Zero Waste Hierarchy of Highest and Best Use[1]

Rethink and Redesign by Manufacturers

- Make products durable; from reused, recycled and/or compost materials; and recyclable
- Use materials that are more environmentally sustainable
- Offer services instead of products and lease products to customers

Reduce, Conserve, and Efficient Systems

- Refuse - Tell suppliers to stop sending products in packaging that causes problems or creates waste
- Return - Tell suppliers to takeback packaging
- Toxics Use Reduction - Reduce amounts of toxic chemicals in production and replace toxic chemicals with less toxic or non-toxic alternatives
- Consumption and Packaging Reduction - Use less; buy less; buy stuff with less packaging; avoid disposables & non-recyclables; bring your own bag, cup, mug, water bottle, cloth napkin, etc.

Reuse

- Reuse product for original use and retain value and function of product
- Reuse product for alternative use
- Reuse parts to repair and maintain products still in use
- Thrift stores; used building materials stores (e.g., ReStores); garage sales; flea markets; charity collections; ; freecycle.org, craigslist.org; ebay.com
- Household hazardous waste "swaps"

Recycle

- Cluster businesses that can reuse, recycle or compost products most efficiently and locally
- "Clean Materials Recovery Facility (MRF)" - Source separate materials, sort at MRF and recycle inorganic materials in closed loop systems
- Downcycle - Recycle inorganic materials in single-use applications (like recycled paper into tissue paper; recycled plastic shampoo bottles into park benches)
- "Dirty MRF" - Sorting recyclables from mixed materials or wastes

"Rot" Organics

- Food donations to people, or animals
- On-Site composting (backyard or on-premises at businesses)
- Combined organics (yard trimmings, discarded food and food-soiled paper) composting
- Yard trimmings only composting
- Combining organics with bio-solids
- Digester Gas - From bio-solids, animal waste and/or food scraps

Regulate Disposal, and Dispersal or Destruction of Resources

- Ban materials or products that are toxic or not able to be reused, recycled or composted
- Recover Energy and Bio-fuels
- Sustainable biodiesel - From used vegetable oils
- Cellulosic ethanol - From urban wood waste, bio-solids, animal waste and/or food scraps;
- From mixed construction and demolition wood waste; From tires; From mixed solid waste and bio-solids
- Landfill
- Land application of organics for non-food crops
- "Alternative Daily Cover" (ADC) or "beneficial use" in landfill
- Landfill in "bioreactor" designed without cost constraints
- Landfill gas recovery (should be required, not subsidized)
- Monofill landfill
- Landfill in Subtitle D landfill
- Landfill in bioreactor designed within cost constraints
- Incineration of Mixed Municipal Waste - Mass Burn, Fluidized Bed, Gasification, Plasma Arc, Pyrolysis
- Recycle toxic or radioactive wastes into consumer products or building materials

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[1] Prepared by Gary Liss & Associates, www.garyliss.com, September 18, 2006, based on ***Environmental Hierarchy of Waste Management & Energy Production Methods / Fuels / Technologies***, Energy Justice Network, Mike Ewall, 215-743-4884, catalyst@actionpa.org, www.energyjustice.net.

Environmental Hierarchy of Waste Management & Energy Production Methods / Fuels / Technologies

Cleanest ← Solid Waste Management → Dirtiest

Redesign	**Reduce**			**Reuse**	**Recycle**			←Solutions	Problems→ **Disposal / Dispersal**		
Manufacturing	Toxics Use Reduction	Consumption Reduction	Packaging Reduction	Reuse	Source Separate	Recycle	Downcycle	Compost	Landfill	Deregulate	Incinerate
Make products durable, recycled and recyclable Use materials which are more environmentally sustainable	Reduce amounts of toxic chemicals in production Replace toxic chemicals with less toxic or non-toxic alternatives	Use less Buy less Buy stuff with less packaging Avoid disposables & non-recyclables	Bring your own bag	Thrift stores Charity collection Dumpster diving	Avoid mixing different types of materials		Recycling things into other products that can't be recycled – like paper into tissue paper		Landfill Mine Fill Monofill	Land Application Beneficial Use Recycling toxic or radioactive wastes into consumer products or building materials	Mass Burn Co-firing Fluidized Bed Gasification Plasma Arc Pyrolysis

Cleanest ← Electricity Production → Dirtiest

Conservation	**Efficiency**	**Clean Renewables** ←Solutions					Problems→	**Dirty Energy**				
		Solar	Wind	Micro-hydro	Geothermal	Ocean	Hydroelectric	Natural Gas	Oil	Incineration	Coal	Nuclear
Lighting	Lighting Motors Appliances Geothermal heat pumps	Electric grid can be run 100% on intermittent technologies using hydrogen to balance the load. This should be done with grid-tied closed-loop systems where clean renewable energy would be used to split water when there is excess electricity and fuel cells would turn the hydrogen back into water and electricity when needed.						Simple Cycle Combined Cycle Fuel Cell		(see "biomass feedstocks" list below)	Conventional Gasification ('Clean coal')	Fission [Fusion]

Cleanest ← Transportation & Heating Fuels → Dirtiest

Conservation	**Efficiency**	**Clean Energy** ←Solutions		Problems→ **Dirty Energy**								
		Clean Electricity	Sustainable Biodiesel	Biodiesel	Ethanol	Natural Gas	Landfill Gas	Oil	Waste-Based Fuels	Coal	Tires	Hazardous Waste
Mass Transit Carpooling Telecommuting Reduce Sprawl Trails-to-Rails Bicycling Walking	Fuel Efficiency Standards Hybrids Weatherization Geothermal heat pumps	Plug-in Hybrids or Full Electric Vehicles (electricity must come from clean sources)	From used vegetable oils or algae *[can meet a very small portion of fuel demand]*	Soybeans Sugarcane Palm Oil	Corn-based ethanol Cellulosic ethanol (from biofuel feedstocks – see below)		Boiler Piped into natural gas lines	[and other petroleum products]	Trash / sludge-to-ethanol (cellulosic ethanol) Thermal de-polymerization	Coal-based liquid fuels	Cement Kilns Paper Mills	Cement Kilns Chemical Plants

Least Dirty ← Biomass / Biofuel Feedstocks → Most Dirty

Digester Gas	Landfill Gas		Trees	Energy Crops	Agricultural Crop Residue	Paper / Lumber Mill Wood Waste	Animal Factory Wastes	Construction / Demolition Wood Waste	Sewage Sludge	Tires	Municipal Solid Waste
Sludge Animal waste Food waste	Gases	Solids	Tree Trimmings ("Urban Wood Waste") Forest Cutting	Phytoremediation plants Biotech			Poultry litter	Painted/treated wood			

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