Energy Recovery

A Viable Resource Management Option

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Terminology Matters

'Waste' Management vs <u>Resource Management</u>

Energy from 'Waste' (EFW)

'Waste' to Energy (WTE) vs <u>Energy Recovery</u>

<u>'Waste'</u>		**<u>'Post-consumer Packaging'</u>**
*"something **<u>rejected</u>**, **<u>worthless</u>**,*		*<u>A previously used resource which</u>*
*. . . of **<u>no value</u>**"*	***vs***	*<u>still has value</u>*

Packaging is not a waste

Packaging is a valuable resource

Extends shelf life

- Prevents food spoilage
- So less people go hungry
- So we ship less frequently
- Consume less resources
- Generate less emissions
- Reduce impact of climate change

Protects against product theft and damage

Fosters a safer and healthier society

Facilitates economic development

Landfills are Not the Answer

Wasting Valuable Energy

Visual Pollution

Water table Contamination

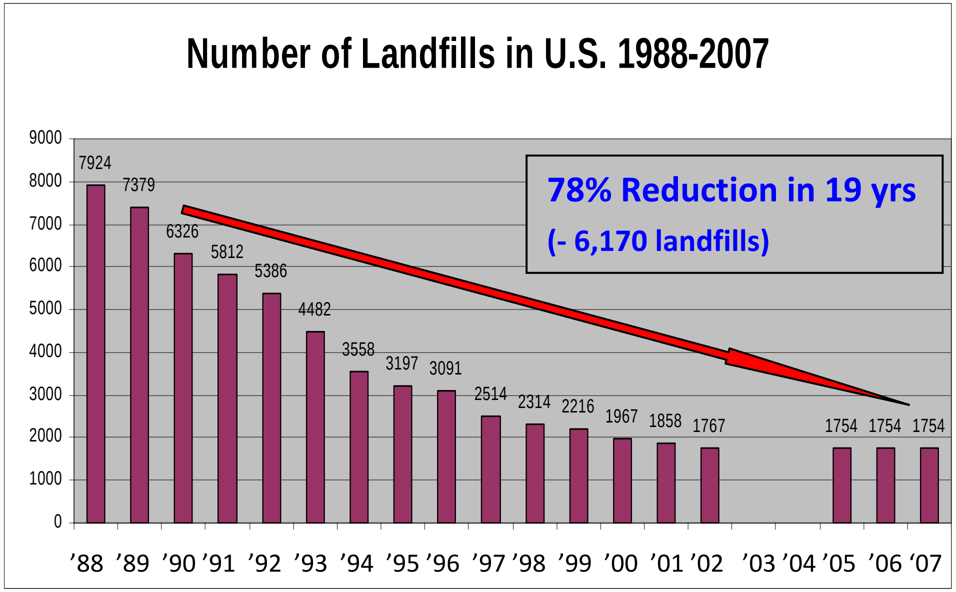
High $ Costs

- Tipping Fees
- Shipping

Chemical Instability

Limited Space

Methane Emissions



Mechanical Recycling is a Major Part of the Solution - But has Limitations

Technical

- Foodservice ware
- Multi-layer packaging
- Difficult to show material codes on all materials

Unrealistic to expect mechanical recycling alone will meet the required diversion goals

Costs

- Collection, Sorting, Cleaning

Lack of infrastructure

- Inconsistent national approach
  - Curbside vs Deposits vs Depots vs Retail stores
  - Not compatible with collection and recycling needs of flexible packaging
- End markets are not being supported

Why do We Recycle?

To reduce "waste" - To prevent physical materials from being buried in a landfill when they are still a valuable resource

To reduce extraction of the earth's limited natural resources (minerals & fossil energy)

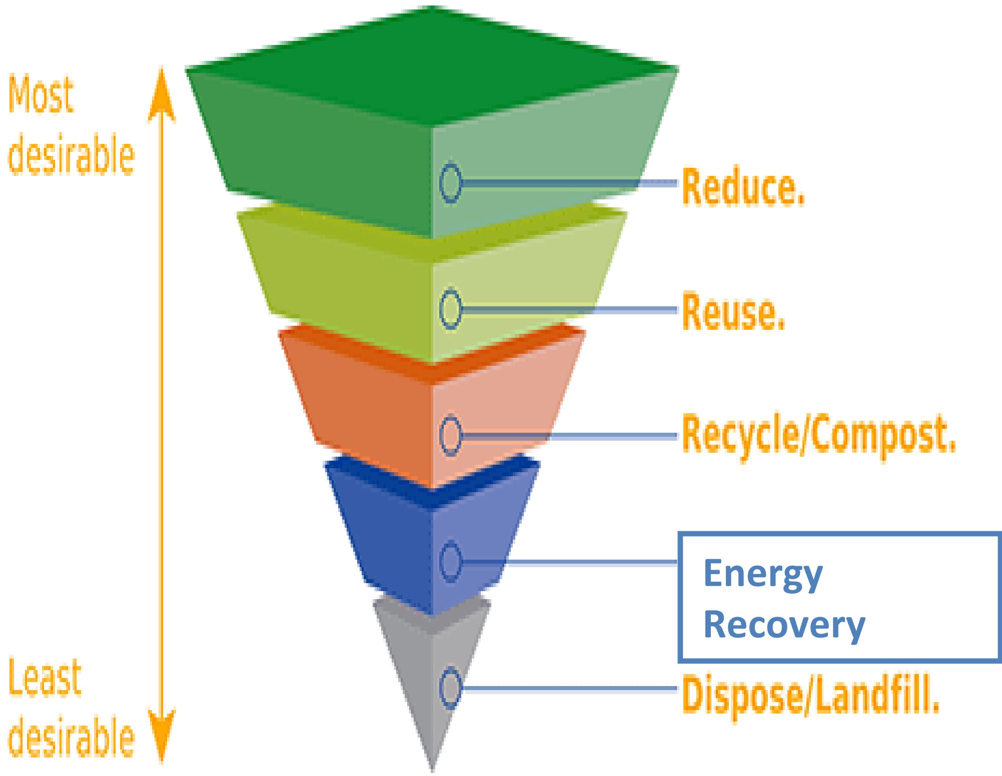
To reduce energy consumption, particularly fossil energy

