Trash Talk

Understanding the Biotech Laboratory Waste Stream and Ways to Reduce its Cost and Environmental Impact

BayBio
Gene Acres 16

Wednesday,
September 24, 2008
11:45 a.m.

Panel Moderator:

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PRESIDENT
KORNBERG ASSOCIATES | ARCHITECTS

Panel Speakers:

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Steve Mello
MANAGER OF OPERATIONS
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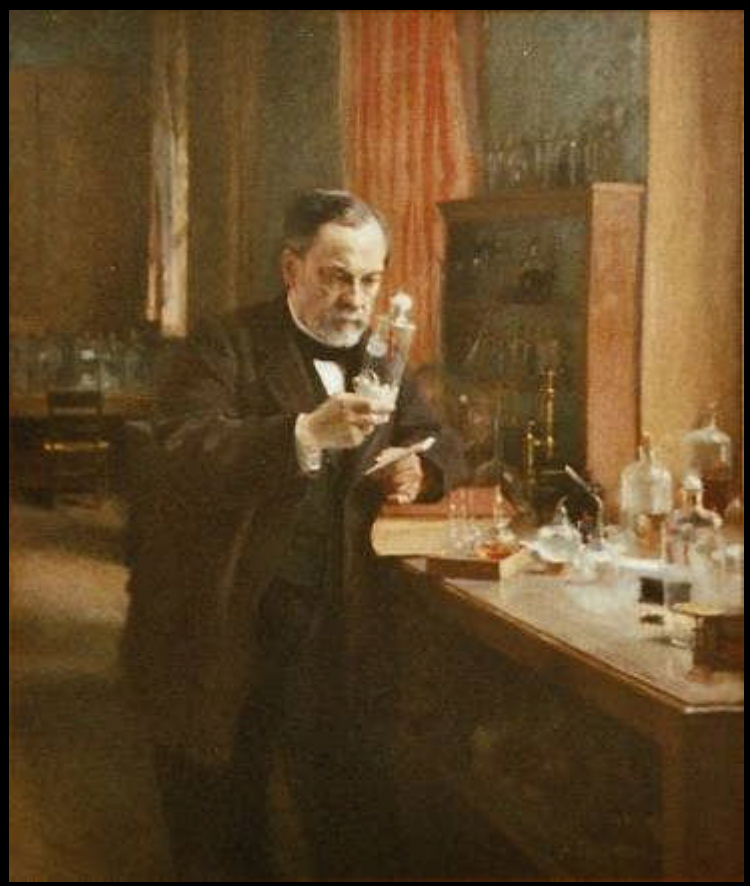


