Materials Management and Greenhouse Gas Mitigation Potential within OECD Countries

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Workshop on Methods to calculate GHG mitigation potentials in Solid Waste Management

Presse- und Besucherzentrum,

Reichstagsufer 14, 10117 Berlin

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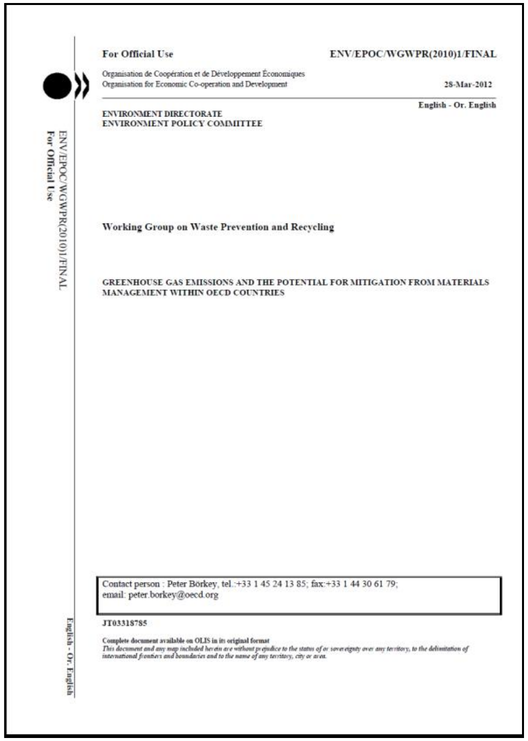
Outline

- Brief background on the study
- Results
- Discussion of major influencers or assumptions



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Working Group on Waste Prevention and Recycling

GREENHOUSE GAS EMISSIONS AND THE POTENTIAL FOR MITIGATION FROM MATERIALS MANAGEMENT WITHIN OECD COUNTRIES

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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT
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BETTER POLICIES FOR BETTER LIVES DES POLITIQUES MEILLEURES POUR UNE VIE MEILLEURE

March 2012

GREENHOUSE GAS EMISSIONS AND THE POTENTIAL FOR MITIGATION FROM MATERIALS MANAGEMENT WITHIN OECD COUNTRIES

Key Messages

- Due to the integrated stages of materials production, consumption and end-of-life management, a systems view is needed to assess GHG emissions associated with materials and waste.
- When viewed from a life-cycle perspective, GHG emissions arising from material management activities are estimated in this study to account for 55 to 65 percent of national emissions for four OECD member countries. This suggests that there is a significant opportunity to potentially reduce emissions through modification and expansion of materials management policies.
- Integrated waste management practices represent one set of materials management options available that can achieve GHG reductions in OECD member countries

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- An order-of magnitude estimate of life-cycle GHG reductions across potential municipal solid waste management scenarios shows that achievable reductions are on the order of current annual emissions from the conventional waste sector quantified in OECD countries' GHG inventories. In other words, in most countries, at least 4 percent of current annual GHG emissions could be mitigated if waste management practices were improved.
- The new OECD report "Greenhouse gas emissions and the potential for mitigation from materials management within OECD countries" provides support to governments in showing the importance of using a life-cycle approach to analyse GHG mitigation options from materials management. Further, the literature suggests that substantial emission reductions can be achieved at low or zero costs.

Consider life-cycle analysis in order to assess GHG emissions from materials and waste more accurately

Although GHG emissions from the waste sector typically account for 3 to 4 percent of total emissions in OECD member countries' GHG emission inventories, this emission source only considers direct emissions primarily from landfill methane emissions and incinerators. In contrast, a life-cycle perspective of materials management-related GHG sources encompasses emissions from the acquisition, production, consumption, and end-of-life treatment of physical goods in the economy. This perspective allows policy-makers to evaluate a more complete, systems-based understanding of the relationships between materials management activities and their associated climate-related impacts.

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For more information see www.oecd.org/env/waste

Overview of Timeline, Comment Response, Final report

2010

- **Project Initiation** (February)
- **Draft Presented** (October)
- **Comments Received*** (November)

2011

- **Final Delivered to OECD** (March)

2012

- **Final available to public OECD** (March)

* Formal comments from

- Canada, France, Germany, the United States, the European Commission, the Business and Industry Advisory Committee to the OECD (BIAC), and the OECD

