Sustainable Materials Management

Rethink

CHANGING HOW WE THINK ABOUT OUR RESOURCES FOR A BETTER TOMORROW

EPA United States Environmental Protection Agency

www.epa.gov/smm

What is Sustainable Materials Management?

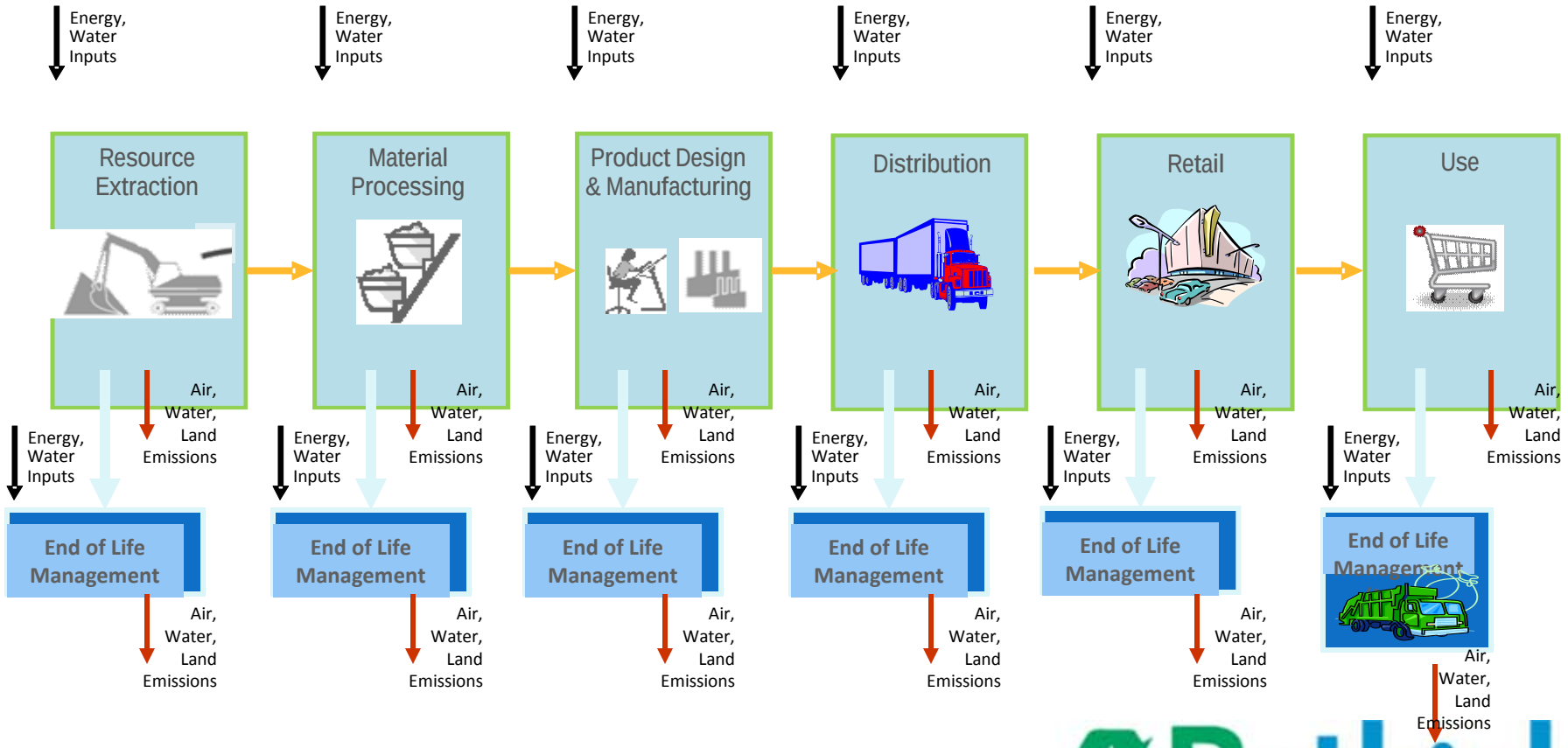
Historical approach to conserving resources:

- Reduce, Reuse, and Recycle

Our approach moving forward:

- refocus our thinking to consider how materials are managed over their entire life cycle

Material/Product Life Cycle



Rethink

CHANGING HOW WE THINK ABOUT OUR RESOURCES FOR A BETTER TOMORROW

How is SMM different from Reduce, Reuse, Recycle?

