

# The Role of Waste-to-Energy in a Zero Waste World

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S.W.A.T. – Taking Waste Down  
SWRC Waste Minimization Forum  
Sept 24 - 25, 2009

# Waste Management Hierarchy

**3Rs**

Reduce

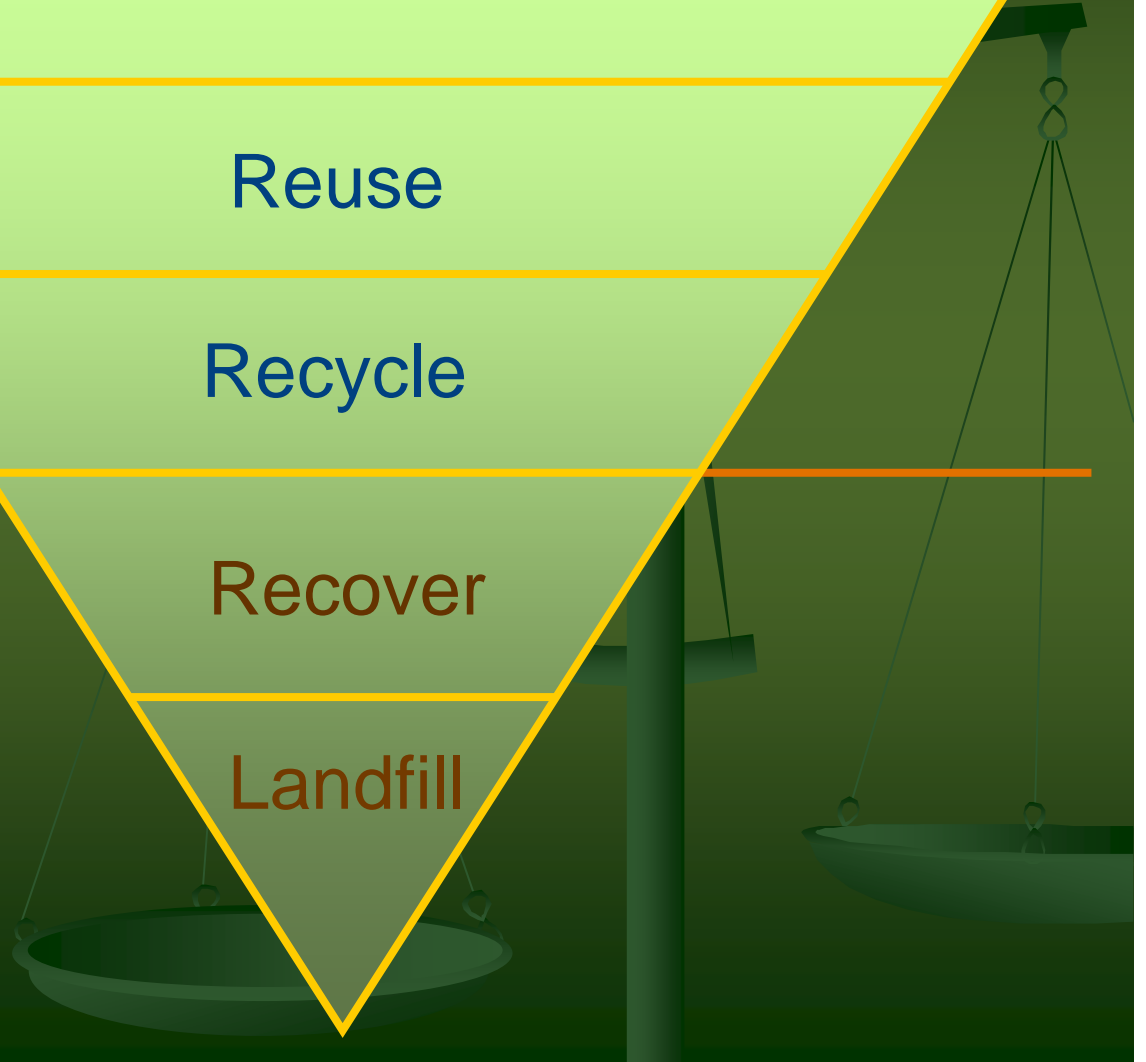
Reuse

Recycle

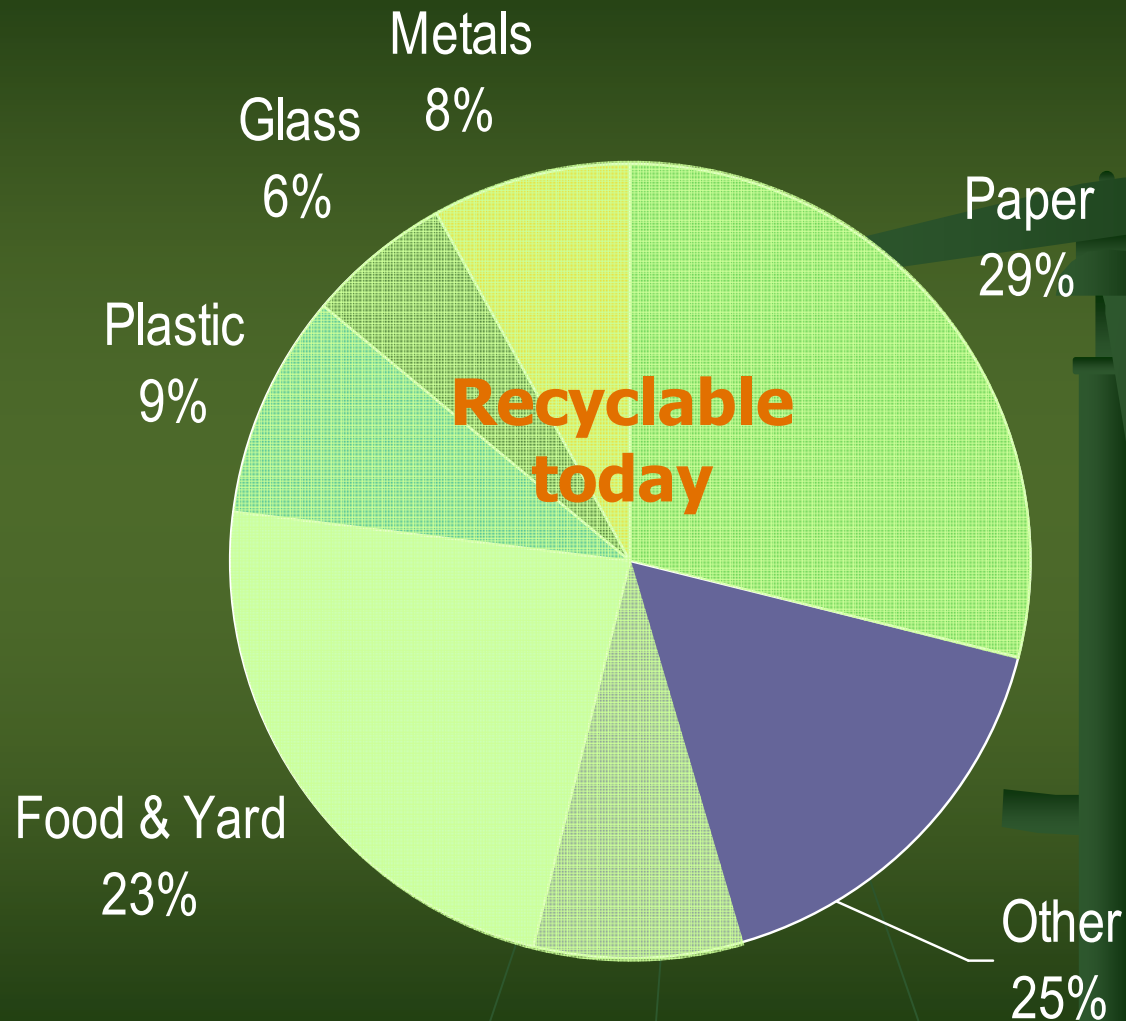
Recover

Landfill

Residuals  
Management  
Disposal Options



# MSW Waste Composition



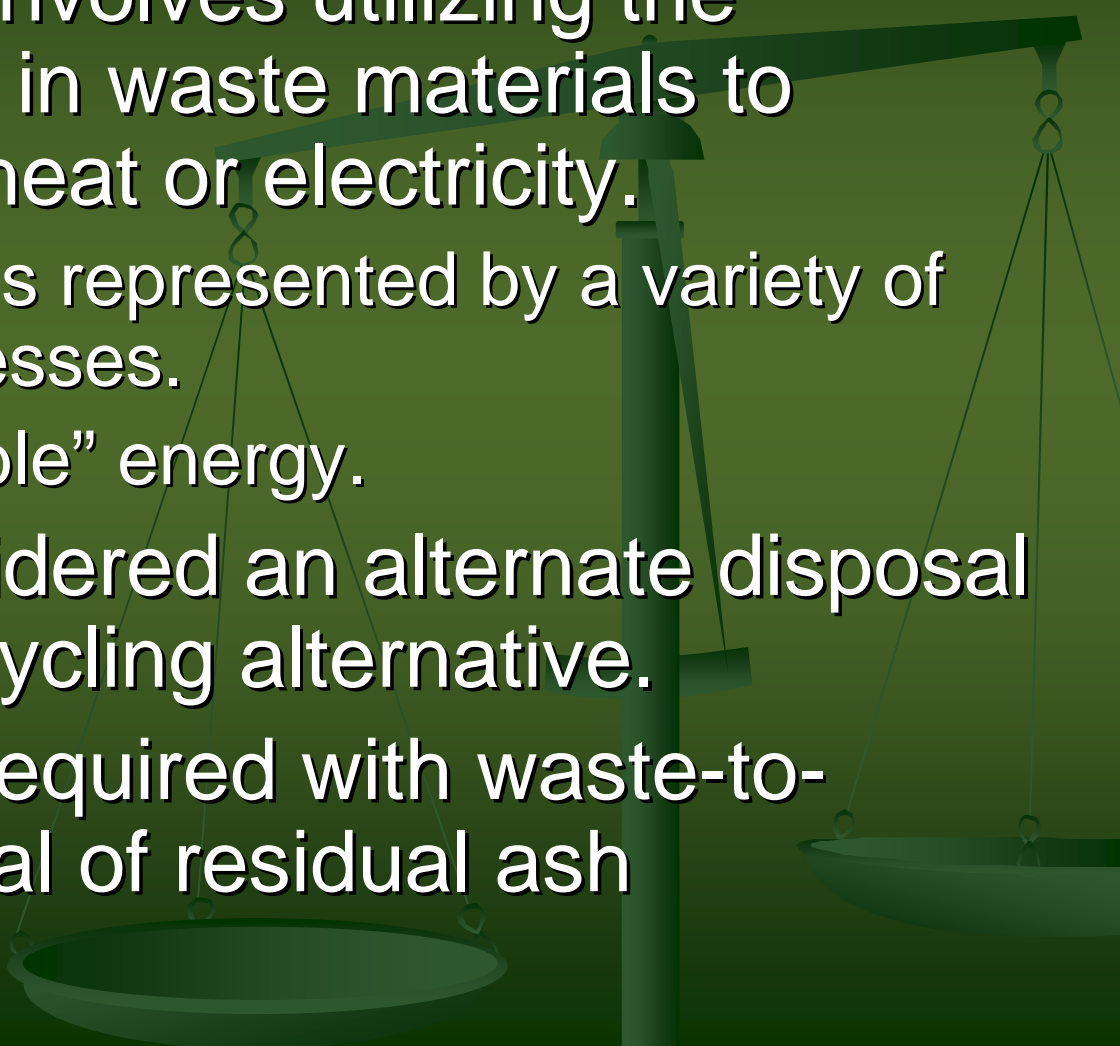
Municipal solid waste composition in Alberta (1994)  
Source: Alberta Environment, SOER for Alberta

# Residuals



- Materials that cannot reasonably be reduced, reused or diverted for recycling or composting.
  - ~20% of the municipal waste stream
- The long-term zero-waste objective is to eliminate residuals from the waste stream.
- Residuals may be a temporary situation
  - Lack of markets
  - Poor product design
- True residuals require a disposal option.

