Strategic & Sustainable Waste Disposal Options

Keith Savel

August 2025

Agenda

- Regulation Baseline
- Regulated Waste and Sustainability Goals
- The Lab Waste Problem & Common Examples
- Conventional vs. Sustainable Waste Disposal Methods
- Tangible Solutions & Successful Sustainability Goals

The Regulations

- The Resource Conservation & Recovery Act (RCRA) is the primary federal law that governs the disposal of solid and hazardous waste.
  - **42 U.S.C. §6901 et seq. (1976)**
- The Environmental Protection Agency (EPA) is responsible for enforcing these laws, under title 40 of the code of federal regulations (CFR).
- Local state by state agencies who regulate more stringent then the EPA.
  - Alaska & Iowa only two states that do not have state programs.

HAZARDOUS WASTE DETERMINATION

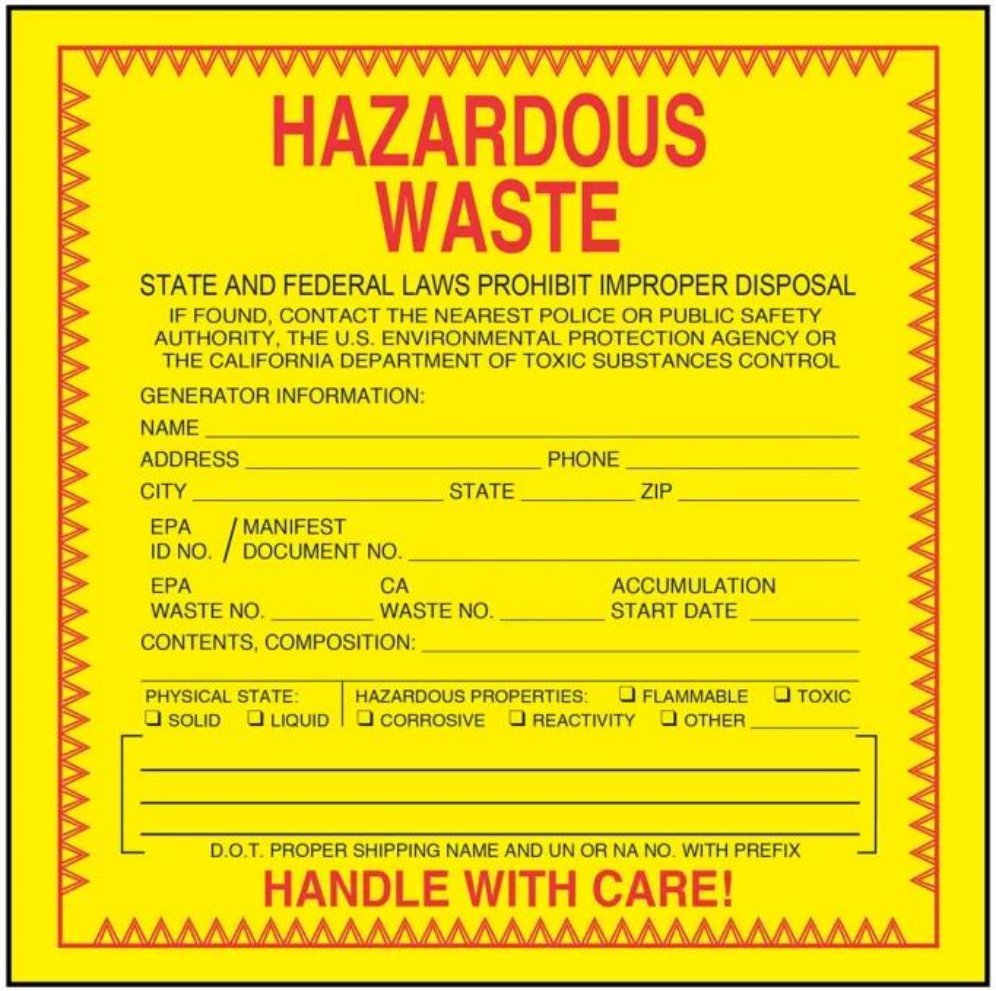
Generator's Responsibility

1. By Knowledge of Process/Waste
2. By Analytical Testing

TRIUMVIRATE ENVIRONMENTAL

Laboratory Hazardous Wastes

- Oxidizers
- Oxidizing Acids
- Flammable liquids
- Inorganic bases
- Organic bases
- Organic Acids
- Inorganic acids
- Poisons (Toxic chemicals)
- Cyanides
- Sulfides
- Water-reactives