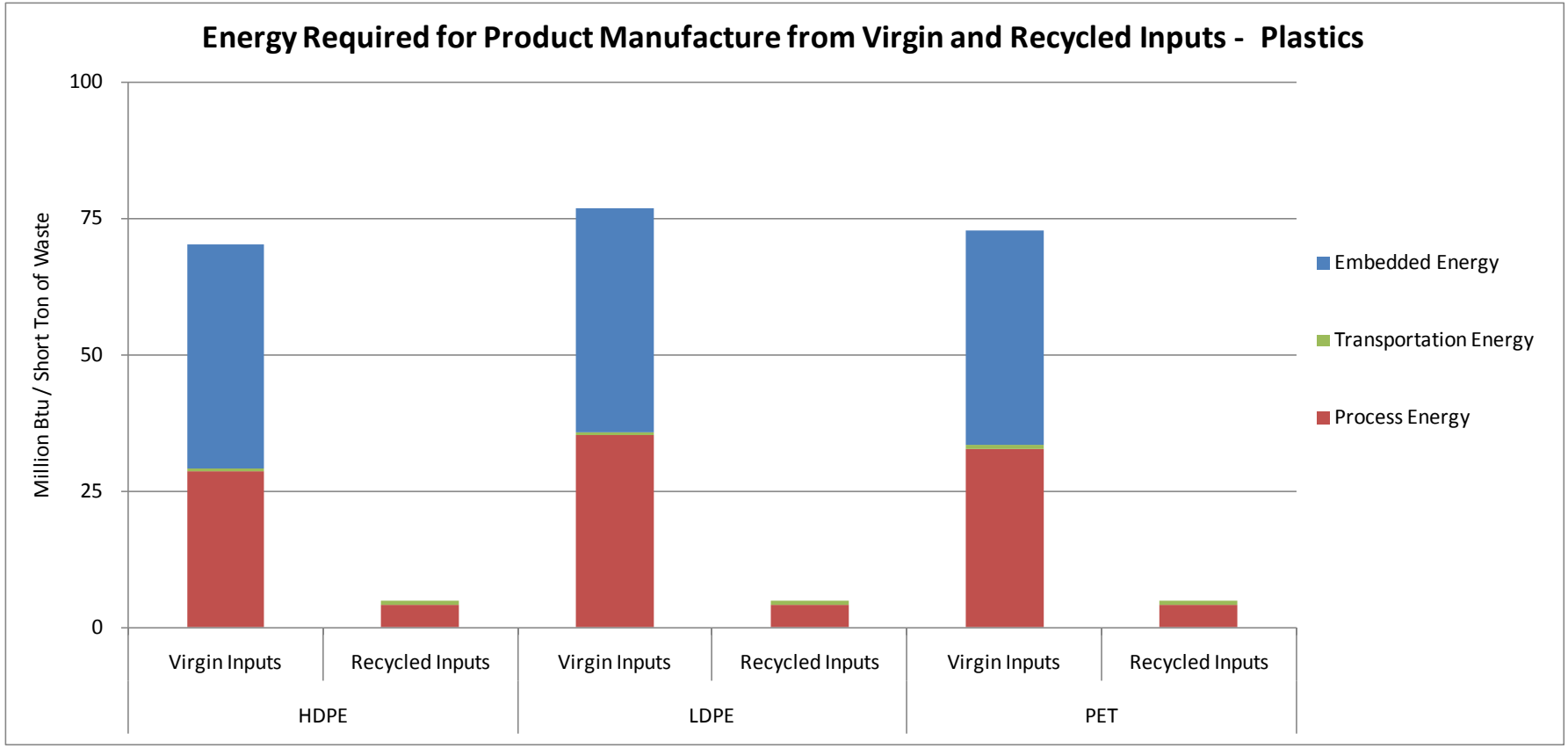
Reduce, Reuse, and Recycle is an end-of-life perspective

SMM considers the entire lifecycle

We care about all environmental impacts, so SMM gives us a more complete picture of how we should manage materials, goods and services

Recycling is an Important Part of SMM

- GHG emissions associated with energy production are avoided through recycling & source reduction
  - For most materials, the manufacturing process energy for recycled materials uses a fraction of the energy used to produce virgin materials.
- Use less energy – produce fewer GHGs