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CAUTION

THE TOXIC SUBSTANCES CONTROL ACT

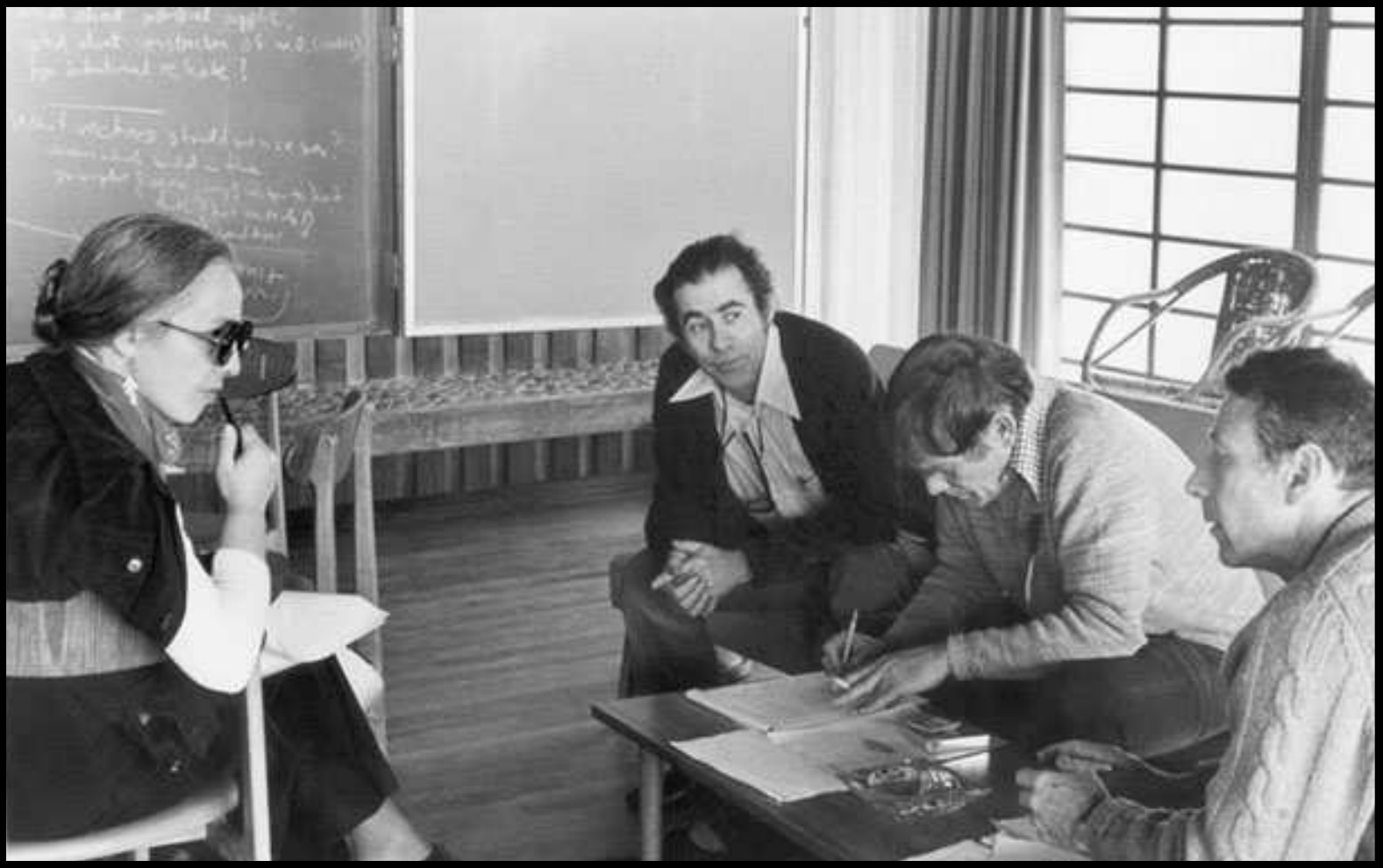
- **The Toxic Substances Control Act** (TSCA) became law on October 11, 1976 to became effective on January 1, 1977, except Section 4 (f) which took effect two years later. The Act authorized EPA to secure information on all new and existing chemical substances, as well as to control any of the substances that were determined to cause unreasonable risk to public health or the environment. Congress later added additional titles to the Act, with this original part designated at Title I - Control of Hazardous Substances. Further information on the titles is as follows:
- **Title I - Control of Toxic Substances:** This title includes provisions for testing of existing chemical substances and mixtures, regulation of hazardous chemical substances and mixtures, manufacture and processing notices, in addition to managing imminent hazards and reporting and recordkeeping requirements.
- **Title II - Asbestos Hazard Emergency Response:** This was added by the Asbestos Hazard Emergency Response Act (AHERA) (P.L. 99-519), passed on October 22, 1986. This amendment established asbestos abatement programs in schools.
- **Title III - Indoor Air Radon Abatement:** In October 1988, Congress added a third title to TSCA regulating radon with the Radon Reduction Act (PL 100-551). This amendment was to assist states in responding to the human health threats posed by exposure to radon.
- **Title IV - Lead Based Paint Exposure:** In October 1992, TSCA was again amended to add the Lead-Based Paint Exposure Reduction Act (PL 102-550). This legislation was to reduce environment exposure to lead contamination and prevent the adverse health effects caused by it.

CALIFORNIA PROPOSITION 65

Safe Drinking Water and Toxic Enforcement Act of 1986

- 25249.5. *Prohibition On Contaminating Drinking Water With Chemicals Known to Cause Cancer or Reproductive Toxicity*. No person in the course of doing business shall knowingly discharge or release a chemical known to the state to cause cancer or reproductive toxicity into water or onto or into land where such chemical passes or probably will pass into any source of drinking water, notwithstanding any other provision or authorization of law except as provided in Section 25249.9.
- 25249.6. *Required Warning Before Exposure To Chemicals Known to Cause Cancer Or Reproductive Toxicity*. No person in the course of doing business shall knowingly and intentionally expose any individual to a chemical known to the state to cause cancer or reproductive toxicity without first giving clear and reasonable warning to such individual, except as provided in Section 25249.10.
- 25249.7. *Enforcement*. (a) Any person violating or threatening to