TRIUMVIRATE ENVIRONMENTAL

State Waste Requirement – Example Used Oil

- Used oil is not considered a hazardous waste under Federal RCRA regulations.
- California, Florida and Massachusetts consider used oil a hazardous waste.
  - Applies to oil, oil rags, and oil filters (petroleum-based oils)
- Containers must follow hazardous waste requirements:
  - In good condition and kept closed when not in use
  - Stored indoors or with secondary containment
  - Identified and labeled as “Used oil”
- Sent to an authorized recycling or disposal facility

40 CFR 279

Mixture Rule

Non-Hazardous Waste

+

Hazardous Waste

Is a Hazardous Waste

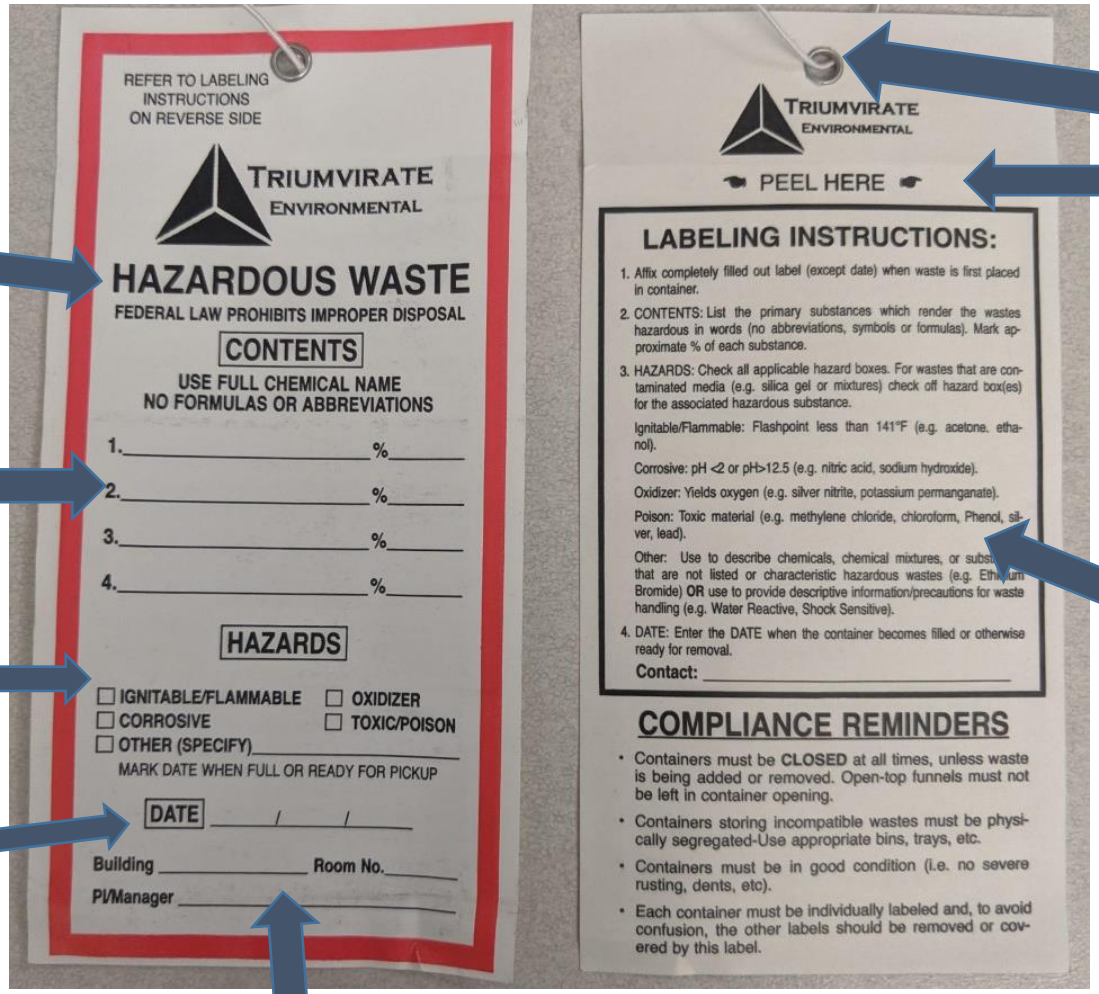
TRIUMVIRATE ENVIRONMENTAL

The Lab Waste Problem

- Federally regulated hazardous waste are all treated the same (i.e., not down the drain!)
- From hazardous chemicals to infectious biologicals, hazards are treated very differently in the lab space from state to state.
- However, as the state rules get more stringent, the federal disposal regulations remain options for disposal.
- Increased volume of hazardous waste and infectious biological waste increases volume into specific landfills and treatment technologies.