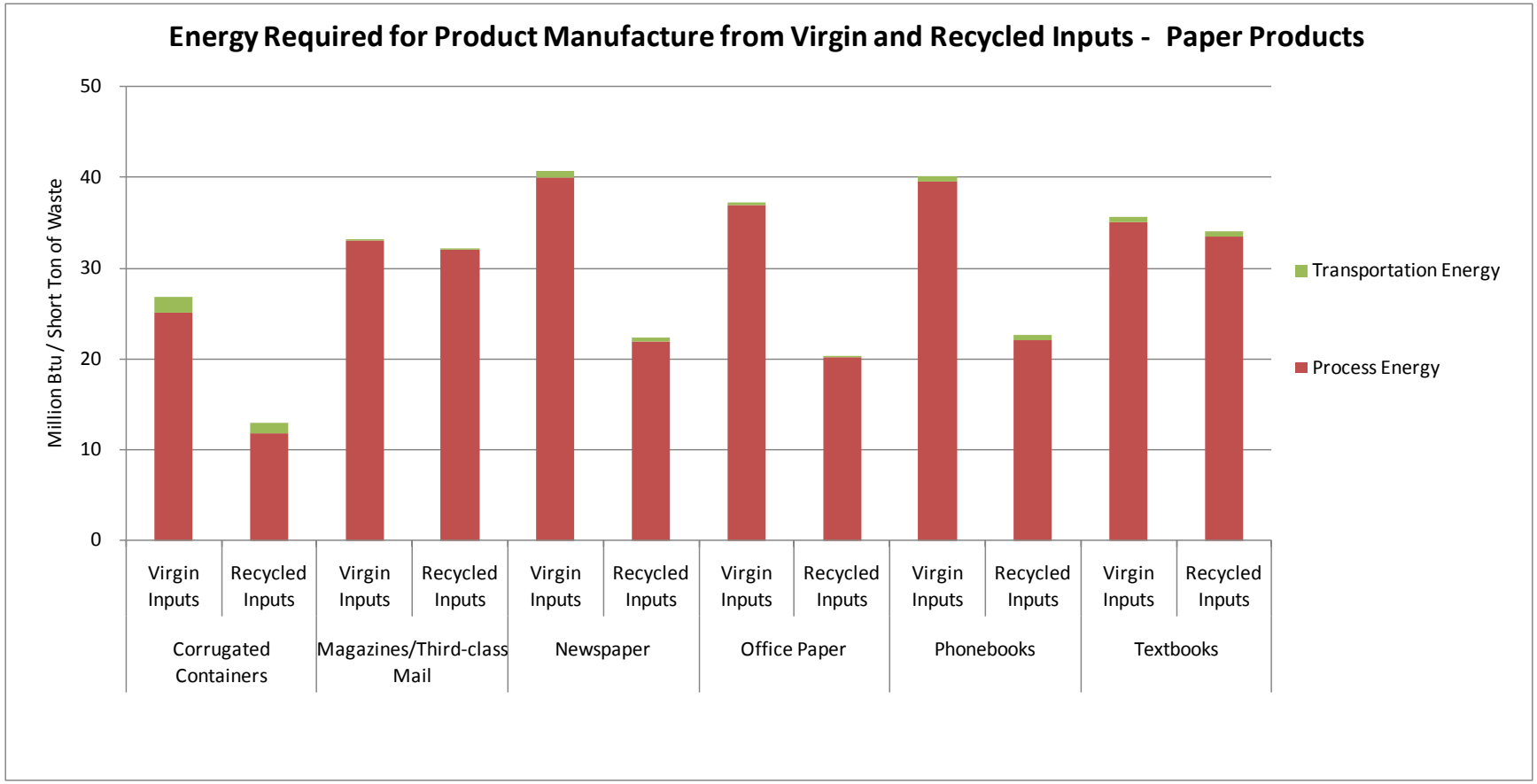


Rethink

CHANGING HOW WE THINK ABOUT OUR RESOURCES FOR A BETTER TOMORROW

EPA United States Environmental Protection Agency

www.epa.gov/smm



Rethink

CHANGING HOW WE THINK ABOUT OUR RESOURCES FOR A BETTER TOMORROW

EPA United States Environmental Protection Agency

www.epa.gov/smm

Recycling is an Important Part of SMM

- Forest carbon sequestration increases when wood products are source reduced & recycled
  - trees sequester carbon from the atmosphere through photosynthesis, converting CO2 in the atmosphere to carbon in their biomass.

