

Southern CA Conversion Technology Conference

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Environmental Findings from Conversion Technology Studies: 2000 - 2014

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Background

AB 939 Mandate: 50% landfill waste diversion by 2000

In 1999 waste diversion was about 35%

Concerns drives interest Conversion Technologies (CT's)

Waste Board commissions major CT study in 2002

UC Riverside, UC Davis, NREL, RTI and others

Various Cities start various additional CT studies

CT opponents of assert:

CT's can't comply with CA Environmental requirements

CT's deployment will reduce waste recycling

State Funded Conversion Technologies (CT's)

Research: 2001-13: **A Partial List**

- **2001: The CA Integrated Waste Management Board (CIWMB) hosts CT Forum**
 - <http://www.calrecycle.ca.gov/organics/conversion/Events/TechForum00/>
- **2002: AB 2770 (Matthews, Statutes of 2002) requires Board to research emerging CT's:**
 - **2003: Biomass Collaborative (CBC) reviews CT, issues database of current and emerging technologies.**
 - **2004: UCD & UC Riverside evaluate CTs, deliver report & April Workshop**
 - **2004: RTI performs a Life Cycle Assessment of Waste Conversion Technologies**
- **2006: Board hosts Emerging Technologies (CT) Forum**
 - <http://www.calrecycle.ca.gov/organics/conversion/events/TechForum06/>
- **2007: Biofuels from MSW, Biomass Collaborative Forum (CBC) (Sponsor: CIWMB)**
- **2008: UC Davis report on AD systems for MSW (CIWMB Funding)**
- **2009: UC Riverside report on thermal CT's (Bioenergy Producers Assoc. funding)**
- **2009: Conversion Technologies Status Update Survey (UC Davis; CIWMB Funding)**
- **2010: Urban biomass management Forum, CBC (CEC & CalRecycle sponsorship)**
- **2011: Intl. Advanced Waste Management Forum, CBC (CEC and CalRecycle sponsorship)**
- **2011: Waste-to-Energy in California: Technology, Issues, and Context (CCST)**
 - <http://ccst.us/publications/2011/2011wte.php>
- **2011: Waste to Energy Forum: California Natural Resources Agency & Governor's Office**
- **2012: Digesting Urban Organics Residuals: A Forum on Technology, Economics & Permitting (CalRecycle, City of San Jose, CBC sponsorship)**
- **2013: Survey of MSW Conversion Options (UC Davis; CEC Funding)**

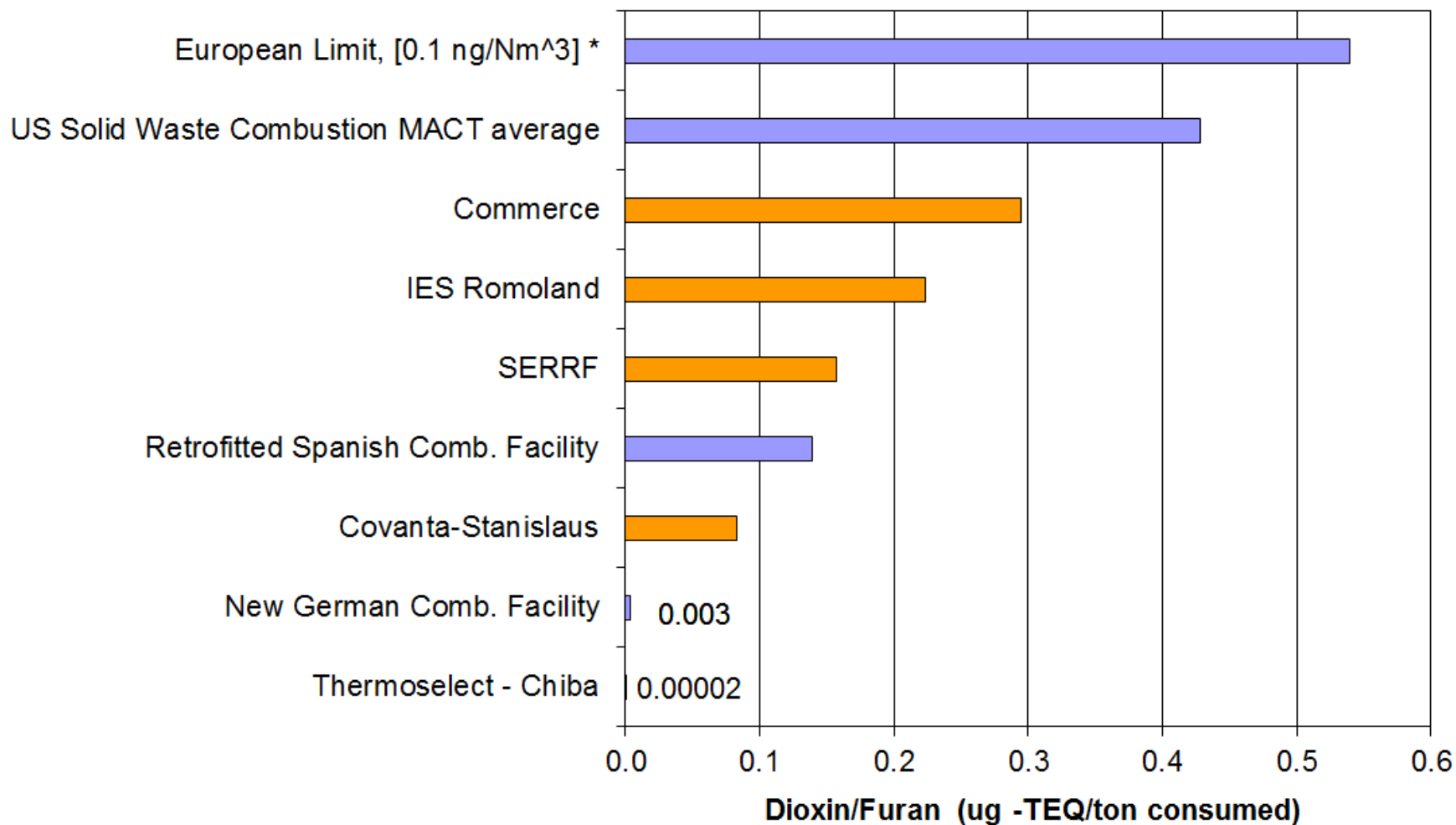
Emission Control Technology Advancements

