

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
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Waste Management Hierarchy

3Rs

Reduce

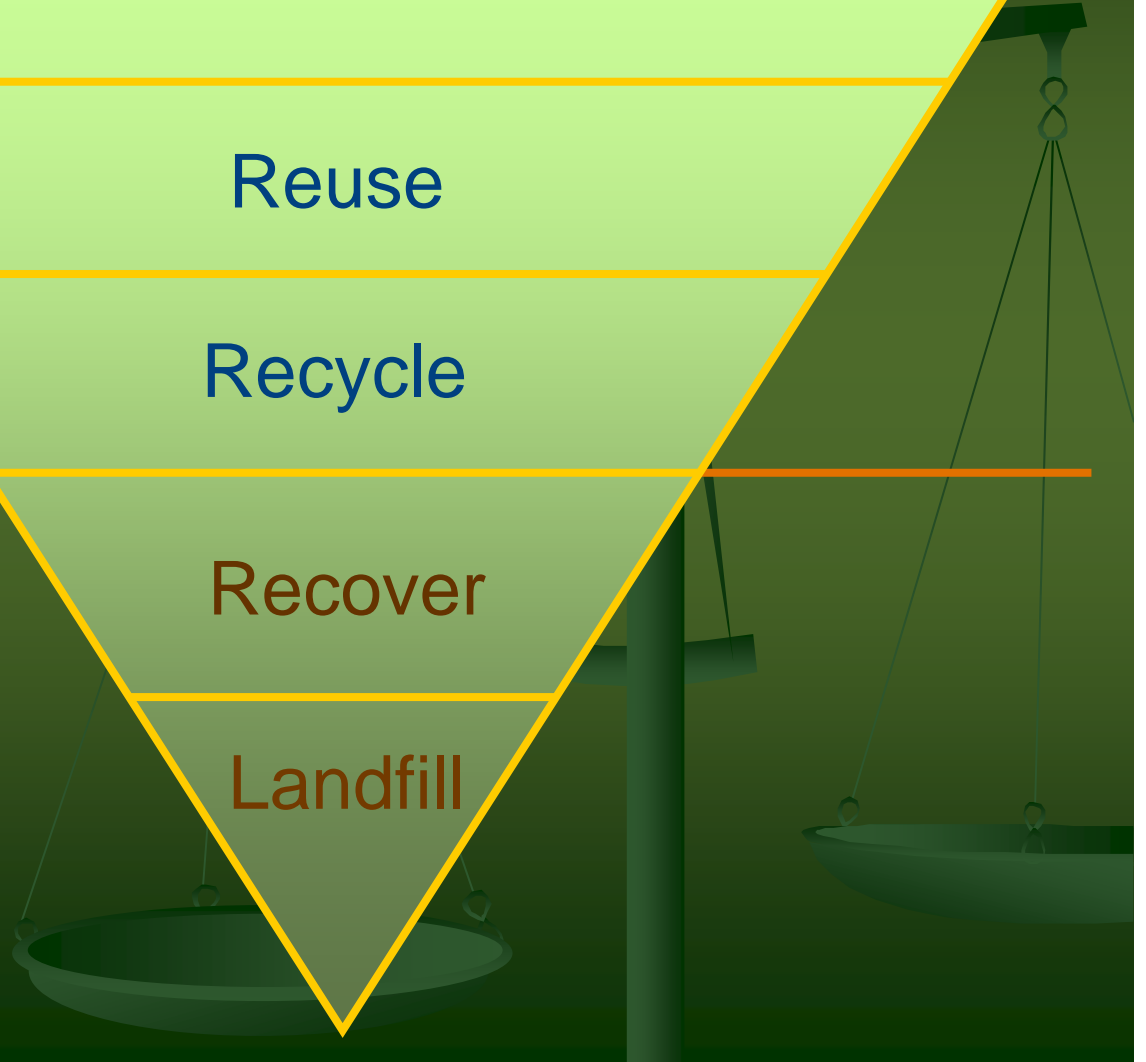
Reuse

Recycle

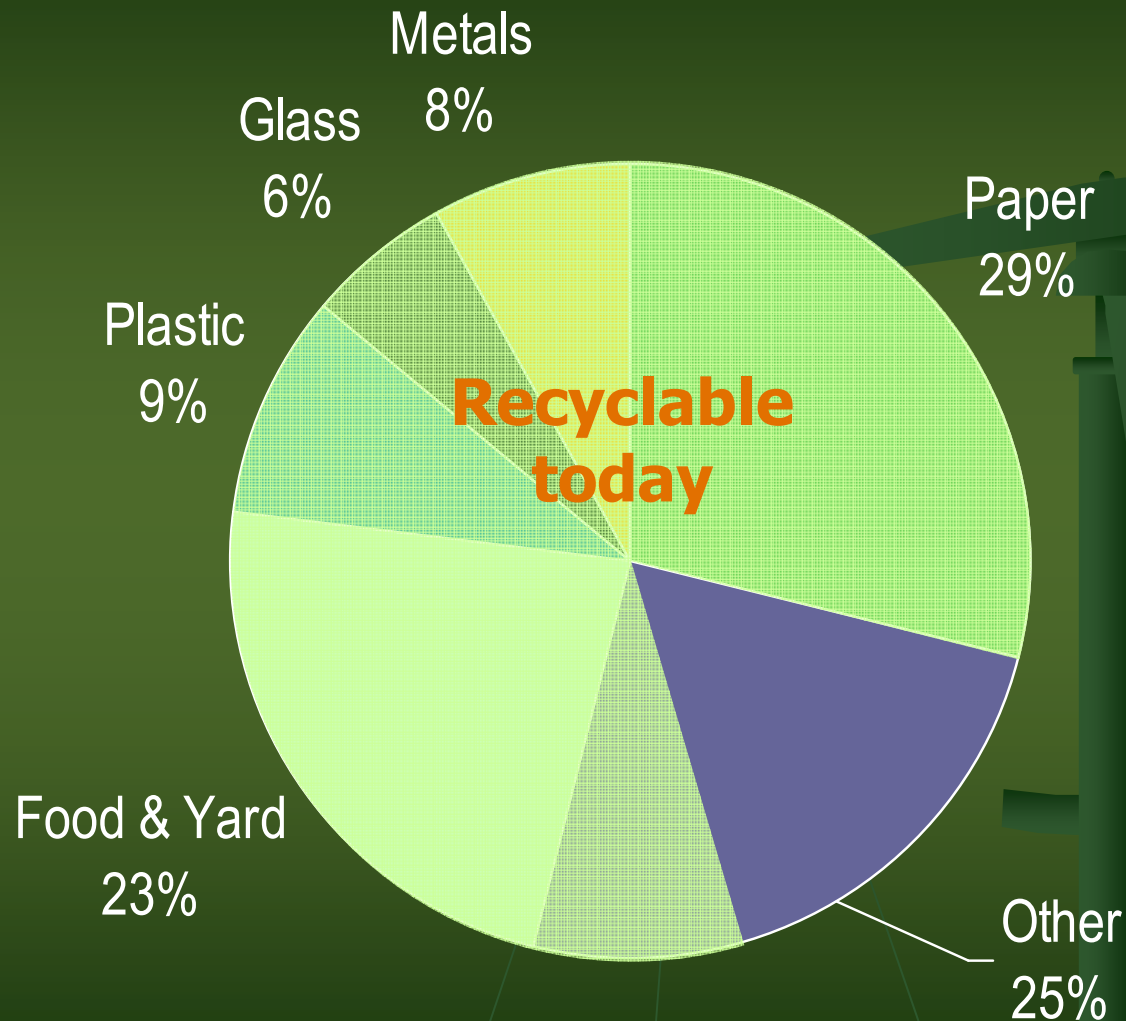
