

Zero Waste Strategy LCA Results:

Why the Vancouver Region Should Fund & Promote 3Rs not 2Ds

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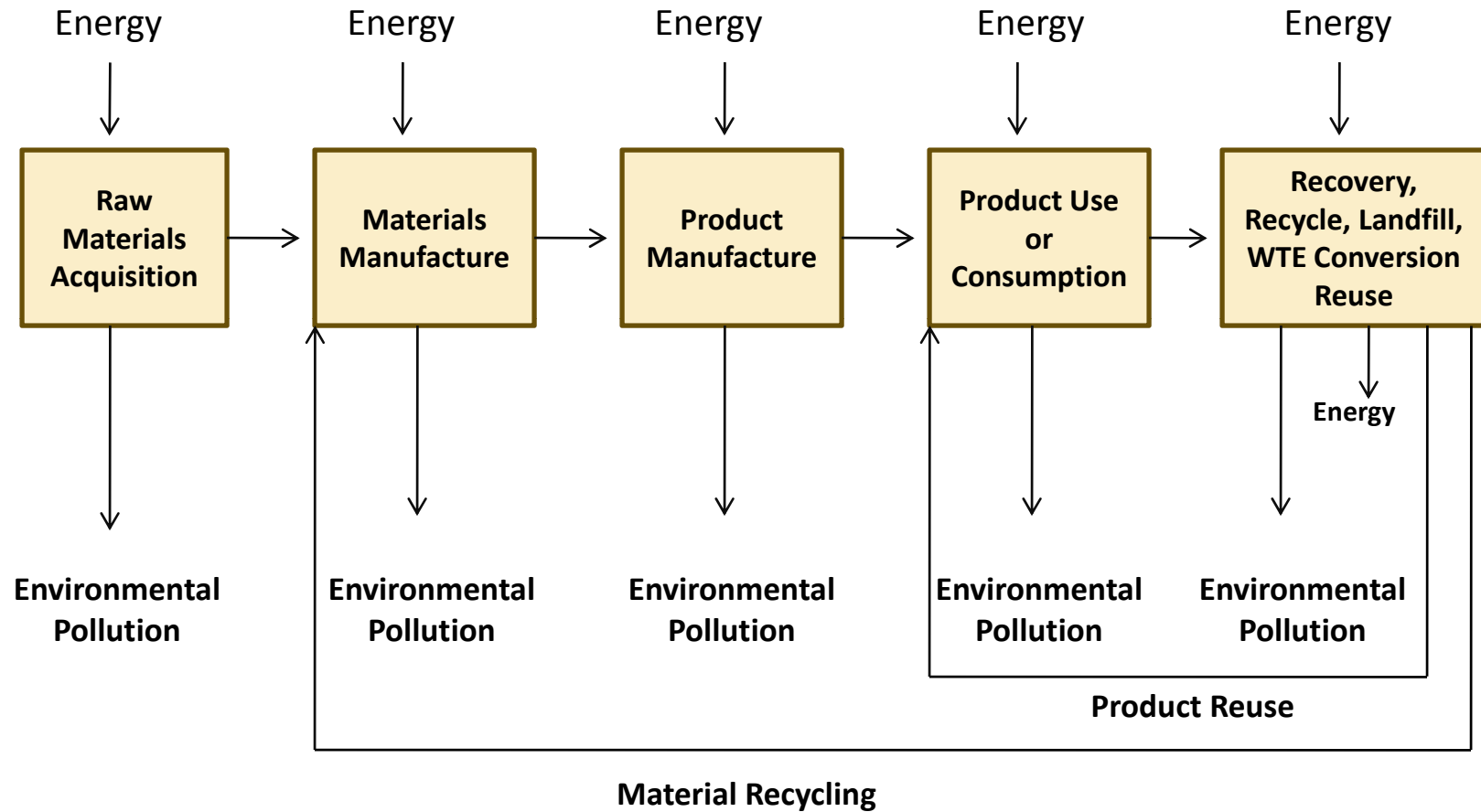
Presentation Outline & Summary

- ✘ MSW: garbage glob vs. discarded resources
- ✘ Recycling widely preferable to disposal in terms of energy and pollution savings
- ✘ Disposal is interim solution not THE solution
- ✘ Landfills better than WTE for climate, human health and ecosystems
- ✘ WTE needs steady fuel supply, which can interfere with waste prevention and recycling opportunities
- ✘ Recycling provides green jobs and local economic development potential

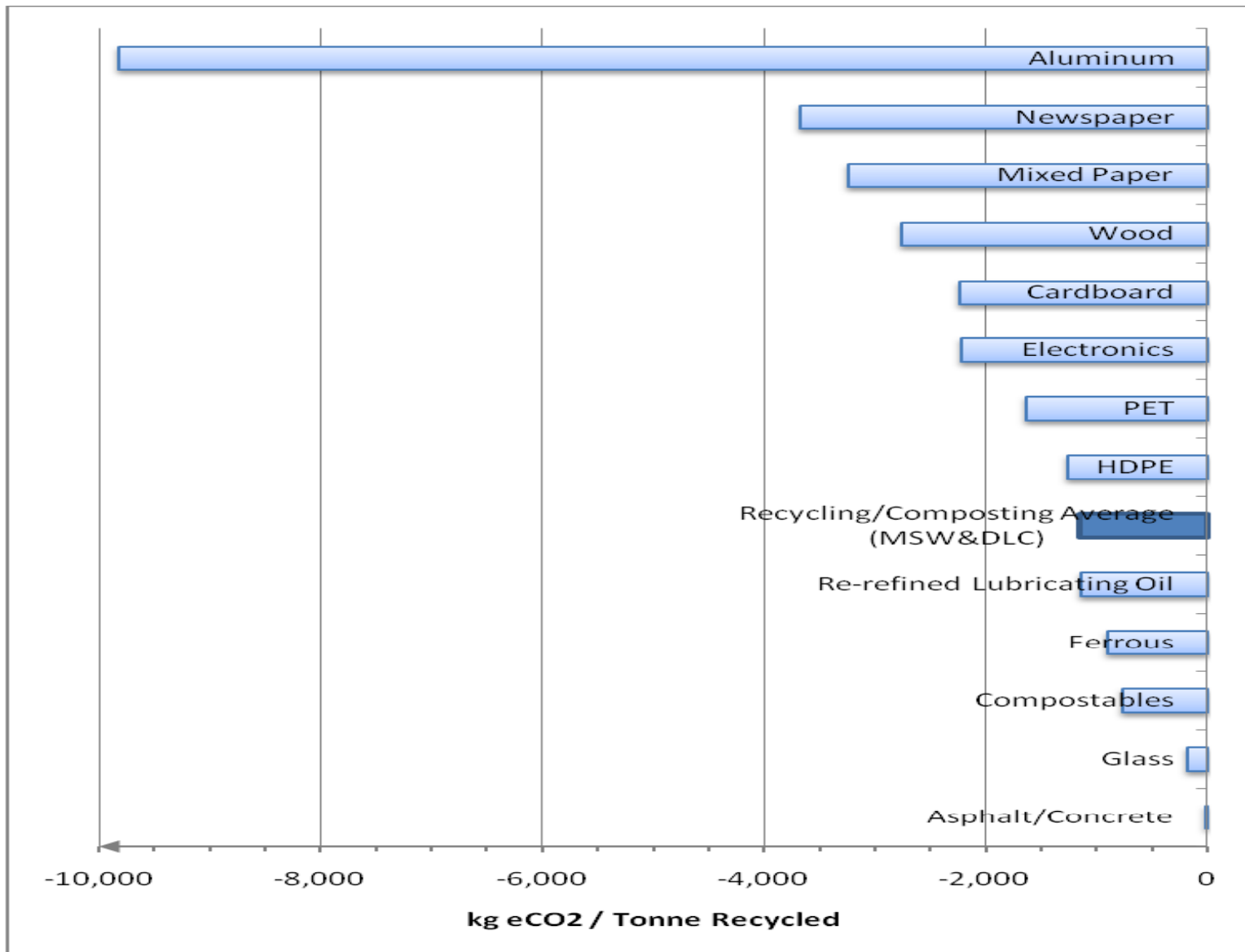
Zero Waste Focus:

**Waste Materials Are Resources
That Reduce Pollution & Energy Use!**

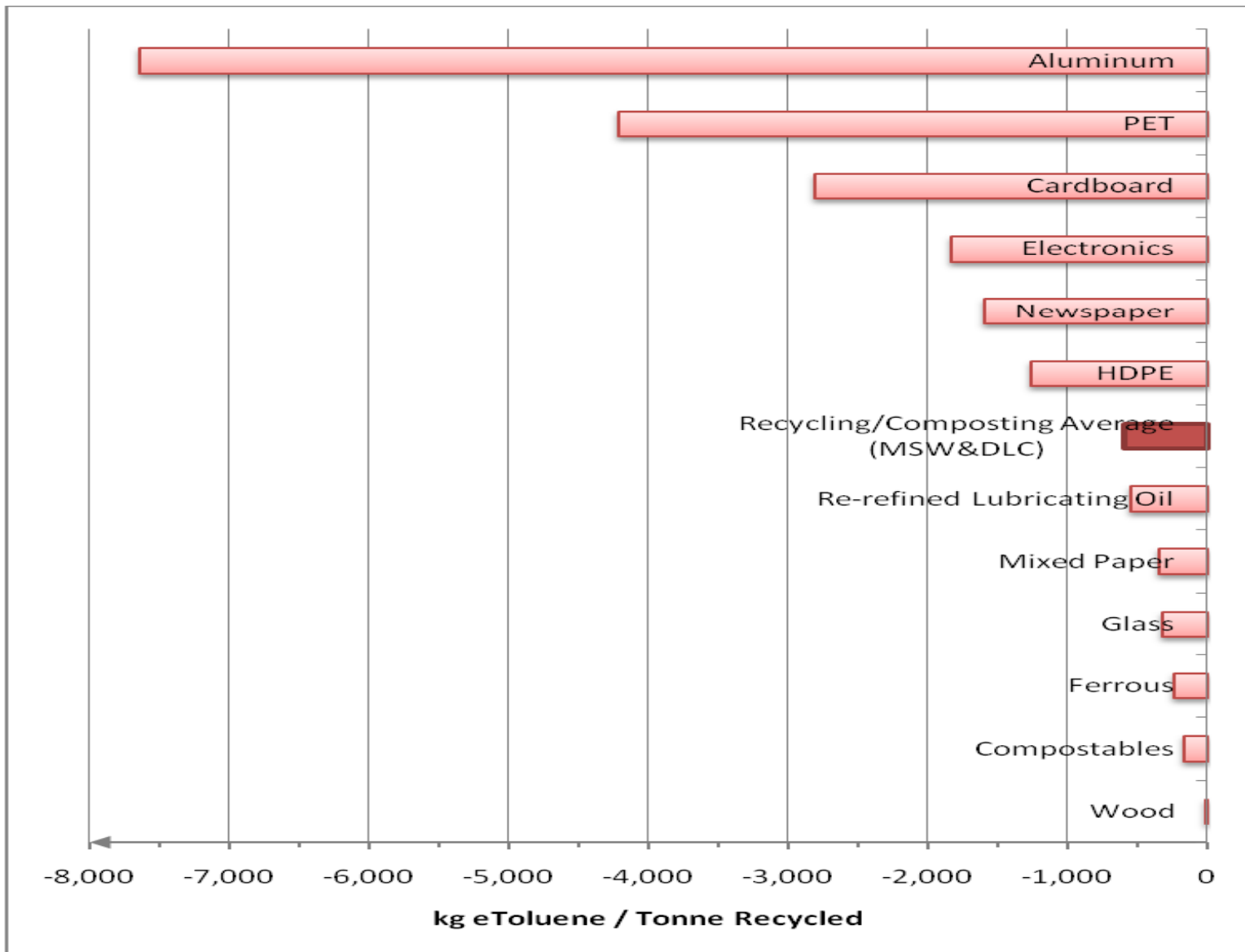
Life Cycle Analysis (LCA)



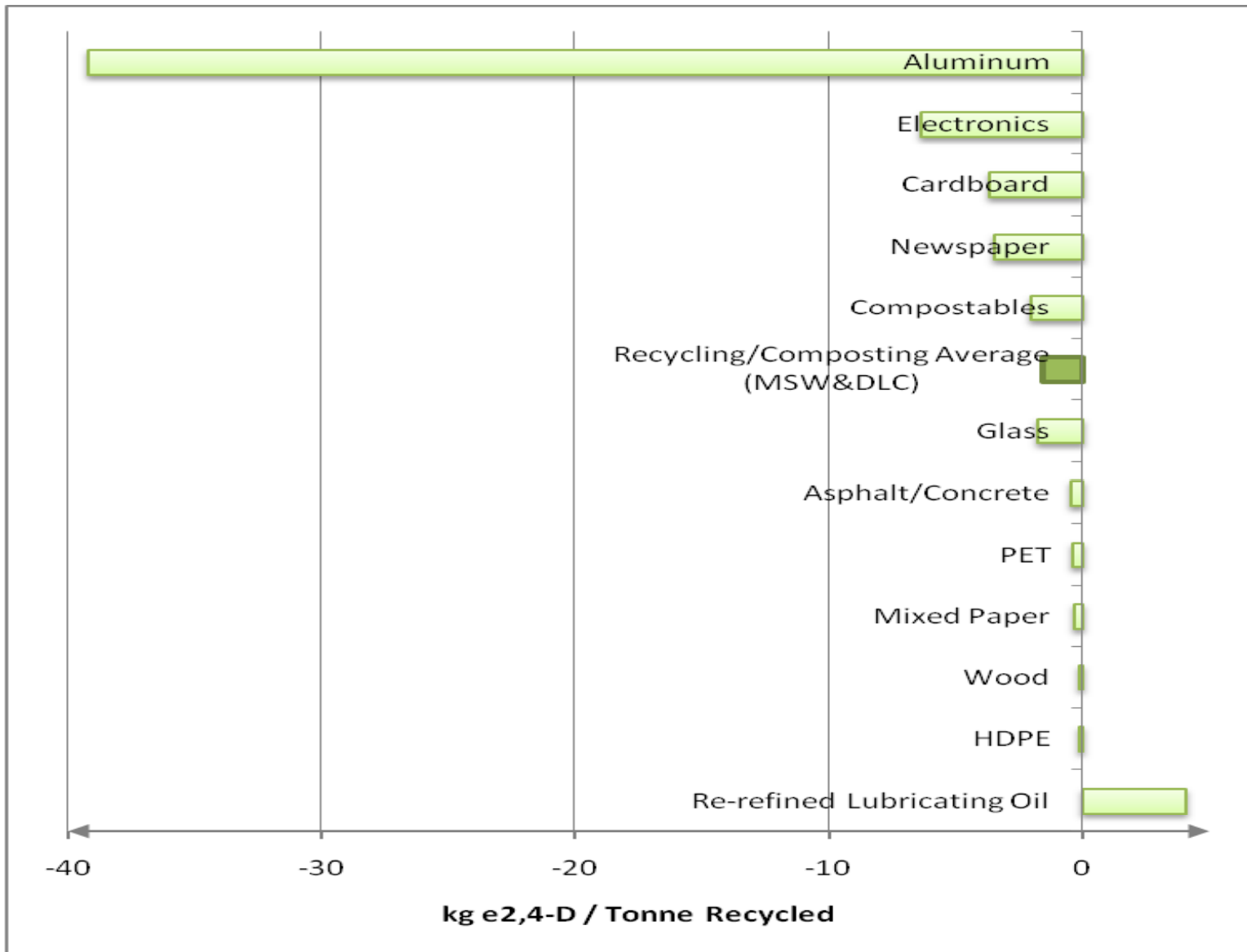
Greenhouse Gas Emissions per Tonne – Select Recyclable Materials (2008)



Human Health Emissions per Tonne – Select Recyclable Materials (2008)



Ecosystem Toxicity Emissions per Tonne – Select Recyclable Materials (2008)