To reduce greenhouse gas emissions & other pollution

Note: Not all types of recycling accomplish all of these goals!

Must Utilize All EOL Resource Mgt Options

U.S. EPA's Integrated Solid 'Waste' Management Hierarchy



Emerging Technologies (Chemical Transformation)
Eg. Gasification, Pyrolysis, Plasma Arc, Microwave

Solid Recovery Fuel
Eg. Cement Kilns / Power Plants

Combustion with Energy Recovery

~~**Combustion No Energy Recovery**~~

All options are needed to minimize disposal in landfills. Resource conservation is key.

Source: U.S. Environmental Protection Agency

Energy Recovery: Common Misconceptions

MYTH #1: Emits massive amounts of GHGs

FACT: - One of the cleanest forms of energy generation available today

- Operates within strict emission standards (US EPA - Maximum Control Technology (MACT) Standards; European Union, Canadian - A-7 Guidelines)
- Cleaner than coal utilities

MYTH #2: Reduces mechanical recycling rates

FACT: - Does not compete with recycling, rather complements it

- Locations with E.R. experience recycling rate 4%-5% > national average

MYTH #3: Economically uncompetitive

FACT: - Combustion: High capital costs but competitive pay-backs (B.C. facility 8 years break-even)

- Emerging Technologies: Lower upfront costs.

MYTH #4: Low public acceptance - N.I.M.B.Y.

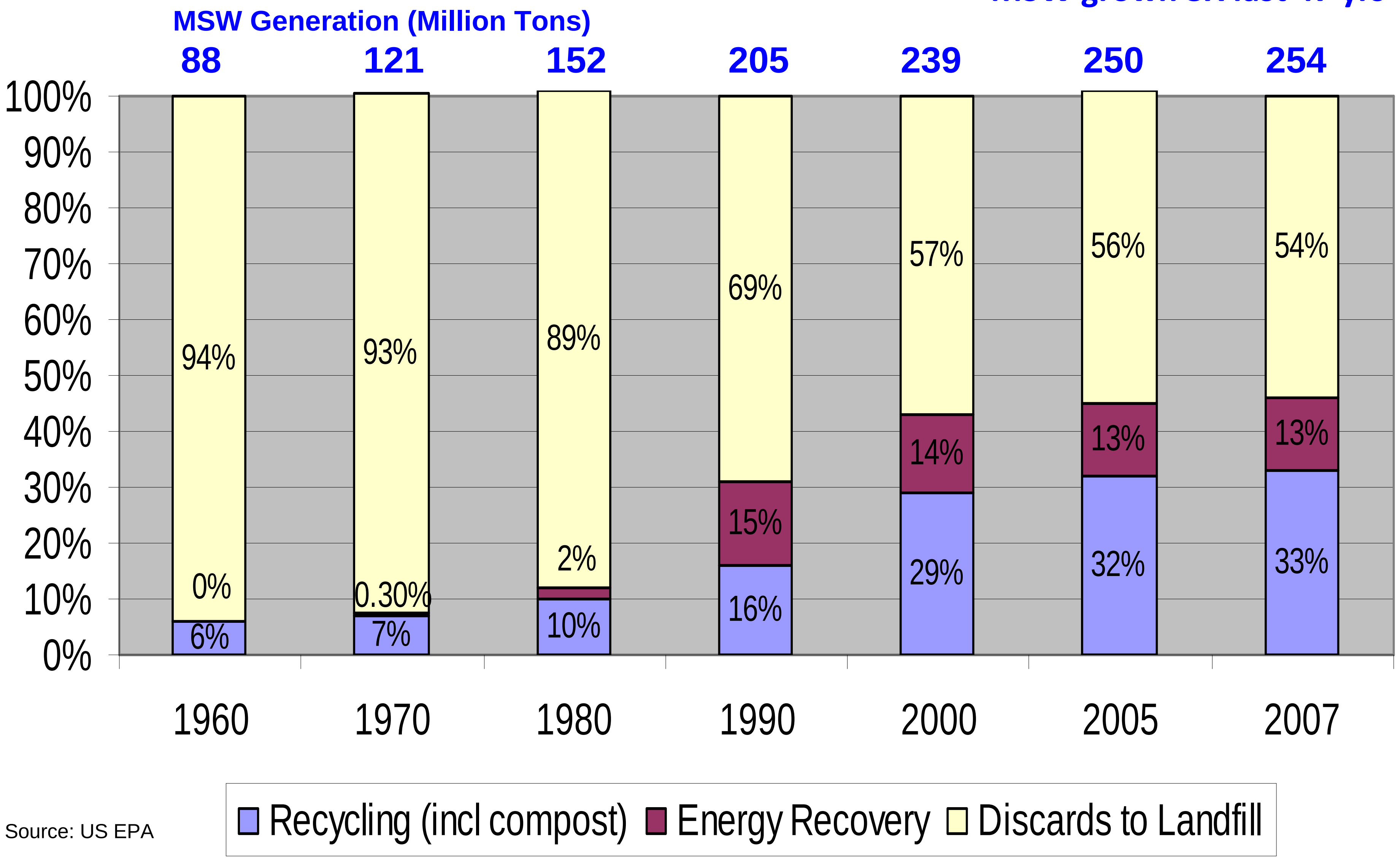
FACT: - Canadian study shows 83 % public support E.R. technologies (~ 24% increase last 4 yrs)

