



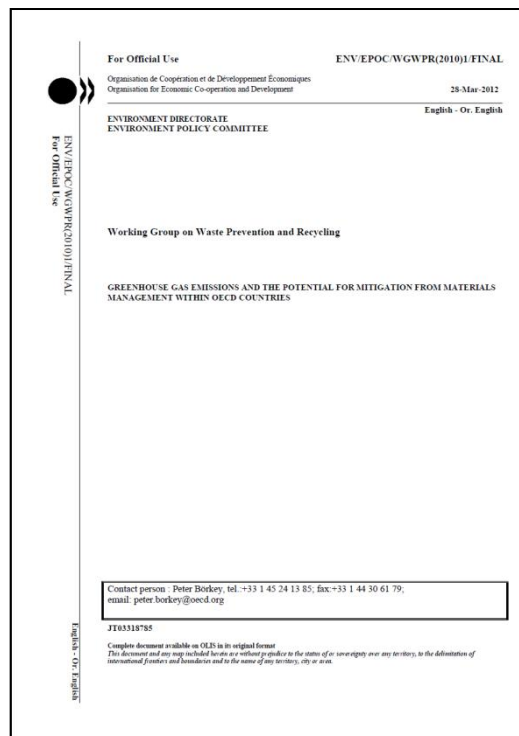
# Materials Management and Greenhouse Gas Mitigation Potential within OECD Countries

Adam Brundage, ICF International  
Workshop on Methods to calculate GHG mitigation potentials in Solid Waste Management

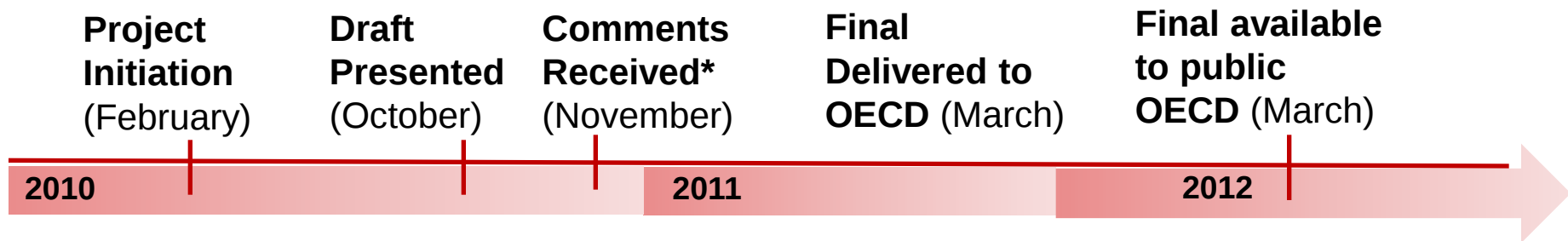
Presse- und Besucherzentrum,  
Reichstagsufer 14, 10117 Berlin  
18 June 2012, Berlin, Germany

# Outline

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



# Overview of Timeline, Comment Response, Final report



\* 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

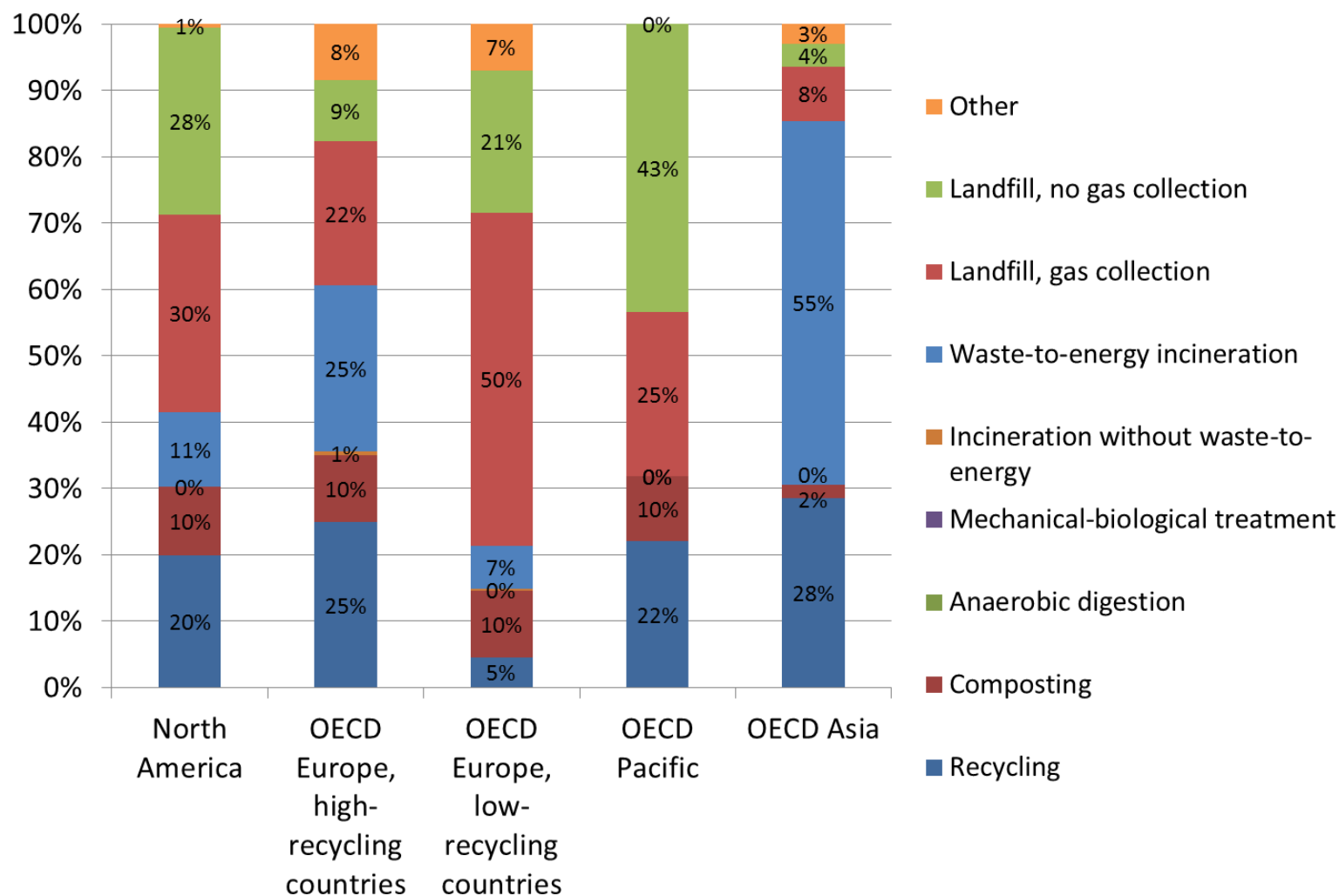
- **GOAL: Provide OECD with an initial framework for observing the relationship between materials management and greenhouse gas (GHG) emissions**
- Separate but interrelated analyses using a materials management perspective
  1. Reallocation of national GHG inventory emissions from sector-based to systems-based 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.