1975 ASILOMAR CONFERENCE ON RECOMBINANT DNA



Left to Right: Maxine Singer, Norton Zinder, Sydney Brenner, Paul Berg

CASE STUDY – TYPICAL RESEARCH BIOTECH (70Ksf, 150 employees)

Trash

- Cardboard boxes
- Plastic wrappers/sleeves, absorbent materials, consumables, etc.
- Packing material – Styrofoam
- Construction and demolition
- Landscape waste
- Containers e.g. sharps containers
- Electronic waste
- Vivarium – bedding, disposable garments
- Hazardous materials

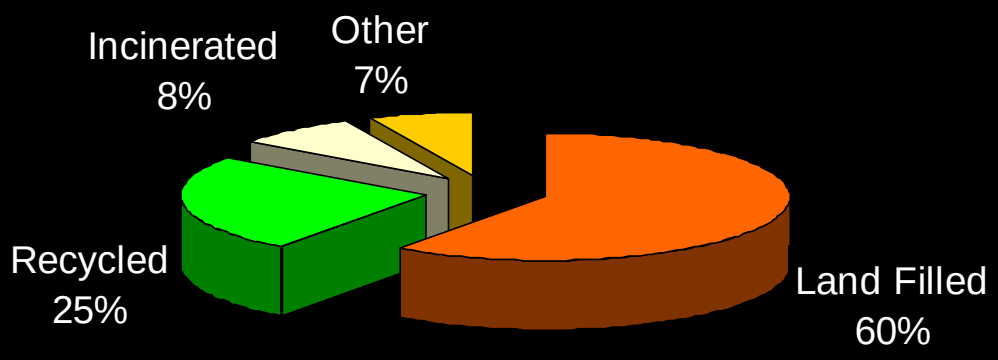
Sewer – process waste water, hand washing, flushing, etc.

Emissions – from operations

TRASH – TYPICAL RESEARCH BIOTECH (70Ksf, 150 employees)

Annually Produces About 180 Tons of Trash

About one ton per employee each year



- Of all the waste, about 15% is hazardous
- Costs about $1,700 per employee per year to manage hazardous waste & programs
- Disposal fees are about $1,500 per employee per year

SEWER – TYPICAL RESEARCH BIOTECH (70Ksf, 150 employees)

Disposes about 1.8 million gallons/year
(30 gallons per employee per day)

- In California, water related electrical consumption is 52,000 GWh or 19% of total electrical consumption *
  = 35,000 tons CO2

Consumes 23,000 kWh worth of water
= 15 tons CO2

* Water Supply Related Electricity Demand in California, Lon W. House, December 2006

EMISSIONS – TYPICAL RESEARCH BIOTECH (70Ksf, 150 employees)