- 10 of 15 'Most Livable Cities in the World' have Energy Recovery facilities (Vienna, Zurich, Geneva, Vancouver, Dusseldorf, Munich, Frankfurt, Bern, Toronto, Helsinki)

Sources: Canadian EFW Coalition, 2009 / Mercer's 'Quality of Living Survey', 2009 / The Economists 'World's Most Livable Cities', 2009

U.S. MSW Generation, Recycling, Energy Recovery & Landfill 1960-2007

MSW grown 3X last 47 yrs

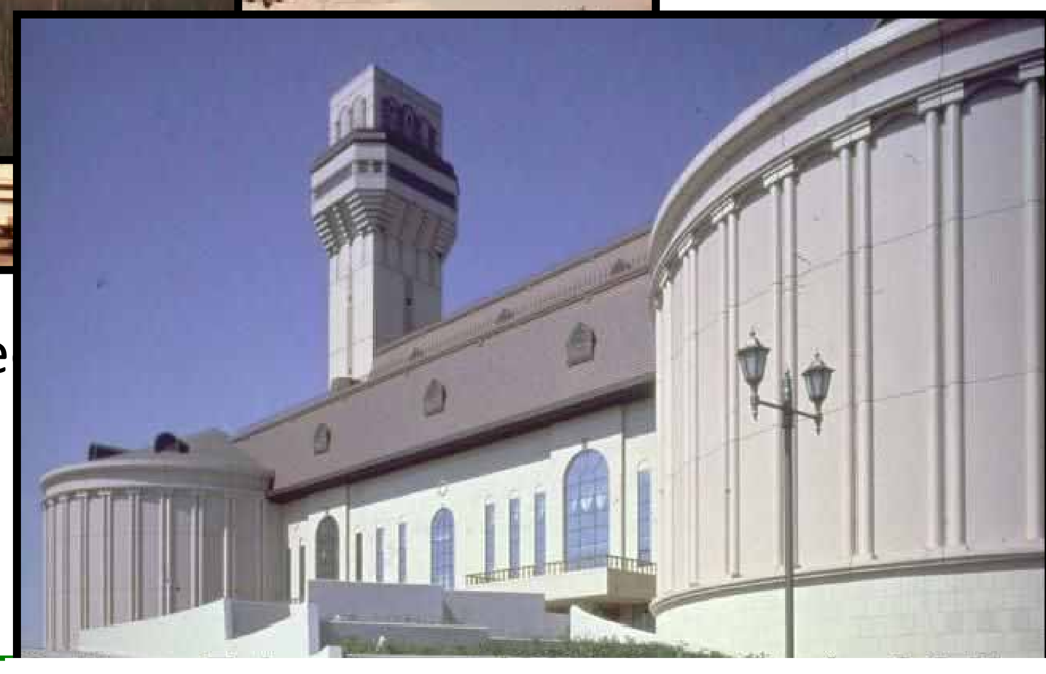


Source: US EPA

Energy Recovery Facilities

Modern Energy Recovery Facilities

Outdate



Energy Recovery Facilities Globally

	# Facilities	MSW Processed Annually	% Total MSW
N.A.			
U.S.A.	89		
Canada	5		
	94	30 million tonnes	13%
Europe	390	60 million tonnes	40%
Asia Japan accounts for 83%	301	70 million tonnes	75%
Total:	**785**	**160 million tonnes**	**29%**

Source: Energy Recovery Council, Waste to Energy Research and Technology Council, Columbia University, US EPA, Canadian Plastics Industry Council