- ICF conducted a comprehensive review

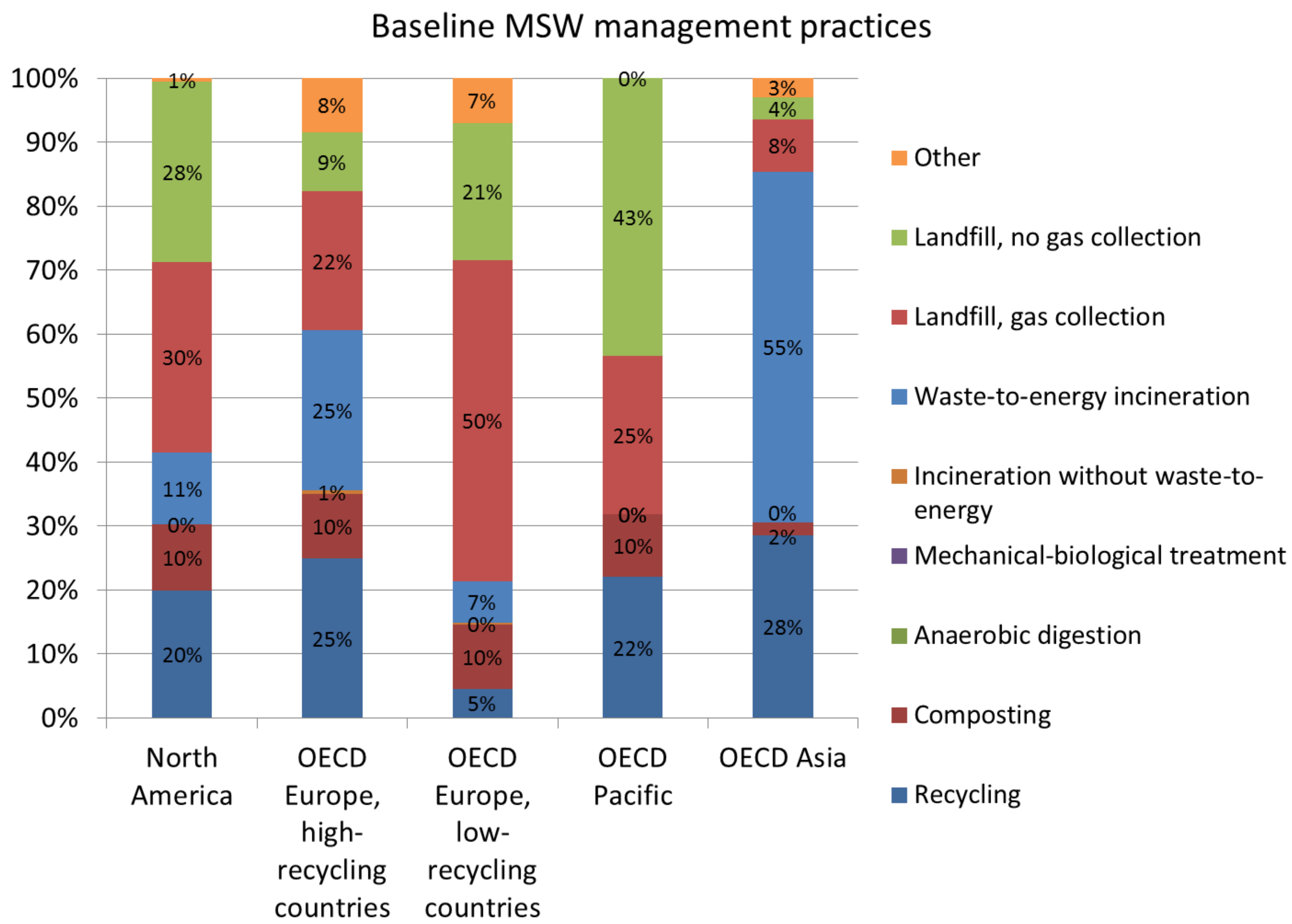
Overview of Study

- **GOAL: Provide OECD with an initial framework for observing the relationship between materials management and greenhouse gas (GHG) emissions**
- Separate but interrelated analyses using a materials management perspective
  1. Reallocation of national GHG inventory emissions from sector-based to systems-based to highlight emissions associated with materials management
  2. GHG emissions mitigation potential of alternative municipal solid waste (MSW) management practices

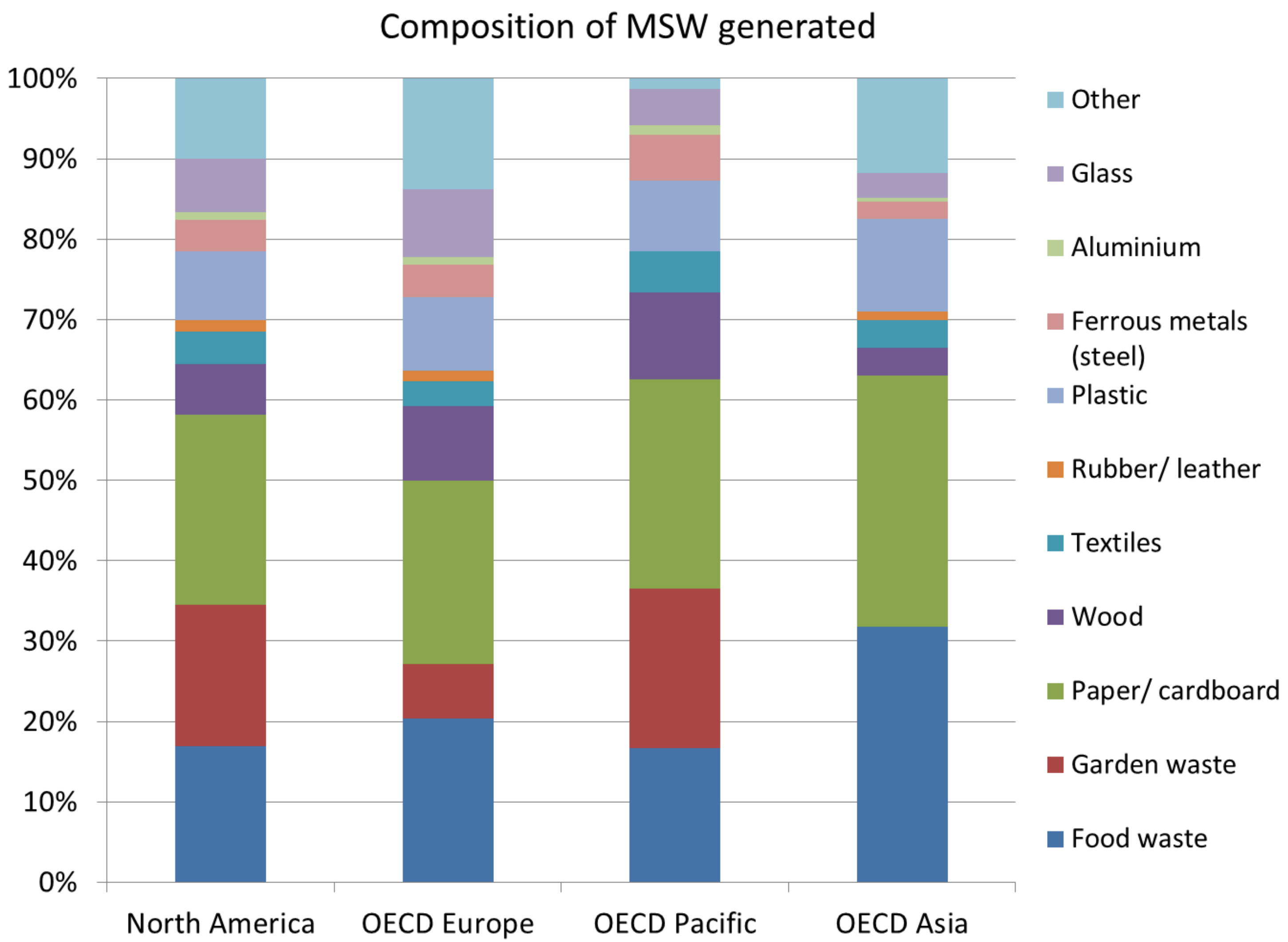
Development of regional waste management GHG mitigation model

- Method for evaluating **life-cycle** GHG mitigation potential from alternative waste management practices and source reduction:
  1. Developed **regional groups**.
  2. Described **MSW management options**.
  3. Established **current MSW generation, composition, MSW management practices** for each region.
  4. Evaluated **GHG emissions and reductions** using life-cycle emission factors.
  5. Extrapolated **baselines out to 2030.**
  6. Specified **alternative scenarios in 2030**.
  7. **Calculated mitigation potential** between alternative vs. baseline practices for each scenario.