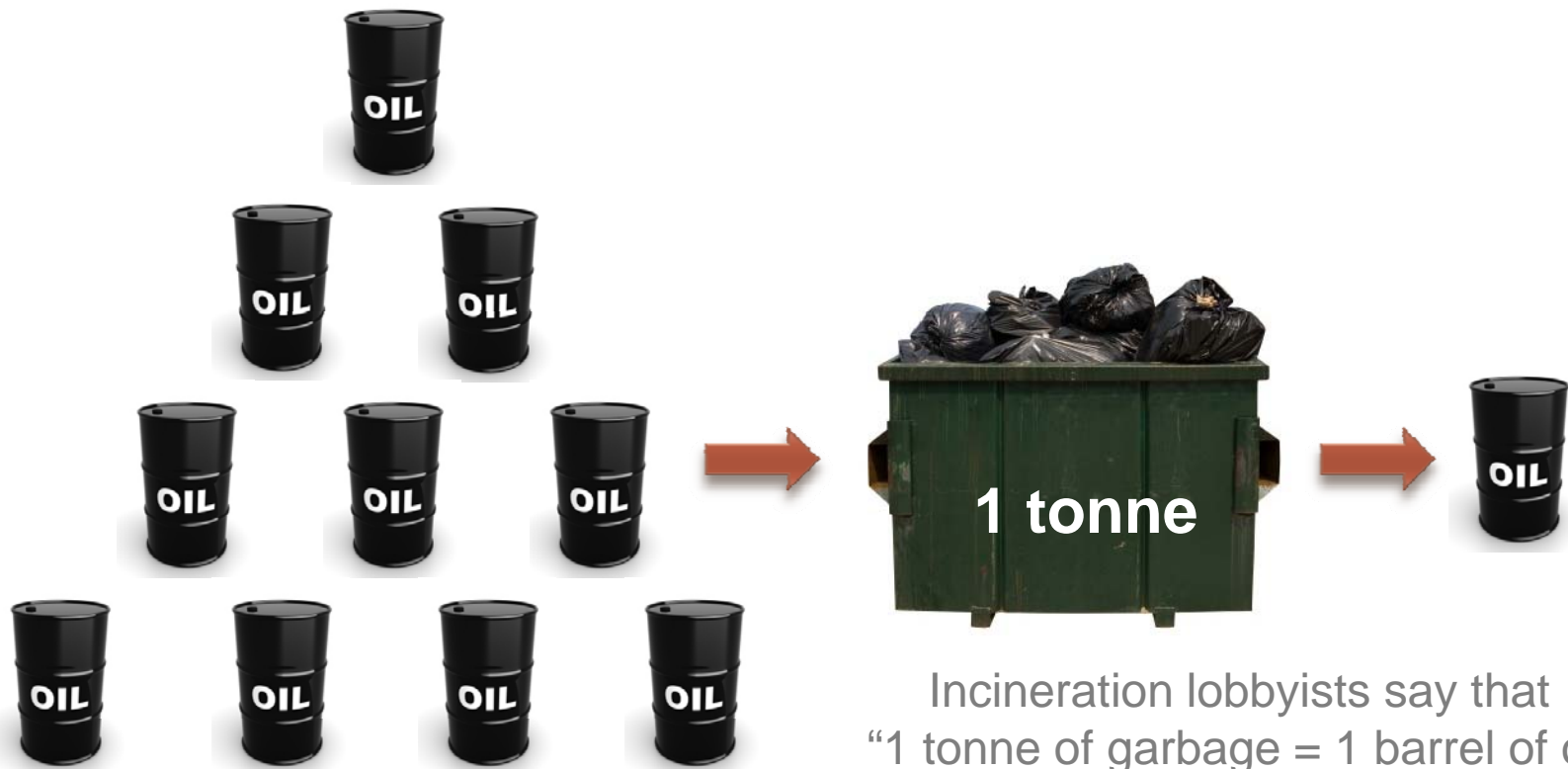


Garbage is:

Renewable & Sustainable Energy?



Incineration lobbyists say that
"1 tonne of garbage = 1 barrel of oil"



The full picture: it takes **8-10 barrels** of oil to produce 1 tonne of garbage. From this perspective, garbage is neither a sustainable nor a renewable fuel.



Recycling **saves** the equivalent of 4 barrels of the oil needed to produce 1 tonne of garbage

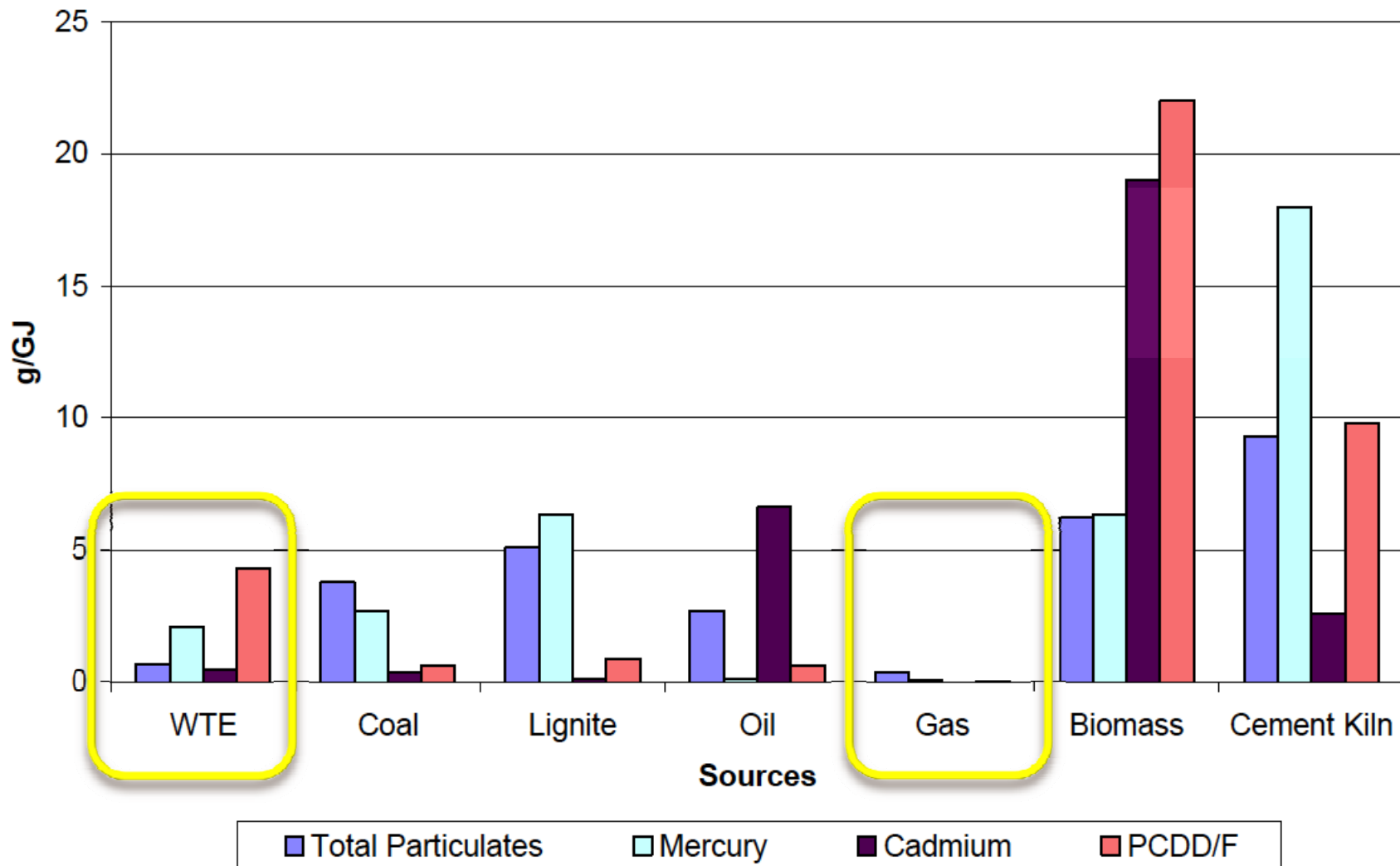
Garbage is:

Clean & Green Energy?