Energy Recovery - USA

89 facilities operating in 29 States

- Down 12% since 2000
- 75% use mass burn technology
- > 6,000 workers

Dispose of 94,721 tons of material per day

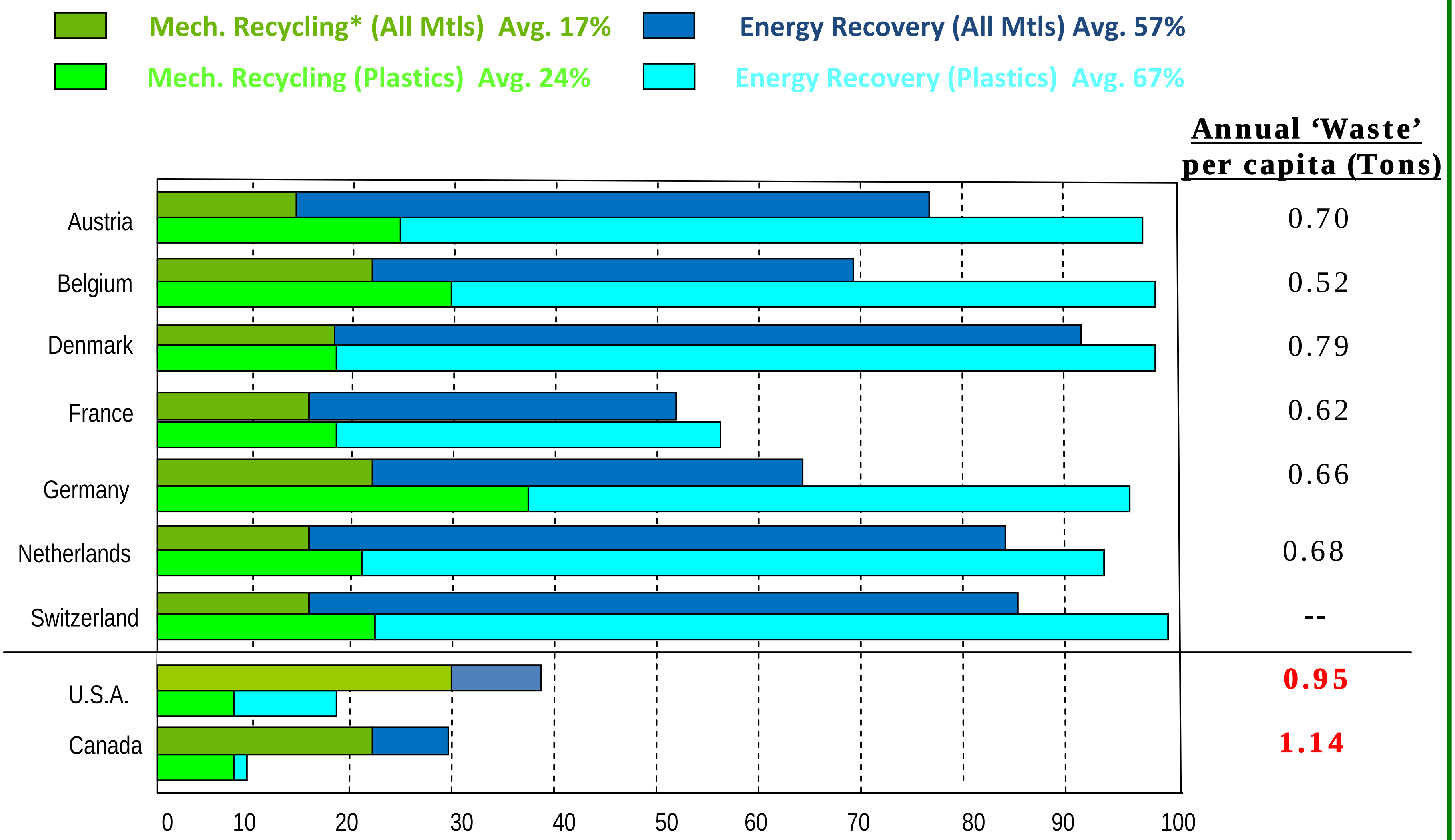
- Generates 2,700 MW of electricity (2.3 Million households)
- Saves about 30 Million barrels of oil per year

According to US DOE, prevents the annual release of;

- 40 million tons of GHG as CO_2 equivalents
- 25,000 tons of nitrogen oxides
- 2.6 million tons of volatile organic compounds

Source: Waste to Energy Research and Technology Council / Joseph Trieshler, Covanta Energy, NAWTEC 2009