# Residuals Disposal Options – Energy Recovery

- Energy recovery involves utilizing the embodied energy in waste materials to produce needed heat or electricity.
    - Energy recovery is represented by a variety of combustion processes.
    - Issue of “renewable” energy.
  - Recovery is considered an alternate disposal method, not a recycling alternative.
  - Landfills are still required with waste-to-energy for disposal of residual ash (~10-25%).
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# Zero Waste Definition

Zero Waste is a goal that is both **pragmatic and visionary**, to guide people to emulate sustainable natural cycles, where **all discarded materials are resources for others to use**. Zero Waste means designing and managing products and processes to **reduce the volume and toxicity of waste** and materials, conserve and recover all resources, and **not burn or bury them**. Implementing Zero Waste will eliminate all discharges to land, water or air that may be a threat to planetary, human, animal or plant health."

# Zero Waste Principles

- **Zero Waste to landfill or incineration**
  - divert more than 90% of solid wastes from landfill
  - no solid wastes are processed in facilities that operate above ambient biological temperatures (more than 200 degrees F) to recover energy or materials

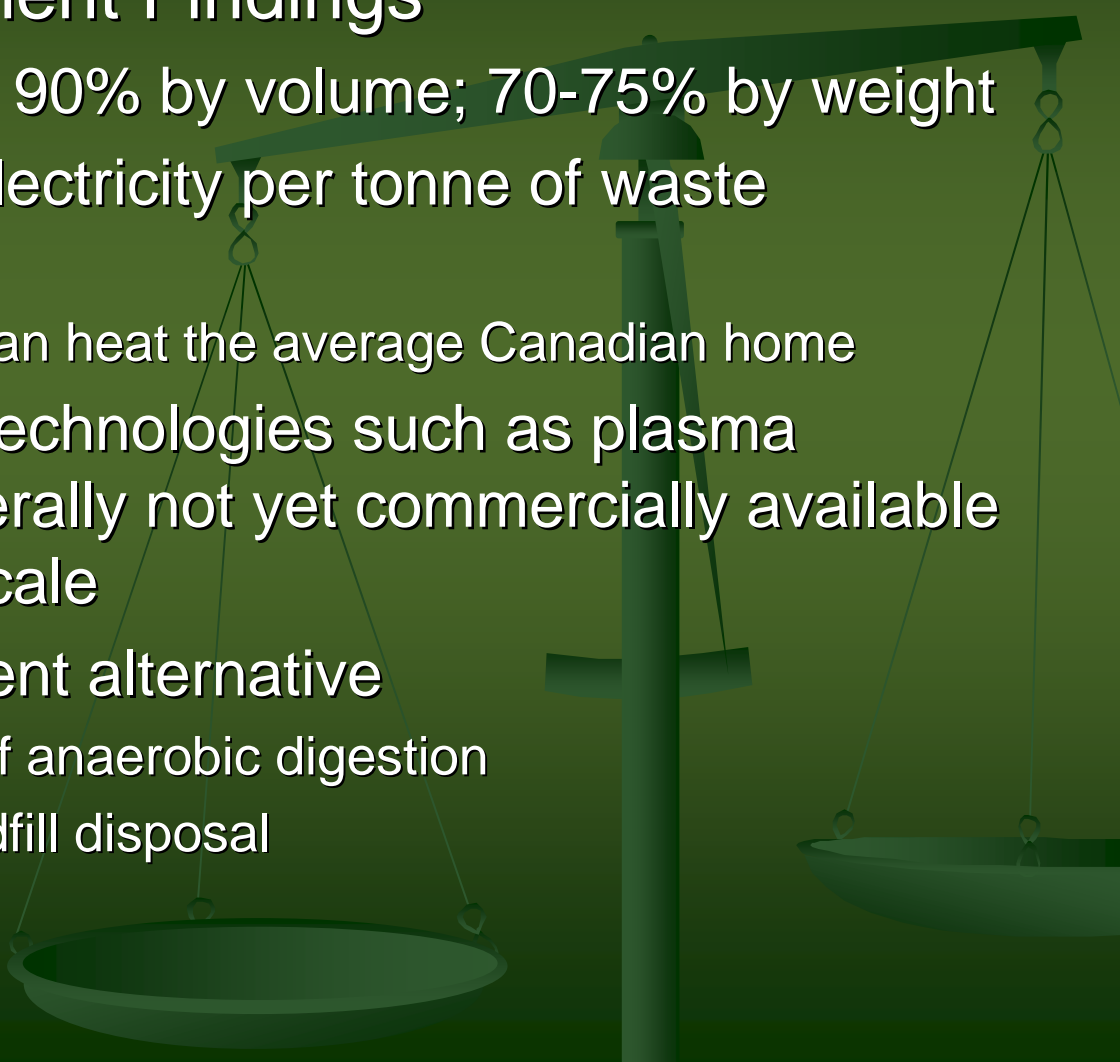
# MSW Options Report



- Considered 3 community sizes
  - population of 20,000 / 80,000 / 200,000
- Looked at a number of management methods
  - composting
  - anaerobic digestion
  - sanitary landfill
  - bioreactor landfill
  - thermal treatment
- Full report available on RCA website



# MSW Options Report

- Key Thermal Treatment Findings
    - Can reduce material 90% by volume; 70-75% by weight
    - 450 to 500 kWh of electricity per tonne of waste processed
      - 24 tonnes of waste can heat the average Canadian home
    - New and emerging technologies such as plasma gasification are generally not yet commercially available or proven on a full scale
    - Costly waste treatment alternative
      - comparable to cost of anaerobic digestion
      - more costly than landfill disposal
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# WTE Costs (from operating facilities)

	Annual Volume (tonnes)	Capital Cost (millions)	Operating Cost (per tonne)
Batch Process Starved Air	2600 – 5200	\$5 – \$7	\$430 – \$466
Semi-Continuous Starved Air	6,000 – 160,000	\$9.5 – \$118	\$110 – \$257
Mass Burn	300,000	\$200	\$100
Gasification (Edmonton estimates)	100,000	\$90	TBD