GHG Emissions for Electricity Generation (tonnes eCO₂ per GWh)

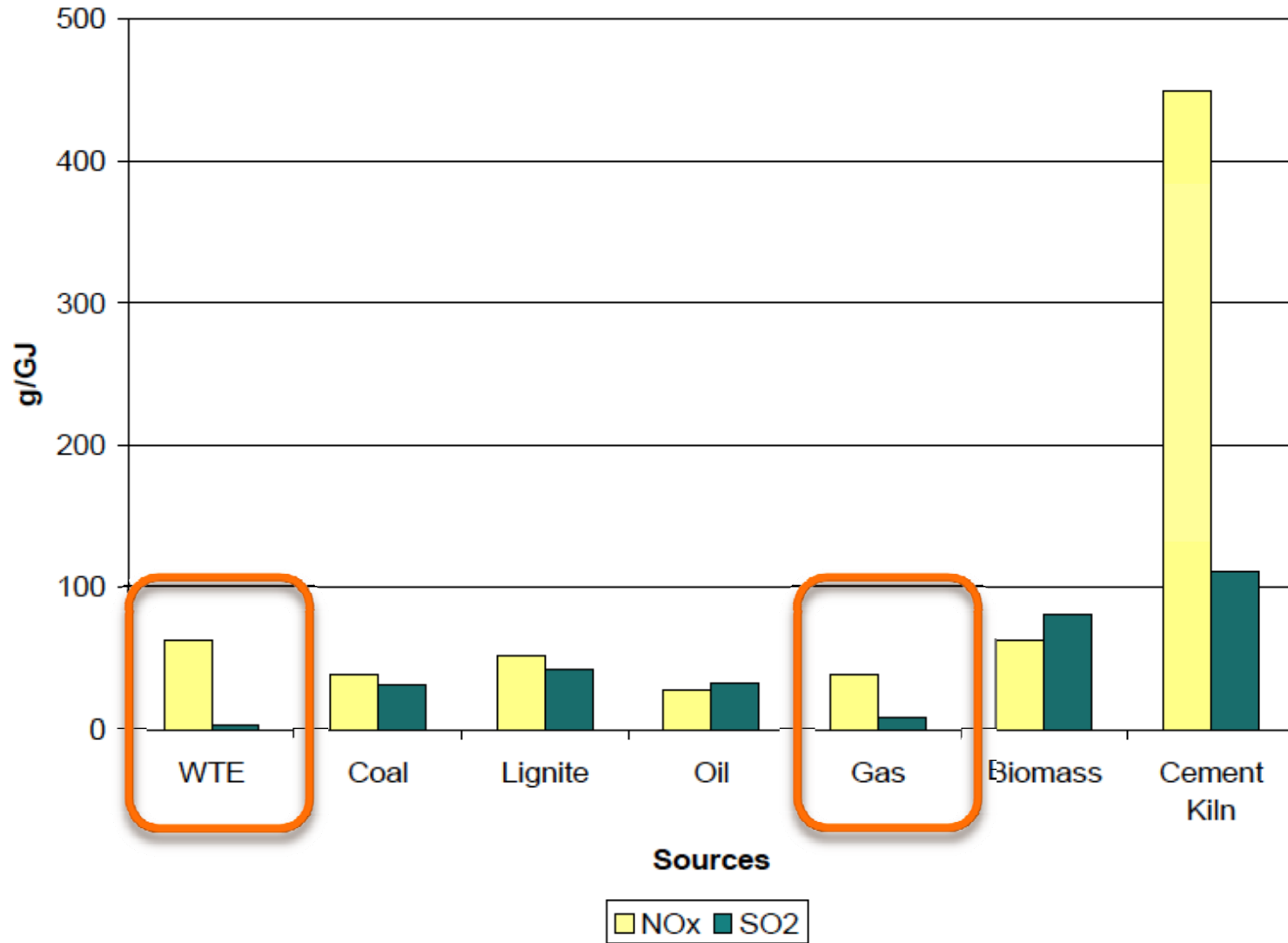
Coal	900 - 1000
MSW Waste-to-Energy	600 - 900
Natural Gas	350 - 400
BC Consumption Avg.	87
Wind	0

Figure 18. Emissions per GJ of Energy Input (1)



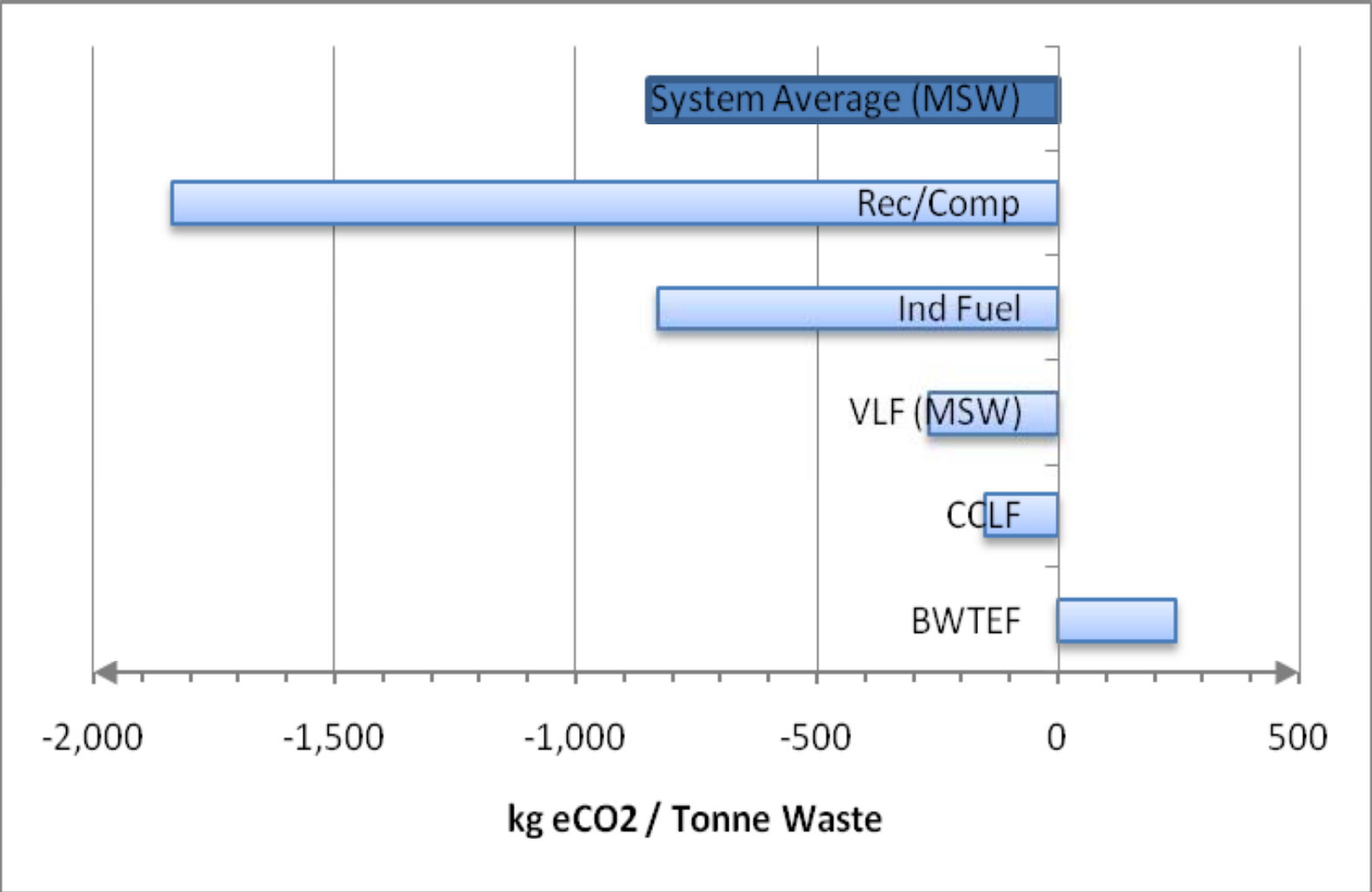
Source: AECOM Canada (2009). *Management of Municipal Solid Waste in Metro Vancouver*.