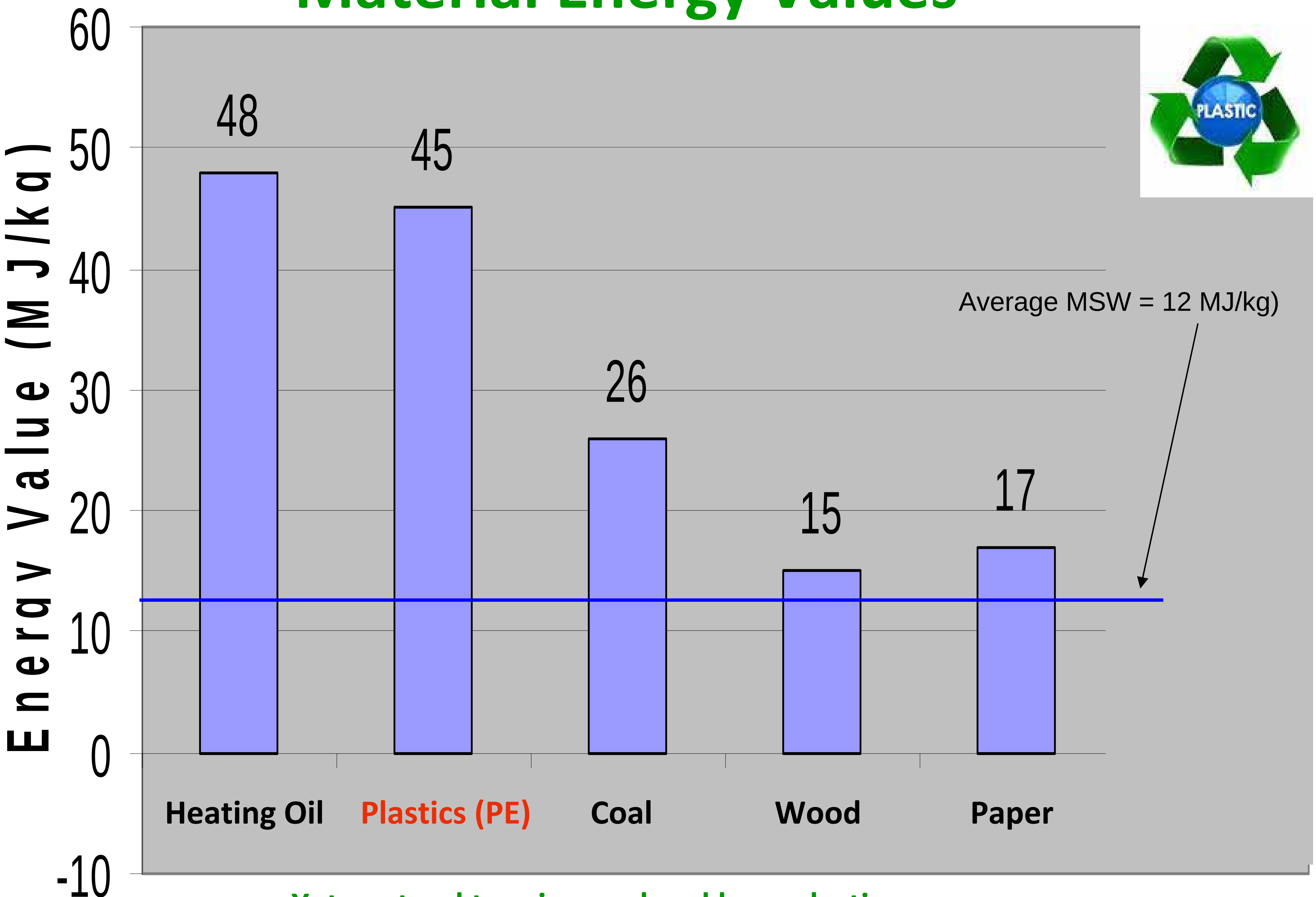
Energy Recovery Can Play a Major Role in 'Waste' Diversion



Sources: European Environmental Agency / Plastics Europe / U.S. EPA / CPIA / Covanta Energy

* USA & Cda includes composting

Material Energy Values



Yet we tend to mine coal and bury plastics

Source: CPIA

Municipal Solid Waste (MSW) and the Environment

MSW contains thousands of chemicals, including chlorine , particulate matter, metals, and microorganisms

All 'waste' management options involve the destruction of some chemicals and the creation of others

– None of these chemicals are unique to waste management

Hazard vs Risk (exposure)

Need to manage MSW effectively to minimize risks to human health and environment

Source: Professor James Bridges, Chair of European Unions Science Committee, University of Surrey

Air Emissions from Top Ten Energy Recovery Plants at WTERT Awards

	Average WTE (mg/Nm3)		EU Standard (mg/Nm3)	US EPA Standard (mg/Nm3)
Particulates (PM)	3.1	<	10	11
Hydrogen Chloride (HCl)	8.5	<	10	29
Sulphur Oxides (SOx)	3	<	50	63
Nirogen Oxides (NOx)	112	<	200	264
Mercury (Hg)	0.01	<	0.05	0.06
Carbon Monoxide (CO)	24	<	50	45
Total Organic Carbon	1.02	<	10	n/a
Dioxins	0.02	<	0.10	0.14

All well within EU and U.S. Standards

Source: Gershman, Brinkner & Bratton, Inc., Waste to Energy Research & Technology, Columbia University

Dioxins

All combustion generates dioxins

Dioxins are hazardous – cancer, nervous systems, reproduction

Dioxins are persistent in the environment and come from a variety of sources

- Only 1% of dioxins in U.S. come from Energy Recovery

Main source of exposure is not via air emission but through diet (fish)

Source: Professor James Bridges, Chair of European Unions Science Committee, University of Surrey

Maintaining Perspective – Dioxin Exposure

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1. The 15 minutes London Millennium fireworks display produced emissions equivalent to 120 years from a single Energy Recovery facility

2. BBQ for 2 hours results in higher dioxin exposure than residing beside an energy recovery facility for 10 years

Source: Professor James Bridges, Chair of European Unions Science Committee, University of Surrey
APSWG briefing on Energy from Waste; UK Environment Agency 2000
Magnus Schonning, Embassy of Sweden; Carl Lilliehöök, Waste & Recycling, Tekniska Verken AB, Linköping Sweden