- EPA regulations for solid waste combustion required US facilities to retrofit emission control, especially for hazardous air emissions (1995)
- Industry Dioxin/Furan emissions were reduced by 99.9% (between 1987 and 2000)*

* Adapted from Williams, R. B. (2006) - US EPA Docket A-90-45, VIII. B.11 and USEPA Dioxin source Inventory 2002.

Dioxin Emission Factors

(emission mass per ton material consumed)



* assumes $6000 \text{ Nm}^3/\text{tonne}$, 0.1 ng TEQ/Nm^3 (11% O_2).

Adapted from Williams, R. B. (2006)

New and Emerging Conversion Technologies: Report to the Legislature,

California Waste Management Board, June '07

- There are lower emissions of criteria air pollutants (NO_x and SO_x) from conversion technologies than from landfilling and transformation.
- There are lower carbon emissions from CT's than from landfilling and transformation

Evaluation of Emissions from Thermal CT's Processing MSW and Biomass,

UC Riverside College of Engineering, June '09

- Independently-verified emissions test results show that thermochemical conversion technologies are able to meet existing local, state, federal emissions limits
- Facilities with advanced environmental controls are very likely to meet regulatory requirements in California. The actual impacts of specific facilities will need to be evaluated on a case-by-case basis as part of a local permitting process.

Waste to Energy in CA: Tech, Issues & Context

CA Council on Science and Technology, Oct '11

- Waste-to-Energy technologies could have positive environmental impacts in California
- There are CT's that will meet California's environmental quality standards. CEQA requires that each project be scrutinized and evaluated in the permitting process to ensure that land use, air and water quality standards will be met; however, there are always operational uncertainties with new technologies

Is It Better To Burn or Bury Waste for Clean Electricity Generation? [US EPA, Feb '09](#)

- Compares combustion to landfill, both with **energy recovery** using US average post-recycled waste
- When comparing electricity (kWh) per ton of municipal waste, WTE is on average **six to eleven times** more efficient at recovering energy from waste than landfills.