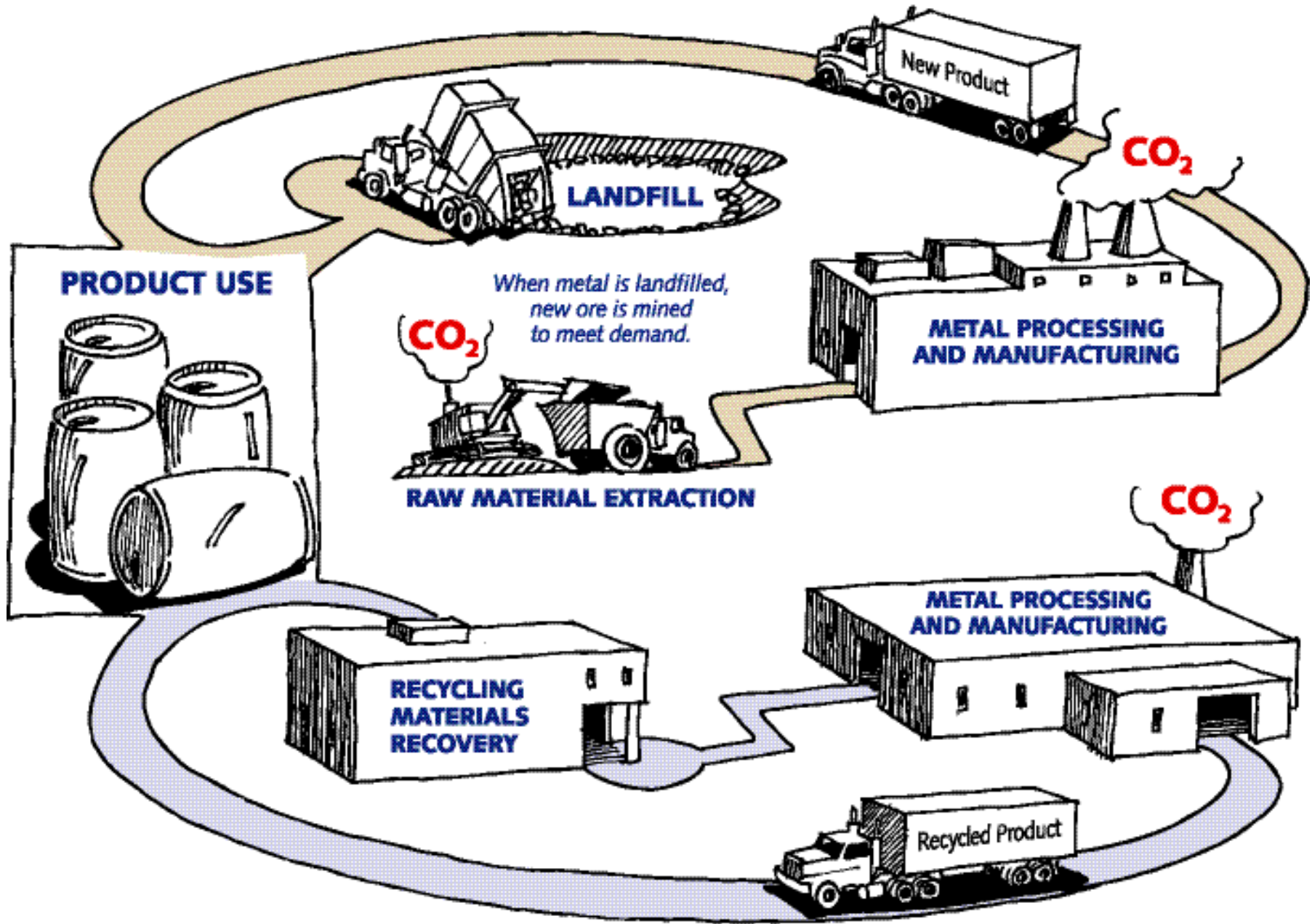
# Environmental Impacts



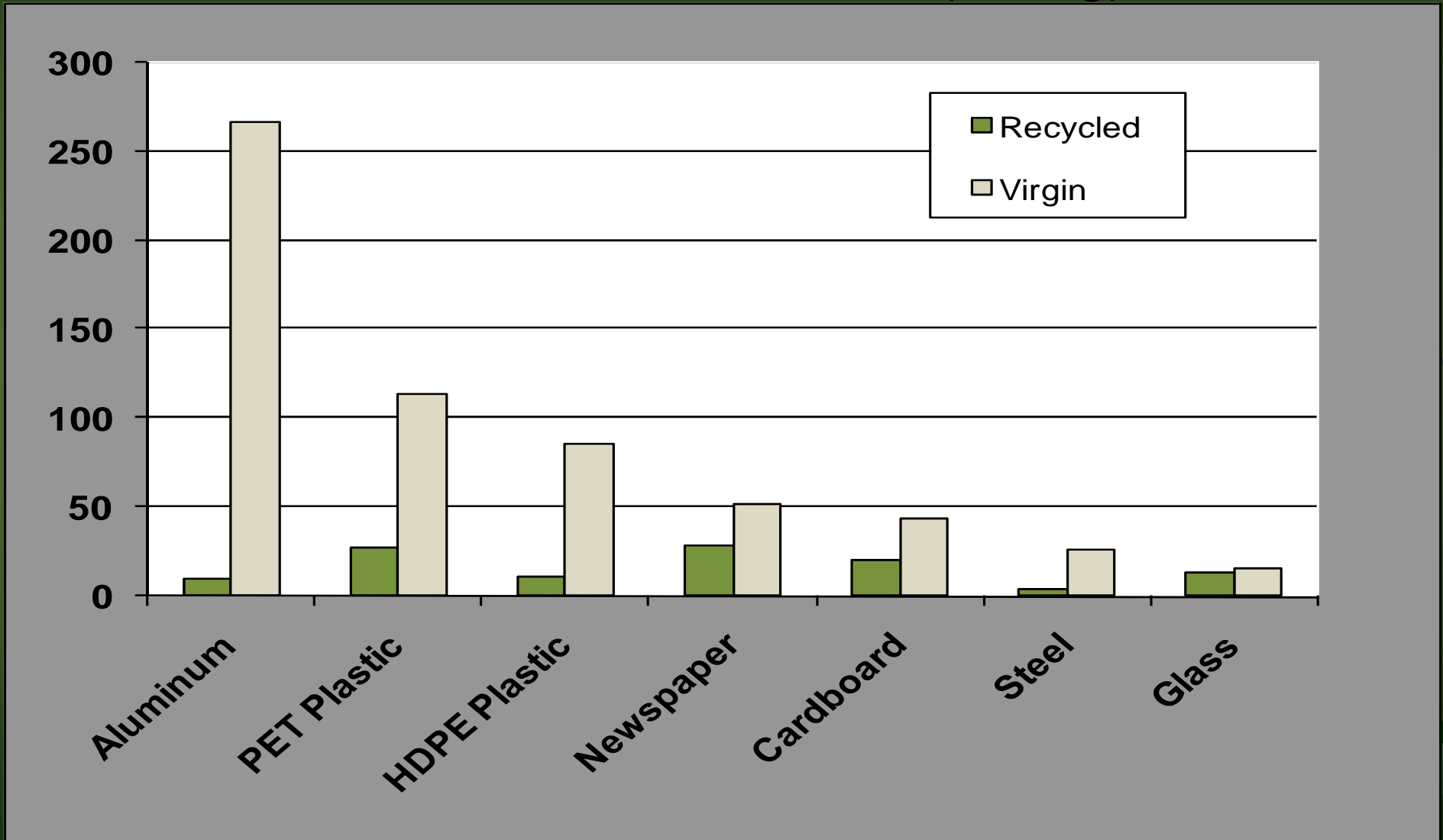
- EPA / Environment Canada studies
  - Reducing waste (eliminating it at the source) has the most dramatic impact on reducing greenhouse gasses
  - Recycling is also effective way of reducing GHGs
    - less energy is required to manufacture materials from recycled materials than from virgin material
    - no gases occur from landfilling or incinerating those materials