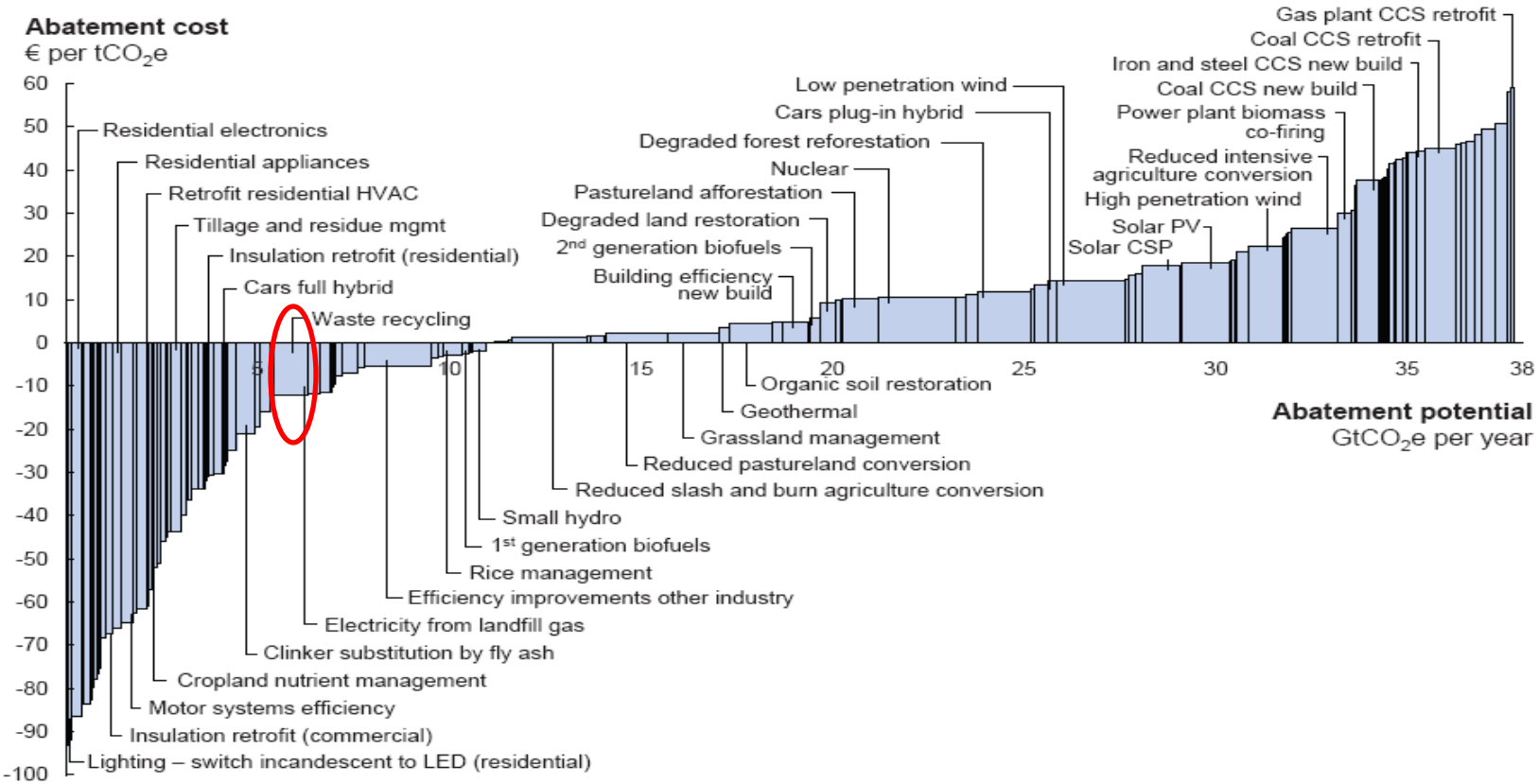
- Carbon storage increases when organics are composted and added to soil

Recycling is an Important Part of SMM

- Recycling & Source Reduction Avoid:
  - CH_4 emissions from landfills
  - CO_2 emissions from waste combustion

Recycling is a cost-effective GHG abatement strategy

Global GHG abatement cost curve beyond business-as-usual – 2030



Note: The curve presents an estimate of the maximum potential of all technical GHG abatement measures below €60 per tCO_2e if each lever was pursued aggressively. It is not a forecast of what role different abatement measures and technologies will play.
Source: Global GHG Abatement Cost Curve v2.0