Figure 19. Emissions per GJ Energy Input (2)



Source: AECOM Canada (2009). *Management of Municipal Solid Waste in Metro Vancouver*.

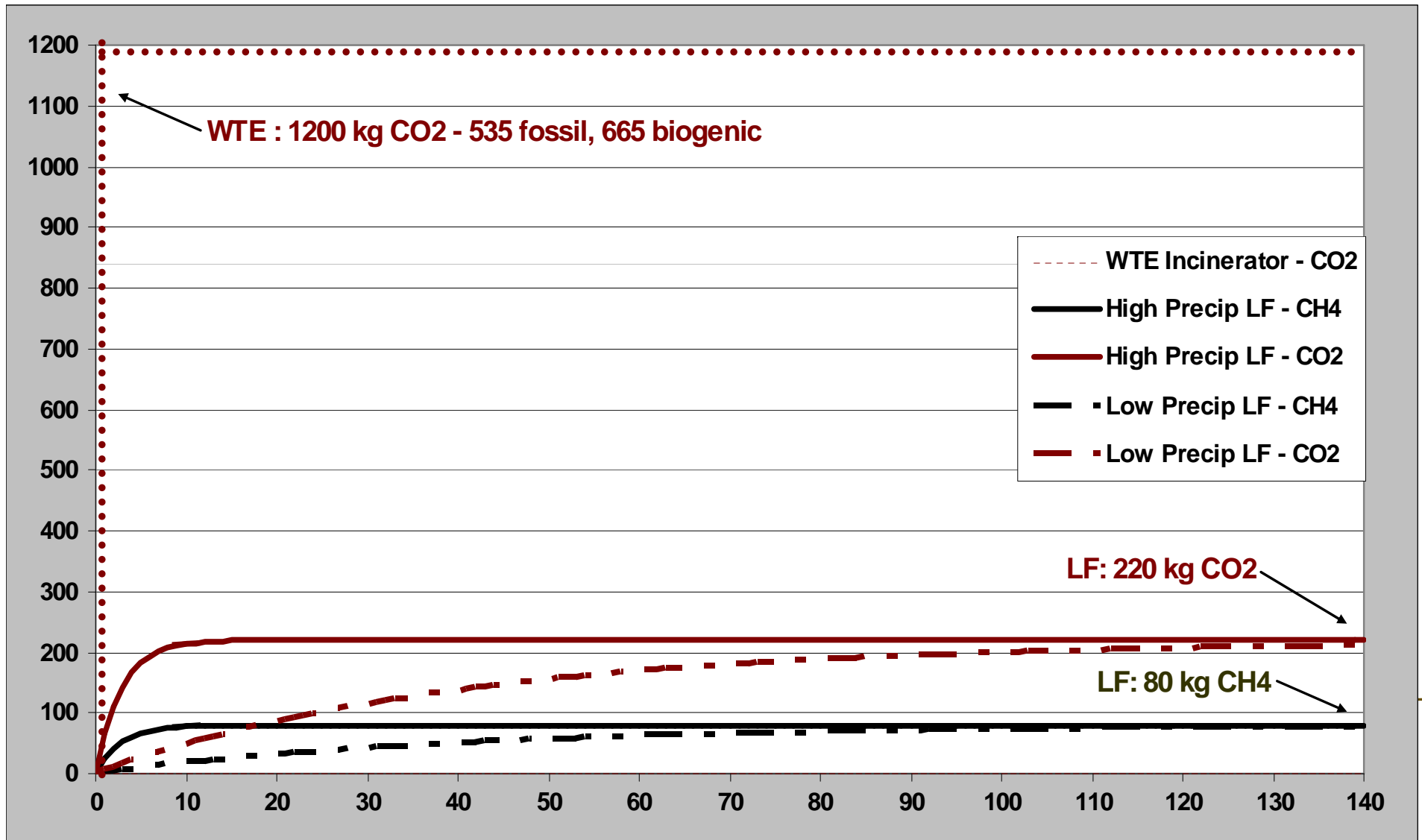
Greenhouse Gas Emissions per Tonne – MSW (2008)



Average Environmental Impact per Tonne – MSW (2008)

	Climate (eCO ₂)	Health (eToluene)	Ecosystems (e2,4-D)
Recycling & Composting	-1,835	-945	-2
Landfill	-215	60	<0.1
WTE	245	105	2

CO2 & CH4 Cumulative Generation Over 140 Years (kilograms per tonne of MSW disposal)



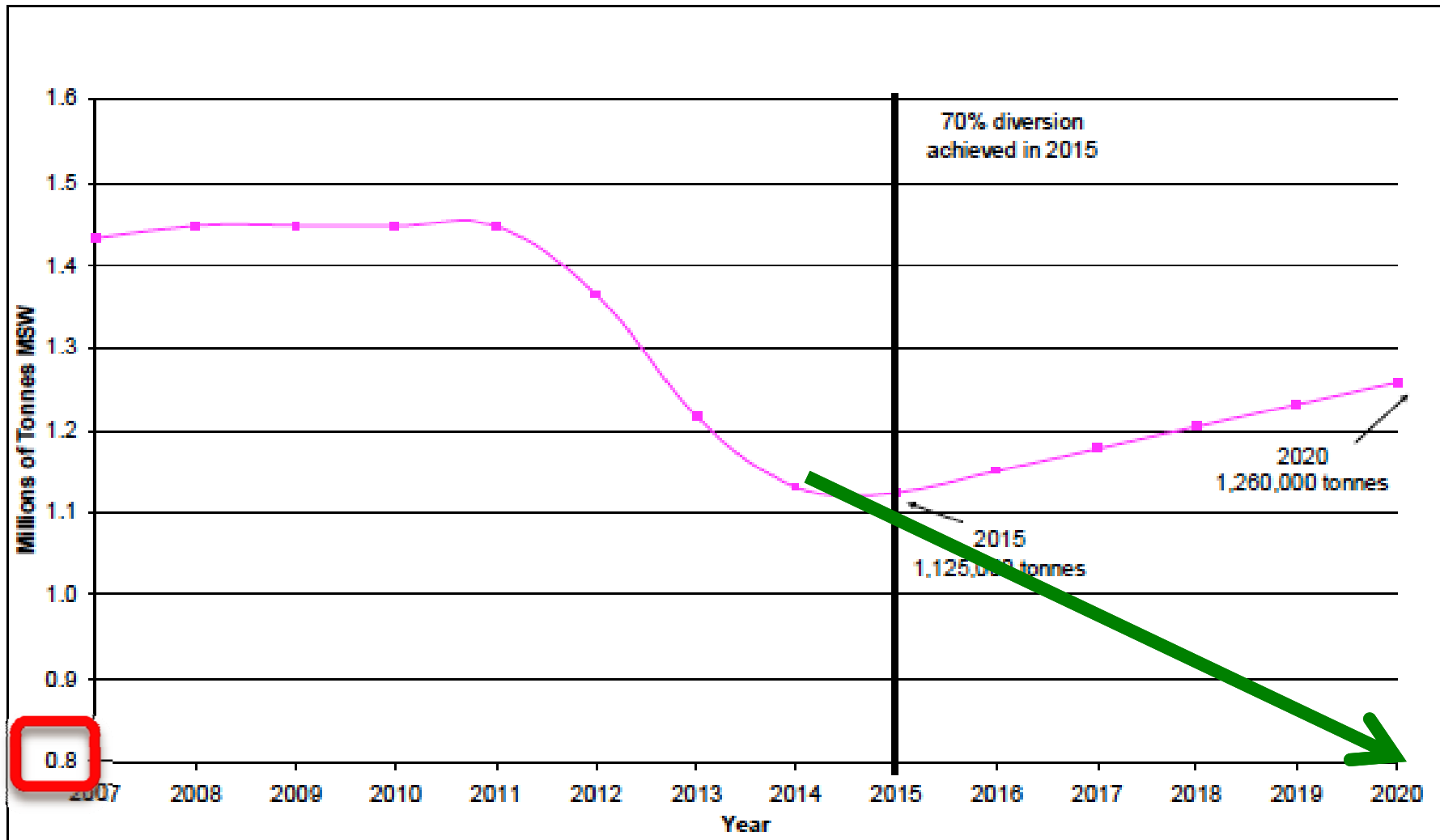
Carbon Content Stored in Landfill – Select Recyclable Materials (US EPA, 2008)