# GHG Emissions for Metals

Life Cycles for Landfilling vs. Recycling

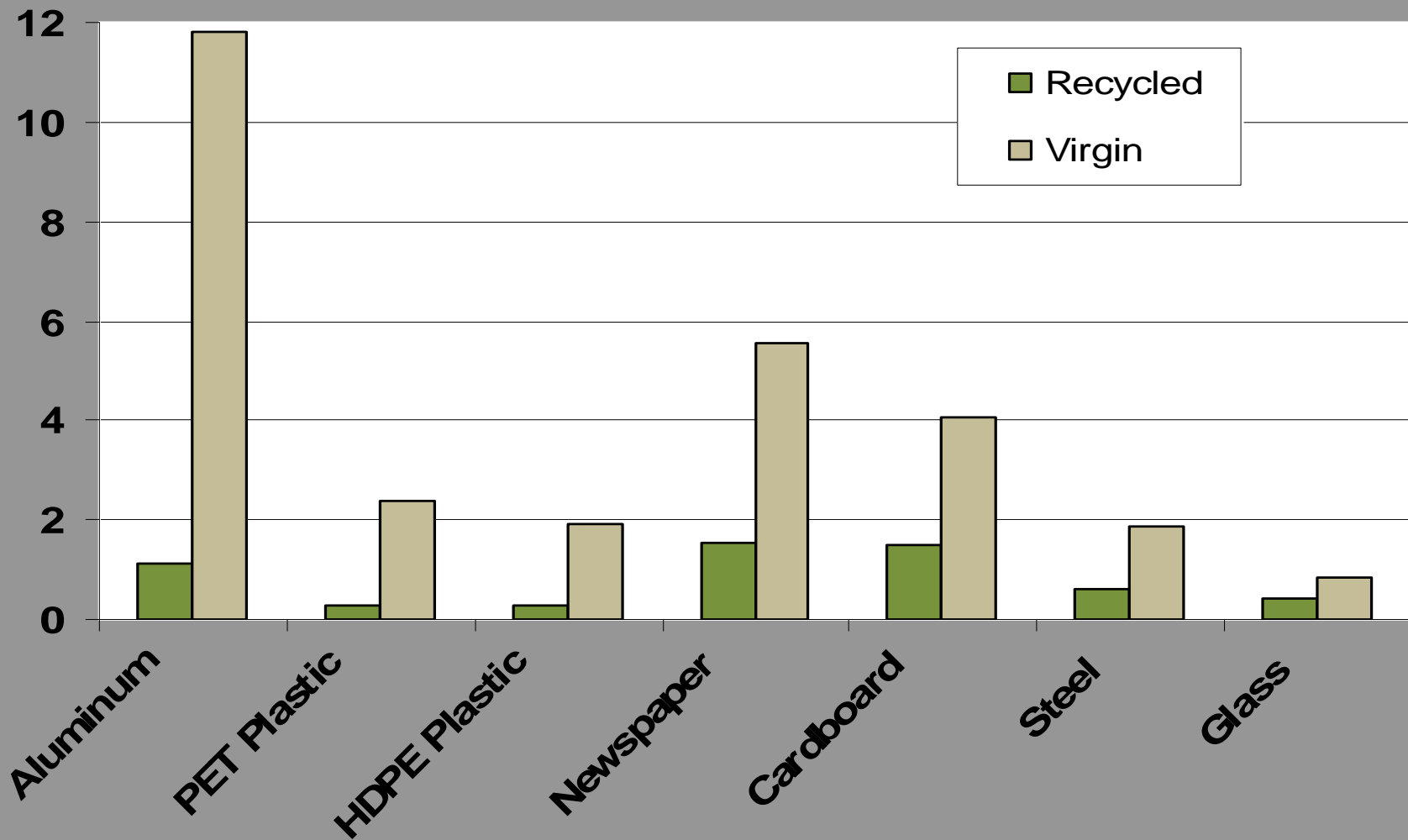


# Energy Use: Recycled & Virgin Content Products (MJ/kg)



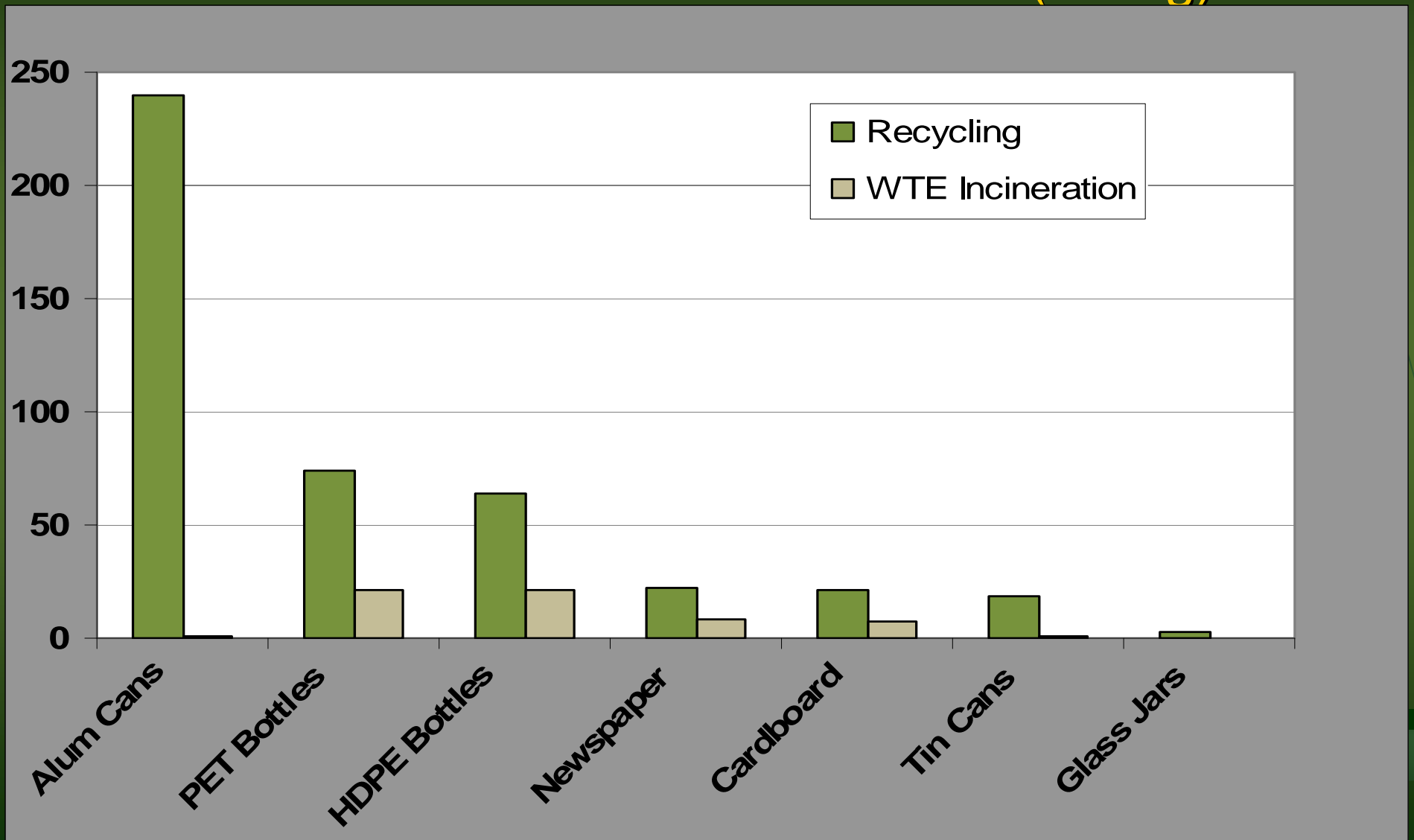