Baseline MSW Waste Management Practices



MSW Waste Composition



GHG Mitigation Scenarios Evaluated

No.	Scenario	Current Rates by Region*	Description of Technically-Achievable Rates
1	Recycling	NA:20%, HE:25%, LE:5%, AN:22%, JK:28%	Recycling rates of Paper: 85%; Wood: 65%; Textiles: 50%; Plastic: 40%; Ferrous: 95%; Aluminium: 87%; Glass: 85%.
2	Composting	NA:10%, HE:10%, LE:10%, AN:10%, JK:2%	Food and garden composting rates of 80%.
3	Anaerobic digestion with energy recovery	NA:0%, HE:0%, LE:0%, AN:0%, JK:0%	Food and garden composting rates of 80%.
4	Recycling and Mechanical Biological Treatment (MBT)	NA:0%, HE:0%, LE:0%, AN:0%, JK:0%	Scenario 1 recycling rates; for remaining MSW, 75% processed by MBT, 25% landfilling and incinerated.
5	Increased landfill gas capture efficiency and collection	NA:30%, HE:22%, LE:50%, AN:25%, JK:8%	87% LFG capture efficiency.
6	Increased landfill gas energy recovery	NA:30%, HE:22%, LE:50%, AN:25%, JK:8%	87% LFG capture efficiency and used 100% for electricity generation.
7	Incineration	NA:11%, HE:25%, LE:7%, AN:0%, JK:55%	85% incineration rate with 50% of energy recovered for heat and 16% for electricity in CHP units.
8	Source reduction	NA:0%, HE:0%, LE:0%, AN:0%, JK:0%	30%

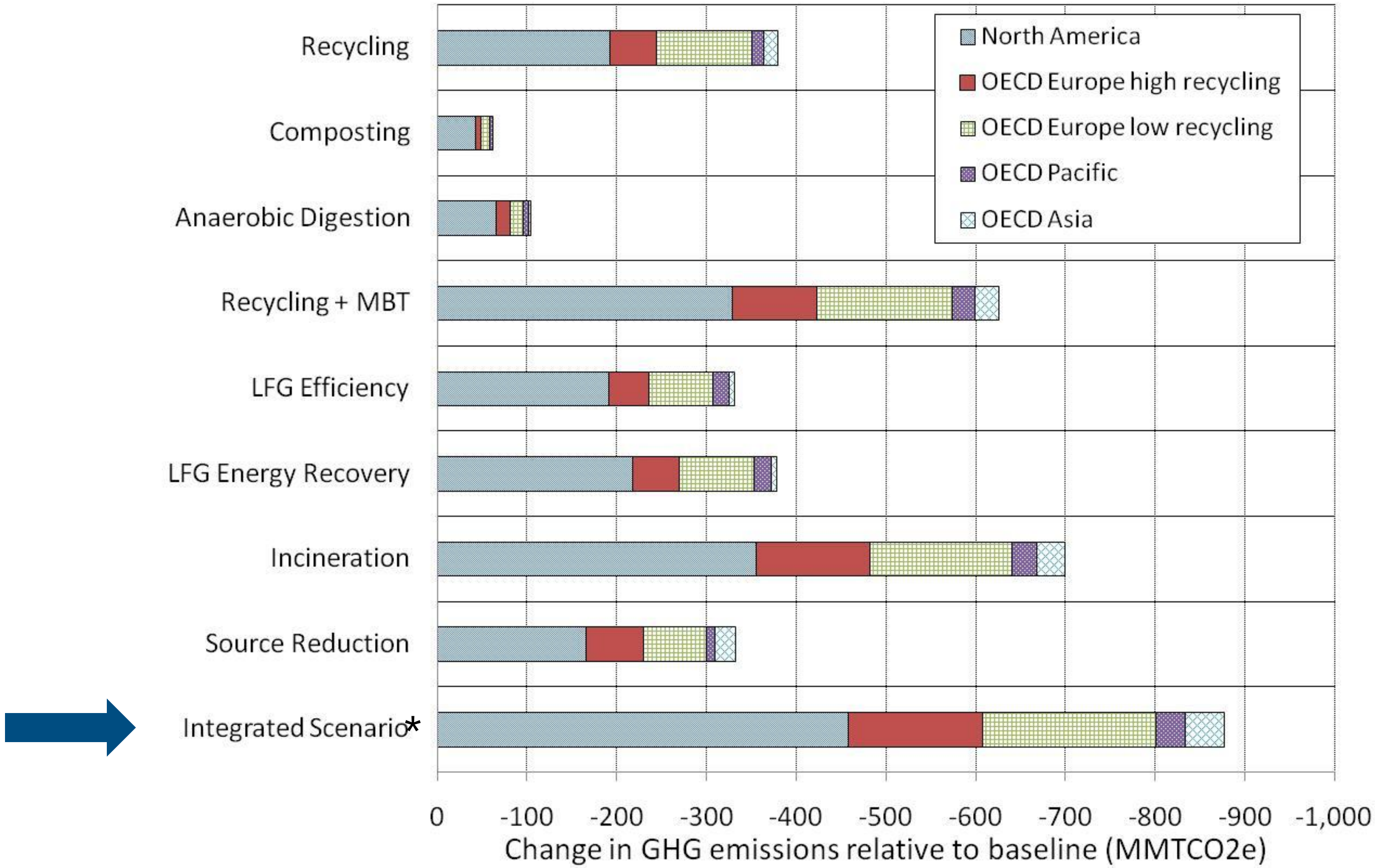
*NA = North America, HE = High Recycling Europe, LE = Low Recycling Europe, AN = Australia/New Zealand, JK = Japan/ S Korea

Life-cycle emission factors for MSW management (GHG emissions/unit of waste)

- *Recycling* – net emissions for remanufacture and avoided virgin production
- *Composting* – net emissions from treating, processing and transporting organic waste
- *Landfilling* – net emissions associated with landfill operation and methane emissions from landfills (including elec. offset).
- *Anaerobic Digestion* – net emissions from methane generation biowaste, and an electricity offset included
- *Incineration* – net emissions from the incineration process, the energy content of the material incinerated (including elec. offset).
- *Mechanical Biological Treatment (MBT)* – net emissions from operation and landfilling the treated organic components (including electricity offset)
- *Source Reduction* – net emissions from avoided upstream manufacture