Recover

Landfill

Residuals
Management
Disposal Options



MSW Waste Composition



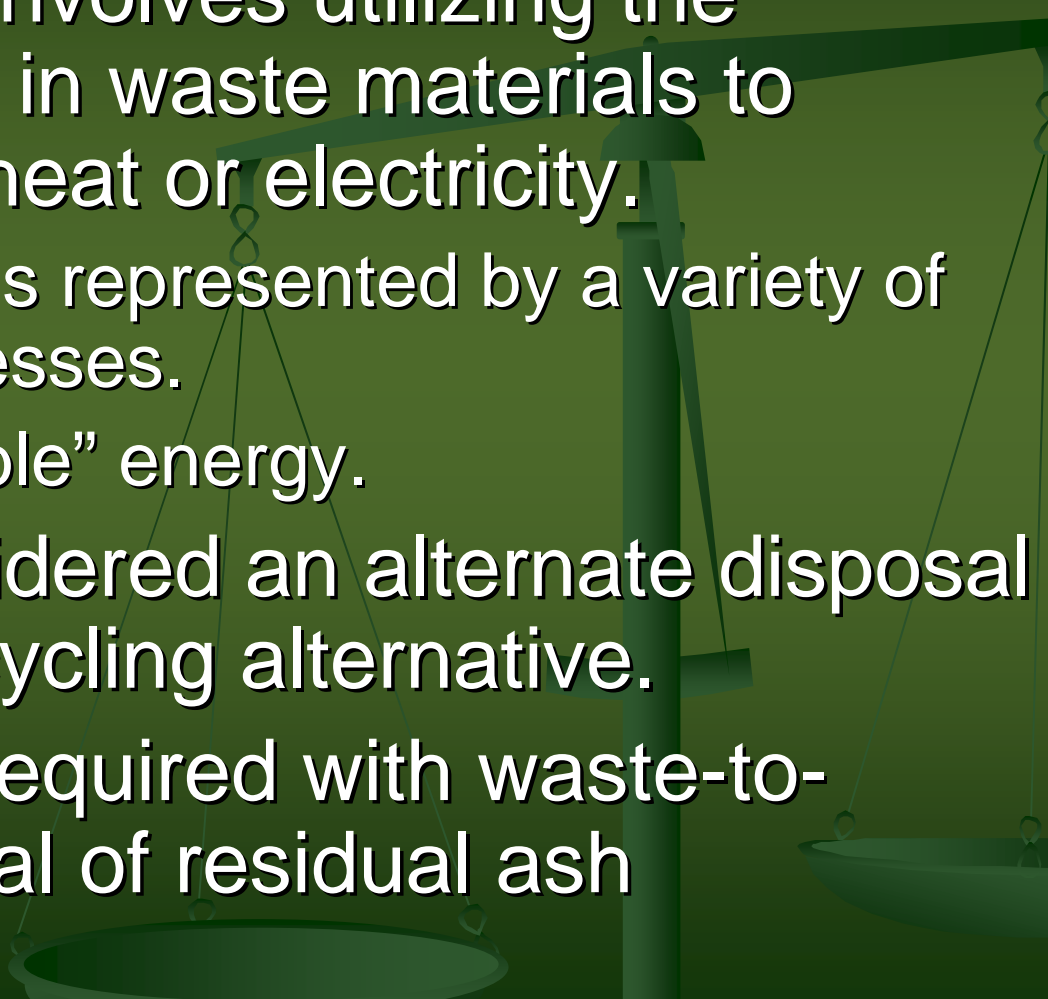
Municipal solid waste composition in Alberta (1994)
Source: Alberta Environment, SOER for Alberta