Is It Better To Burn or Bury Waste for Clean Electricity Generation? US EPA, Feb '09

- For the most optimistic assumptions about landfill-gas-to-energy (LFGTE), the net life-cycle GHG burden is **2 to 6 times** than the amount from WTE
 - GHGs for WTE: **0.4 to 1.4** MTCO₂e/MWh
 - Best LFGTE scenario: **2.3** MTCO₂e/MWh
(landfill carbon storage not included)

Biomass Strategic Analysis,

Integrated Energy Policy Report

CA Energy Commission, June '05

- The Analysis of Conversion technologies (CT's) seems to conclude that converting biomass and solid waste offers environmental benefits and significant public benefits, including reduced health risks

Biomass in Solid Waste in California,

California Energy Commission, April '06

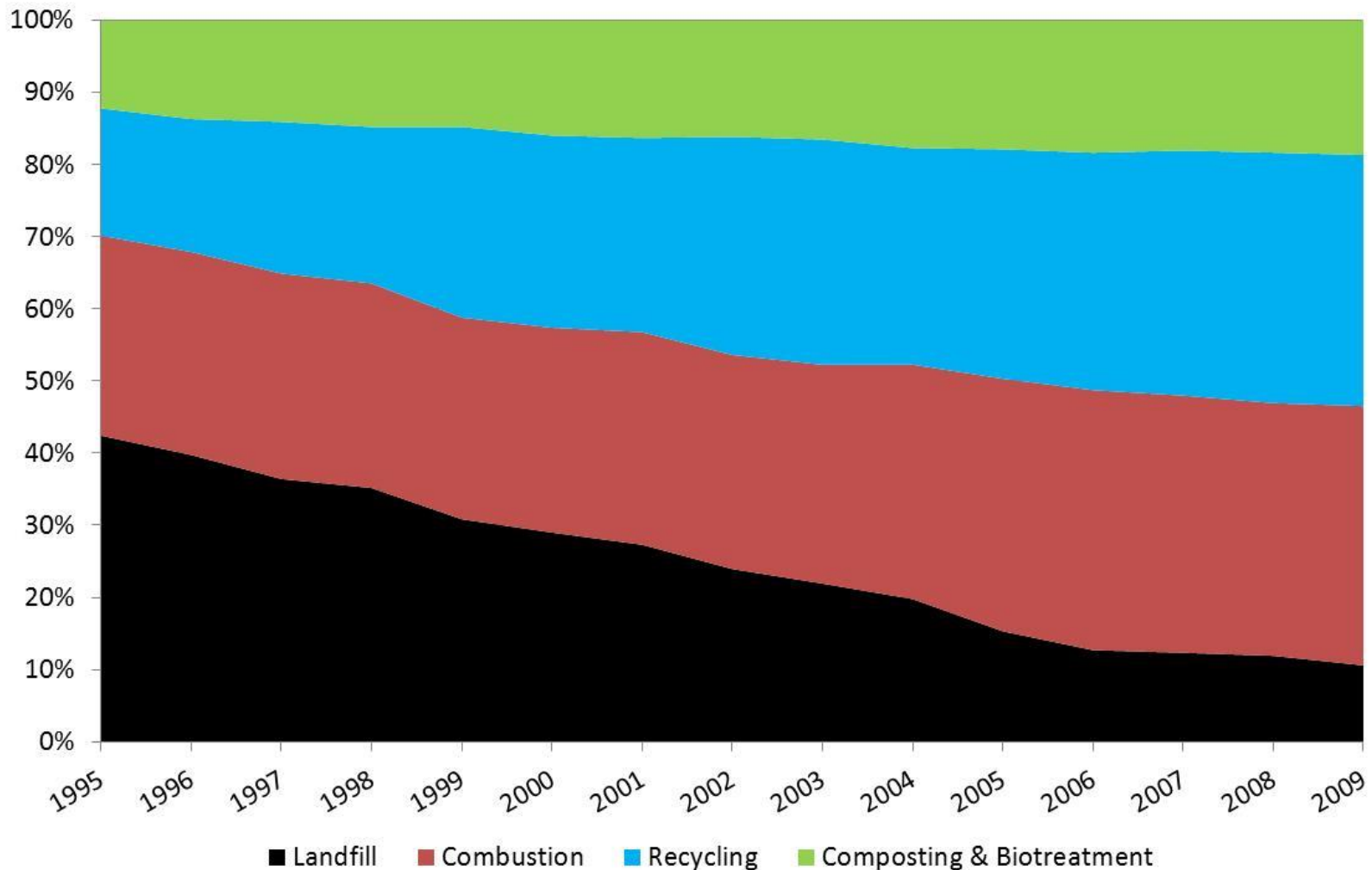
- Waste management Life Cycle studies from Europe and Korea consistently rank landfills as having the worst environmental impact.
- Anaerobic digestion w/ energy recovery and solid combustion with energy recovery consistently rank having least environmental impacts of waste management options.

Biomass in Solid Waste in California,

California Energy Commission, April '06

- Energy and solid waste policies in Europe have advanced the state of technology for waste management and conversion.
- There are potential opportunities to adapt these policies and systems to the emerging California market.