Consumes about 23 million cu ft of natural gas annually

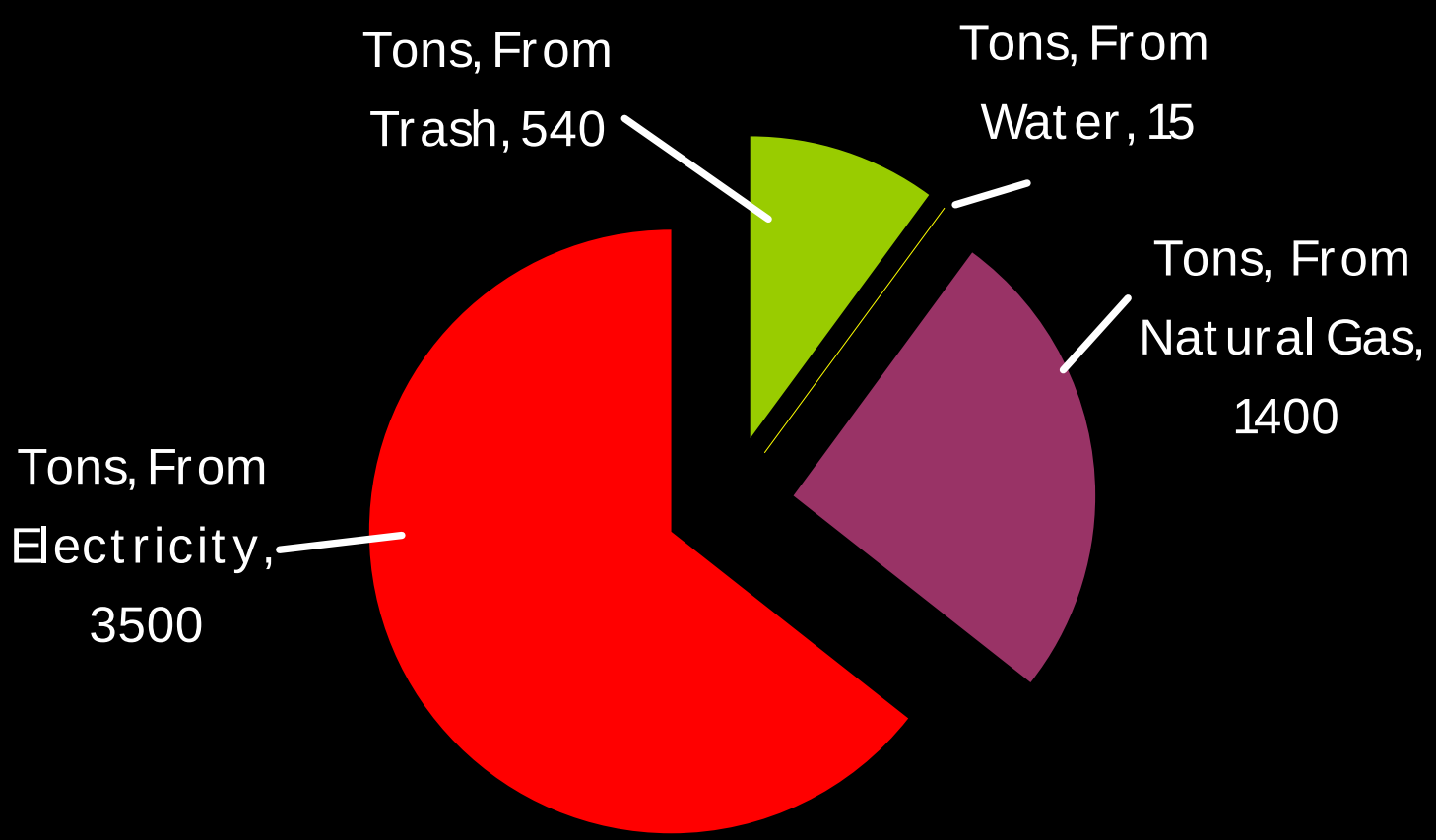
- 1,400 tons of CO_2 generated from burning the gas

Consumes about 5.2 million kWh annually

- 3,500 tons of CO_2 generated in the process

TOTAL WASTE FOOTPRINT – TYPICAL RESEARCH BIOTECH

Green House Gases Created



SPACE CONSIDERATIONS – TYPICAL RESEARCH BIOTECH

- Waste containers occupy about 6% of floor space
- In a 700 sq. ft. lab, that represents 42 sq. ft. of floor space
- About 6 waste streams = about 7 sq. ft. per stream
- About 14 sq. ft. per person (3 people per lab)
- Total facility space devoted to waste = 2,300 sq. ft.