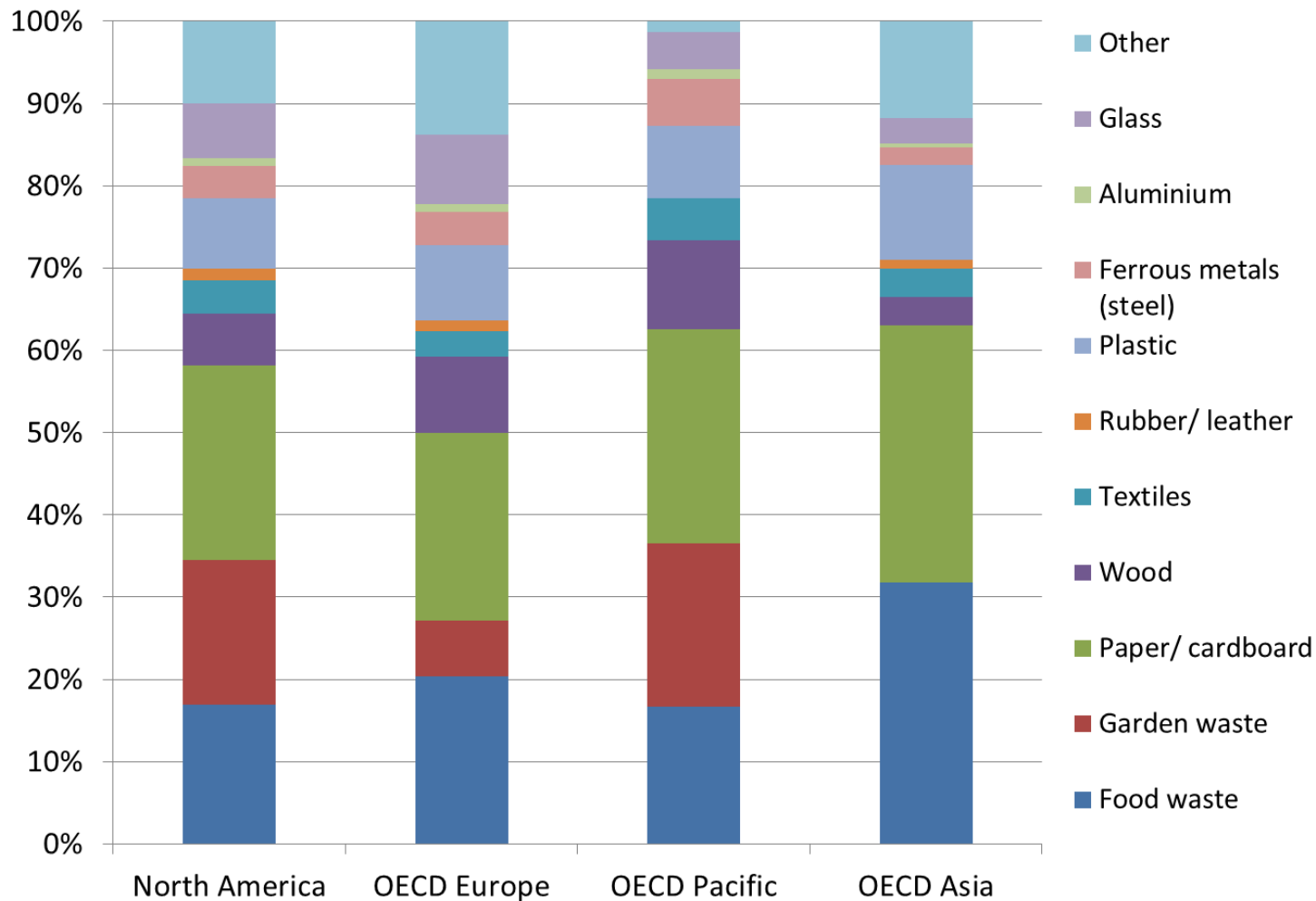
# Baseline MSW Waste Management Practices