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

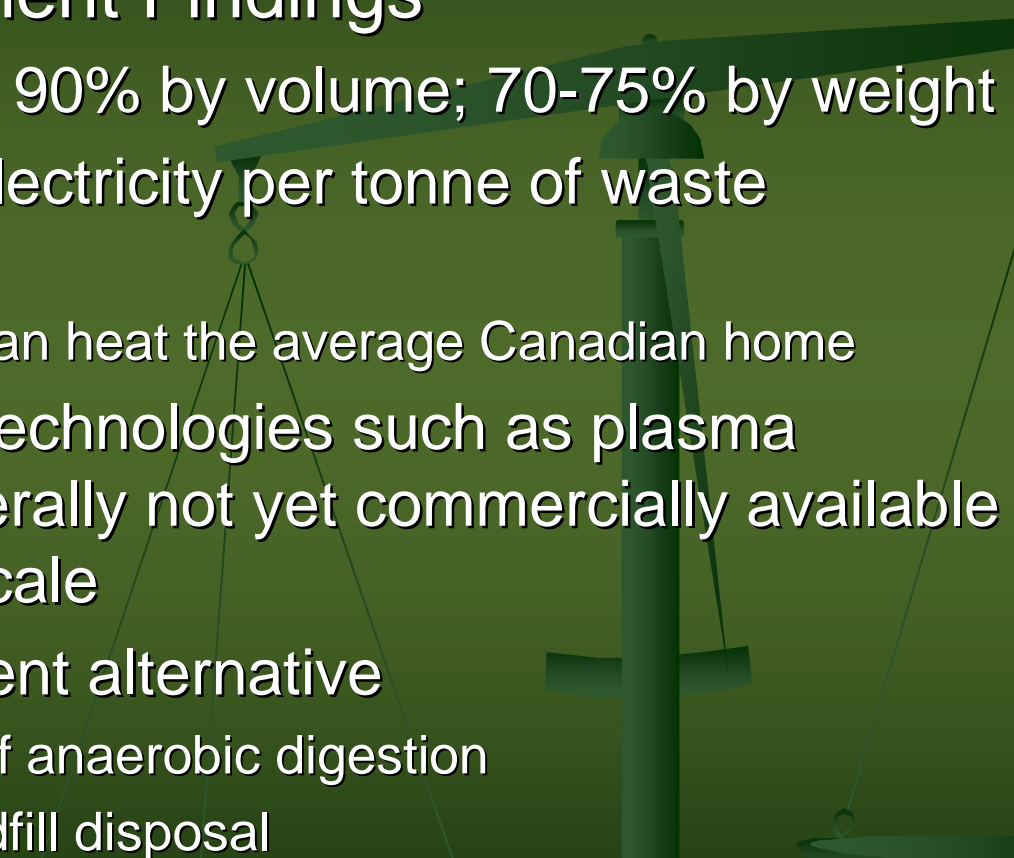
- **Zero Waste to landfill or incineration**
 - divert more than 90% of solid wastes from landfill
 - no solid wastes are processed in facilities that operate above ambient biological temperatures (more than 200 degrees F) to recover energy or materials

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

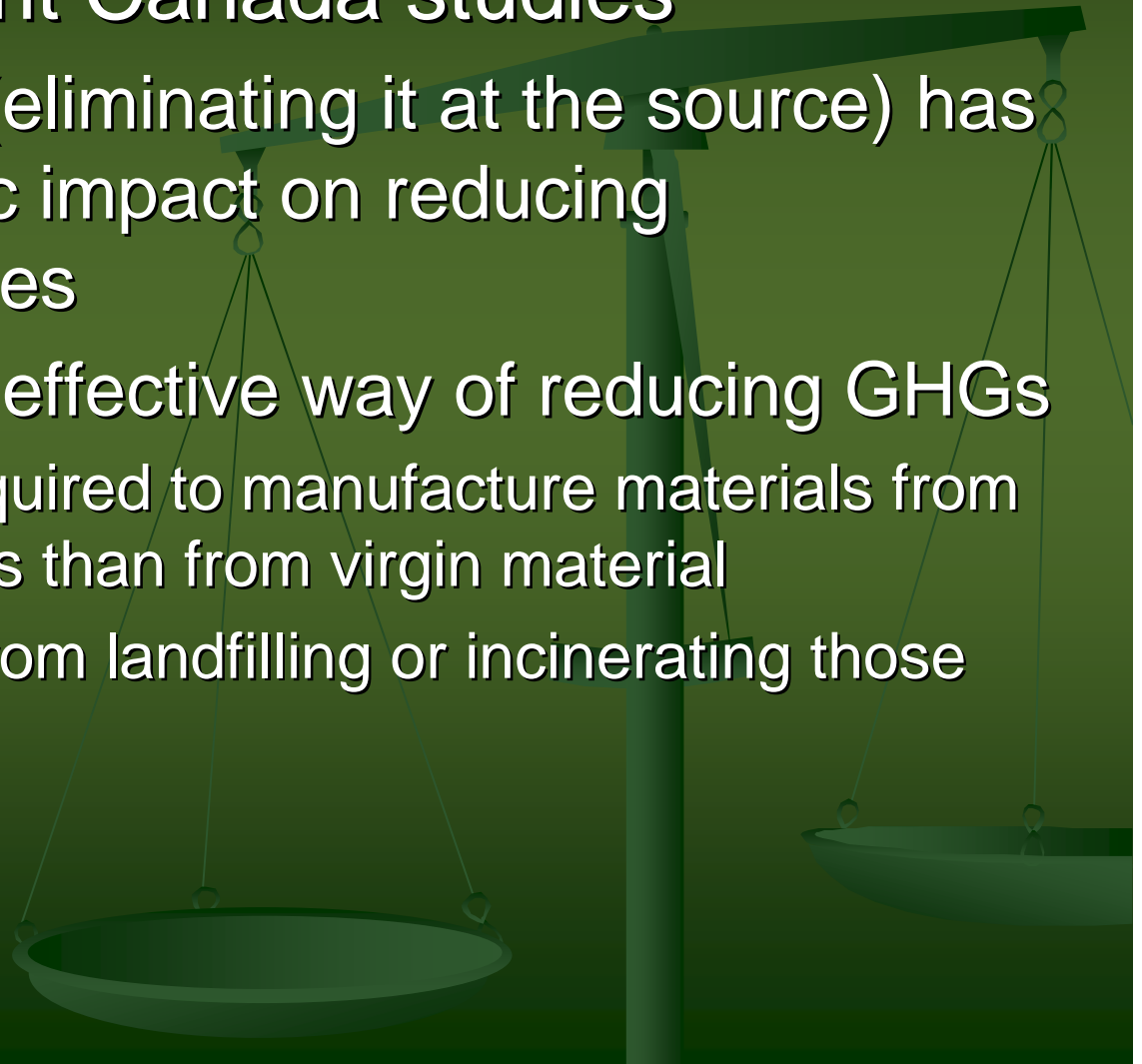
- Key Thermal Treatment Findings
 - Can reduce material 90% by volume; 70-75% by weight
 - 450 to 500 kWh of electricity per tonne of waste processed
 - 24 tonnes of waste can heat the average Canadian home
 - New and emerging technologies such as plasma gasification are generally not yet commercially 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

