

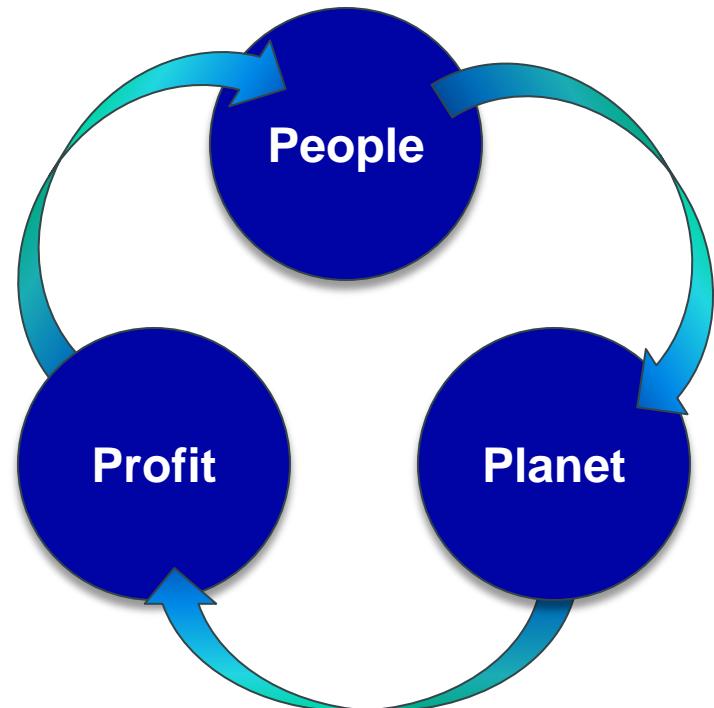


A Perspective from the Private Sector: The Business Realities of Waste Reduction, Recycling & Reuse

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Sustainability is Everyone's Responsibility



Dow Understands the Role We Play in Protecting Our Planet & Contributing to Society



Source: Dow 2015 Sustainability Goals

Sustainability Also Means Profitability

In our first set of Sustainability Goals (2005), we:

- Reduced solid waste by 1.6 billion pounds
- Reduced water use by 183 billion pounds
- Saved 900 trillion BTUs of Energy

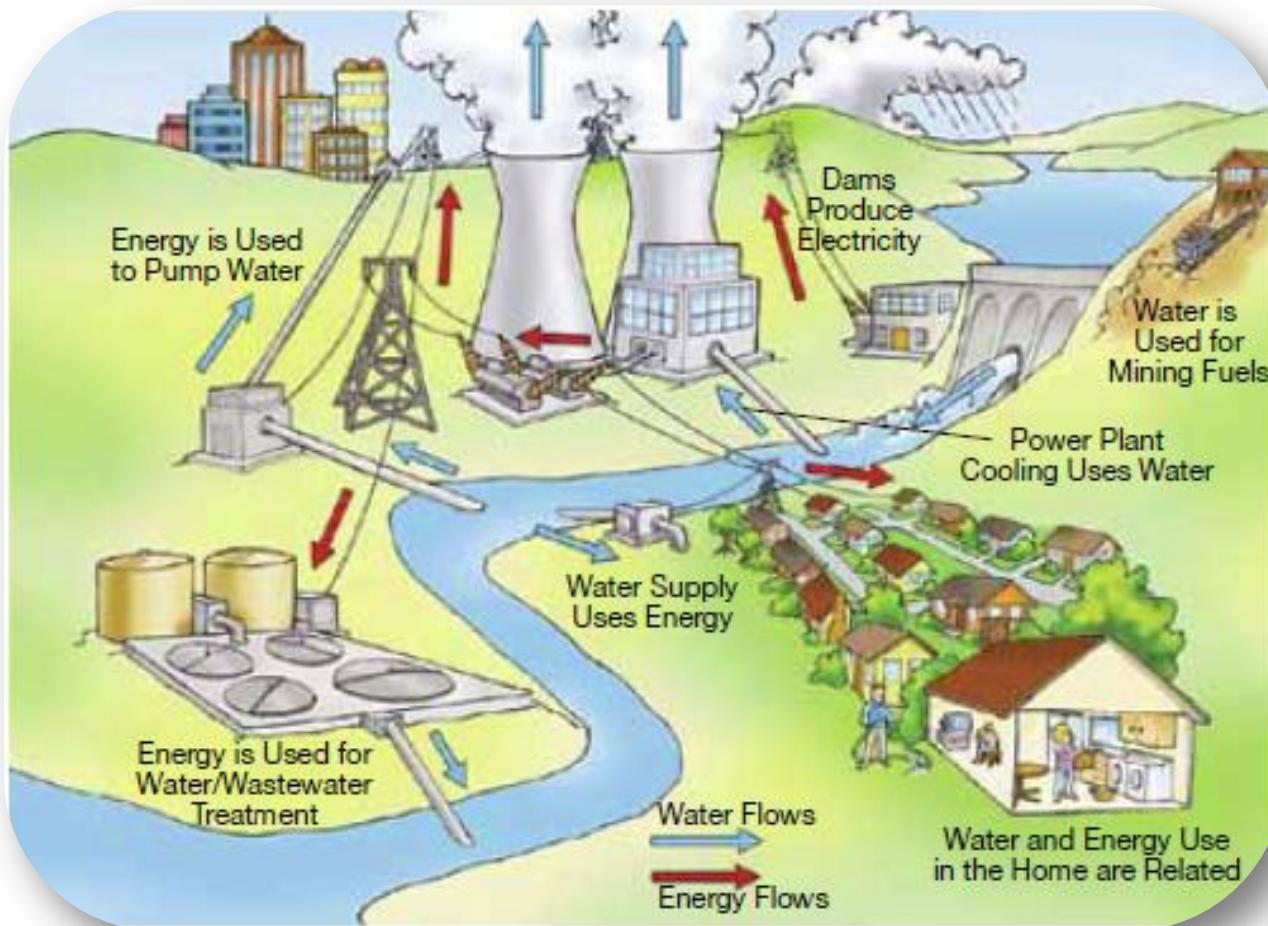
Translating to:

- Waste savings that could have filled 415 football fields 1 meter deep
- Water savings that could have served 170,000 homes for a year
- Energy savings that could have powered 8,000,000 single-family homes for a year

\$1B Invested → \$5 B Saved

Source: Dow 2005 Environment, Health & Safety Goal Reporting

As a Manufacturer, Dow Lives the Energy-Water-Waste Nexus



All Companies Must Evaluate Profitability of Alternatives



Source: U.S. Environmental Protection Agency

Waste Reduction is the Simplest Way to Drive Sustainability and Impact the Bottom Line



Waste Reduction Always Pays
Always Pays Reduction Waste



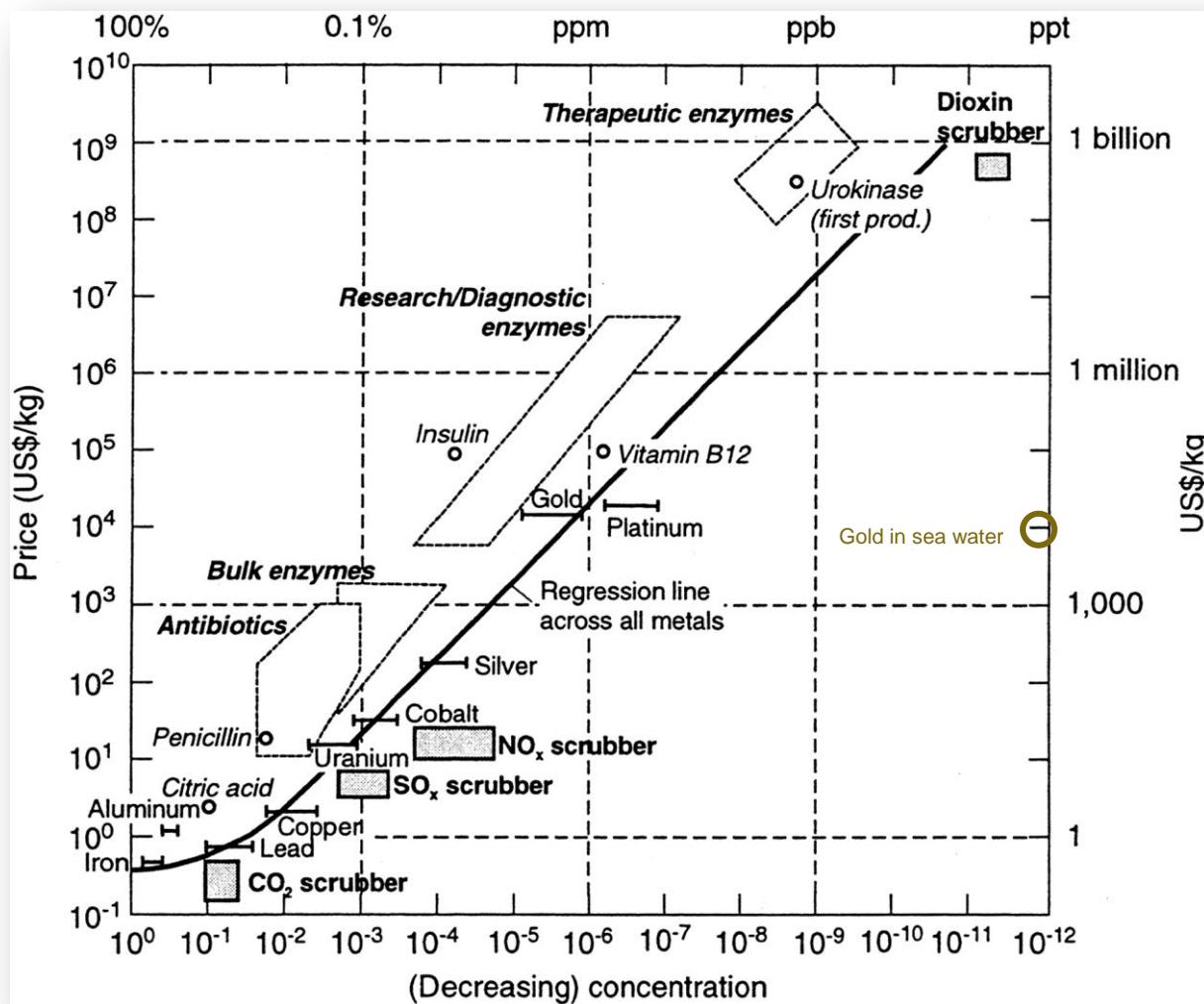
Material Reuse Can Also Deliver Value, Both to the Customer and the Bottom Line