Innovative solutions from in the lab to end disposal will support sustainable results with greener solutions.

Waste Labels – Is the label the problem?



The words Hazardous Waste

Description of the waste

Check boxes to identify the hazard(s)

Space to add a date, when a container is ready for pickup

Bungie string and sticky back that can be used to attach it to the container

Guidance for proper labeling

Definitions of characteristic wastes

SAA compliance reminders

Best practice to include information about where and who generated the waste

TRIUMVIRATE ENVIRONMENTAL

Regulated Waste and Sustainability Goals

Drive sustainable environmental goals with our customers

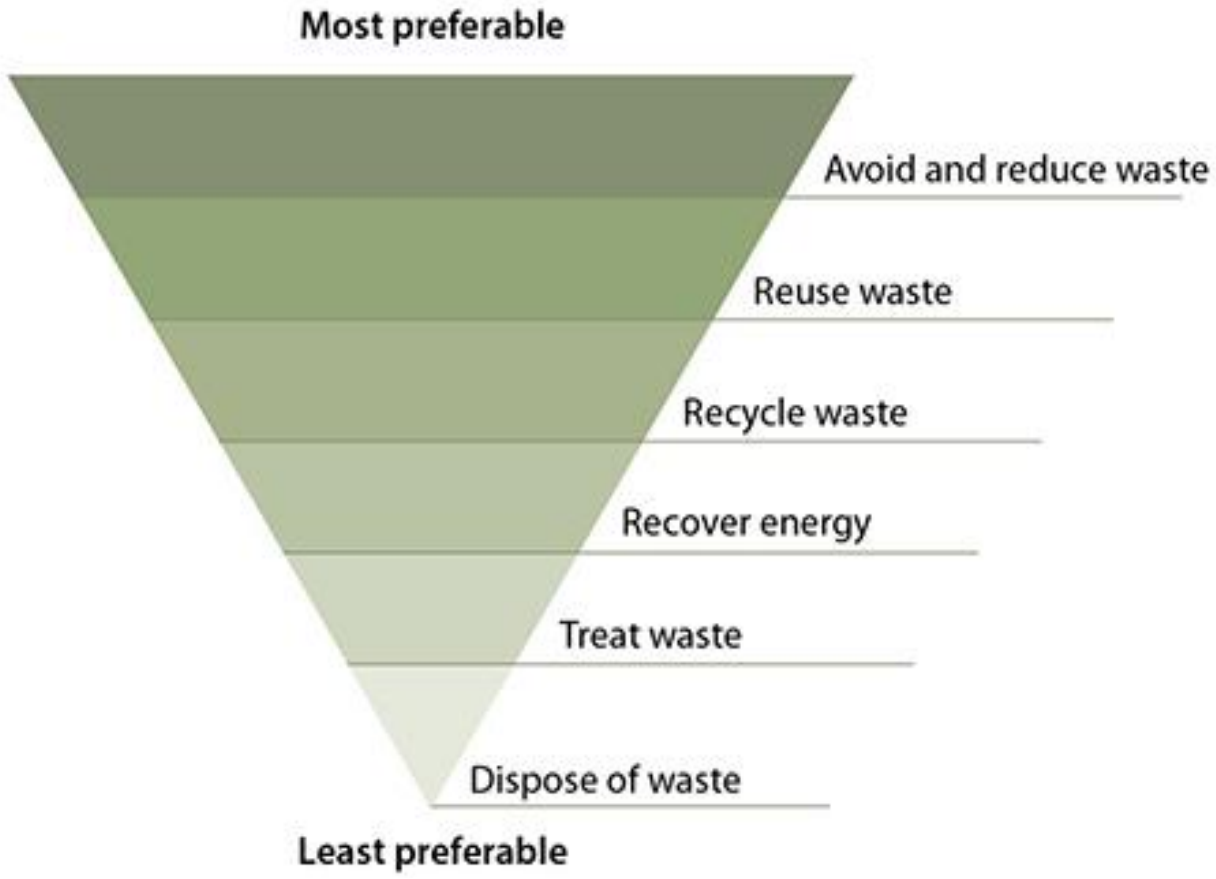
Improved Sustainability Programs as emerging Key Performance Indicators (KPI's)