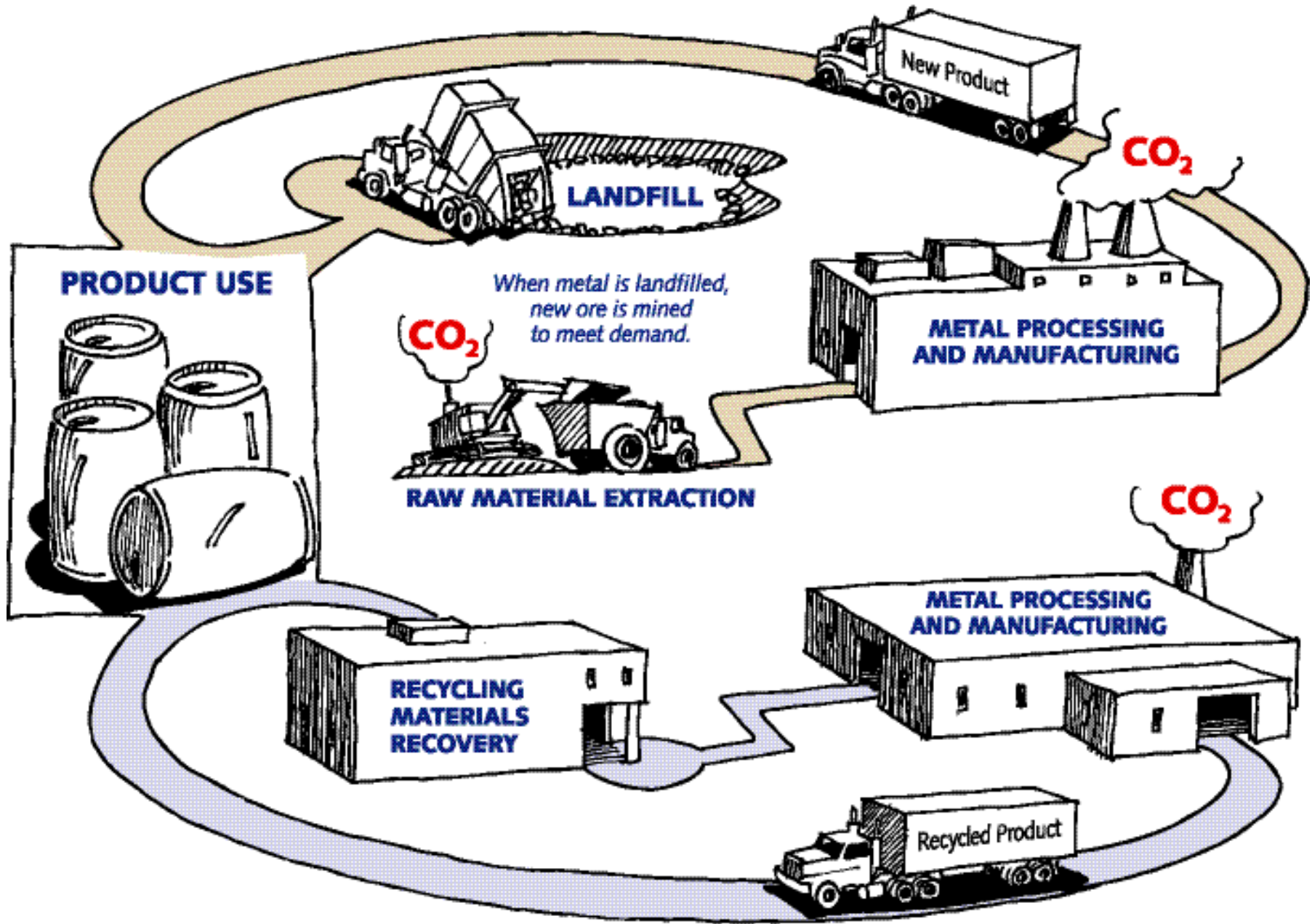
Environmental Impacts

- 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

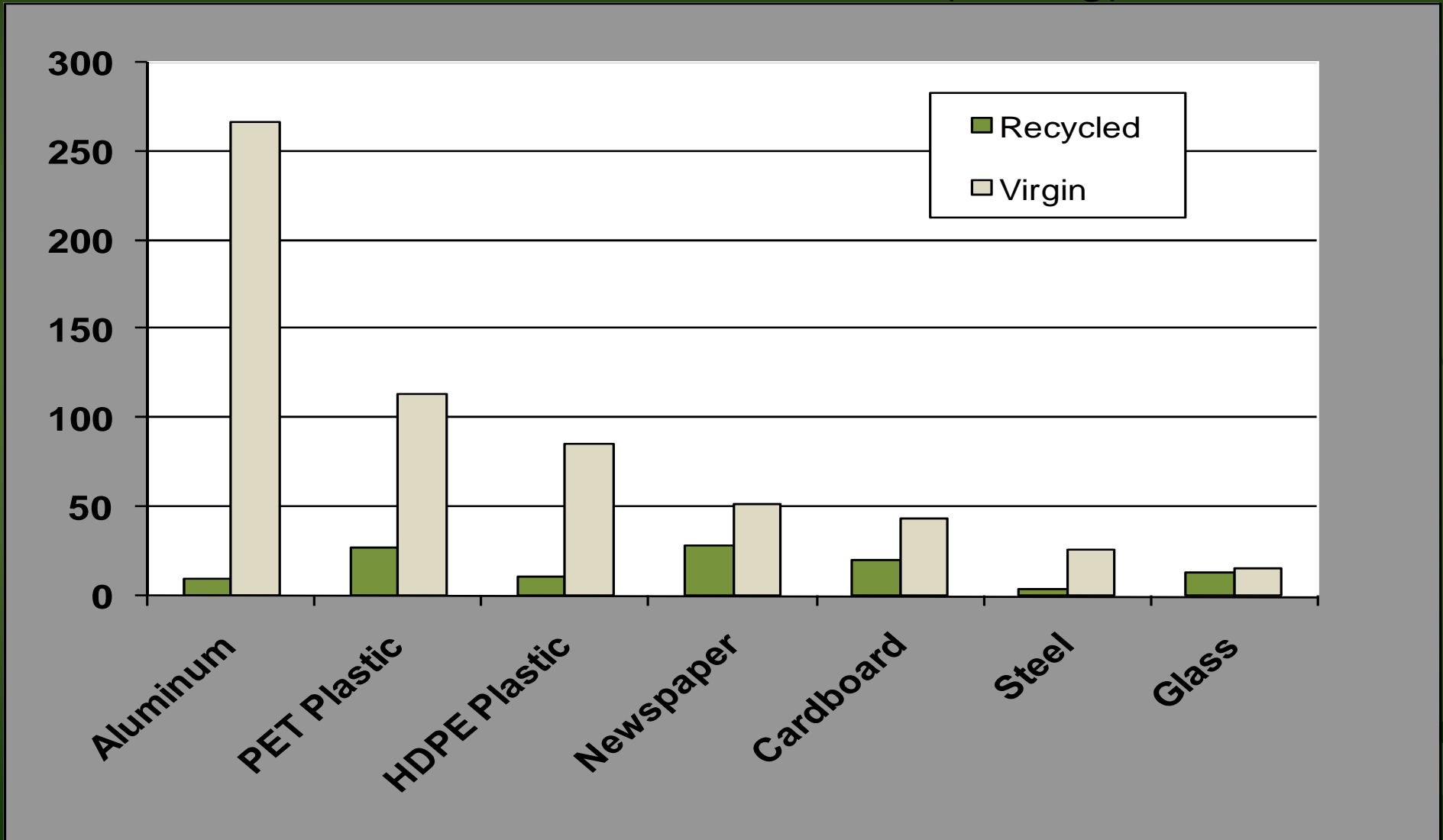