Baseline MSW management practices



# MSW Waste Composition

Composition of MSW generated



# GHG Mitigation Scenarios Evaluated

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

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

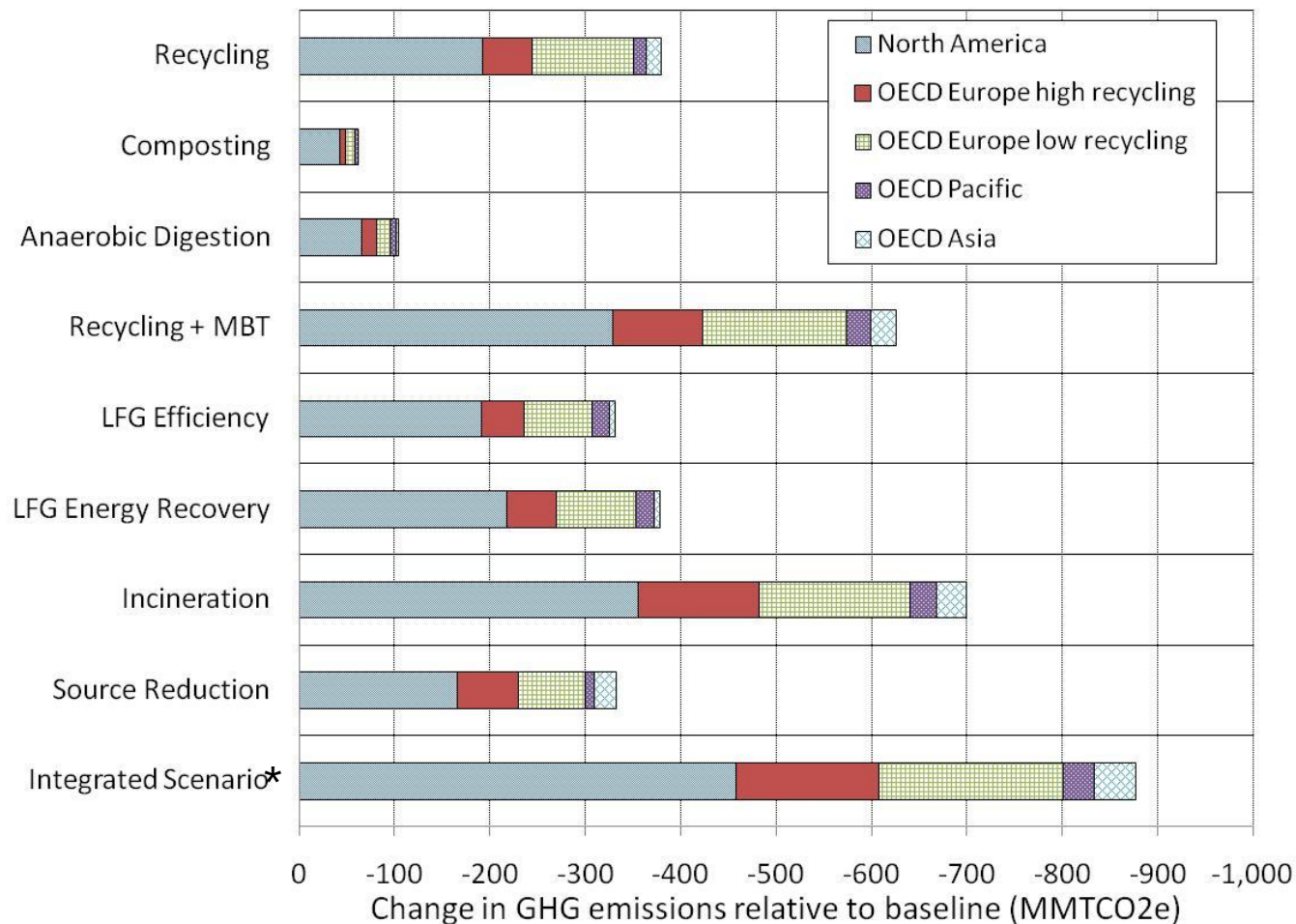
# Life-cycle emission factors for MSW management (GHG emissions/unit of waste)