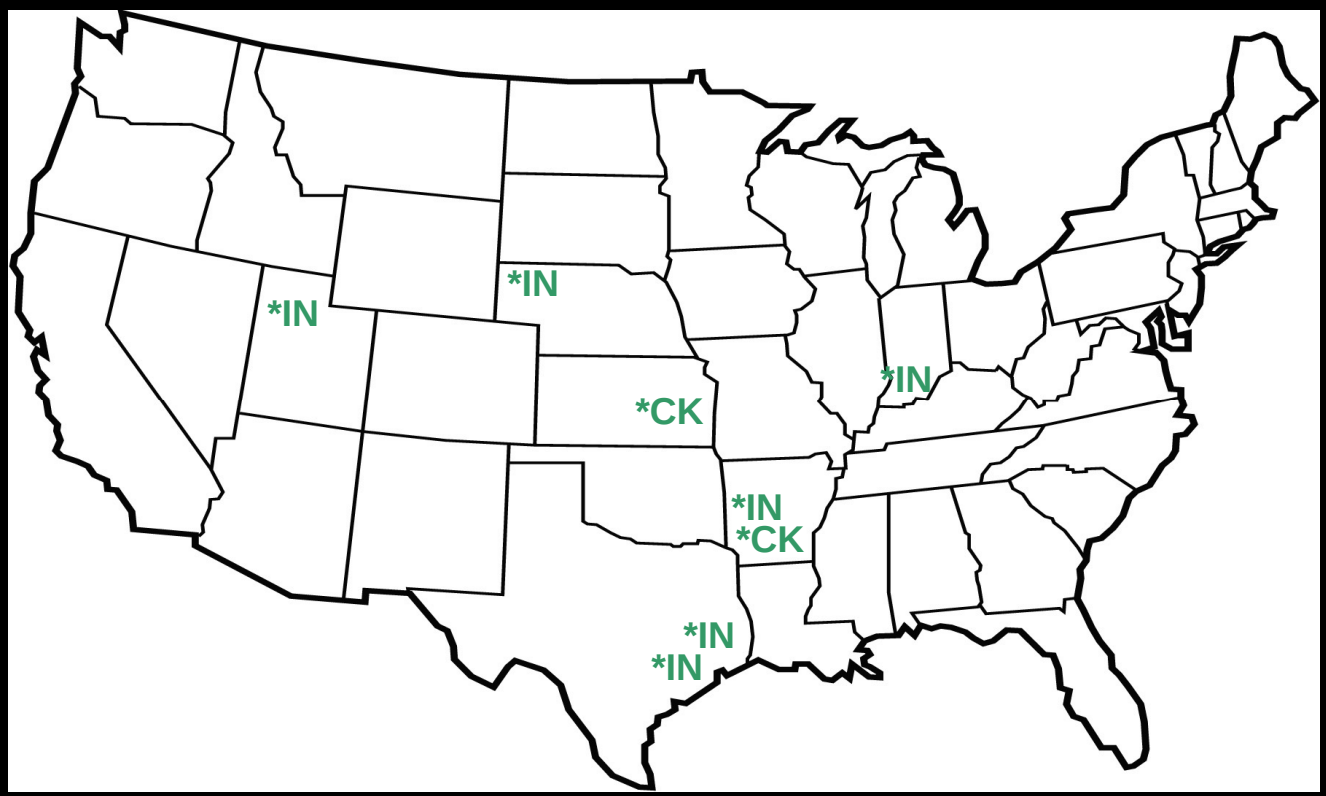
WASTE STREAM MATRIX

No.	Item	Qty	Description	Current Location	Proposed Location	Size	Empty	Liner	Off-site Collector	Building Collector	Reusable
1	Aqueous chemicals	2	carboy	on floor	lab entry	5 gal	weekly	no	chemical waste TSD	haz. waste contractor	yes
2	Biohazard: large	3	red metal box	on floor	in cabinet rack	12X12X20	daily	yes	medical waste handler	haz. waste contractor	yes
3	Biohazard: medium										
4	Biohazard:small										
5	Corrosives										
6	Dirty glassware	1	rolling cart	on cart, in sink	on cart, in sink	30X18X34	daily	no	none	staff	yes
7	Equipment fluid waste	3	sealed vessels	on cart, on floor, on bench	in equipment rack	1 gal	weekly	no	chemical waste TSD	haz. waste contractor	yes
8	E-waste: computers, cables	1	various	on floor	entry station	varies	daily	no	staff	city	yes
9	Flammables	1	container	on floor	hood cabinet	5 gal	weekly	no	chemical waste TSD	haz. waste contractor	yes
10	Heavy metals(Ag, Cu,..)										
11	Poisons										
12	Radioactive: aqueous Cr 51	1	lead drum	on wheels on floor	next to hood	30 gal	monthly	no	rad. waste transporter	haz. waste contractor	yes
13	Radioactive: aqueous P33	1	plexi box	on bench	on bench	2.5 gal	2x / mo	no	rad. waste transporter	haz. waste contractor	yes
14	Radioactive:aqueous 3H										
15	Recycle: cardbd										
16	Recycle: pap,plast, met, gl.	1	box on floor	on floor	central station	12X12X20	daily	no	city	janitor	no
17	Recycle: styrofoam, peanuts	1	box	on floor	central station	varies	daily	no	service vendor	staff	yes
18	Recycling:plastic wrap	1	box on floor	on floor	central station	12X12X20	daily	no	city	janitor	no
19	Sharps (large)	2	cardboard box	floor	entry station	12X12X20	as needed	no	city	janitor	no
20	Sharps (large):biohazard										
21	Sharps (large):radioactive										
22	Sharps (med):radioactive										
23	Sharps (medium): biohazard	4	free standing red plastic box	on floor	in cabinet rack	12X12X16	daily	no	medical waste handler	haz. waste contractor	no
24	Sharps (small): radioactive										
25	Sharps (small):biohazard										
26	Standard trash	4	floor standing bin	in lab adjacent to researcher and sink	bin in lab cabinet	8W24X27	daily	yes	city	janitorial	yes
27	Standard trash at desk	4	floor standing bin	cubicle area and offices	bin in cabinet	8X24X27	daily	yes	city	janitorial	yes
28	Toxics										
29	U-waste:sw's, bulbs, ballasts	1	various	on floor	loading dock	varies	varies	no	staff	staff	no
	Total	**31**									