Source: Dr. Jeffrey Morris, Sound Resource Management

# CO<sub>2</sub> Emissions: Recycled & Virgin Content Products (kg eCO<sub>2</sub>/kg)



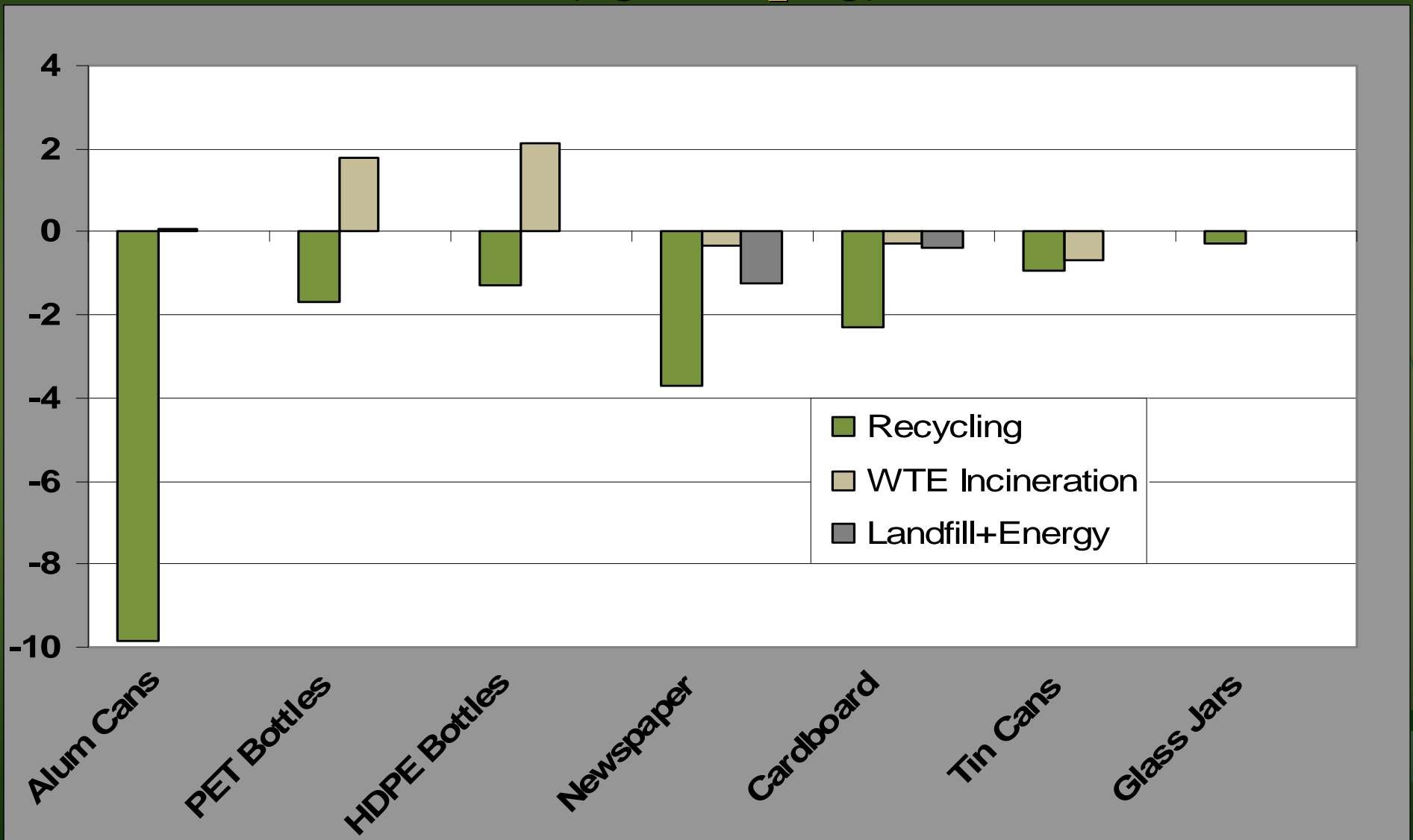
Source: Dr. Jeffrey Morris, Sound Resource Management