- *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

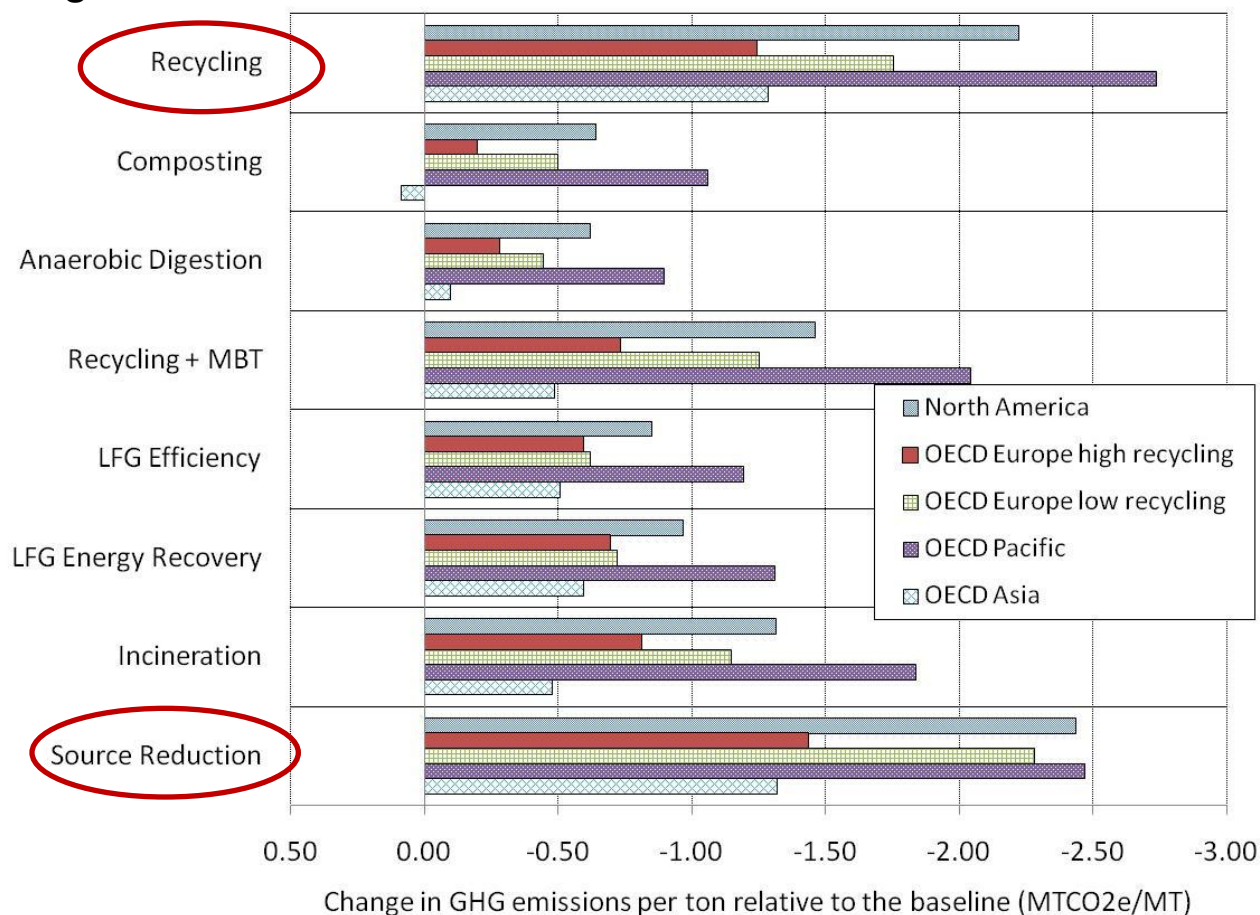
Absolute Reduction in GHGs relative to baseline practices by implementing alternative MSW management practices in 2030 across OECD regions