Hazardous Waste Incinerators and Cement Kilns

61 Offsite Hazardous Waste Facilities in CA

0 Hazardous Waste Incinerators in CA



HW Incinerator: IN **HW Cement kiln: CK**

The Transportation Environmental Cost

Energy Consumption/ Greenhouse Gases

(Assume 55 gallons of waste fuels transported 800 miles)

- **Highway - truck trailer***
  - **220,000 BTU**
  - **36 lb CO2**

- **Rail - tank car****
  - **48,000 BTU**
  - **8 lb CO2**

Note: 1 gallon of gasoline has approximately 125,000 BTU

****Assumes trailer with 100 55-gallon drums. 5 mile/gal. BTU/gallon (diesel) of 138,700**

*****Based on 330 BTU/ton-mile from Transportation Energy Data Book: 2007-2008.**

RESEARCH FACILITY REGULATORY CITATIONS

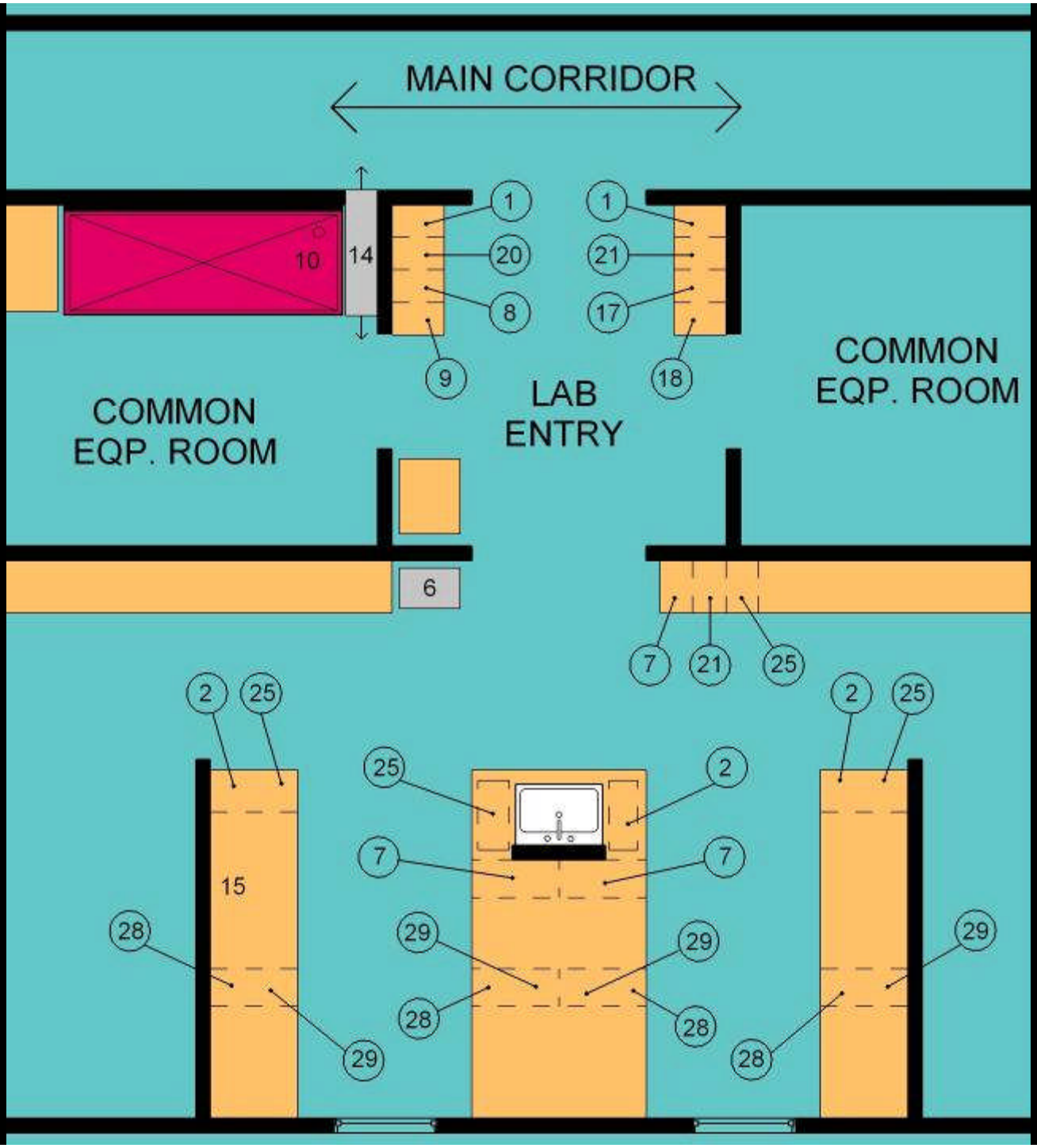
- **Medical Waste Management**
  - California Health & Safety Code, Section 65600 et seq.
- **Radioactive Waste Management**
  - Title 17 CCR, Section 30100 et seq.
  - Title 10 CFR, Part 20
- **Hazardous Waste Management**
  - California Health & Safety Code, Section 25100 et seq.
  - Title 22 CCR, Section 66001 et seq.