Marketing & Public Relations

TRIUMVIRATE ENVIRONMENTAL

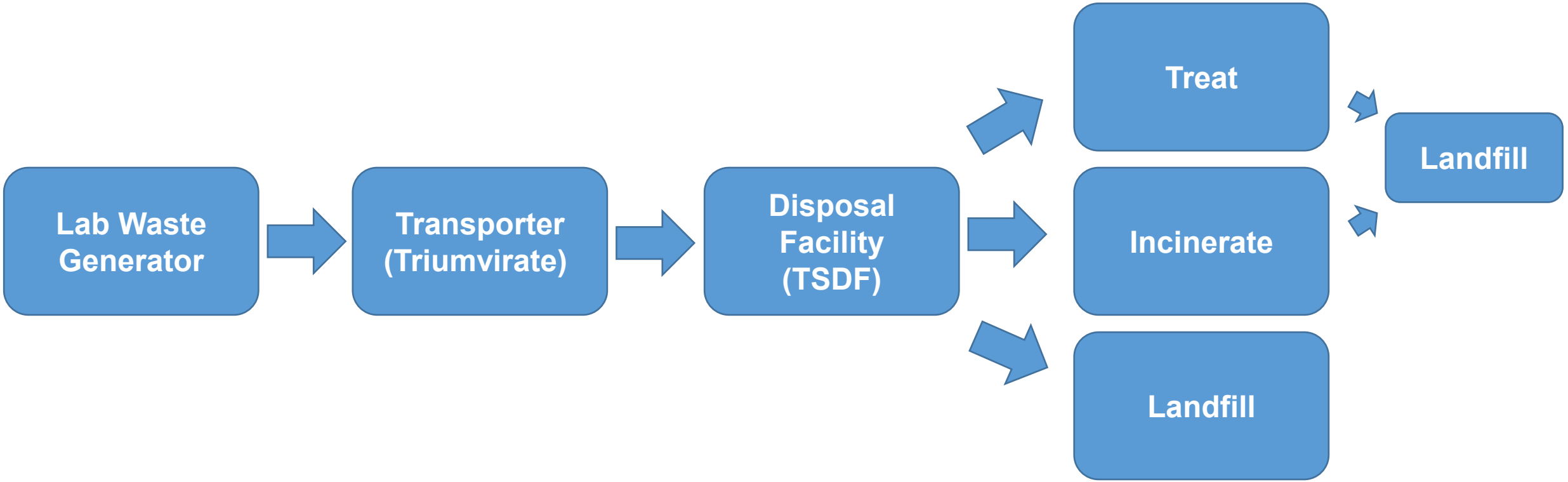
Waste Disposal Hierarchy

- Sustainable treatment technologies
  - Reuse/Recyle
  - Waste-to-Energy
  - Wastewater Neutralization
  - Incineration
  - Fuel blending, solvent distillation, etc.
- Cost varies depending on methodology.



TRIUMVIRATE ENVIRONMENTAL

Conventional Regulated Waste Disposal



TRIUMVIRATE ENVIRONMENTAL

Incineration, Treatment, & Landfill

Incineration

- Hazardous waste streams
  - Liquids, solids, aerosols
- Waste is incinerated and turned into ash
- Ash is ultimately disposed of at a hazardous waste landfill
- Air emissions scrubbed with air pollution control devices

Treatment & Landfill

- Stabilization
- Chemical oxidation/reduction
- Deactivation
- Microencapsulation
- Non-hazardous
  - Direct to landfill