GHG Emissions for Metals

Life Cycles for Landfilling vs. Recycling

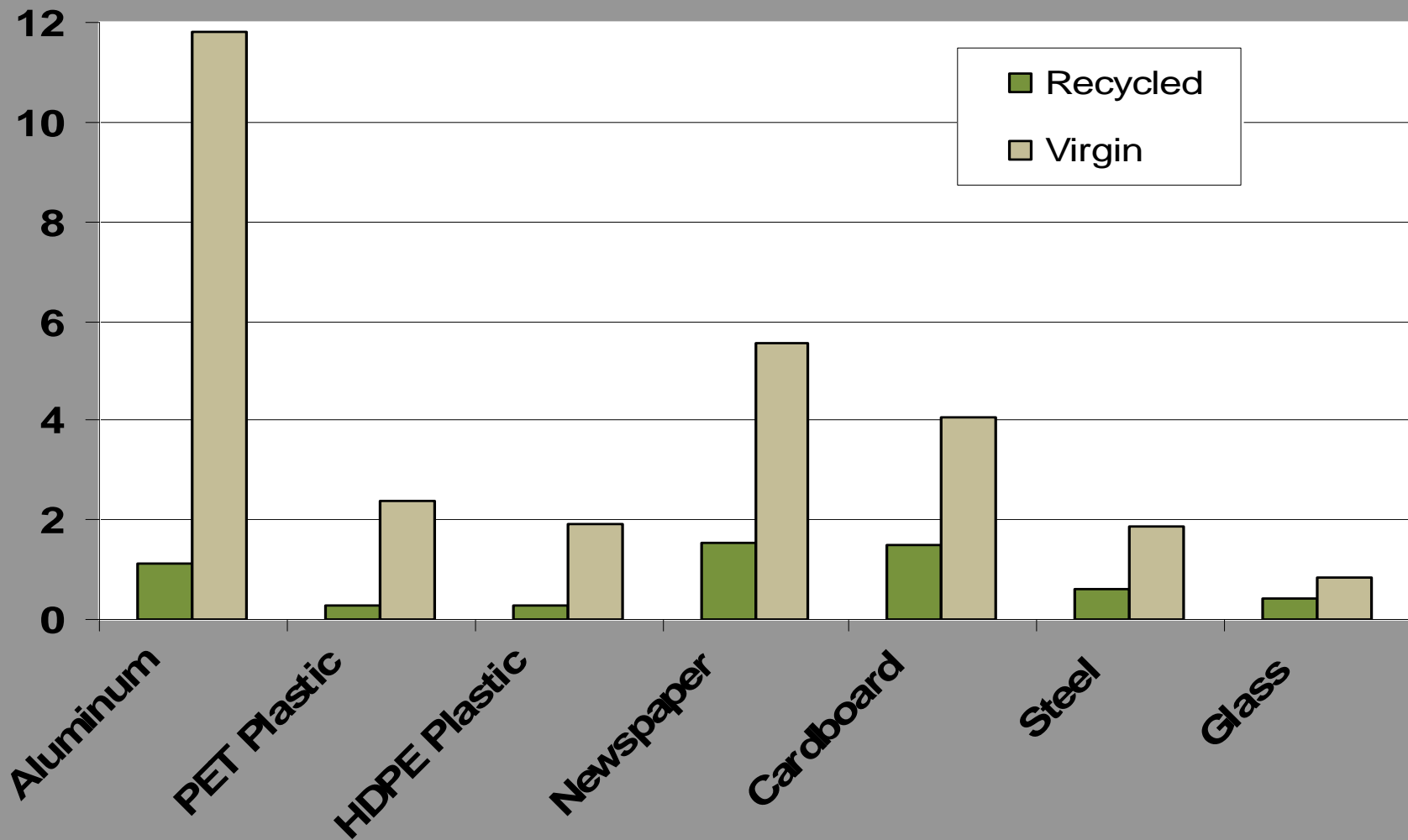