\*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.”*

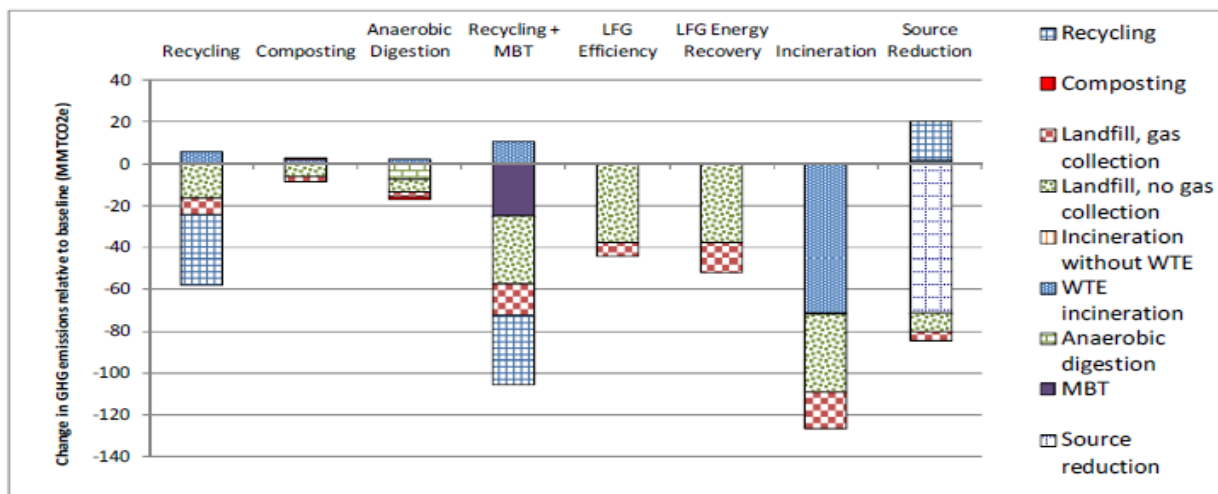
- OECD working definition



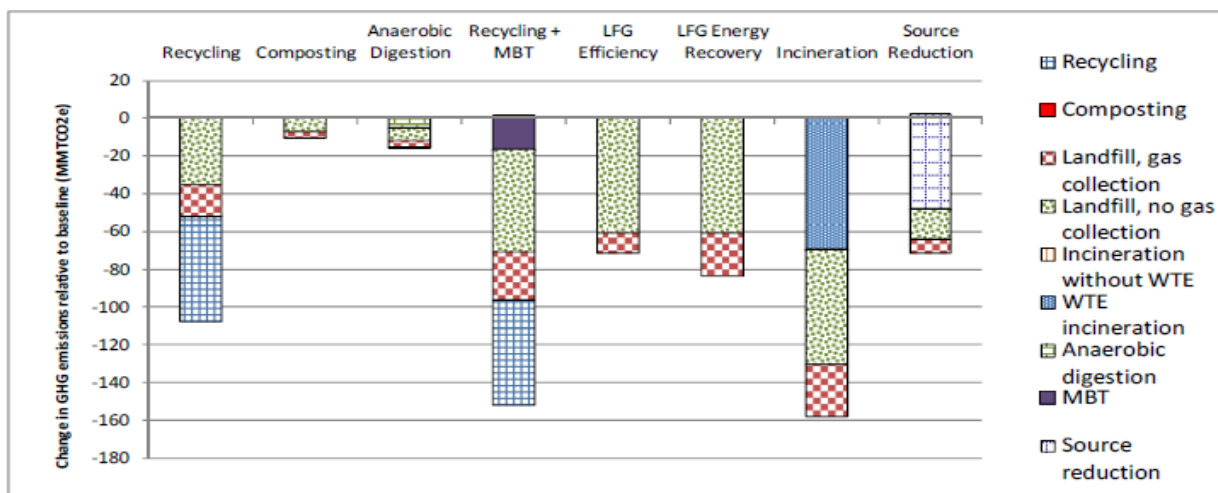
## Life-cycle perspective for materials

- 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**



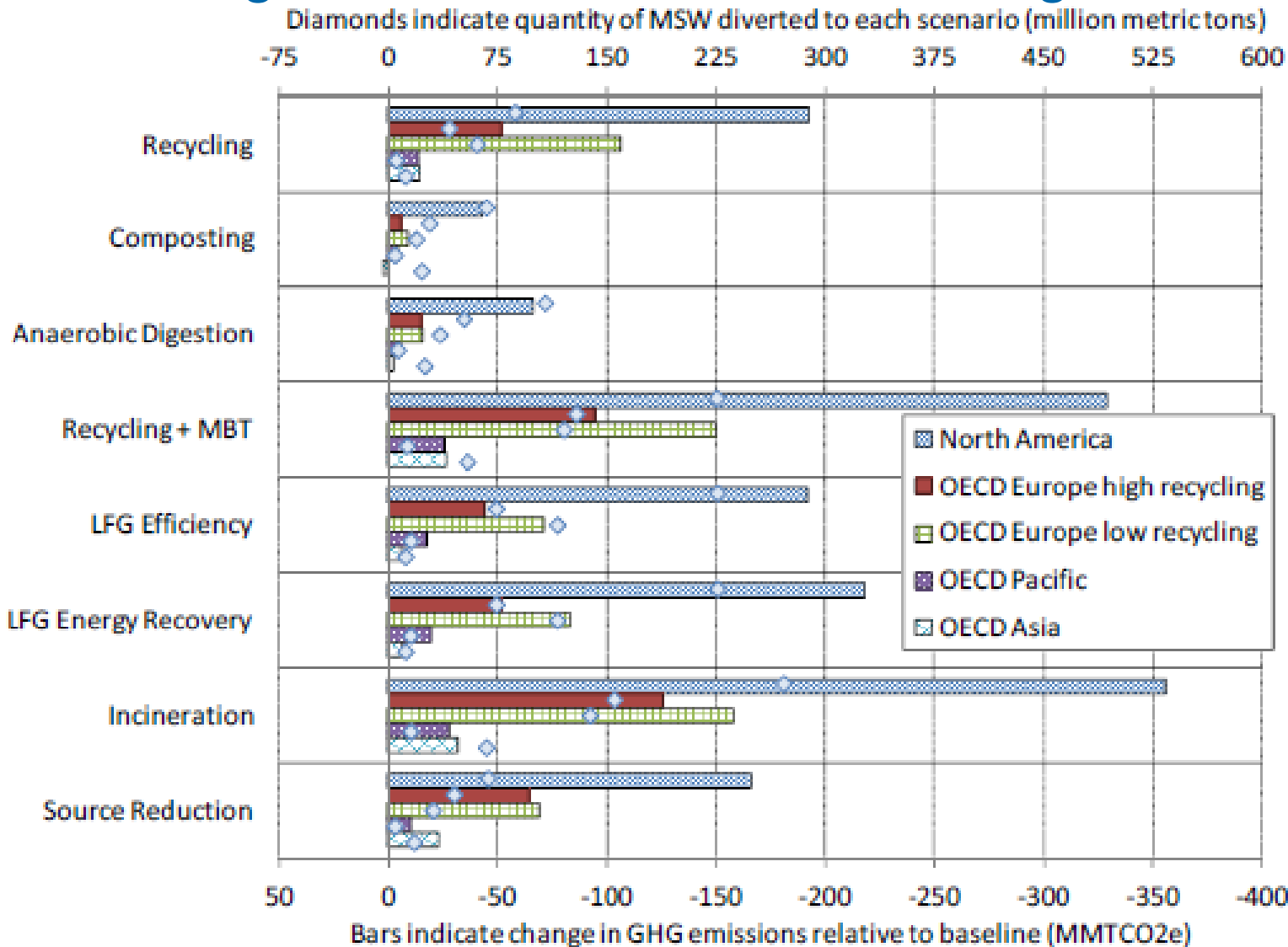
**Figure 17. OECD Europe Low Recycling Countries - Change in GHG Emissions Relative to Baseline MSW Management Practices Resulting From Implementation of Alternative MSW Management Scenarios in 2030**