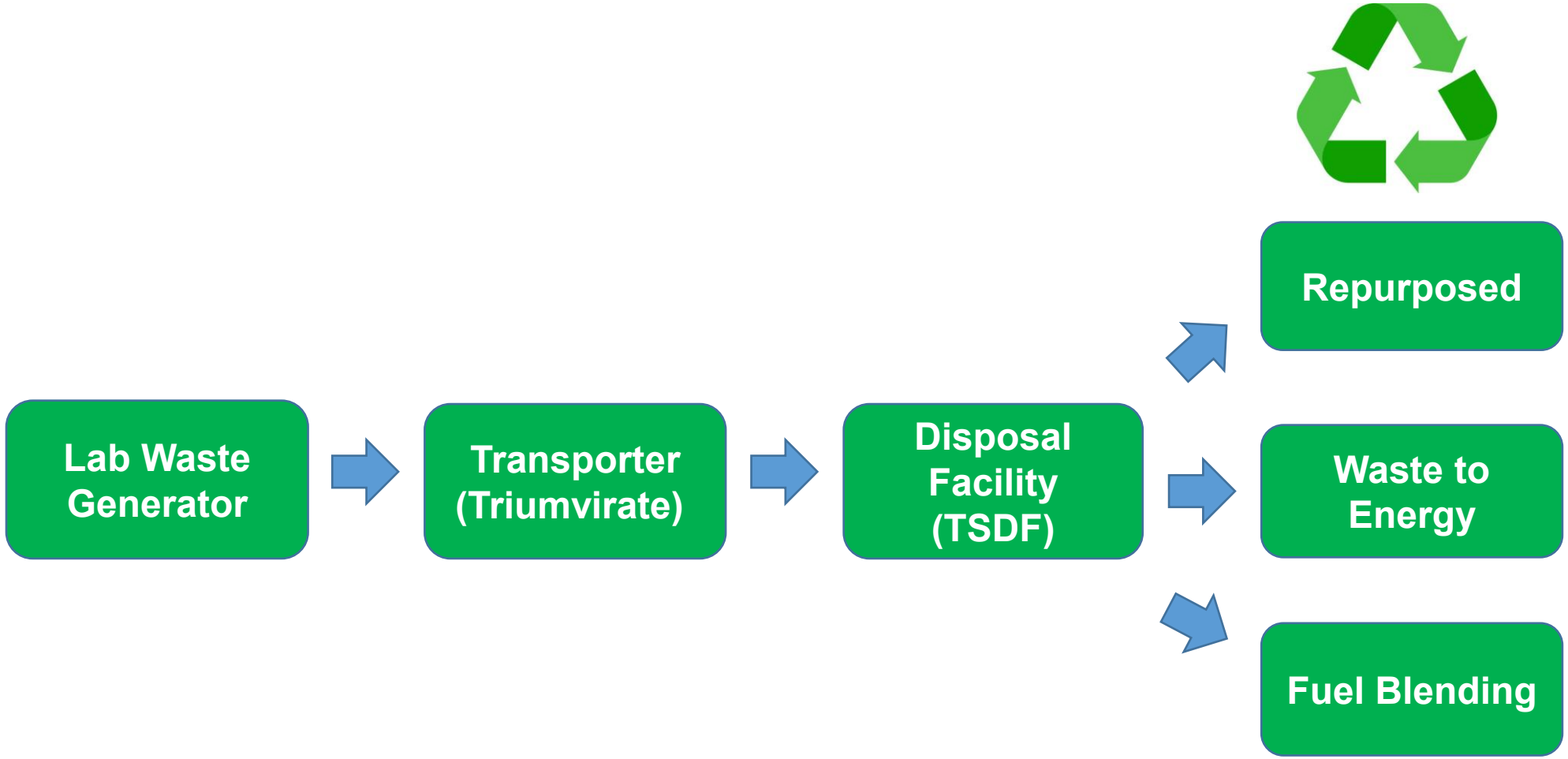
Not all waste can be turned away from these treatments, but many can!

Conventional Regulated Waste Disposal

What are the real environmental impacts?

- Emissions
  - Air scrubbers, Air pollution control devices, Title V Clean Air Act – Permitting/Approvals
- Leachate
  - Monitoring, Engineering Standards for landfill lining mechanisms
- Community
  - Proximity, Odor, Appearance, Incidents, Activism