Newspaper	86%
Cardboard	55
Food Scraps	16
Grass	53
Leaves	85

Zero Waste Strategy:

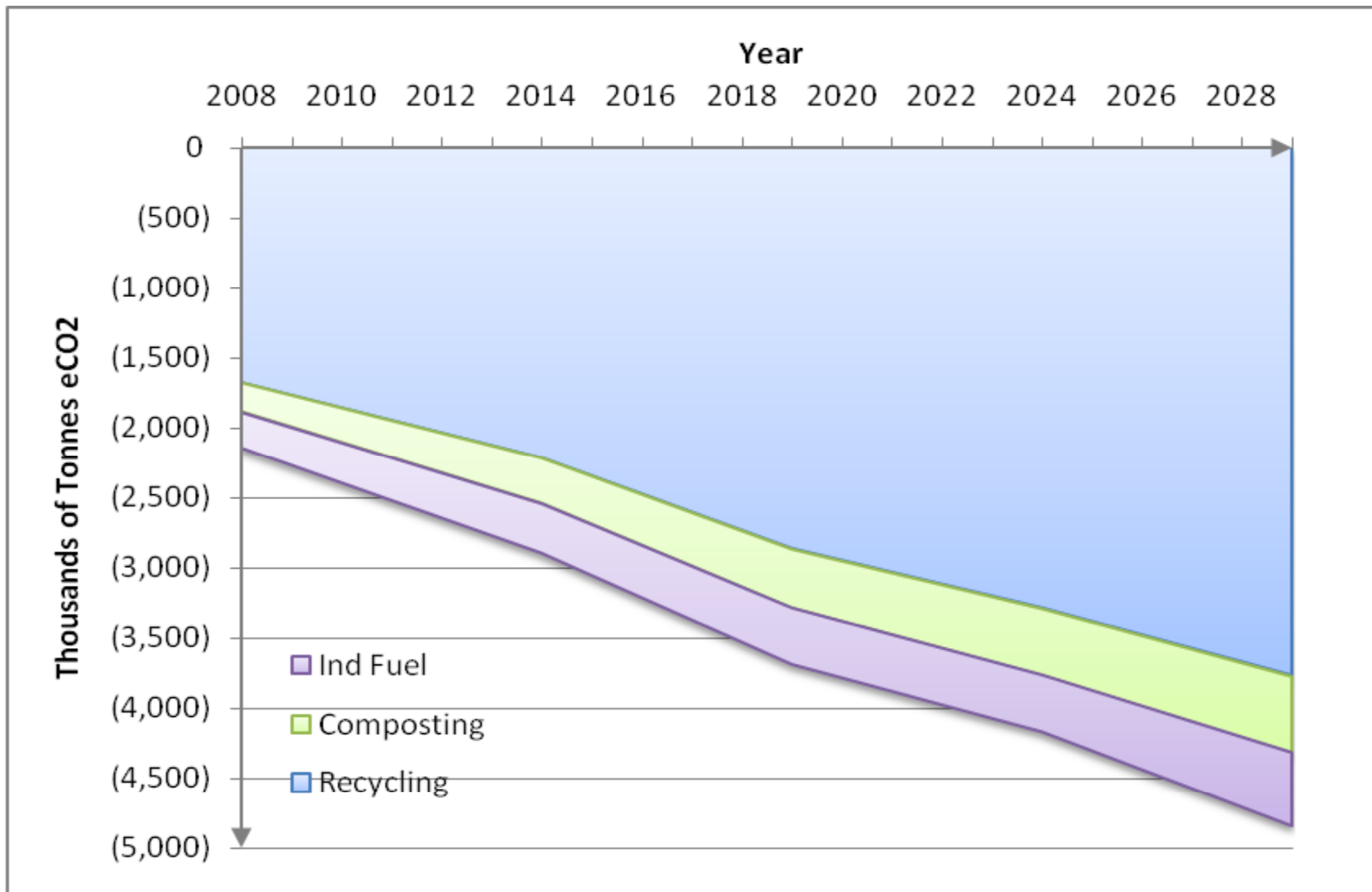
Benefits & Methods

Waste Requiring Further Treatment and Disposal

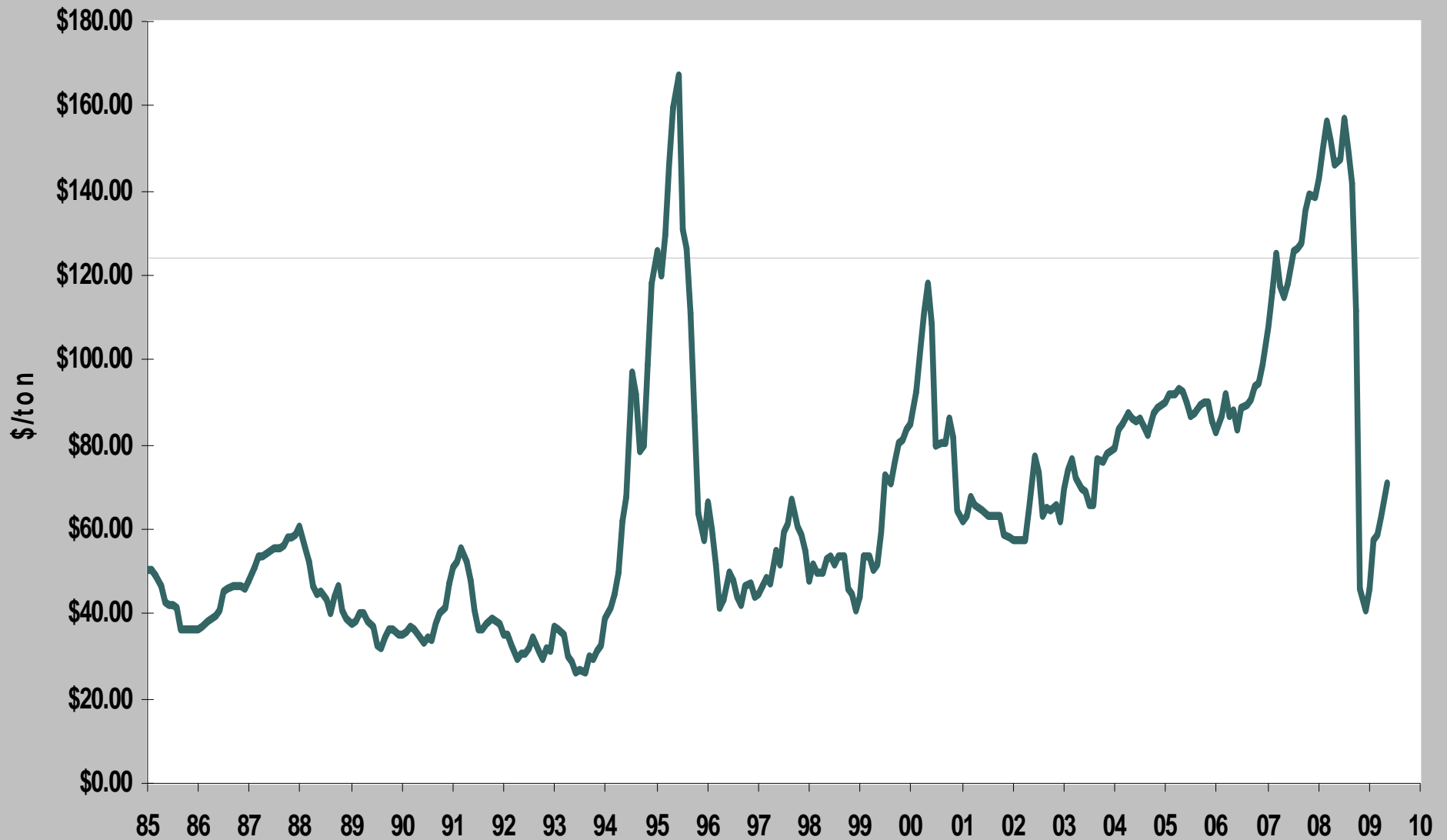


Source: AECOM Canada (2009). *Management of Municipal Solid Waste in Metro Vancouver*.