GHG Mitigation from Alternative MSW Mgmt

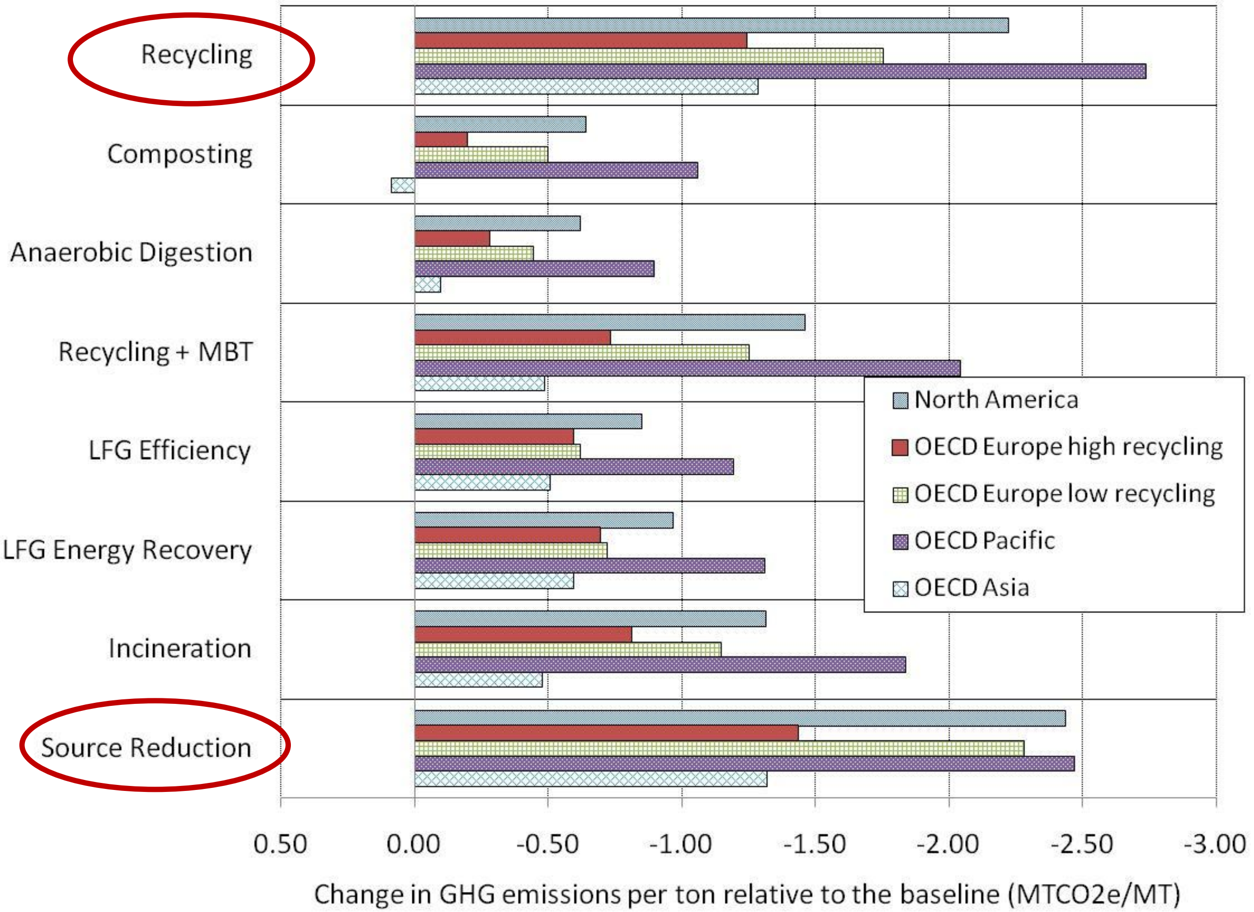
Absolute Reduction in GHGs relative to baseline practices by implementing alternative MSW management practices in 2030 across OECD regions



*In the integrated scenario, source reduction, recycling, and composting are implemented at their technically-achievable levels and the remaining MSW fraction is processed in highly-efficient incineration facilities with energy recovery.

GHG Mitigation from Alternative MSW Mgmt (cont.)

Change in GHGs **Per Metric Ton** of MSW Diverted to Alternative MSW Management Scenarios Relative to Baseline Practices in 2030 across OECD Regions



Study Conclusions

- **Source reduction and recycling** provide the **highest reduction in GHG emissions per metric ton** of MSW diverted.
- ***Integrated* waste management practices** offer the **greatest benefit** in GHG mitigation.
- **MSW management policies are one lever** for reducing emissions.
- **Economic, political, and social conditions** will play an important role in determining which and to what extent policies are realized.

Key Assumptions – Appendix C

Large influencers

- Baseline waste management practices and composition remain constant through time
- Biogenic carbon storage is excluded for consistency across regions
- Waste diverted from landfilling and incineration equally
- Technical potentials of incineration scenario (85%) and source reduction scenario (30%)

Small influencers

- WTE and LFG to energy electricity offset is calculated at the margin
- LFG collection efficiency potential
- Technical potential of recycling rates (including composting)

Options for improvement: Mitigation Analysis

- Improve existing analysis:
  - Include other waste streams beyond MSW;
  - Investigate effects of landfill, soil, and forest carbon storage;
  - Account for region-specific characteristics in more detail;
  - Incorporate dynamic effects from large scale changes in MSW management practices;
  - Develop framework for detailed economic analysis of costs and benefits of abating GHG emissions;
  - Use economic and infrastructure considerations when designing policy scenarios.