## 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 <b>additional case studies</b> for systems-based emissions analysis (Slovenia and Germany)                                                                                                                                                                                                                                                                                                                                                 |
| Concern about <i>perceived ranking</i> of waste management practices                            | <ul style="list-style-type: none"> <li>•Evaluated the <b>effectiveness</b> (i.e., GHG emissions reduced per ton of MSW materials diverted) of each scenario, in addition to absolute (total) GHG reductions</li> <li>•Included an <b>integrated scenario</b> to strengthen the report's key finding that integrated MSW management practices are most effective</li> <li>•Clarified the report's key <b>messages</b> in the Executive Summary</li> </ul> |
| Concern about assumptions in the GHG mitigation analysis                                        | <ul style="list-style-type: none"> <li>•<b>Clarified assumptions</b> and data inputs in the report and appendices, <b>but did not modify base assumptions.</b></li> <li>•Added Appendix C to describe the rationale and data sources for the full list of assumptions</li> </ul>                                                                                                                                                                         |

- 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

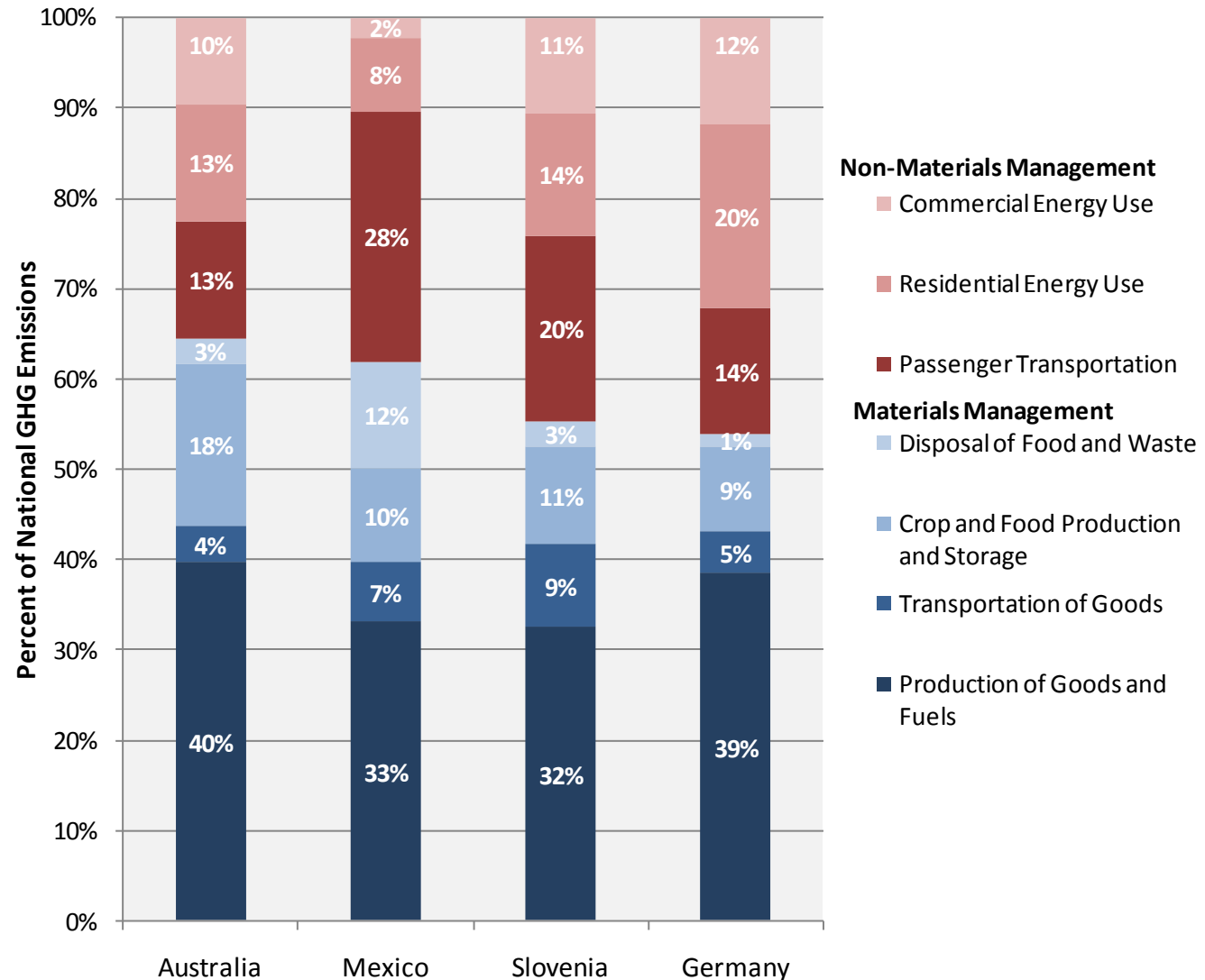
Disposal of Food and Waste

Yes

# National GHGs Attributable to Materials Management

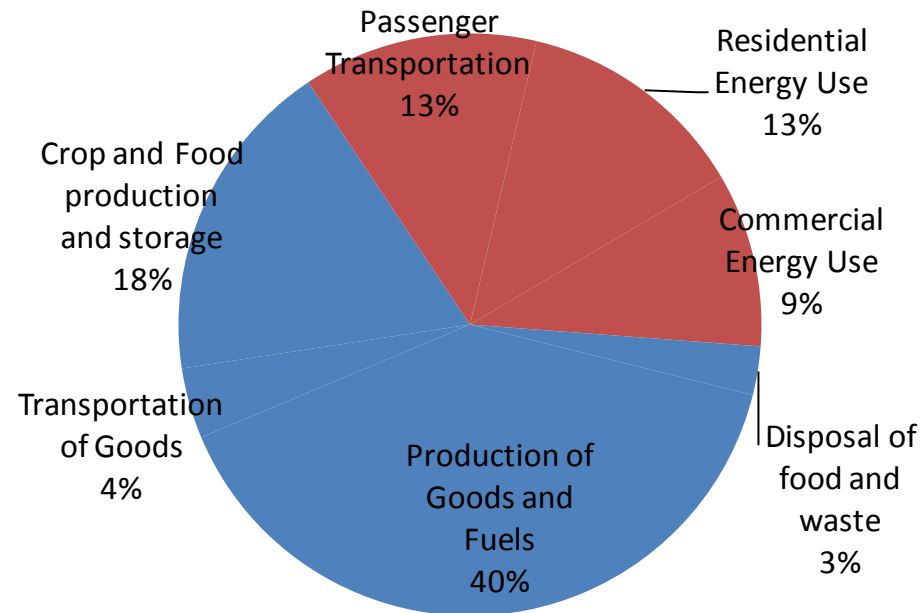
Australia, Mexico, Slovenia, and Germany national GHG emissions according to “systems-based” categories related to materials management (MM) activities and non-MM activities

| GHG/capita in 2005 (MTCO <sub>2</sub> e) |      |
|------------------------------------------|------|
| Australia                                | 26.9 |
| Mexico                                   | 6.1  |
| Slovenia                                 | 10.1 |
| Germany                                  | 11.9 |



# Case Study Results – Systems-based GHGs

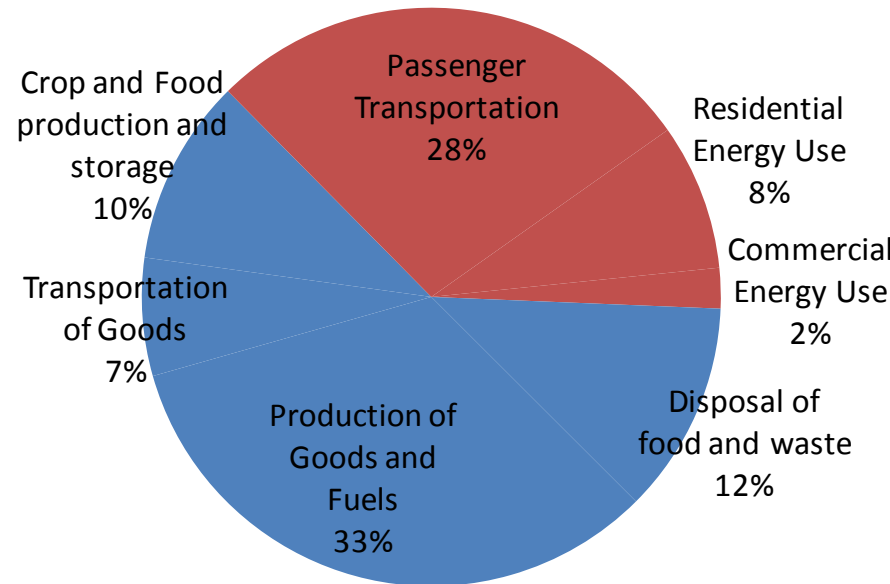
**Systems-based Emissions Categories for Australia 2007**