Net GHG Emissions from Waste Diversion (2008-29) Zero Waste Scenario



Average Value for Curbside Recycled Materials Pacific Northwest, 1985-2009



Zero Waste Strategy Methods

- ✘ Economic Incentives – linear garbage rates, deposits and refunds, EPR, sin taxes
- ✘ Collection Opportunities - curbside, on site, streetside, and public event containers for recyclables and compostables
- ✘ Bans & Regulations – disposal bans, recycling bylaws, building code specs for collection containers
- ✘ Education & Social Marketing

Conclusions

- ✘ Zero waste strategy optimizes environmental and local economic development potentials of recycling
- ✘ Disposal should be viewed as bridging option on the road to zero waste
- ✘ Landfills definitely better than WTE for climate, and at least as good for human health and ecosystems
- ✘ WTE is neither clean, green, renewable, nor sustainable
- ✘ WTE needs steady fuel supply, which can interfere with waste reduction and recycling opportunities
- ✘ Recycling provides green jobs and local economic development potential

Thank you.

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Current research and consulting interests – Economic cost/benefit valuation of pollutant emissions, life cycle assessment emissions impact categories (e.g., global warming, acidification, eutrophication, criteria air pollutants, human toxicity and ecological toxicity), natural capital, and nonmarket services (e.g., litter control, graffiti control, illegal dumping cleanup, watershed ecological management, and recycling) that often are bundled with traditional market-based services such as water supply, wastewater management, and garbage collection. Particular expertise and interest in accounting for externalities and nonmarket products & services in decision-making.

Clients include the US Department of Justice, WA Department of Ecology, WA Clean Washington Center, MA Department of Environmental Protection, MA Executive Office of Environmental Affairs, ON Ministry of the Environment, King County (WA), San Luis Obispo County (CA), Seattle Public Utilities, New York City, San Francisco, Toronto (ON), Vancouver (BC), Halifax (NS), MA Public Interest Research Group, RI Clean Water Fund, NJ Environmental Federation, and Pollution Probe (Toronto).

Employment History

2008 - 2009 Visiting Faculty, The Evergreen State College, Olympia, WA – teaching Ecological and Social Sustainability, a required course for the Master of Environmental Studies degree

1987 - Present Principal, Sound Resource Management Group, Inc., Olympia, WA

1985 - 2001 Chief Forecaster, PhotoWorks (previously Seattle FilmWorks), Seattle, WA

1978 - 1984 Self-employed, Advocacy Econometrics, Bellingham, WA

1975 - 1977 Assistant Professor of Economics, University of Colorado, Denver, CO

1971 - 1973 Assistant Professor of Economics, University of Washington, Seattle, WA

1972 Project Director, US NIE grant on Educational Training and Careers of Ph.D.s

1969 - 1970 Research Analyst, Ford Foundation Program for Research in University Administration

1964 - 1966 Financial Analyst, Price Analysis and Programming/Production Scheduling Departments, Finance Staff, Ford Motor Company, Dearborn, MI

Peer-Reviewed Articles

Measuring environmental value for natural lawn and garden care practices, with co-author Jennifer Bagby, *International Journal of Life Cycle Assessment*, Vol. 13, No. 3, May 2008, pp. 226-234

A hedonic model for evaluating the effect of illegal dumping on residential home prices, with co-author Gregory M. Duncan, *Journal of Risk and Uncertainty* (invited submission 2006)

Comparative LCAs for curbside recycling versus either landfilling or incineration with energy recovery, *International Journal of Life Cycle Assessment*, Vol. 10, No. 4, July 2005, pp. 273-284

Recycling versus incineration: An energy conservation analysis, *Journal of Hazardous Materials*, Vol. 47, Issues 1-3 (Special Issue on Energy-from-Waste), May 1996, pp. 277-293

Inside the Standard Industrial Classification codes: How many paper mills are there in Washington? with co-author Frank Ackerman, *Structural Change and Economic Dynamics*, December 1993

Source separation vs. centralized processing: An avoided-cost optimization model provides some intriguing answers, *Journal of Resource Management and Technology*, Vol. 19, No. 1, March 1991, pp. 37-46

Some simple tests of the direct effect of education on preferences and nonmarket productivity, *The Review of Economics and Statistics*, Vol. LVIII, No. 1, February 1976, pp. 112-117

Reviewed Studies

- The Washington State Consumer Environmental Index (CEI) – A Summary of the Development of a Tool to Understand and Support Consumer Choices That Have Preferable Environmental Outcomes*, prepared for the Washington State Department of Ecology, July 2007
- Economic & Environmental Benefits of a Deposit System for Beverage Containers in the State of Washington*, with co-authors Rick Hlavka and Bill Smith, City of Tacoma Solid Waste Management, Tacoma, WA 2005
- Comparison of Environmental Burdens: Recycling, Disposal with Energy Recovery from Landfill Gases, and Disposal via Hypothetical Waste-to-Energy Incineration*, San Luis Obispo County 2002, San Luis Obispo County Integrated Waste Management Authority, San Luis Obispo, CA 2004
- Pathways to Sustainability: A Comprehensive Strategic Planning Model for Achieving Environmental Sustainability – Developed at the Washington State Department of Ecology for Use in Public and Private Organizations*, prepared with the Washington State Department of Ecology, Olympia, WA 2003
- Understanding Beverage Container Recycling: A Value Chain Assessment prepared for the Multi-Stakeholder Recovery Project*, with RW Beck, Boisson & Associates, Franklin Associates, and Tellus Institute, Global Green – Businesses and Environmentalist Allied for Recycling, San Francisco, CA 2002
- Economic & Environmental Benefits of Updating Massachusetts' Bottle Bill*, Massachusetts Public Interest Research Group, Boston, MA 1998
- Recycled Material Prices – Two decades Past & Future*, City of Seattle Solid Waste Utility and Washington State Clean Washington Center, Seattle, WA 1994
- The Economics of Recycling and Recycled Materials*, Clean Washington Center - A Division of the Washington State Department of Trade and Economic Development, Seattle, WA 1993
- Review of Waste Management Systems Options – City of Halifax (NS)*, with Angus Environmental Ltd., The City of Halifax Waste management Task Force, Halifax, NS 1992
- Recycling Versus Incineration:: An Energy Conservation Analysis*, with co-author Diana Canzoneri, Pollution Probe, Toronto, ON 1992
- Household Mixed Waste Paper Recycling – Volume 3: Analysis of Paper Sorting Facilities*, New York City Department of Sanitation, New York City, NY September 1990
- Household Mixed Waste Paper Recycling – Volume 2: Paper Mill Survey Results and Existing & Potential End Uses for New York City's Household Mixed Waste Paper*, New York City Department of Sanitation, New York City, NY July 1990
- Household Mixed Waste Paper Recycling – Volume 1: Domestic & European Collection Program Survey Results and Urban Household Waste Paper Generation Data*, New York City Department of Sanitation, New York City, NY February 1990
- The Duration of Participation in AFDC – A Comparison of Two Systems for Reporting Eligibility*, Mathematica Policy Research, Princeton, NJ 1979
- Educational Training and Careers of Ph.D. Holders – Academic Training and Occupational Mobility: Ph.D.'s Often Find Other Scientific Fields Greener*, National Institute of Education, US Department of Health, Education and Welfare, Washington, DC 1973
- Some Theoretical Results on Rate of Return Analysis for Investments in Education*, University of Washington Institute for Economic Research, Discussion Paper No. 73-8, Seattle, WA April 1973
- Towards a Theory of the Flexibility-Specialization Trade-off in Educational Investments*, University of Washington Institute for Economic Research, Discussion Paper No. 73-7, Seattle, WA April 1973
- Educational Training and Careers of Ph.D. Holders – An Exploratory Empirical Study*, University of California Ford Foundation Program for Research in University Administration, Paper P-27, Berkeley, CA January 1972