Acknowledgments

- The following OECD member countries and organizations: Canada, Germany, France, United States, European Commission, Business and Industry Advisory Committee to the OECD (BIAC) **for their thoughtful comments**, critiques, and ideas on the report.
- Peter Börkey, Henrik Harjula, Anthony Cox, and Soizick de Tilly of the OECD for their **guidance, direction, and support of this study.**
- Christopher Evans, Deanna Lizas, Veronica Kennedy, Nikhil Nadkarni, Emily Rowan, Randall Freed, and Pam Mathis from ICF International **for conducting the analyses, writing, and compiling the report.**

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Appendix Slides for further information

Introduction and Background

Sustainable Materials Management – *"an approach to promote sustainable materials use, integrating actions targeted at reducing negative environmental impacts and preserving natural capital throughout the life-cycle of materials, taking into account economic efficiency and social equity."*

- OECD working definition

Life-cycle perspective for materials

- Raw material acquisition
- Manufacturing
- Transportation
- Use
- End-of-Life

Figure 16. OECD Europe High Recycling Countries - Change in GHG Emissions Relative to Baseline MSW Management Practices Resulting From Implementation of Alternative MSW Management Scenarios in 2030

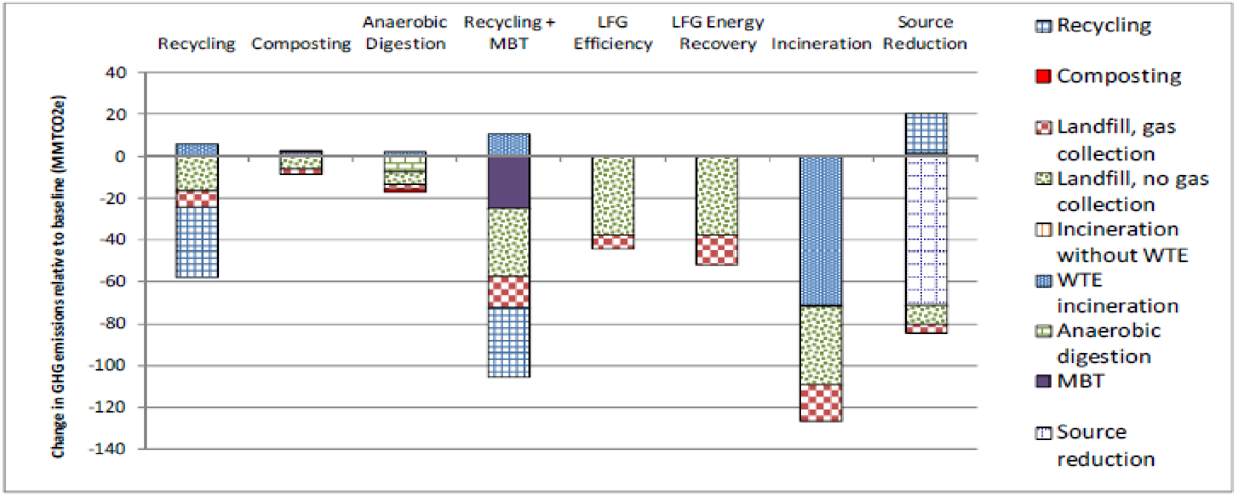
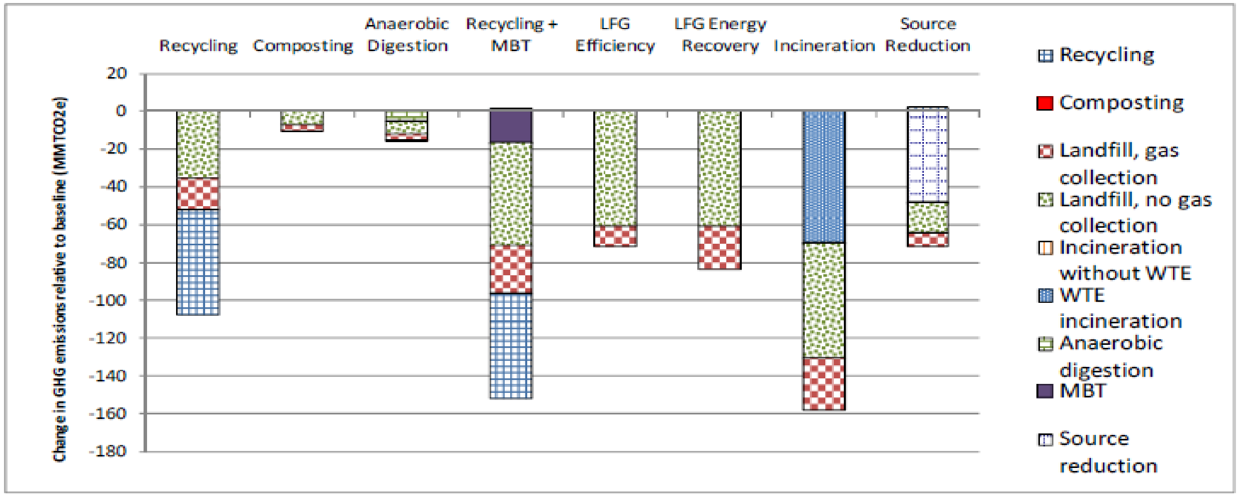


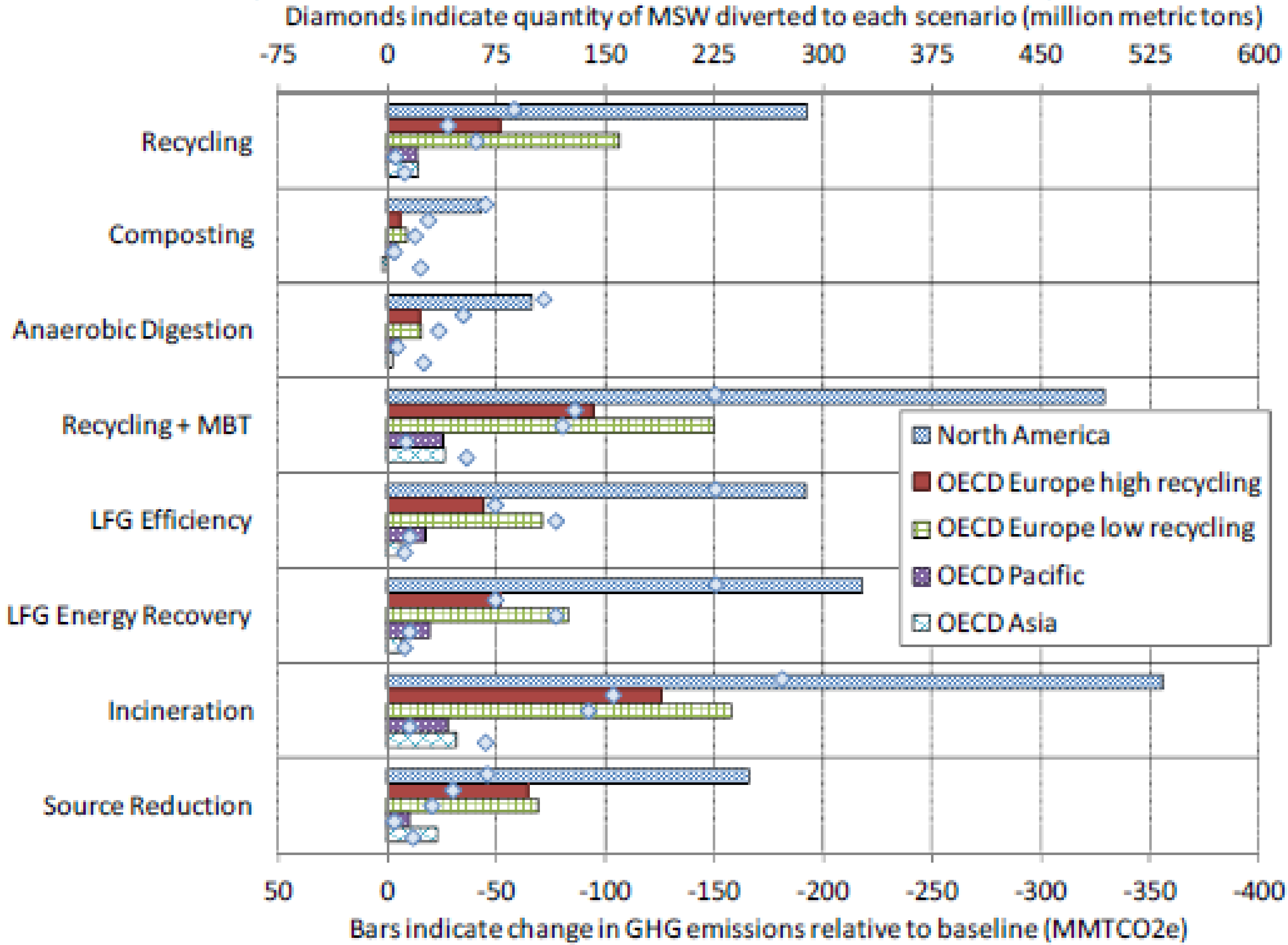
Figure 17. OECD Europe Low Recycling Countries - Change in GHG Emissions Relative to Baseline MSW Management Practices Resulting From Implementation of Alternative MSW Management Scenarios in 2030