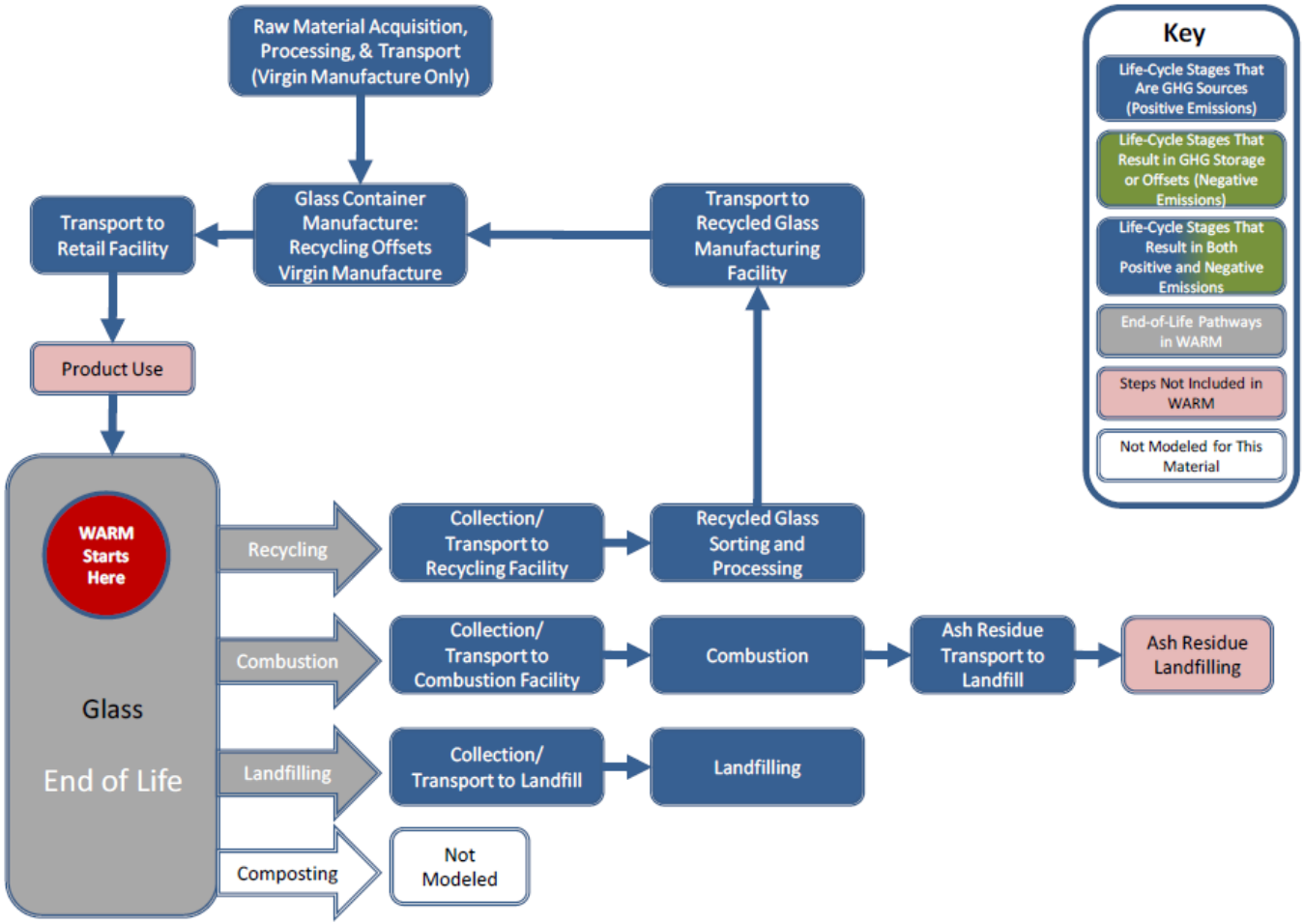
Tools

- Waste Reduction Model (WARM)
  - epa.gov/warm
- Individual Waste Reduction Model (iWARM)
  - epa.gov/iwarm
  - Also available as an app on itunes
- Recycled Content Tool (ReCon)
  - http://www.epa.gov/climatechange/wycd/waste/calculators/ReCon_home.html
- Greenhouse Gas Equivalency Calculator
  - http://www.epa.gov/cleanenergy/energy-resources/calculator.html

WARM

- Web-based and Excel (downloadable)
- 46 material types
- Baseline and alternative management scenarios
  - source reduction, recycling, combustion, composting, and landfilling
- GHG (MTCO2e or MTCe) and energy (mBTUs)