MSW Treatment trend; 10 Northern European Countries*



Adapted from Williams R.B, 2006

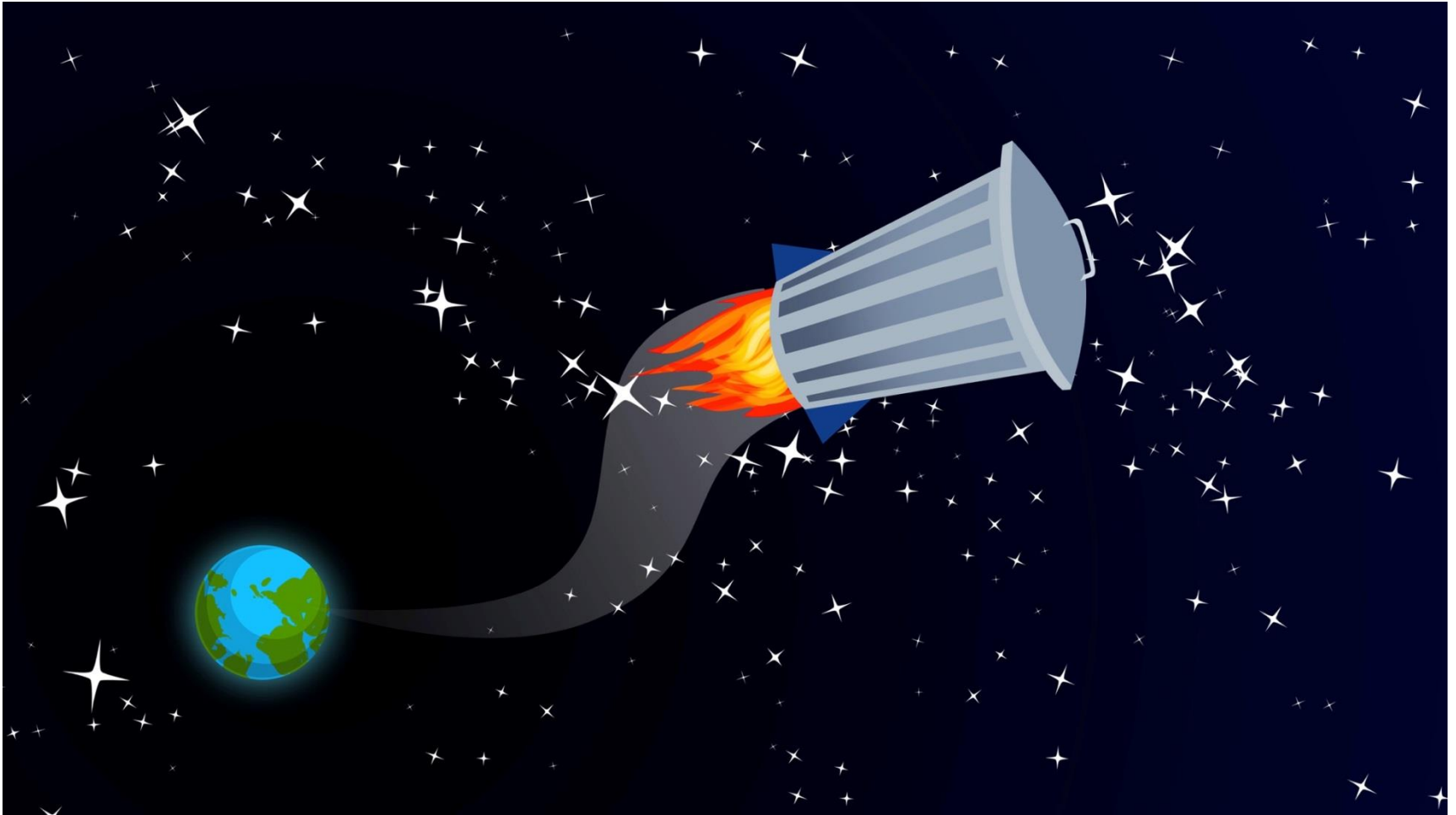
* Group 1: Switzerland, Germany, Austria, Netherlands, Sweden, Denmark, Belgium, Norway, Luxembourg, France

Eurostat (2011)

Summary

- Properly designed, operated and maintained CT plants can meet CA environmental performance standards
- Life Cycle Studies show that compared to landfilling, CT's have a better environmental performance
- The experience in Europe shows that with the right policies in place, CT use to manage the post recycled fraction of waste, does not appear to negatively affect recycling
- Next Steps ?

The Solid Waste Technology of the Future ?



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Credit: Gil Franco