SAFECHEM

- Fully enclosed solvent-delivery system in broad use in Europe
- Delivers solvent in this specialty container, which is connected to dry cleaning machines – resulting in zero emissions
- Once the solvent is exhausted, the container containing the waste is picked up and taken to our kilns
- The chlorinated waste streams are then burned, generating hydrochloric acid – which is then used on site or sold



Recycling is More Complex: Profitability Must be Assessed



Source: Dahmus and Gutowski

What Gets Recycled: An Information Theory Based Model for Product Recycling
Environ. Sci. Technol. 2007, 41, 7543-7550

The Cost-Benefit of Material Recycling Varies by Market

Table II. Recoveries of different elements in end-of-life products as a function of processing route.

Recoverability ^a (per equipment/application)	PMs		PGMs		Rare earths (oxides)			Other						
	Ag	Au	Pd	Pt	Y	Eu	Other rare earths	Sb	Co	In	Ga	W	Ta	
Washing machines	Red/Yellow	Red/Yellow	Red/Yellow											
Large household appliances (excluding refrigerators)	Red/Yellow	Red/Yellow	Red/Yellow											
Video recorders	Yellow	Yellow	Yellow				Red/Yellow	Red				Red/Yellow		
DVD players	Yellow	Yellow	Yellow				Red/Yellow	Red				Red/Yellow		
Stereo systems	Yellow	Yellow	Yellow				Red	Red				Red/Yellow		
Radios	Yellow	Yellow	Yellow				Red	Red				Red/Yellow		
Cathode-ray-tube televisions	Yellow	Yellow	Yellow	Yellow	Yellow		Red/Yellow	Red	Green			Red/Yellow		
Mobile telephones	Green	Green	Green		Red	Red	Red		Green	Yellow		Red/Yellow		
Fluorescent lamps					Yellow	Yellow	Yellow					Red/Yellow		
Light-emitting diodes					Red/Yellow	Red/Yellow	Red/Yellow		Yellow	Green	Red			
Liquid-crystal display screens	Yellow	Yellow	Yellow						Green					
Batteries (NiMH)	Grey	Grey	Grey		Green	Green	Green		Green					
Recovery possible	If separately recovered and/or if appropriate technology and recovery are available													
Limited recovery/recovery under certain conditions	If separately recovered; partial or substantial losses during separation and/or processing/metallurgy; recovery if appropriate systems exist													
No separate recovery	Pure recovery not possible; lost in bulk recyclates during separation and/or during metallurgy into different nonvaluable phases													
For a combination of colors	Depending on process route followed, high recovery or high losses possible; requires careful attention to design, infrastructure, legislation, and so on; especially applies to most closely linked metals, where one metal can be recovered whereas the other is lost as a result; driven by thermodynamics, technology, design, and so on													

^a Recovery is a function of processing route and product design, among other factors. The table indicates recoveries for the present most-likely route, but the results could change if suitable technology is developed.