Material Types Recognized by WARM		
Aluminum Cans	Grass	Office Paper
Aluminium Ingot	HDPE	Personal Computers
Asphalt Concrete	LDPE	PET
Asphalt Shingles	Leaves	Phonebooks
Branches	LLDPE	PLA
Carpet	Magazines / Third-Class Mail	PP
Clay Bricks	Medium-density Fiberboard	PS
Concrete	Mixed Metals	PVC
Copper Wire	Mixed MSW	Steel Cans
Corrugated Cardboard	Mixed Organics	Textbooks
Dimensional Lumber	Mixed Paper (general)	Tires
Drywall	Mixed Paper (primarily from offices)	Vinyl Flooring
Fiberglass Insulation	Mixed Paper (primarily residential)	Wood Flooring
Fly Ash	Mixed Plastics	Yard Trimmings
Food Scraps	Mixed Recyclables	
Glass	Newspaper	



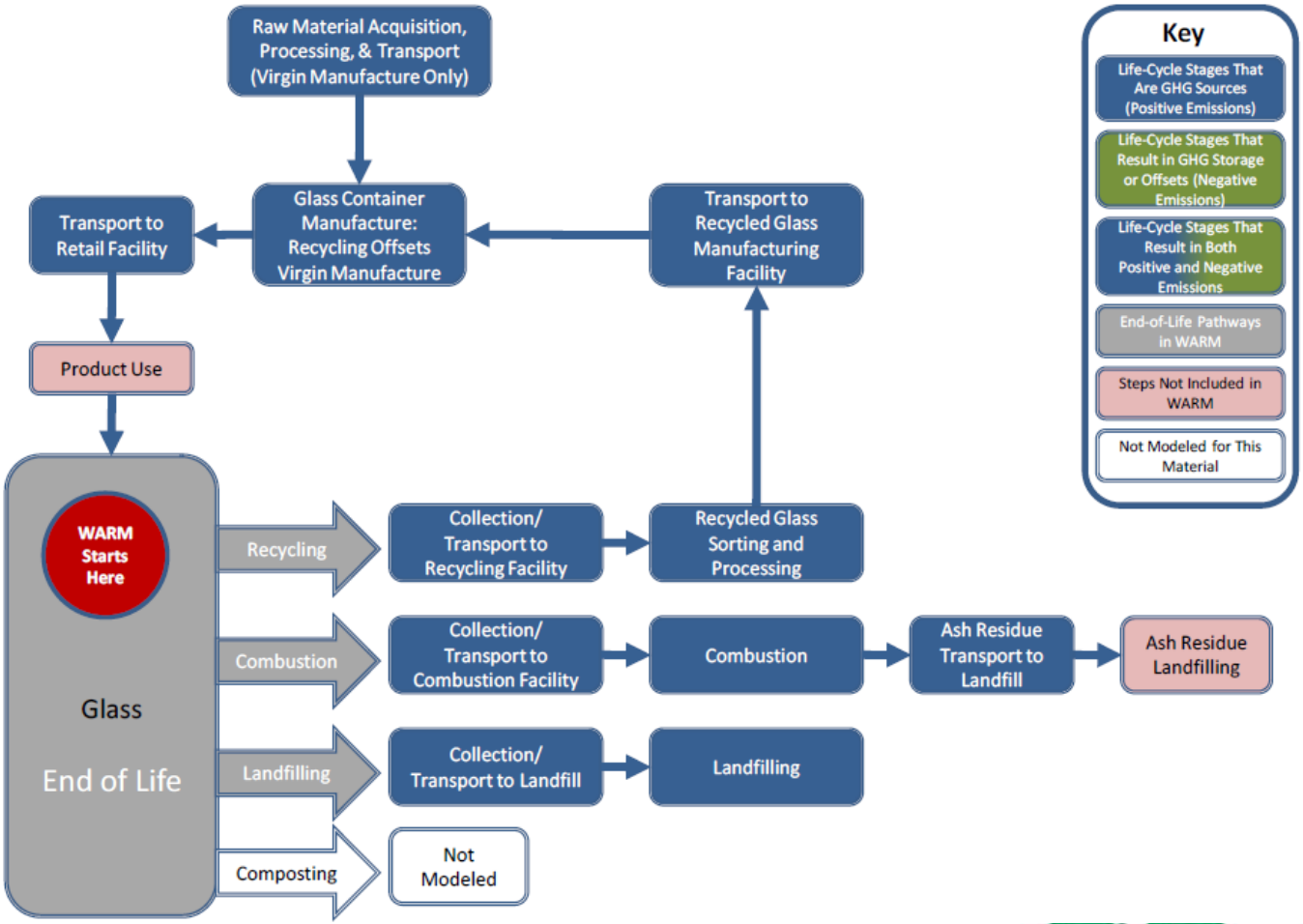
Rethink

CHANGING HOW WE THINK ABOUT OUR RESOURCES FOR A BETTER TOMORROW

EPA United States Environmental Protection Agency

www.epa.gov/smm

Pathway-specific modeling



Rethink

CHANGING HOW WE THINK ABOUT OUR RESOURCES FOR A BETTER TOMORROW

EPA United States Environmental Protection Agency

www.epa.gov/smm

WARM – recent revisions

- last updated February 2012 (Version 12)
- Added LLDPE, PP, PS, PVC, & PLA & aluminum ingot
- Revised
  - EFs for aluminum cans
  - combustion and open-loop recycling pathways for residential broadloom carpeting
  - EFs for HDPE, LDPE & PET
  - Recycling factors for mixed recycling and mixed plastics recycling factors

The Future of WARM – Organics

- we have begun work on modeling 5 categories of food waste throughout their lifecycle.
  - chicken, beef, dairy, grains, and fruits/vegetables
- we hope to add food donation as well as source reduction as two new waste management scenarios in WARM for organics

The Future of WARM – Electronics

- Currently, WARM considers only one electronics category – a 70 lb desktop computer
- In FY13, we will looking at utilizing the Electronics Environmental Benefits Calculator (EEBC) in lieu of WARM, and whether any additions/changes would need to be made to the EEBC to help better align the two.

The Future of WARM – Landfill Gas

- We are examining three aspects of landfill gas collection modeling in WARM:
  - (1) the fraction of produced gas that is either collected or attenuated by methane oxidation,
  - (2) the timing of gas collection system installation, and
  - (3) the time over which a beneficial use system can be expected to function in consideration of the volume of recoverable gas available.

iWARM

- Downloadable Excel spreadsheet or iPhone app
- Uses data from WARM, translated from tons to weight of individual products
- Estimates the amount of energy saved by recycling small quantities of common waste materials
- Benefit is shown as the operational hours of common appliances.

Individual Waste Reduction Model (iWARM)

1. Inputs

Enter the number of items of each product type you will be recycling in the column on the right

Clear All

Product Type	Number of Items
Aluminum drink can (12 fl. oz.)	12
Steel soup can (15.5 fl. oz.)	
Metal coat hanger	
Glass bottle (12 fl. oz.)	
Glass wine bottle (0.75 liter)	
Gallon plastic milk jug	
Gallon plastic detergent container	
Plastic grocery bag	
Plastic bottle (20 fl. oz.)	
Plastic bottle (2 liter)	
2' x 2' x 2.5' corrugated cardboard box, 3mm thick	
Weekly magazine	
Catalog	
Daily newspaper	
Sunday edition of newspaper	
12-inch stack of newspaper	
Printer paper, 1 ream (500 sheets)	
Sheet of printer paper	
White business envelope	
Paperboard cereal box	

2. Results

Net Energy Savings (Thousand Btu)	Delivered Electricity Equivalent (kWh)
36.30	3.1

3. The energy saved by recycling these products is equal to the electricity required to run ONE of the following appliances for the indicated number of hours:

Click on individual checkboxes to graph the hours equivalent for a particular appliance

Select All

Appliance	Hours Available	Appliance	Hours Available
Room Air Conditioner	2.1	Dishwasher (w/dry cycle)	1.3
Ceiling Fan	25.9	Dishwasher (w/o dry cycle)	2.6
Window Fan	20.4	Light bulb, CFL (60 W equivalent)	239.4
Hairdryer	2.0	Light bulb, Incandescent (60 W)	51.9
Clothes Dryer	0.9	Laptop Computer	62.2
Clothes Washer	7.3	CRT Television, 36"	23.4