Sustainable Regulated Waste Disposal



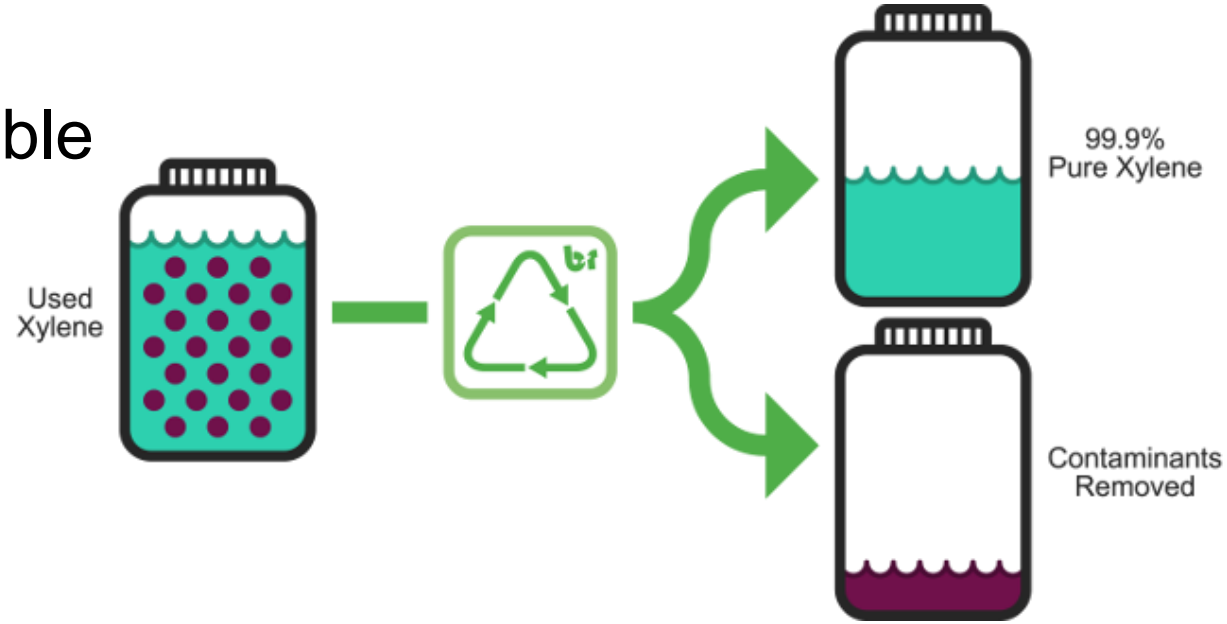
TRIUMVIRATE ENVIRONMENTAL

Waste Minimization/Reduction Plans

- Chemical inventory review
  - Opportunity to track and understand what is in your spaces for sustainability and safety.
- Reduction in toxicity of materials used
  - Substitution of less toxic chemicals
  - *Example: Formaldehyde (corrosive, carcinogenic) vs. Citrasolv (non-hazardous)*
- Reduction in quantity and/or procurement of materials used
- Potential solutions for reuse of waste materials
  - Distillation/Solvent Recovery

Solvent Recycling

- Halogenated/Non-Hal. solvents
- Distilled and recycled into reusable solvents
- Small scale
  - Onsite facility processing
- Large scale
  - Facility offsite to support larger volumes
- Benefits
  - Reuse of solvents
  - Hazardous Waste Generator Status



Ethanol only distillation process available!

TRIUMVIRATE ENVIRONMENTAL

Solvent Repurposing

- Process
  - Distillation equipment to remove solids, water and other impurities
- Output
  - Distillation yield variable by waste stream
  - Generally, all water will be removed; water to fuel blending
  - Solids removed; solids to fuel blending
  - Additional contaminants: removed to fuel blending
- Repurpose
  - Cement Kilns
  - Waste is used to fire the furnaces in place of coal
  - Burning waste solvents is less hazardous than burning coal

Ethanol Recycling

- Columns recover 99% of the ethanol via distillation
- Evaporator recovers about 80% of the water
- Case-by-case / flexibility being integral to process for acceptance
- Prohibited Materials:
  - Anything aside from Ethanol (no other waste codes)
  - High or low pH materials
  - Material with water activated polymers.
- Other outlets for mixes solvent waste streams repurposing: Distillation