Coal vs Energy Recovery

	Coal	Energy Recovery
Air Emissions		
Dioxin[2]	60	12 ✓
CO_2[3]	2,249	837 ✓
SO_2[3]	13	1.3 ✓
NO_x[3]	6	5 ✓
Mercury[4]	41	2 ✓
Calorific Value[1]	26	45 (Plastics) ✓
Current Source of Energy	**48%**	**< 1%**

Units: [1] MJ/Kg [2] g TEQdf-HW098/Yr [3] Comparative units used Tonnes/Yr [4]

Source: WTE Research and Technology Council, Columbia University, New York

Recycling AND Energy Recovery

Mechanical Recycling is important but will not solve 'waste' and 'energy' issues on its own

Energy Recovery …

- Safe and technically proven
- Compatible with recycling
- Environmentally sustainable
  - Generates clean renewable energy
  - Reduces GHG emissions (vs coal & land-filling)
- Promotes energy independence
- 'Green' jobs

Energy Conversion Technologies

Thermal/Chemical

- **Combustion / Mass Burn**
- Acid Catalysis & Distillation
- **Gasification / Pyrolysis**
- Microwave Processes
- Plasma Arc
- Thermal Decomposition

Combustion / Mass Burn:
- Most common in U.S.
- Proven technology
- Creates electricity from steam

Gasification / Pyrolysis:
- O_2 free 'burn'.
- Produces syngas ($CO + H_2$)
- Used to create fuel and chemical feedstock
- Smaller scale than mass burn
- Practiced widely in Japan

Biological

- **Aerobic Composting**
- Anaerobic Digestion
- Biodiesel
- Bio-ethanol
- Biological Pretreatment
- Vermicomposting

Anaerobic Digestion:
- Break down of organics in the absence of oxygen.
- A composting system with energy as bi-product.

Processing

- Fiberboard & Construction Composites
- **Refuse Derived Fuels (RDF)**

Refuse Derived Fuels (RDF):
- Proven technology
- Solid Recovery Fuel (SRF)