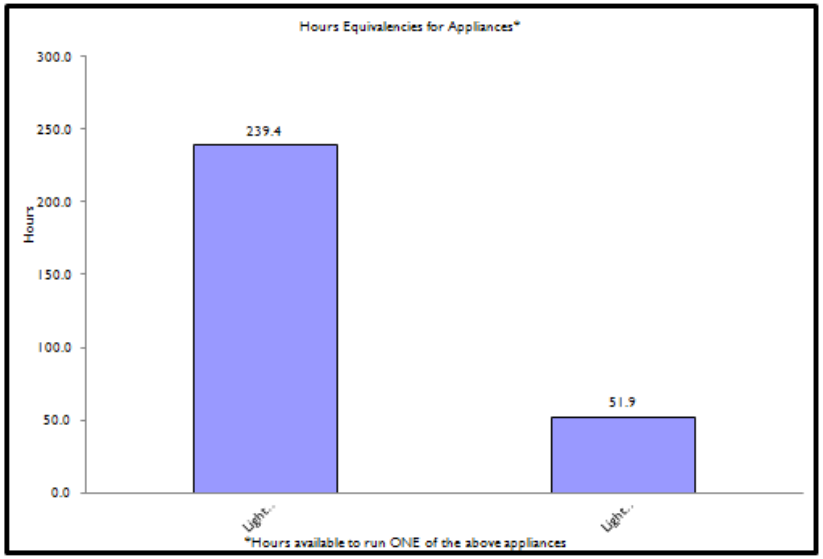
Important Assumptions

- Net energy savings are the result of recycling a product instead of landfilling it. EPA recognizes that not all products that are disposed are sent to a landfill. According to EPA's MSW Facts and Figures report, approximately 80% of all waste disposed is landfilled and the remaining 20% is combusted. The benefits of recycling as compared to combustion would be different than those presented here. However, since the majority of waste disposed is landfilled, this assumption is representative of the main disposal pathway in the United States.

- The recycled product is assumed to be manufactured using 100% recycled inputs, and to displace the manufacture of a product made with 100% virgin inputs. EPA recognizes that products that are recycled generally displace new materials that have a mixture of recycled and virgin inputs (i.e., current average industry mix). The benefits presented here may be overstated for some materials, e.g., aluminum cans, for which the current average industry mix includes a high percentage of recycled inputs.

- All the upstream energy saved via recycling is described in terms of delivered electricity energy downstream. In other words, the energy content of all fuels saved in the production process is expressed in terms of delivered electricity energy equivalent. The delivered electricity equivalent incorporates transmission and distribution losses.

- The hours equivalencies for appliances are not additive and indicate the hours available to operate ONE appliance on the list at a time. The graph shows the comparison of hours available based on typical wattage of an appliance during operation.



ReCon

- The ReCon Tool was last updated October 2010.
- Web-based and Excel (downloadable)
- 17 material types
- Baseline and alternative recycled content scenarios
- GHG (MTCO2e) and energy (mBTUs)

Material Purchased	Surrogate Material	Baseline Recycled Content (percent)	Alternate Recycled Content (percent)	Use Default for Baseline Recycled Content [set all]	Recycled Content Range (percent)
	Aluminum Cans			☐	5 - 60
	Steel Cans			☐	20 - 50
	Copper Wire			☐	0 - 10
	Glass			☐	5 - 30
	HDPE			☐	0 - 15
	LDPE			☐	0 - 15
	PET			☐	0 - 10
	Corrugated Cardboard			☐	10 - 75
	Magazines/Third-class Mail			☐	0 - 30
	Newspaper			☐	0 - 60
	Office Paper			☐	0 - 35
	Phonebooks			☐	0 - 10
	Textbooks			☐	0 - 15
	Dimensional Lumber			☐	NA
	Medium-density Fiberboard			☐	NA
	Miscellaneous Metals			☐	0 - 50
	Miscellaneous Plastics			☐	0 - 10

Greenhouse Gas Equivalency Calculator

Equivalency Results

Click on the question mark **?** link to read the explanation of that particular calculation. Read about all calculations.

The information you entered above is equivalent to one of the following statements:

Annual greenhouse gas emissions from [ ] passenger vehicles ? *(click to read more about this calculation)*

CO_2 emissions from [ ] gallons of gasoline consumed ?

CO_2 emissions from [ ] barrels of oil consumed ?

CO_2 emissions from [ ] tanker trucks' worth of gasoline ?

CO_2 emissions from the *electricity* use of [ ] homes for one year ?

CO_2 emissions from the *energy* use of [ ] homes for one year ?

Carbon sequestered by [ ] tree seedlings grown for 10 years ?

Carbon sequestered annually by [ ] acres of U.S. forests ?

Carbon sequestered annually by [ ] acres of U.S. forest preserved from conversion to cropland ?

CO_2 emissions from [ ] propane cylinders used for home barbeques ?

CO_2 emissions from burning [ ] railcars' worth of coal ?

Greenhouse gas emissions avoided by recycling [ ] tons of waste instead of sending it to the landfill ?

Annual CO_2 emissions of [ ] coal fired power plants ?

Sara Willis Hartwell
Senior Policy Advisor
US EPA
Office of Resource Conservation and Recovery
703-308-7285
hartwell.sara@epa.gov