Energy Use: Recycled & Virgin Content Products (MJ/kg)



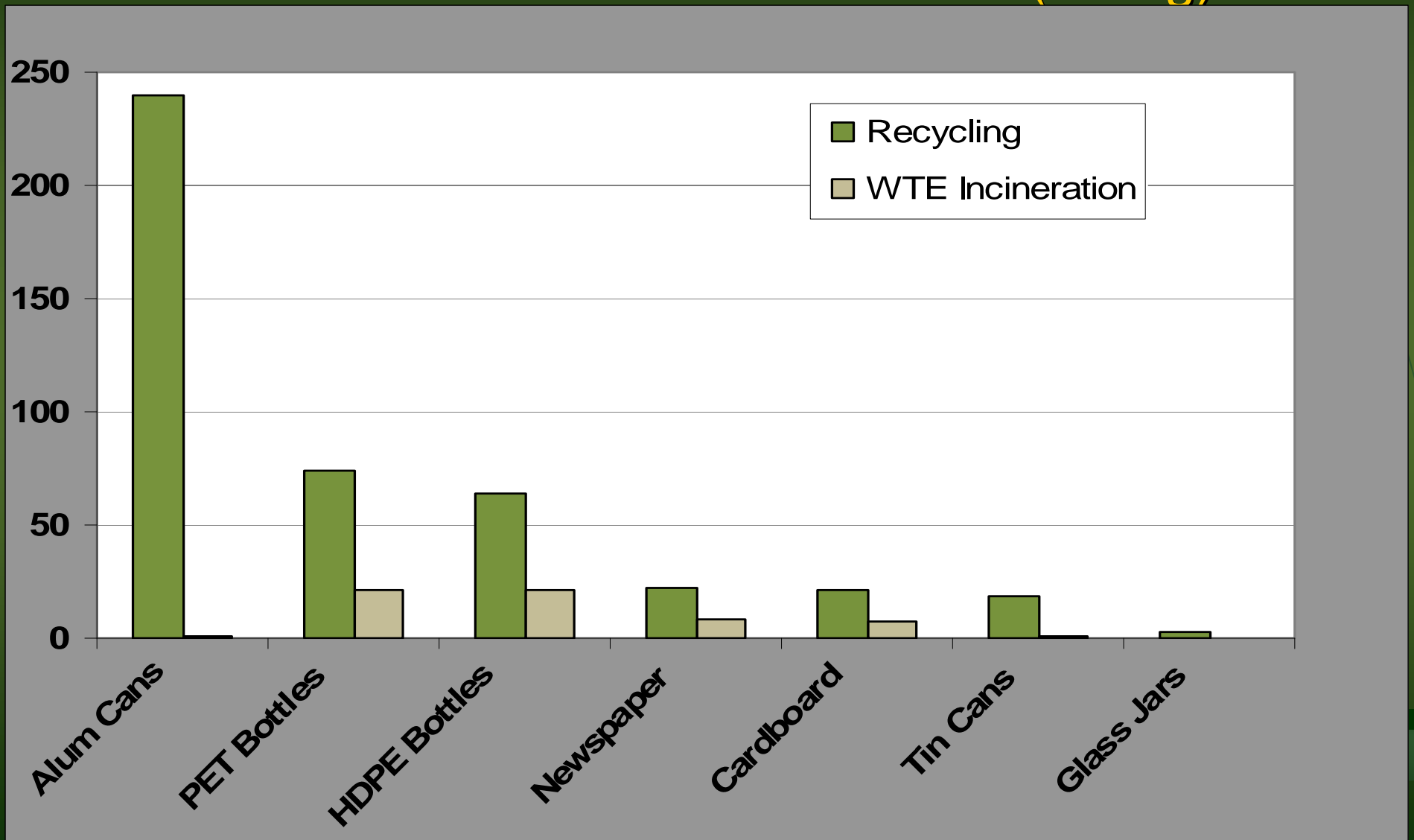
Source: Dr. Jeffrey Morris, Sound Resource Management