How Can OECD Countries Make Use of This Study?

- Apply the GHG emissions system-reallocation framework to your country's GHG inventory.
  - Assess the results - are they in line with the case study examples, how do they vary, and why?
- Identify and consider policies that support integrated waste management solutions in your country.
- Engage with colleagues in climate/energy divisions to elevate materials management in climate change mitigation portfolio.
- Share best practices with other countries to facilitate progress toward realizing GHG mitigation technical potential.
- Use the results of this study to support your SMM program.

GHG Mitigation from Alternative MSW Mgmt



Key Insights from Analysis of GHG Mitigation Potential

- Nearly all of the alternative waste management scenarios result in GHG emission reductions.
- Key drivers of GHG mitigation potential:
  - Effectiveness of each scenario at reducing GHGs per ton of waste diverted (highest for recycling and source reduction)
  - Volume of waste generation in each region
  - Scenarios affecting a wide range of material types (e.g., incineration, recycling and mechanical biological treatment, or MBT)
  - Increasing recycling rates in regions with low recycling

Main Updates in Response to Comments

Key Comment/Concern	Solution
Desire for additional case studies to further illustrate the MM share of national GHG emissions	Developed two **additional case studies** for systems-based emissions analysis (Slovenia and Germany)
Concern about *perceived ranking* of waste management practices	•Evaluated the ***effectiveness*** (i.e., GHG emissions reduced per ton of MSW materials diverted) of each scenario, in addition to absolute (total) GHG reductions •Included an **integrated scenario** to strengthen the report's key finding that integrated MSW management practices are most effective •Clarified the report's key **messages** in the Executive Summary
Concern about assumptions in the GHG mitigation analysis	•**Clarified assumptions** and data inputs in the report and appendices, **but did not modify base assumptions.** •Added Appendix C to describe the rationale and data sources for the full list of assumptions

- Part 1 slides

1. Materials Management Allocation of GHG Emissions

- Scope – Reallocation of UNFCCC GHG data into specific systems categories that relate to materials management
- Applied similar approach to U.S. EPA OSWER's 2009 Foundation Paper

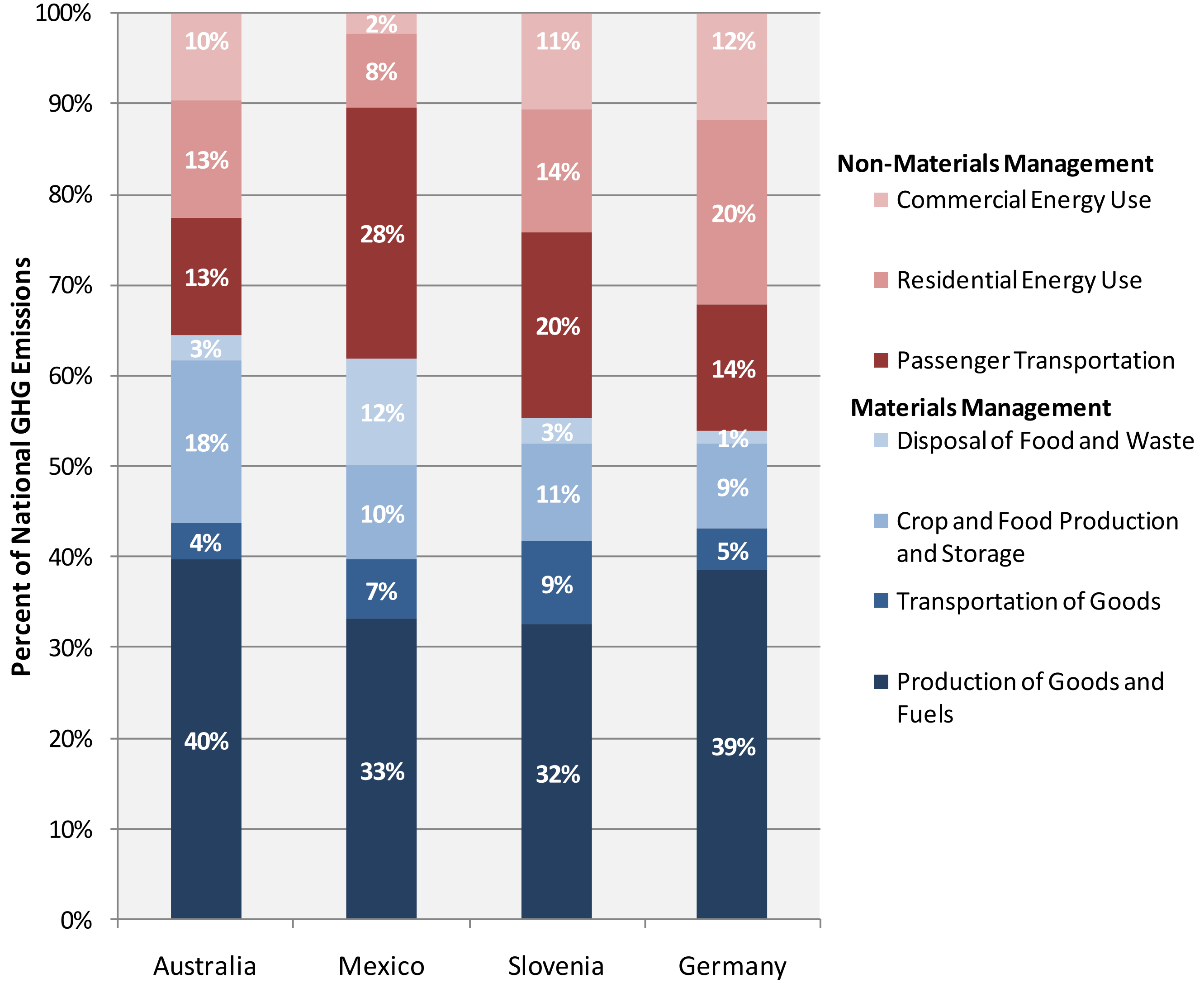
UNFCCC Tier 1 sectors
Energy
Industrial Processes
Solvent and Other Product Use
Agriculture
Waste
Other