Potential Products

Ethanol

Chemical feedstocks

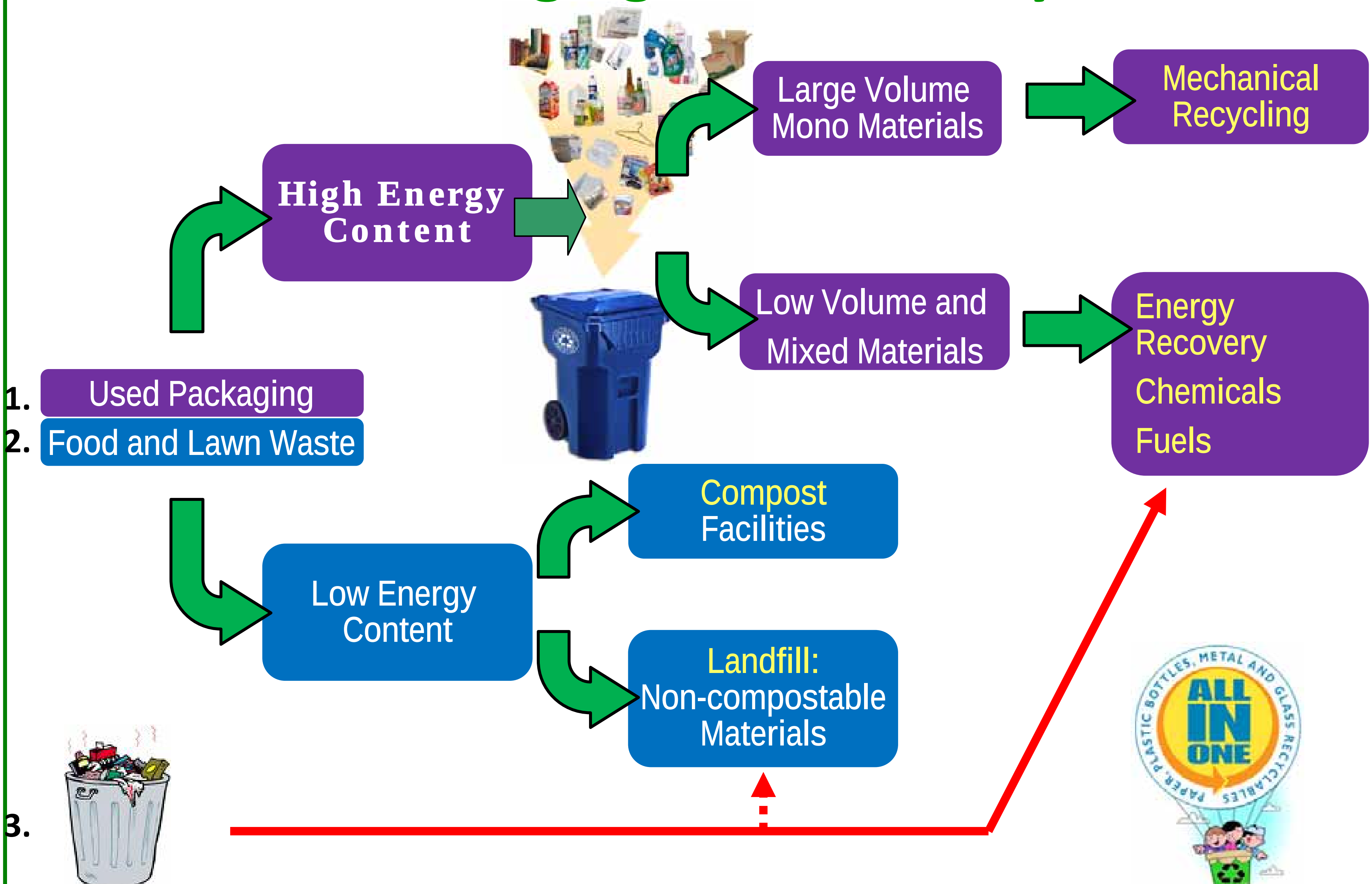
Diesel fuel

Steam

Electricity

Note: Different conversion processes have different potential products; not all products can be made by all processes

‘100% of Packaging into the Recycle Bin’



Why '100% of Packaging into the Recycle Bin'[1]?

Makes it easy for consumers

- Eliminates confusion
- No sorting at home
- Able to participate more easily

Increases collection and reduces packaging going to landfills

Captures energy value of hard to mechanically recycle packaging

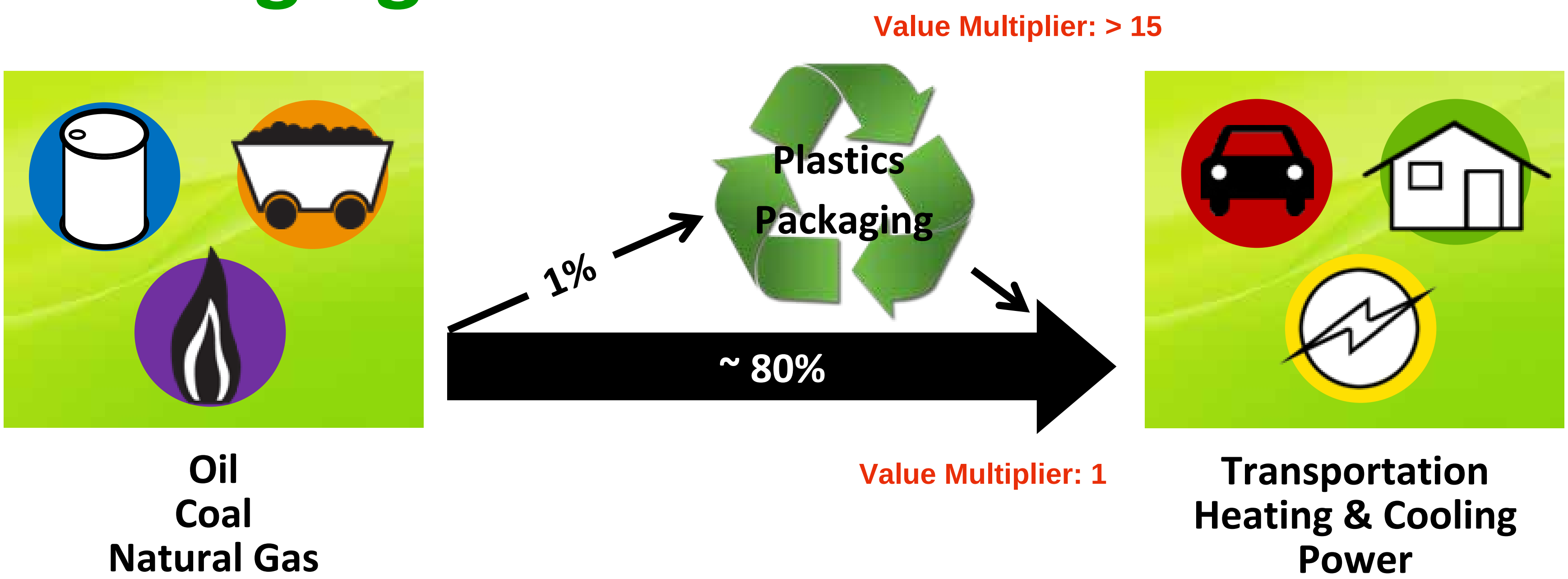
- Eg. Flexible packaging, mixed materials

Improves image of packaging from 'waste' to something of value

Provides a sustainable energy source & reduces need for foreign oil

[1] 100% of Packaging into the Recycle Bin = mechanical recycling + composting + energy recovery + chemical transformation