CO₂ Emissions: Recycled & Virgin Content Products (kg eCO₂/kg)



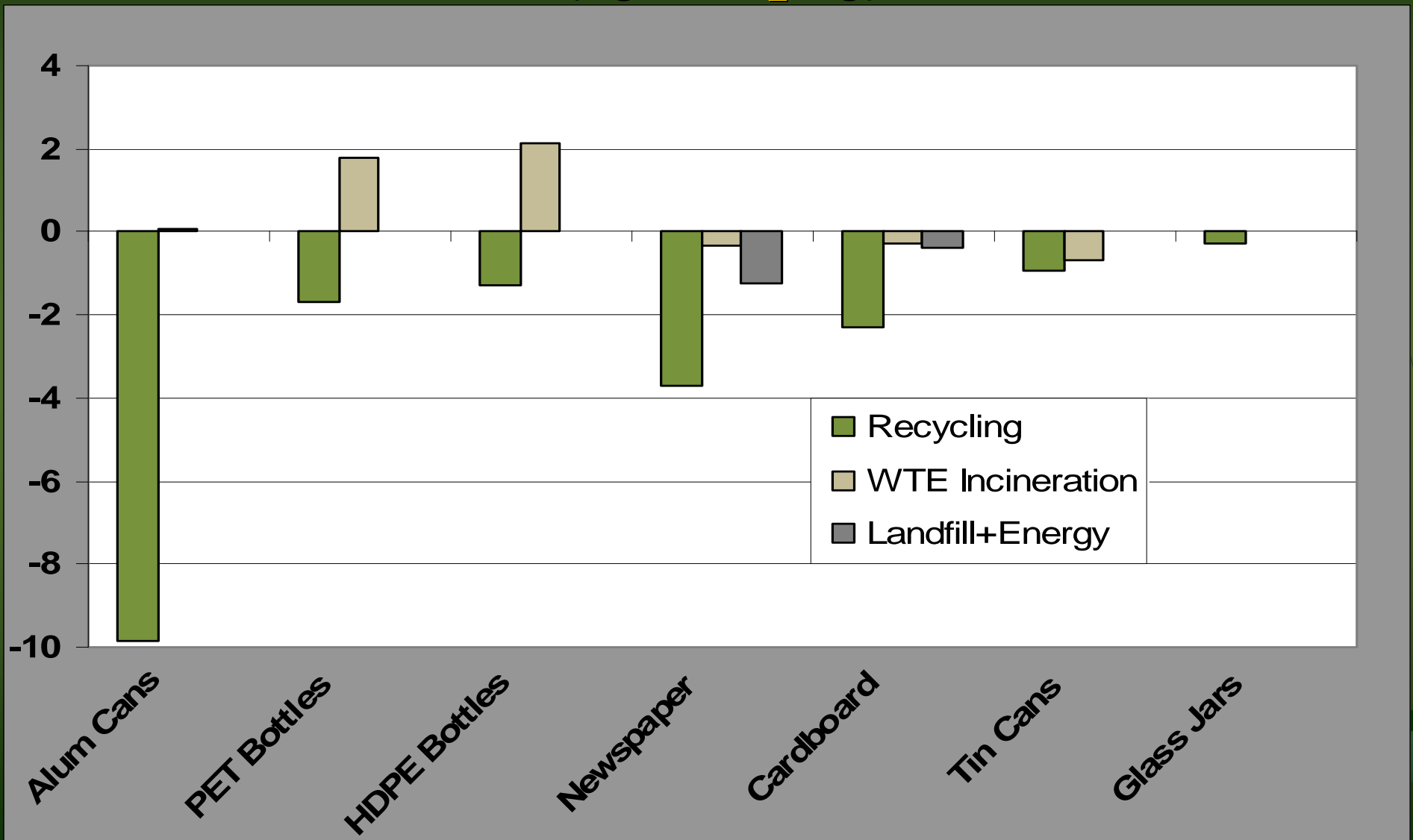
Source: Dr. Jeffrey Morris, Sound Resource Management