OECD Systems Categories	Materials Management Activity?
Production of Goods and Fuels	Yes
Transportation of Goods	Yes
Crop and Food Production and Storage	Yes
Passenger Transportation	No
Residential Energy Use	No
Commercial Energy Use	No
Disposal of Food and Waste	Yes

National GHGs Attributable to Materials Management

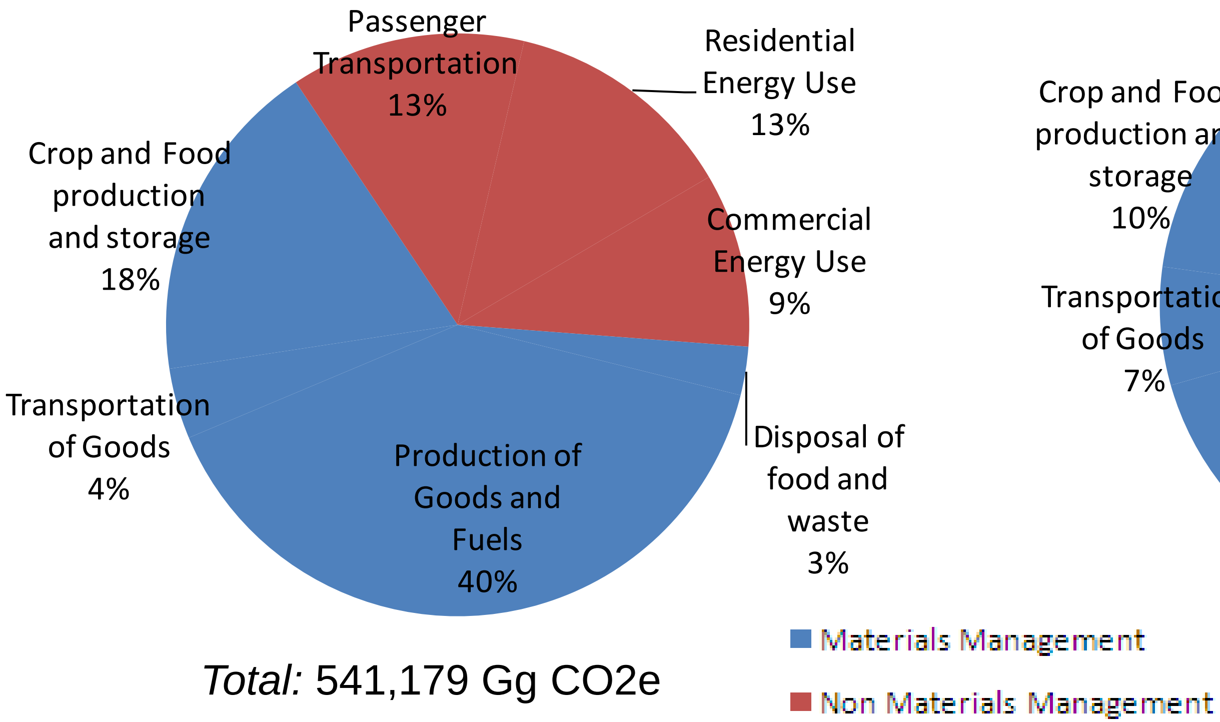
Australia, Mexico, Slovenia, and Germany national GHG emissions according to "systems-based" categories related to materials management (MM) activities and non-MM activities

GHG/capita in 2005 (MTCO2e)	
Australia	26.9
Mexico	6.1
Slovenia	10.1
Germany	11.9



Case Study Results – Systems-based GHGs

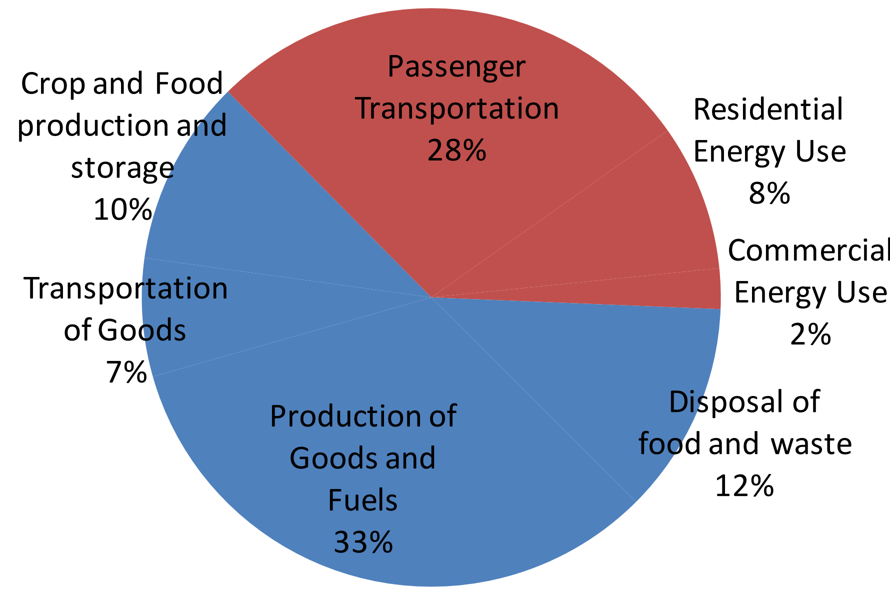
Systems-based Emissions Categories for Australia 2007