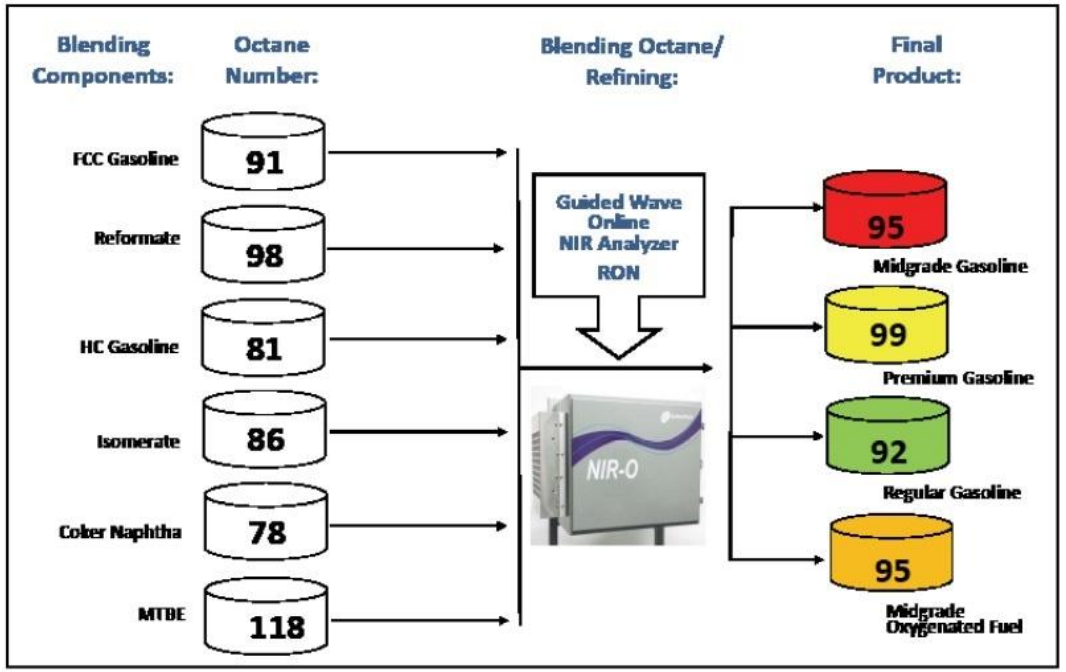
Waste stream separation is key for success.

TRIUMVIRATE ENVIRONMENTAL

Regulated Waste to Energy

- Transformation to Energy
  - Once approved, waste streams are blended and sent for Incineration
  - Incineration → Heat Energy → Electricity (via Steam turbine Generator)
- Powering the local grid
  - Facility feed to local facilities
  - Supplies electricity directly to the grid
- Output
  - Thes processes generate about 550 kWh/ton.

Fuel Blending



Triumvirate owns a Fuel Blending Facility to support more green options.

Tangible Solutions

- Waste routing to non-conventional disposal facilities
  - Communication on potential for increased associated costs
  - Training on how to improve waste acceptance to non-conventional facilities
  - Installation of containers for plastic waste collection
- Waste Minimization/Reduction plans
  - Reasonable metric goals for year-by-year reduction
  - Substitution of less toxic chemicals
  - Procurement changes in quantities
  - Reuse of waste materials
  - Upstream waste management

TRIUMVIRATE ENVIRONMENTAL

Successes in Sustainability Goals

- Eliminate, reuse or reduce waste
  - Reduction in regulatory compliance challenges
  - Cost reduction for waste disposal
- Upcycle wherever possible!
  - Products developed from **BestPLUS** Lumber
  - Limit landfill waste
- Reduce your carbon footprint
  - Waste quantity and disposal tracking
  - Conventional vs. Non-conventional
  - Metric organization and Data Tracking
- Reporting to leadership to aide marketing and public relations initiatives
  - Development of tangible Key Performance Indicators (KPIs)

"Several Waste Streams have been re-routed to more sustainable options. The next steps is to change the hazardous chemicals upstream to reduce the volume." – Large Scale R&D

Allow for flexibility as an emerging sustainability leader in an ever-changing corporate landscape