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



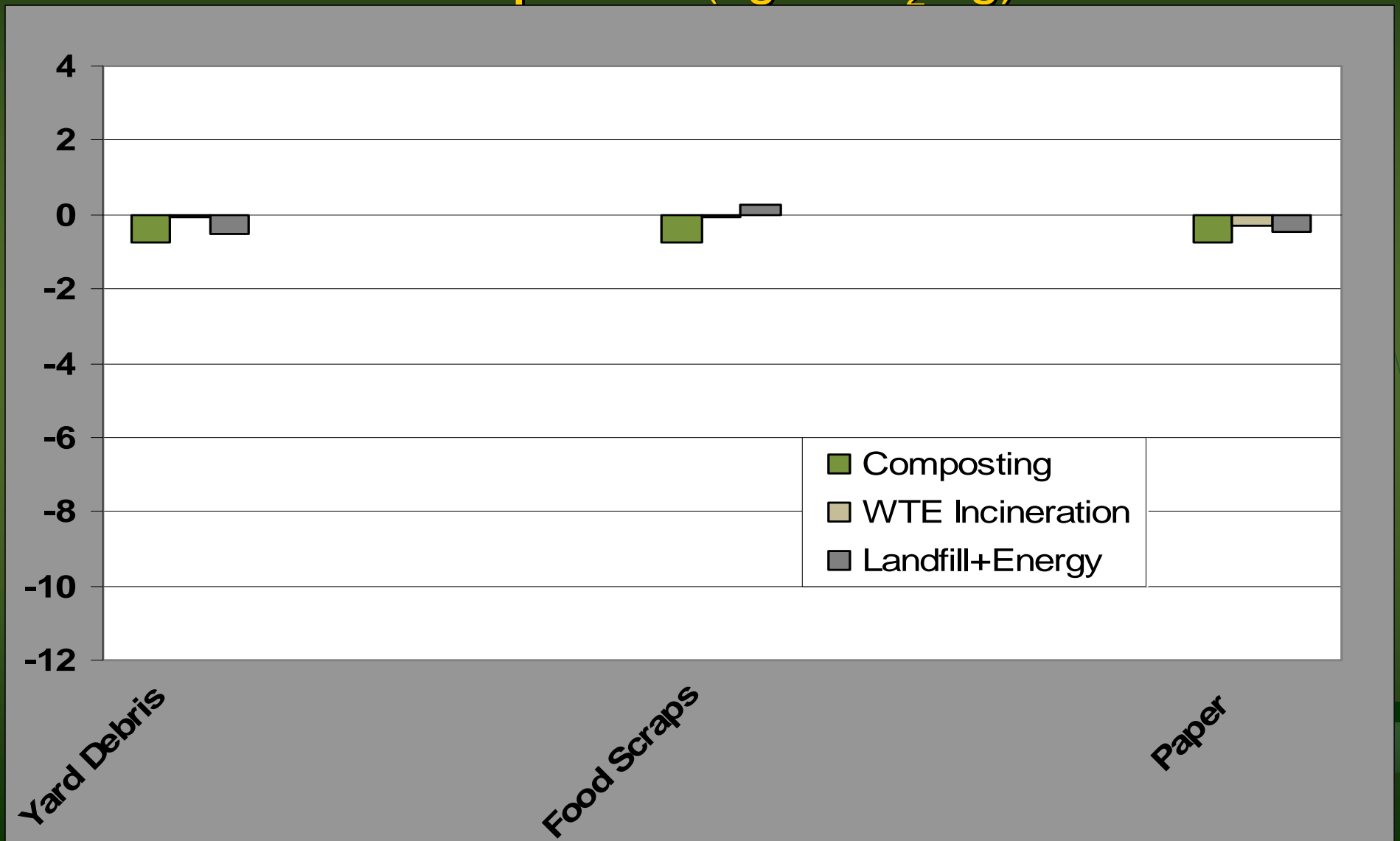
Source: Dr. Jeffrey Morris, Sound Resource Management

CO₂ Emissions: Recycling versus Disposal (kg eCO₂/kg)



Source: Dr. Jeffrey Morris, Sound Resource Management

CO₂ Emissions: Composting versus Disposal (kg eCO₂/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

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

Source: Dr. Jeffrey Morris, Sound Resource Management

3Rs Social Benefits

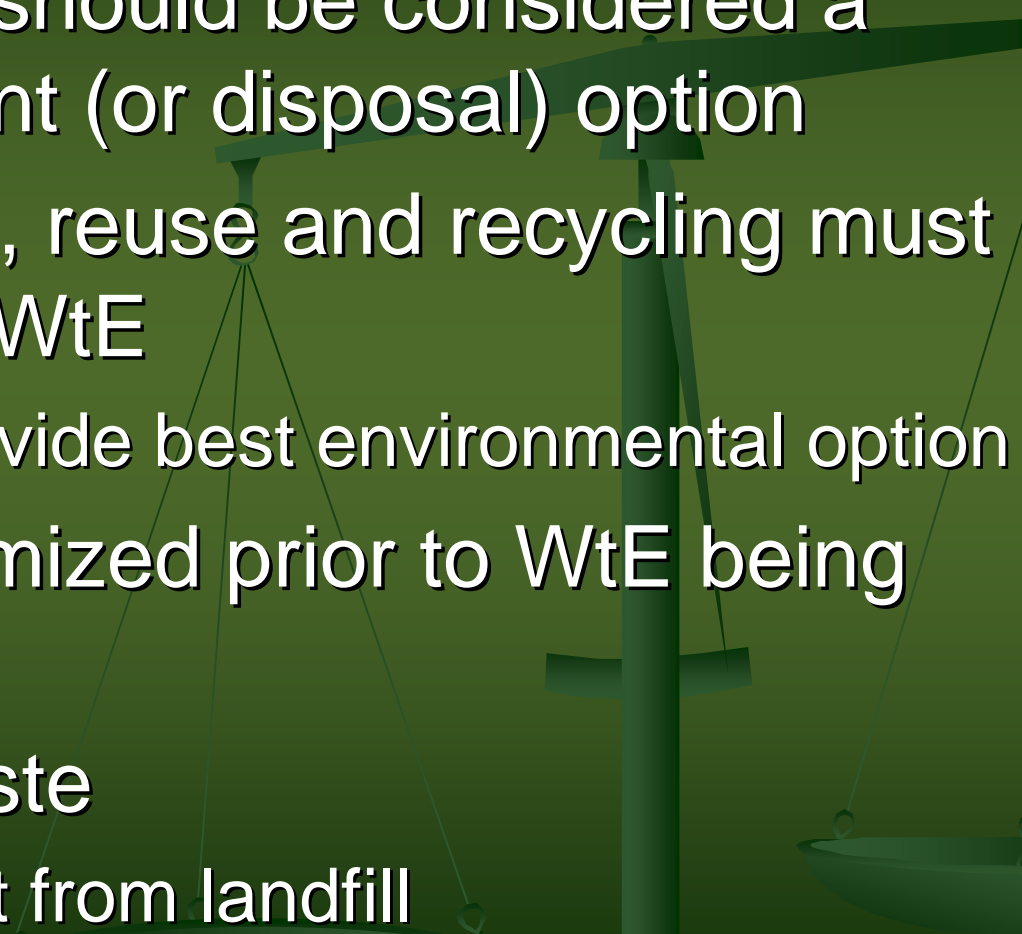
- Jobs
- Training Opportunities
- Personal and Community Pride
- Behavior Change – Waste Reduction



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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