Source: Materials Research Society 2012

Some Companies Are Making Recycling Their Business

CleanTech Project Opportunities



Gas Recovery

- Landfill
- Sewage Treatment
- Agricultural Waste
- Industrial Waste



Water Treatment & Reuse

- Desalination
- Sewage
- Industrial waste
- Produced water



Alternative Energy

- Unconventional Gas
- Biomass Conversion
- Green Diesel/Chemicals
- Solar



Waste-to-Value

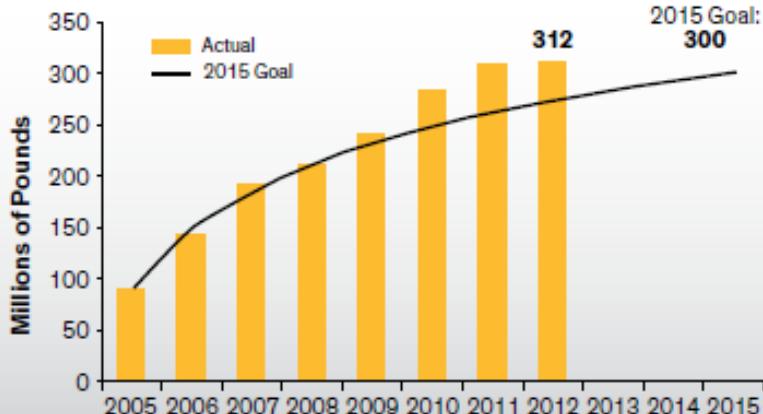
- Gases
- Energy
- Minerals/metals
- Food elements/proteins/pharma/nutraceuticals

Source: Liberation Capital

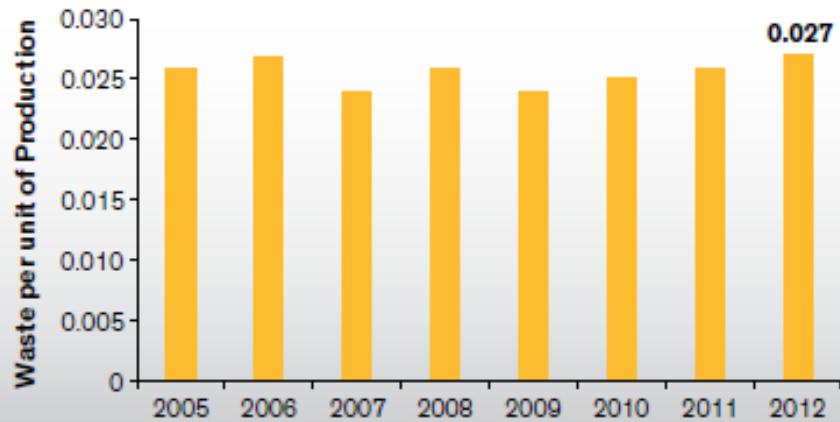
Corporations Are Paying Attention to Waste



By-Product Synergy



Waste Intensity



Source: Dow 2015 Sustainability Goals Reporting

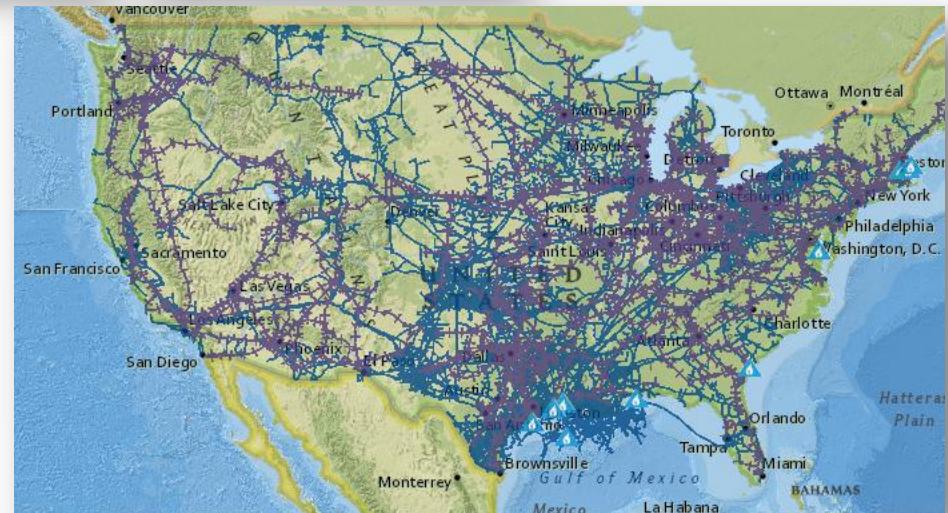


Corporations Still Face Challenges: Energy is Global and Transferrable...