Total: 541,179 Gg CO2e

Estimated Materials Management Emissions as percent of total GHG emissions: **64%**

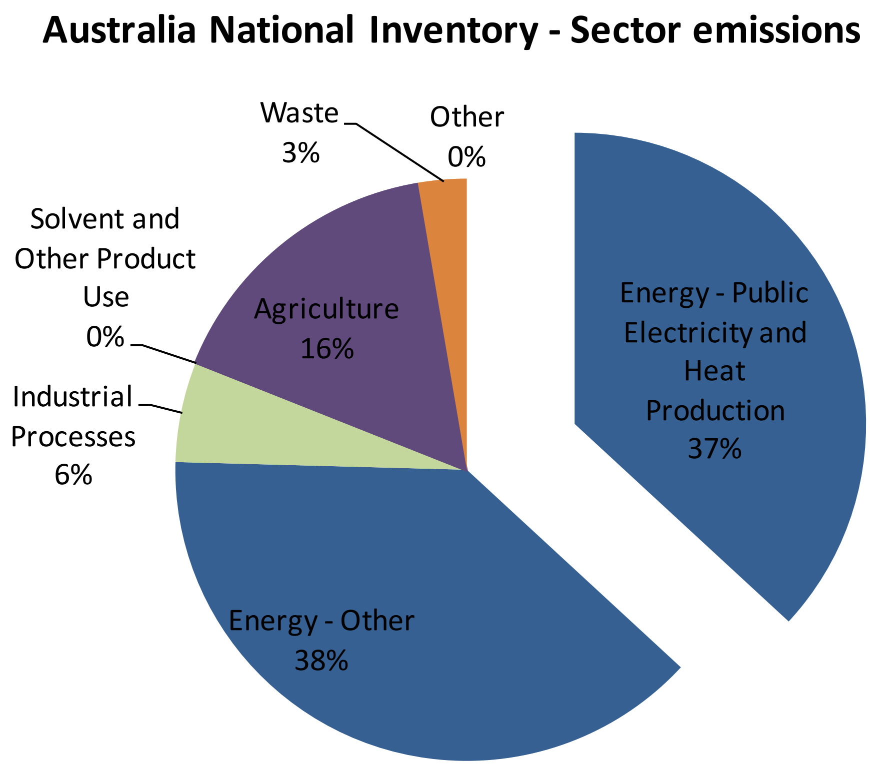
Systems-based Emissions Categories for Mexico 2002

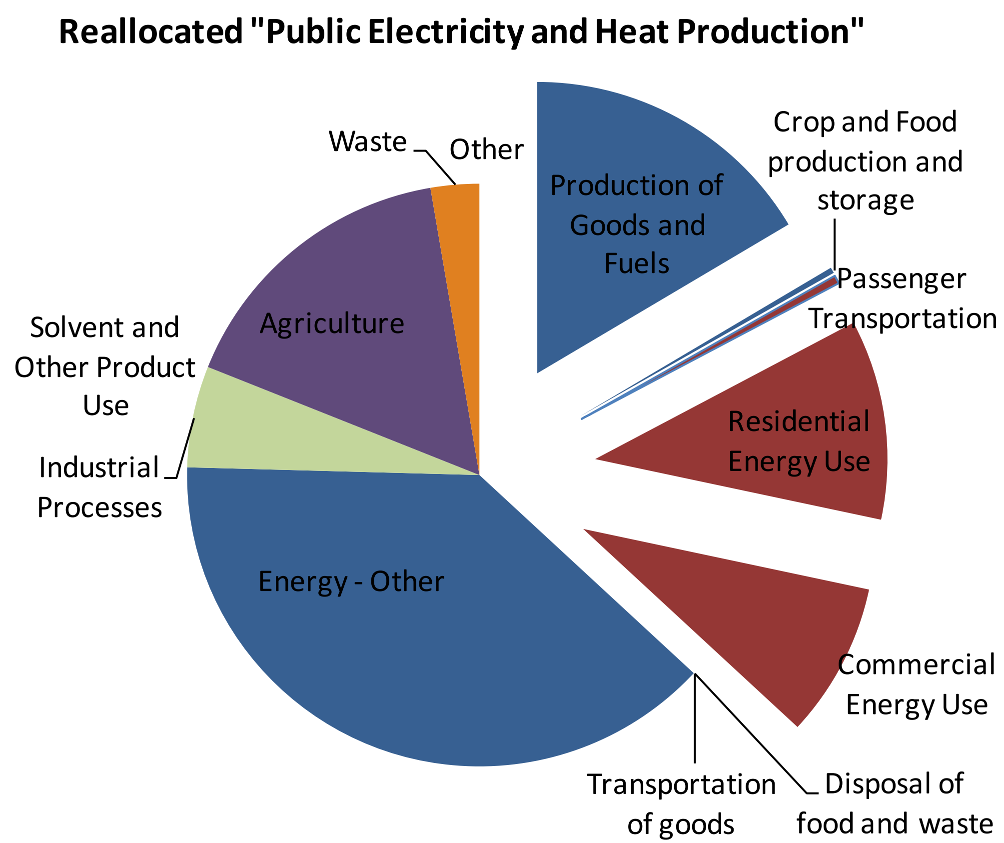


Total: 553,330 Gg CO2e

Estimated Materials Management Emissions as percent of total GHG emissions: **62%**

Example: “Public Electricity and Heat Production” Reallocation





Key Insights from Reallocation of GHGs into Systems Categories

- Systems perspective reveals
  - Magnitude of materials-related national GHG emissions (accounting for over 50% in four country case studies)
  - Systems along the life-cycle that contribute the most to national emissions and that offer potential for GHG mitigation from MM policies
- Provides policy makers with
  - Framework -- for estimating the relative GHG impact of economic activities that span multiple sectors.
  - First step -- in highlighting the importance of viewing GHG emissions from a systems based perspective.
  - Support -- to elevate importance of policies that stress sustainable materials production and consumption practices.
  - Insight – revealing areas across life-cycle for further investigation or intervention.