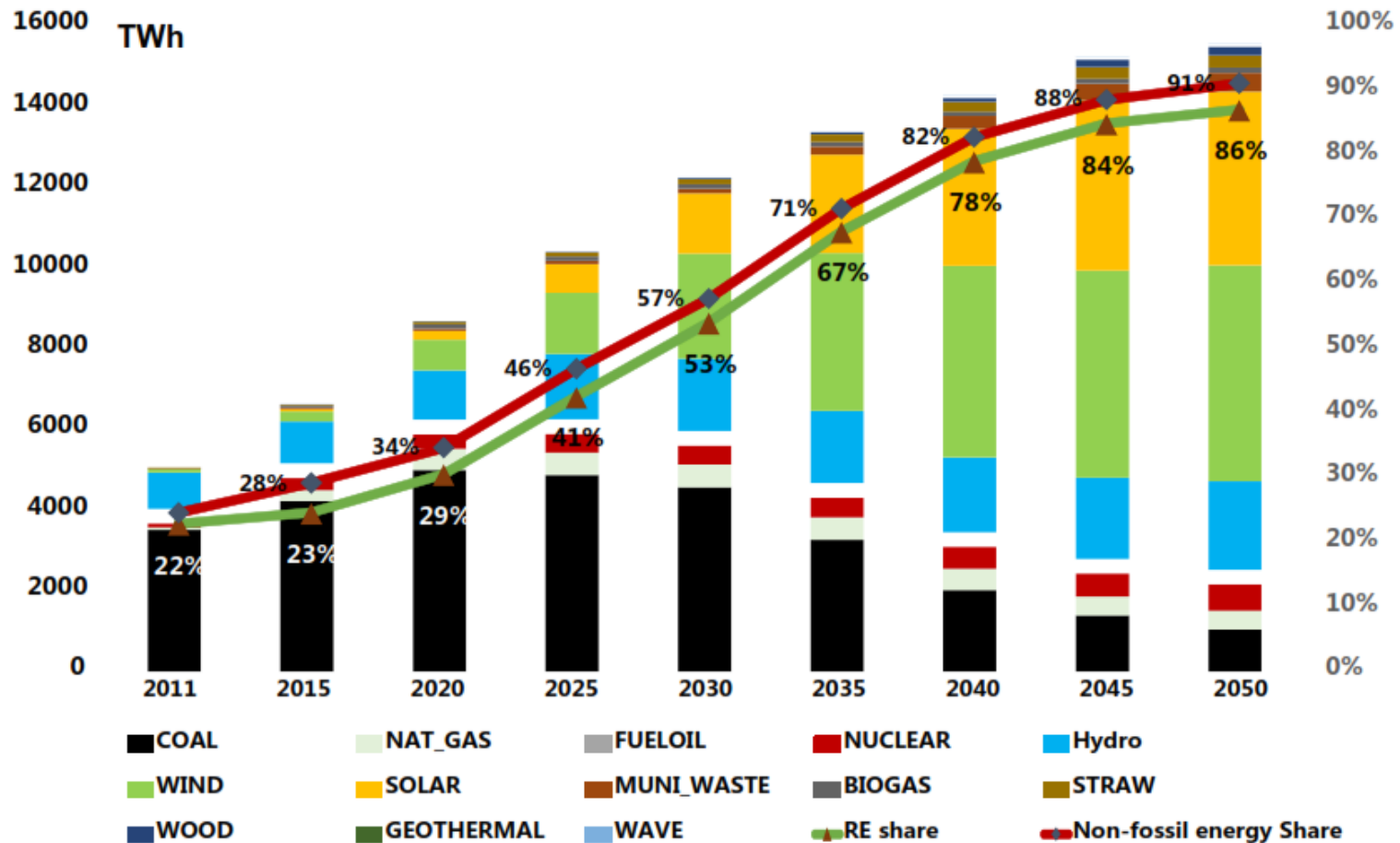
WTE total capacity and number of WTE plants



Average Dioxin emissions of 16 Chinese plants



Governments must include WTE in their plans for reducing carbon emissions

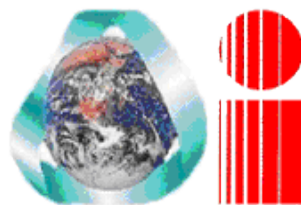


Source: CHINA NATIONAL RENEWABLE ENERGY CENTER
April 20, 2015

The 2016 WTERT Conference

Welcome to the most interesting group of presentations in the fourteen-year history of

WTERT



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