# Energy Savings: Recycling versus WTE Incineration (MJ/kg)



Source: Dr. Jeffrey Morris, Sound Resource Management

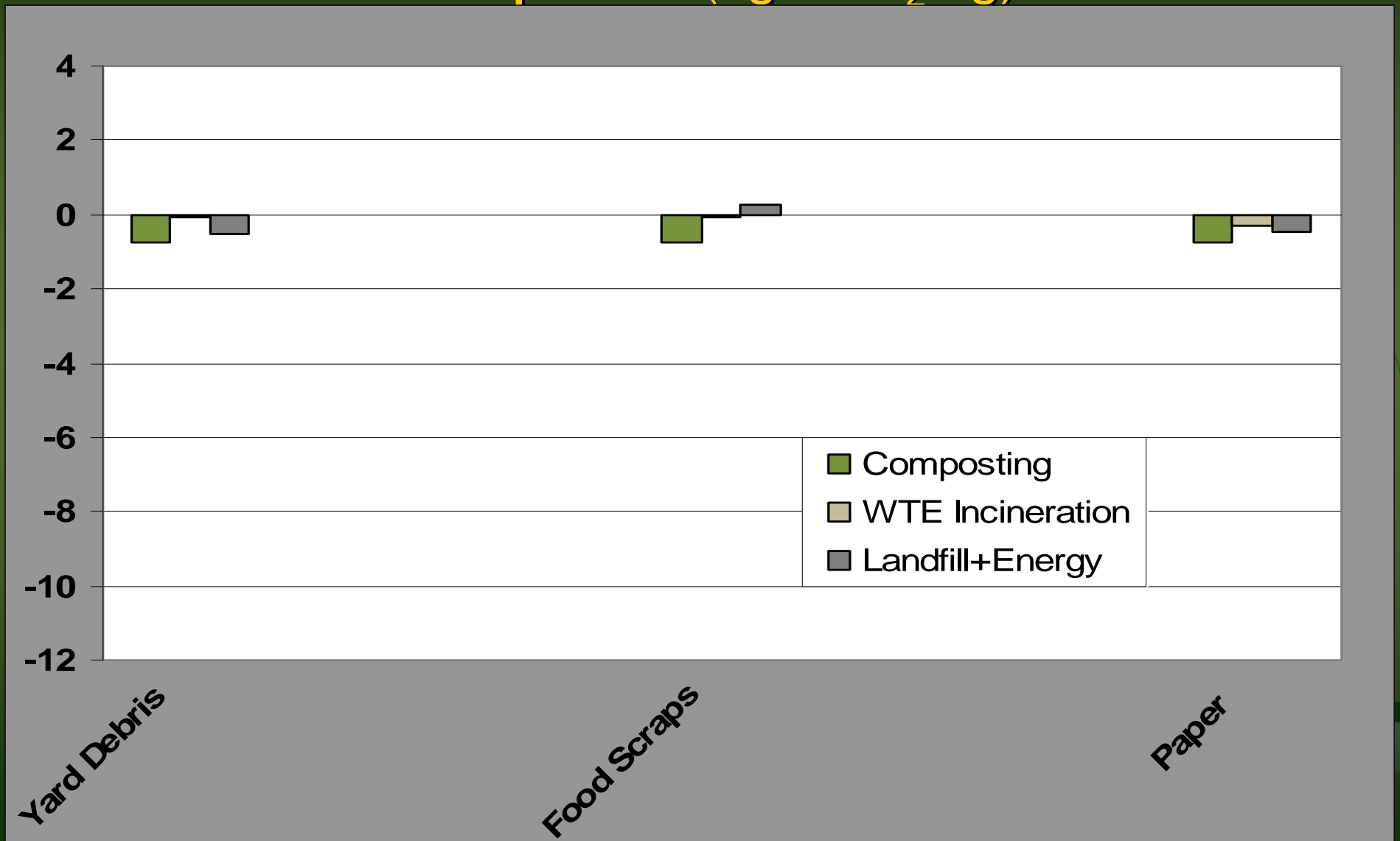
# CO<sub>2</sub> Emissions: Recycling versus Disposal (kg eCO<sub>2</sub>/kg)



Source: Dr. Jeffrey Morris, Sound Resource Management



# CO<sub>2</sub> Emissions: Composting versus Disposal (kg eCO<sub>2</sub>/kg)



Source: Dr. Jeffrey Morris, Sound Resource Management

## Net GHG Emissions from Source Reduction and MSW Management Options Emissions Counted from a Raw Materials Extraction Reference Point (MTCE/Ton)

Material	Source Reduction	Recycling	Composting	Combustion	Landfilling
Newspaper	-0.43	-0.38	NA	0.26	0.25
Office Paper	-0.50	-0.30	NA	0.34	1.06
Corrugated Cardboard	-0.38	-0.30	NA	0.21	0.44
Aluminum Cans	0.00	-0.90	NA	3.01	3.00
Steel Cans	0.00	0.26	NA	0.35	0.85
Glass	0.00	0.06	NA	0.17	0.15
HDPE	0.00	0.24	NA	0.81	0.62
LDPE	0.00	0.40	NA	1.10	0.90
PET	0.00	0.36	NA	1.21	0.99