Marketing the Concept: Plastics Packaging

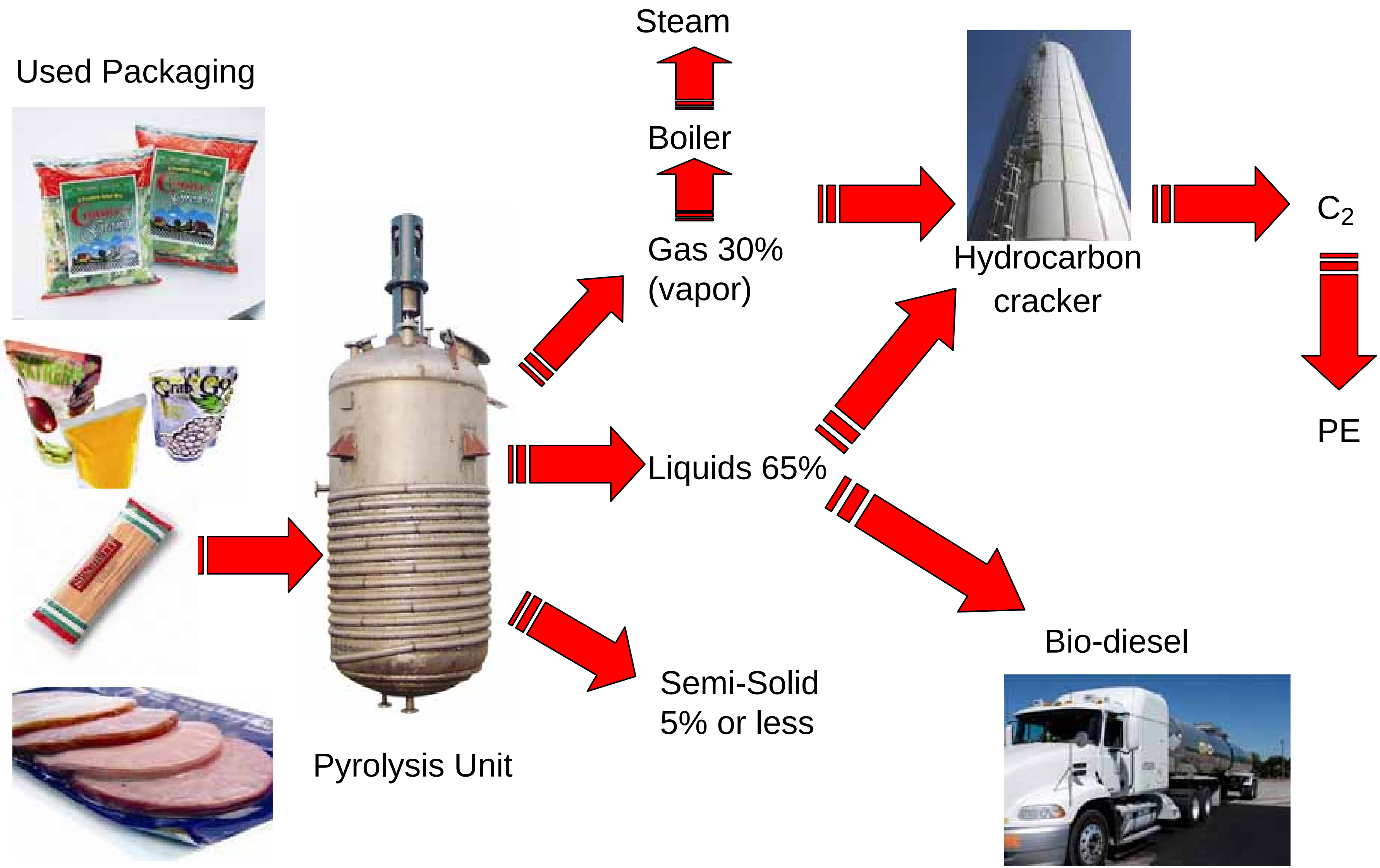


PE retains 2/3 of its original energy content - so let's not waste it

Stop burying oil - instead extend the life of this valuable resource!

Sources: American Chemistry Council; U.S. Energy Information Administration; Canadian Plastics Industry Association.

Chemical Transformation



Artwork for illustrative purposes only

How Much Energy is in Used Packaging?

All household packaging waste (non-recycled plastic & paper of all types) contains the energy equivalent of 90 days supply of household electricity

If processed in a recycle-to-energy facility, the packaging waste (all non-recycled paper & plastic) for a typical household would generate enough electricity to supply the home-use requirements for that household for about 30 days

The non-recycled plastic packaging waste generated by a typical household contains the energy equivalent of 30 days supply of electricity and would generate enough electricity in a recycle-to-energy facility to provide power to that household for 10 days

A year's supply of plastic packaging uses about 3-days supply of the per-capita energy (all types) used in North America

What Now? Let's Work Together . . .

To advance;

- acceptance and use of energy recovery and chemical transformation as a recognized part of the resource management hierarchy
- perception of paper and plastic packaging as;
  - captured energy
  - a valuable resource even after its original use
  - a contributor to a national energy solution
- education & communication with key stakeholders and decision-makers
  - Case Studies, consistent messaging, joint advocacy
- change
  - Drive change ourselves before change is forced upon us
    - Mandated discriminatory legislation & regulations

Let’s Seize the Opportunity

- Packaging helps ‘people, planet, and profit’
- Industry needs to;
  - communicate the benefits of sustainable packaging and positive role of Energy Recovery
  - educate key stakeholders and decision-makers
  - change perceptions
- Pursue “100% recycling” goals
- Coordination and collaboration

Thank You

For more information:

http://www.AmericanChemistry.com/plastics/

http://www.CPIA.ca/epic/