- All Power Plants
- Biomass Power Plant
- Coal Power Plant
- Geothermal Power Plant
- Hydroelectric Power Plant
- Natural Gas Power Plant
- Nuclear Power Plant
- Other Power Plant
- Other Fossil Gases Power Plant
- Petroleum Power Plant
- Pumped Storage Power Plant
- Solar Power Plant
- Wind Power Plant
- Wood Power Plant

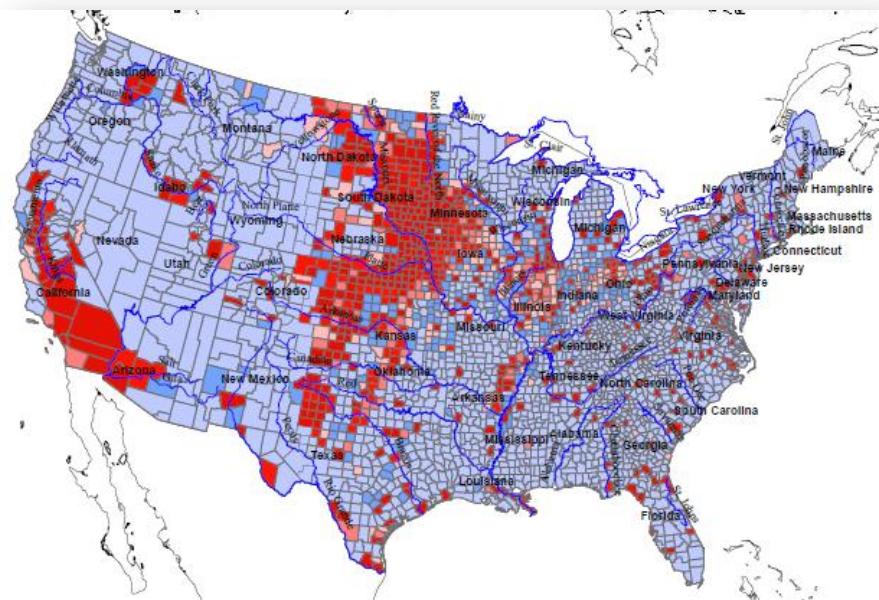
- Transmission and Pipelines
- Electric Transmission Line ($\geq 345\text{ kV}$)
- Natural Gas Interstate/Intrastate Pipeline



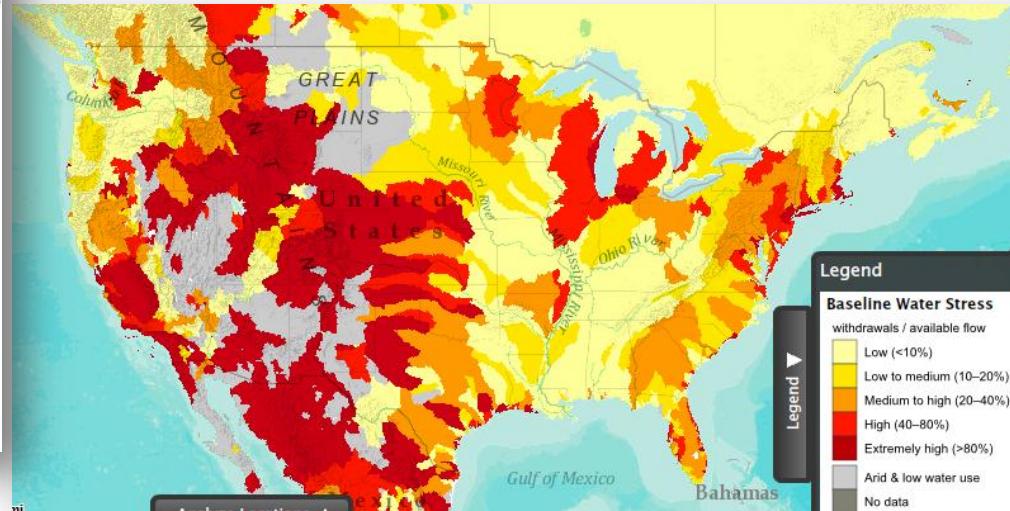
Source: U.S. Energy Information Administration

Corporations Still Face Challenges: ... But Water is Local

Water stress by county



Water stress by watershed



Source: World Resources Institute; Aqueduct

In Summary

- Sustainability requires three elements:
 - People, Planet & Profit
- The energy-water-waste nexus is an area of opportunity for sustainability
- Waste reduction, reuse and recycling can be sustainable solutions, when assessed via the economic lens
- The private sector is delivering results, though challenges remain



- Thank
You