Source: Greenhouse Gas Emissions From Management of Selected Materials in Municipal Solid Waste, EPA, Sept. 1998

# Value of Pollution Reductions from Recycling & Composting

<b>Discard Type</b>	<b>Environmental Value (US\$/metric ton)</b>
<b>Newspapers</b>	<b>\$363-367</b>
<b>Cardboard</b>	<b>467-496</b>
<b>Mixed Paper</b>	<b>172-197</b>
<b>Glass Containers</b>	<b>61</b>
<b>PET Plastics</b>	<b>639-712</b>
<b>HDPE Plastics</b>	<b>224-310</b>
<b>Other Plastics</b>	<b>224-310</b>
<b>Aluminum Cans</b>	<b>1,607</b>
<b>Ferrous Cans &amp; Scrap</b>	<b>18-72</b>
<b>Food Scraps</b>	<b>62-107</b>
<b>Yard &amp; Garden Debris</b>	<b>61-74</b>
<b>Compostable Paper</b>	<b>52-78</b>

Source: Dr. Jeffrey Morris, Sound Resource Management

# 3Rs Social Benefits

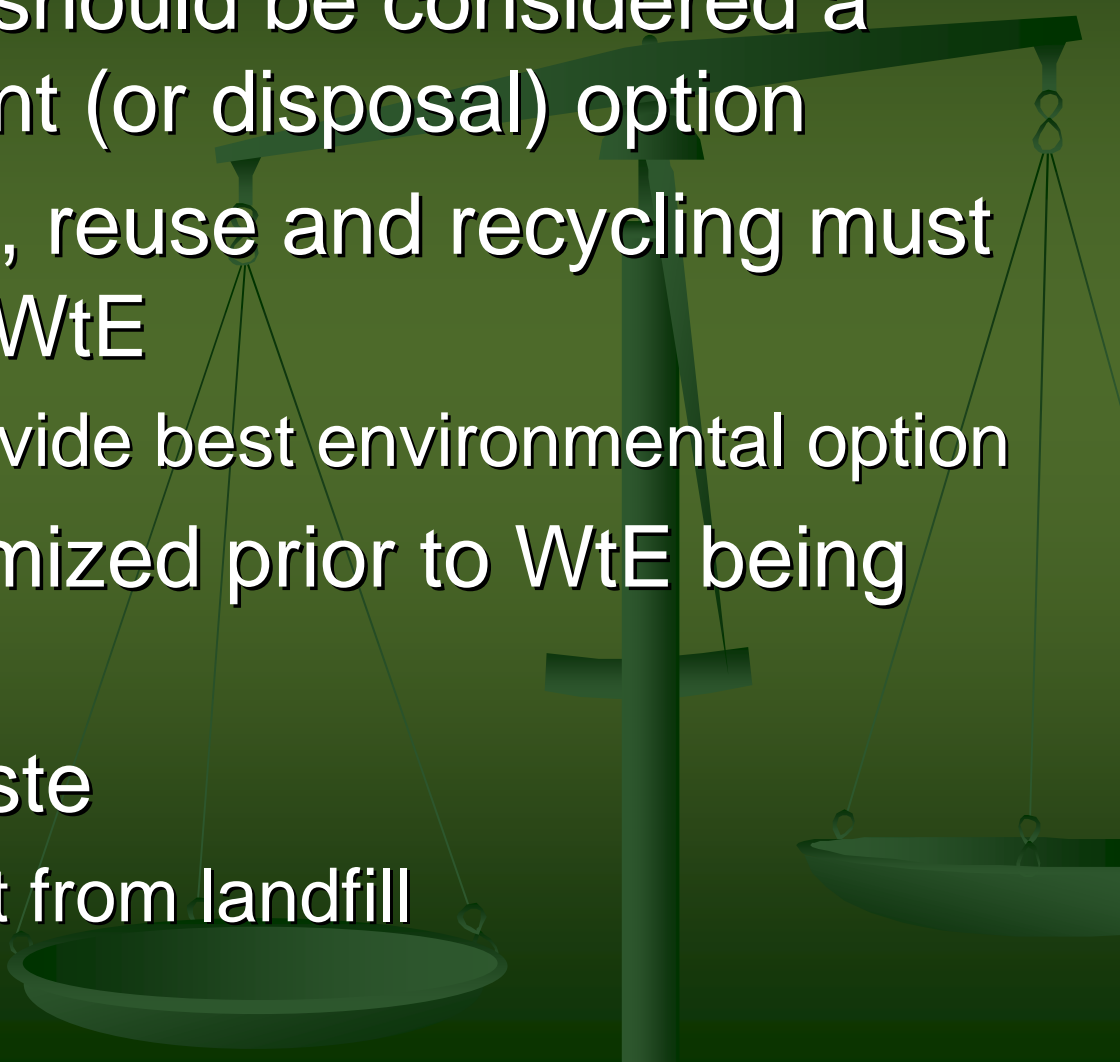
- Jobs
- Training Opportunities
- Personal and Community Pride
- Behavior Change – Waste Reduction



# But, What About Europe?

- Very different policy framework
    - Recycling strongly established
  - Strong focus on hierarchy
    - Prevention, reuse, recycling key elements
  - EU Target: by 2020, 50% of municipal solid waste and 70% of waste from construction, demolition, industry and manufacturing must be re-used or recycled.
    - Netherlands currently at 66% diversion
    - Germany at 65% diversion
  - New targets increase recycling; limit recovery
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# So, What is the Role of Waste-to-Energy in a Zero Waste World?

- Waste-to-energy should be considered a residuals treatment (or disposal) option
  - Waste prevention, reuse and recycling must be priorities over WtE
    - WtE does not provide best environmental option
  - 3Rs must be optimized prior to WtE being considered
  - Plan for Zero Waste
    - from disposal, not from landfill
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# Recycling Council of Alberta

## ■ Vision

- Zero Waste
- Extended Producer Responsibility
- Social Conscience

## ■ Mission

- To Promote and Facilitate Waste Reduction, Recycling, and Resource Conservation in Alberta



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