Other Published Articles

- Best practices in residential collection, part 2: Minimizing generation and maximizing diversion, *Resource Recycling*, May 2004
- Best practices in residential collection, part 1: Determinants of collection quantities, *Resource Recycling*, April 2004
- Measuring the advantages of curbside collection, *Resource Recycling*, August 2002
- Tire recycling choices made easy: Results of recent findings, *Resource Recycling*, March 2002
- Measuring apples and oranges in waste generation, *Resource Recycling*, May 2000
- What works best to increase waste diversion? *Resource Recycling*, Jan 2000

Other Published Articles (continued)

- Incentives to recycle - an end to the Seattle Stomp, *Warmer Bulletin*, No. 70, Jan 2000
- There must be 50 ways to pick a number, *Resource Recycling*, May 1998
- Looking into a crystal ball: What explains the value of recovered paper, with co-authors Jennifer Bagby and Preston Horne-Brine, *Resource Recycling*, November 1993
- The economics of recycling, with co-author Susan Bogart, *Resource Recycling*, September 1993
- Comparative lifecycle energy analysis: Theory & practice for measuring energy in waste, with co-author Diana Canzoneri, *Resource Recycling*, November 1992
- Three 80s for the 90s will cut waste in half, with co-author Lawrence W. Dickey, *Resource Recycling*, March 1991
- Mixed paper recycling practices in North America, *Resource Recycling*, January 1991

Selected Conference & Webinar Presentations

- The green economy: Oxymoron vs. coexistence, or can an oxy-moron learn to coexist? Keynote address at Recycling Council of British Columbia 2009 annual conference - ECONomics: The Green Economy Summit by RCBC
- Biomass management: Ranking management options for wood, yard debris & food scraps. Life Cycle Assessment VIII. 2008
- Lessons learned on LCA impact assessments from analysis of wood & carpet discards management. Special session on Industrial Ecology at Life Cycle Assessment VIII. 2008
- Measuring the environmental impacts of discards management: Models, methods & results. US EPA Live West Coast Webinar at the California Resource Recovery Association annual conference. 2008
- Measuring the environmental impacts of organic material discards. California Resource Recovery Association annual conference. 2008
- Developing indicators to measure environmental progress that are as comprehensive and robust as our economic indicators. 2008 Pacific Northwest Region Economic Conference.
- CEI: A consumer environmental index for Washington State. 2008 National Environmental Partnership Summit.
- Discarded resources management: An environmental & economic comparison of recycling, composting, and disposal (with energy recovery). Keynote address to conference on the environmental and economic impacts of waste management, sponsored by the Quebec (Canada) Ministry of the Environment and the Quebec Recycling Authority. 2008
- Zero waste & waste management in Italy. Conference on local, national and international strategies, sponsored by Comune di Capannori. 2008
- The environmental impacts of discards. Informational presentation to the Environmental Review Tribunal of Ontario (Canada). 2007
- The perils of public health and ecosystems – can a Cyclops see 3D? Washington State Recycling Association Annual Conference. 2007
- The environmental economics of discards. Keynote address for the Recycling Council of Ontario Energy From Waste Forum. 2006
- Life cycle analysis of yard, food and wood waste management options. Biocycle West Coast Conference. 2006
- The economics of backyard composting revisited: Accounting for participant time, compost produced, and ecological benefits, with Jennifer Bagby. 3rd Biennial Conference of the US Society for Ecological Economics. 2005
- Disposal by whatever name still stinks of wasted resources. Keynote address for the Solid Waste Association of North America Winter 2005 Technical Symposia. 2005
- Zero waste economics – global benefits, local costs. International Dialog on Proper Discards Management. 2004
- Preventing pollution and conserving resources by turning trash into jobs: Sustainable economic development for Washington. Pacific Northwest Region Economic Conference. 2004
- Collection fees for single-family discards: characteristics and impacts on waste generation and diversion in King County, WA. Rural Community Assistance Program Conference. 2004

Selected Conference Presentations (continued)

- Energy conservation and pollution prevention/biodiversity enhancing benefits of curbside recycling versus landfill disposal or waste-to-energy incineration disposal. International Life Cycle Analysis and Life Cycle Management Conference. 2003
- What will it take to make diversion of recyclables and organics profitable? BioCycle West Coast Conference. 2003
- Recycling & recycling markets: what will it take to make recycling profitable? Solid Waste Association of North America Waste Reduction, Recycling and Collection Symposium. 2003
- Zero waste economics: prices for garbage vs. recycling are telling the wrong story. Pennsylvania Department of Environmental Protection Professional Recyclers of Pennsylvania Certification Training. 2002
- Making pilot projects sustainable. Recycling Association of Minnesota/Solid Waste Association of North America Annual Conference. 2002
- The pollution prevention benefits of curbside recycling in Washington State; and policy options for correcting the "free" market's failure to correctly price recycling vs. garbage collection/disposal. Closing plenary session for Washington State Recycling Association Annual Conference, 2002
- Zero waste economics: Think globally, pay locally. 6th World Congress on Integrated Resources Management, Geneva, Switzerland, 2002
- The future of recycling. Closing plenary session panel discussion for 20th National Recycling Coalition Congress, 2002
- Three empirical studies on collection/diversion system effectiveness: Residential refuse, recyclables, & yard debris collection; commercial refuse collection. 20th National Recycling Coalition Congress, 2002
- Tracking standards for reporting diversion. California Resource Recovery Association Annual Conference, 2001
- The waste prevention vs. recycling trade-off in variable rates. 19th National Recycling Coalition Congress, 2000
- Comparative analysis of internet sites for trading recycled materials. 19th National Recycling Coalition Congress, 2000
- Picking the best recycling program for your community. 18th National Recycling Coalition Congress. 1999
- Economic & environmental benefits of recycling. 17th National Recycling Coalition Congress, 1998
- The economics of recycling and zero waste perspective. California Resource Recovery Association Annual Conference, 1997
- Mechanisms for hedging against recycled paper price fluctuations. Pulp and Paper Week's Annual International Paper Recycling Conference, 1997
- Energy conservation from recycling. Catalonian (Spain) Conference on Energy & Wastes, 1997
- Recycling market prices and recycling economics. Western States Legislative Conference, 1995.
- Economics of recycling in full perspective. 13th National Recycling Coalition Congress, 1994.
- Prices, prices, prices – Will the future bring the same old roller coaster ride? Solid Waste Association of North America Northwest Regional Solid Waste Symposium, 1994
- Economics of recycling and recycled materials. 12th National Recycling Coalition Congress, 1993
- Calculating economic markets for recyclables. New York State Legislative Committee on Solid Waste Management's 8th Annual Conference on Solid Waste Management and Materials Policy, 1992
- Source separation vs. centralized processing. Journal of Resource Management and Technology's 6th International Conference on Solid Waste Management and Secondary Materials, 1990
- Integrated waste management program planning. 9th National Recycling Coalition Congress, 1990.
- Source separation vs. centralized processing. EPA's 1st U.S. Conference on MSW Management, 1990.
- Markets today vs. the past decade and the need for a recyclables commodity exchange. Washington State Recycling Association Annual Conference, 1989

Professional Associations & Committees

International Association of Environmental and Resource Economists (2007-present)
American Economic Association (2000-present)
National Recycling Coalition (1987-present)
Washington State Recycling Association (1987-present)
Northwest Council on Product Stewardship (2000-2002)
Subcommittee on Hazardous Waste Planning, Washington State Solid Waste Advisory Committee (1989-91)
Regulatory Structures Advisory Committee, Washington State Utilities and Transportation Commission (1990)
Technical Advisory Subcommittee on Markets, Washington State Legislature Joint Select Committee for Preferred Solid Waste Management (1988)

Education

1971 Ph.D., Economics, *University of California - Berkeley*
1969 M.A., Mathematical Statistics, *University of California - Berkeley*
1964 M.B.A., Finance & Operations Research, *Northwestern University*
1963 B.S.B.A., General Business, *Northwestern University*