**Total: 541,179 Gg CO<sub>2</sub>e**

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

**Systems-based Emissions Categories for Mexico 2002**

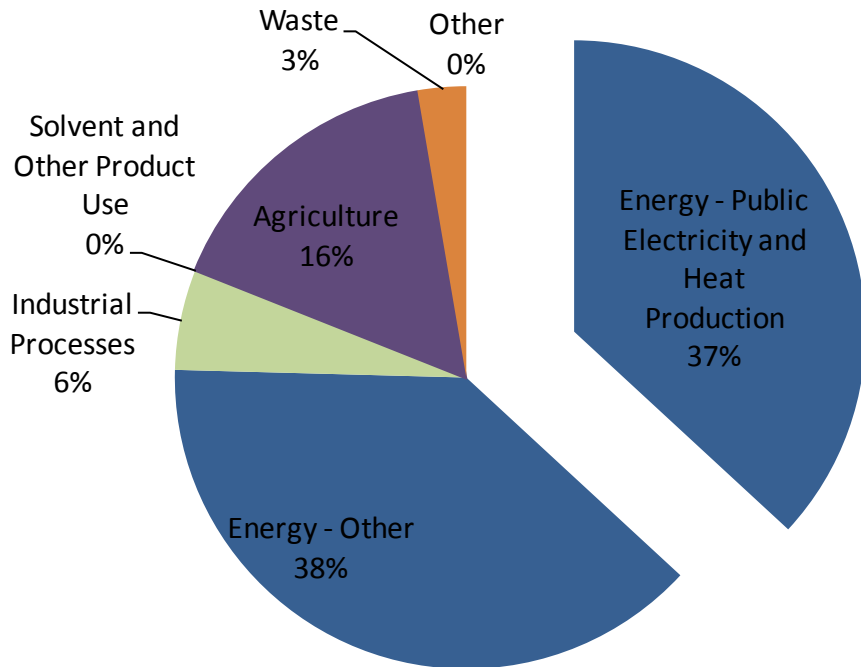


**Total: 553,330 Gg CO<sub>2</sub>e**

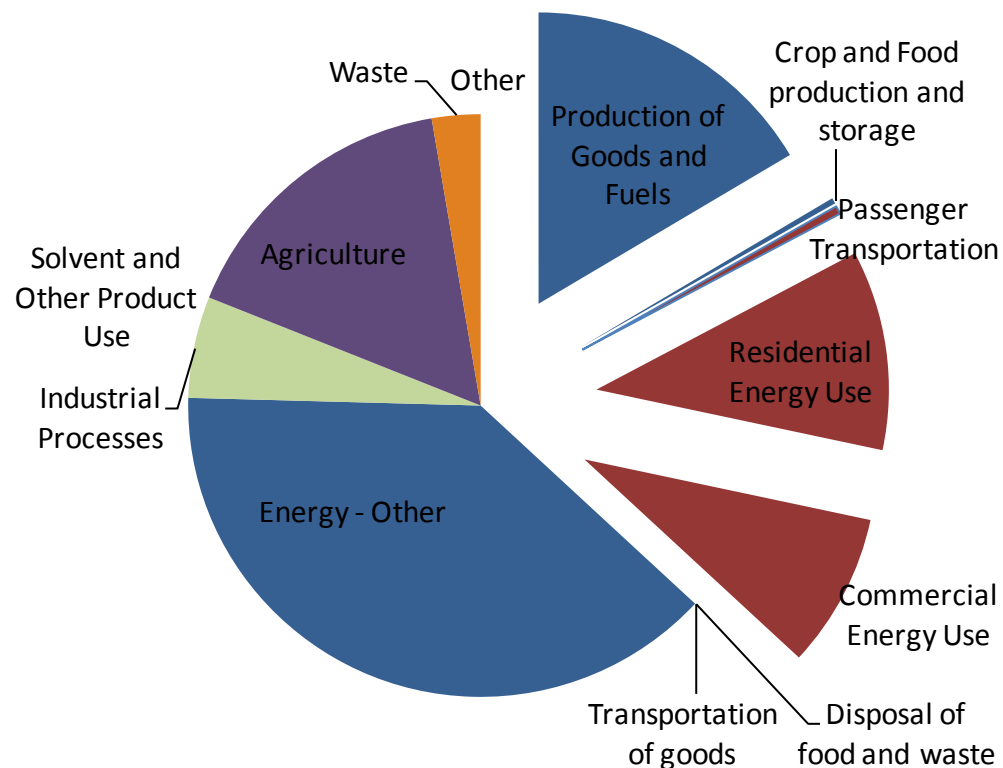
*Estimated Materials Management Emissions as percent of total GHG emissions: **62%***

# Example: “Public Electricity and Heat Production” Reallocation

**Australia National Inventory - Sector emissions**



**Reallocated "Public Electricity and Heat Production"**



# 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.