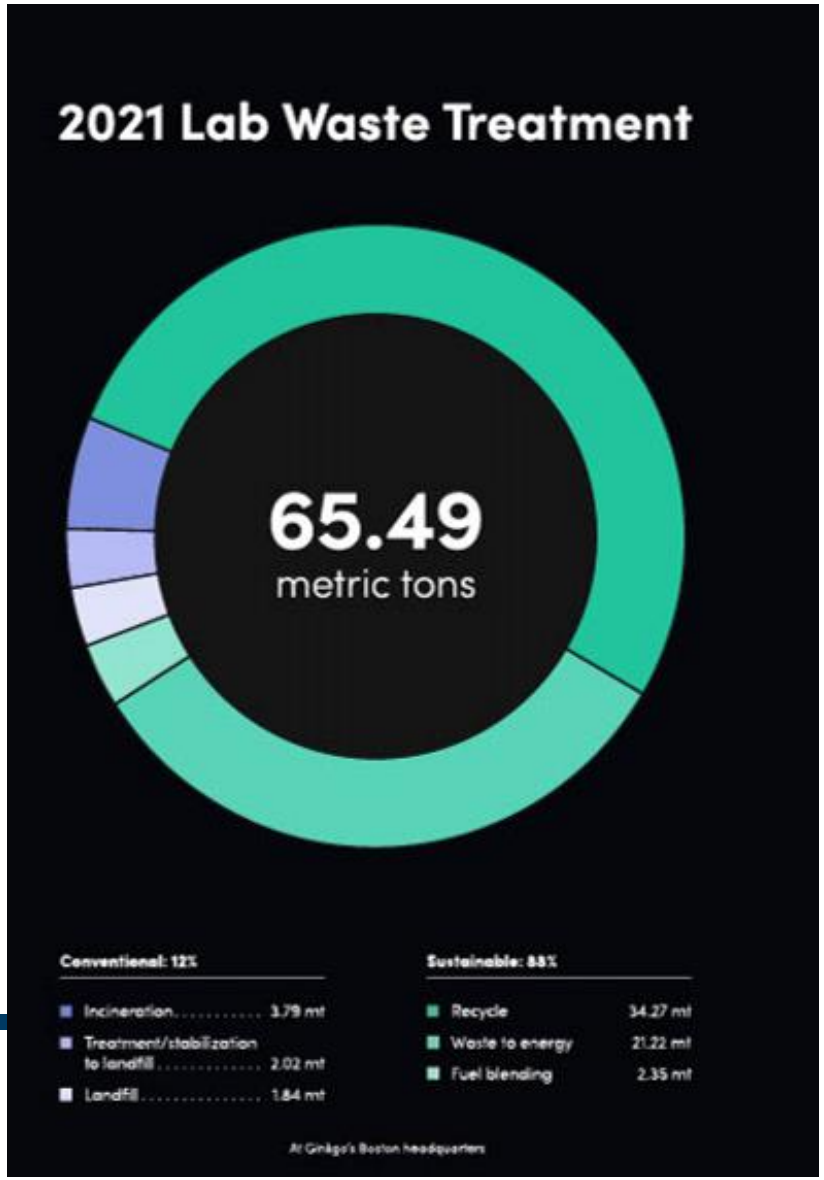
Case Study: Large Biotech 2021 Sustainability Report

- ESG Reporting: Positive Impacts by Triumvirate
  - Environmental, Social, and Governance Goals
  - Waste Tracking, Routing, Minimization

“For this reason, since 2019, we have worked with Triumvirate Environmental on all aspects of our waste management program”

“We have been using Triumvirate Environmental’ s **Red2Green** program to recycle its biologically-hazardous waste”

“The Red2Green program takes biohazardous waste and recycles it into plastic lumber at an 80% efficiency.”



Plastics-4-Purpose & BestPLUS

- Regulated Medical Waste Sterilization & Upcycling
- Plastic Waste Repurposing/Upcycling
- Triumvirate Jeannette, PA

Plastics4Purpose™

BestPLUS
Plastic Lumber

"The Plastics4Purpose program takes biohazardous waste and recycles it into plastic lumber at an 80% efficiency. Our ESG numbers are improving!" – Large Biotech

TRIUMVIRATE ENVIRONMENTAL

Triumvirate Canada: Fuel Blending

- Fuel to power Cement Kilns in New York & Canada
- Waste Composition
  - Organic; BTU Value of > 5,000; < 50% water; low metal composition; low halogen
- Blended in tank farms ranging from 20,000 to 40,000 liters
- Shipped in 3,500-liter totes
- Total Waste Quantity Sent for Fuel Blending: 95%
- Why Cement Kilns?
  - Industry allowance
  - Air emission control devices in place to safely filter residual contaminants

TRIUMVIRATE ENVIRONMENTAL

Disposing of Empty Containers

- Department of Transportation (DOT) and the Resource Conservation & Recovery Act (RCRA) have different definitions.
  - DOT: The container must either be unused, thoroughly cleaned and purged of vapors, or refilled with a non-hazardous material to neutralize any remaining hazardous residue.
  - RCRA: The container must have less then 1 inch of residue or less than 3% of the total volume left in the container.
- It is important to understand what you can rinse, wash, and dispose of compliantly.
- Remember some chemical containers need rinsing but the rinse may make more waste than disposing of the container itself.

Triumvirate Environmental

Professional Services (Consulting)

Lab & Onsite Support Services

Field Services

Professional Services (Engineering & Wastewater)

Disposal

TRIUMVIRATE ENVIRONMENTAL

Thank you!

Keith Savel
VP
973-610-1049
Ksavel@triumvirate.com

Mr. Savel has over 25 years of experience in the management and oversight of Site Remediation Projects as well as the implementation of Hazardous and Non-Hazardous waste programs for clients in the New England and Mid-Atlantic area.

TRIUMVIRATE ENVIRONMENTAL