RESEARCH FACILITY REGULATORY CITATIONS

- **Waste Water**
  - Municipal Sewer Ordinance
  - Title 40 CFR, Part 122
- **Air**
  - Bay Area Air Quality Management District, Rules & Regulations
  - Title 40 CFR, Parts 50-99
  - Clean Air Act, Section 112
- **Waste Minimization**
  - California Health & Safety Code, Section 25244.12 et seq.
  - Title 22 CCR, Chapter 31, Article 1

POSSIBLE FACILITIES SOLUTIONS

- **Conserve Utilities – Water, Gas, and Electricity**
- **Reduce Trash**
  - Buy the right quantities - It may cost 20-50 times more to dispose than to purchase
    - Avoid economic order quantities– Combine orders instead
    - Just-in-time order/delivery – deduct and hold
  - Storage space takes up waste space
    - Create hub-and-spoke distribution
    - Deliver supplies in innermost wrapping
    - Utilize vendor point-of-use programs
    - Reduce number of supplies storage cabinets in lab--use for waste containers


MAIN CORRIDOR
10
14
1
20
8
9
1
21
17
18
COMMON
EQP. ROOM
LAB
ENTRY
COMMON
EQP. ROOM
6
7
21
25
2
25
15
28
29
25
2
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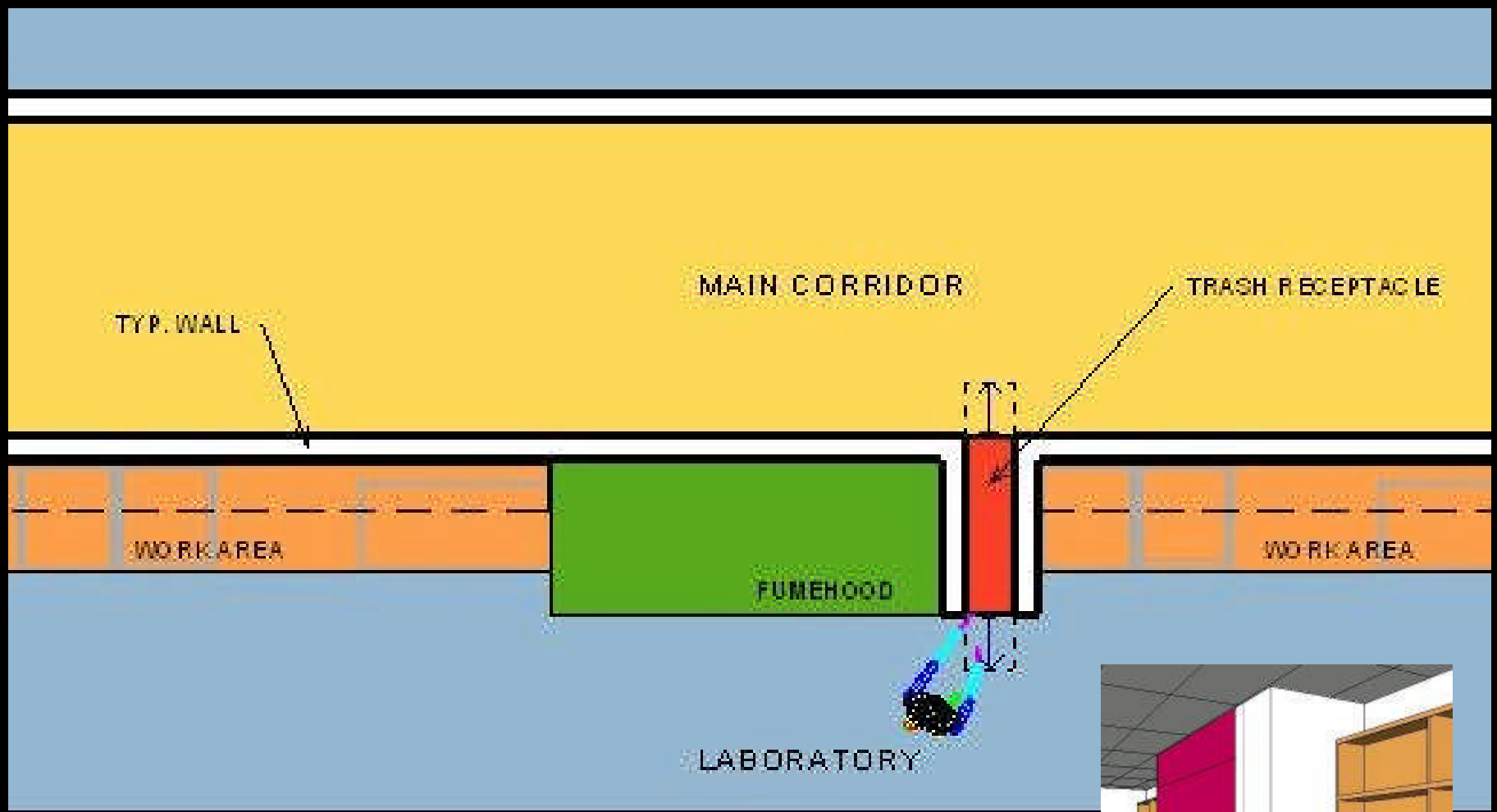
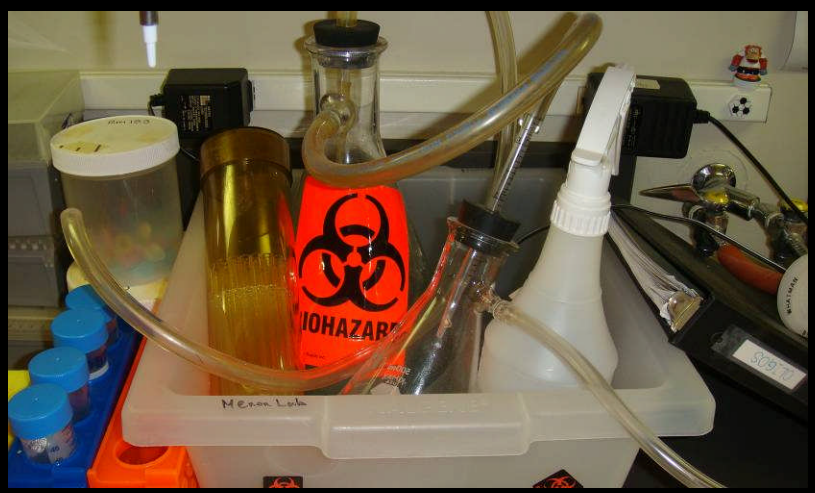

MAIN CORRIDOR
TRASH RECEPTACLE
TYP. WALL
WORK AREA
FUMEHOOD
WORK AREA
LABORATORY

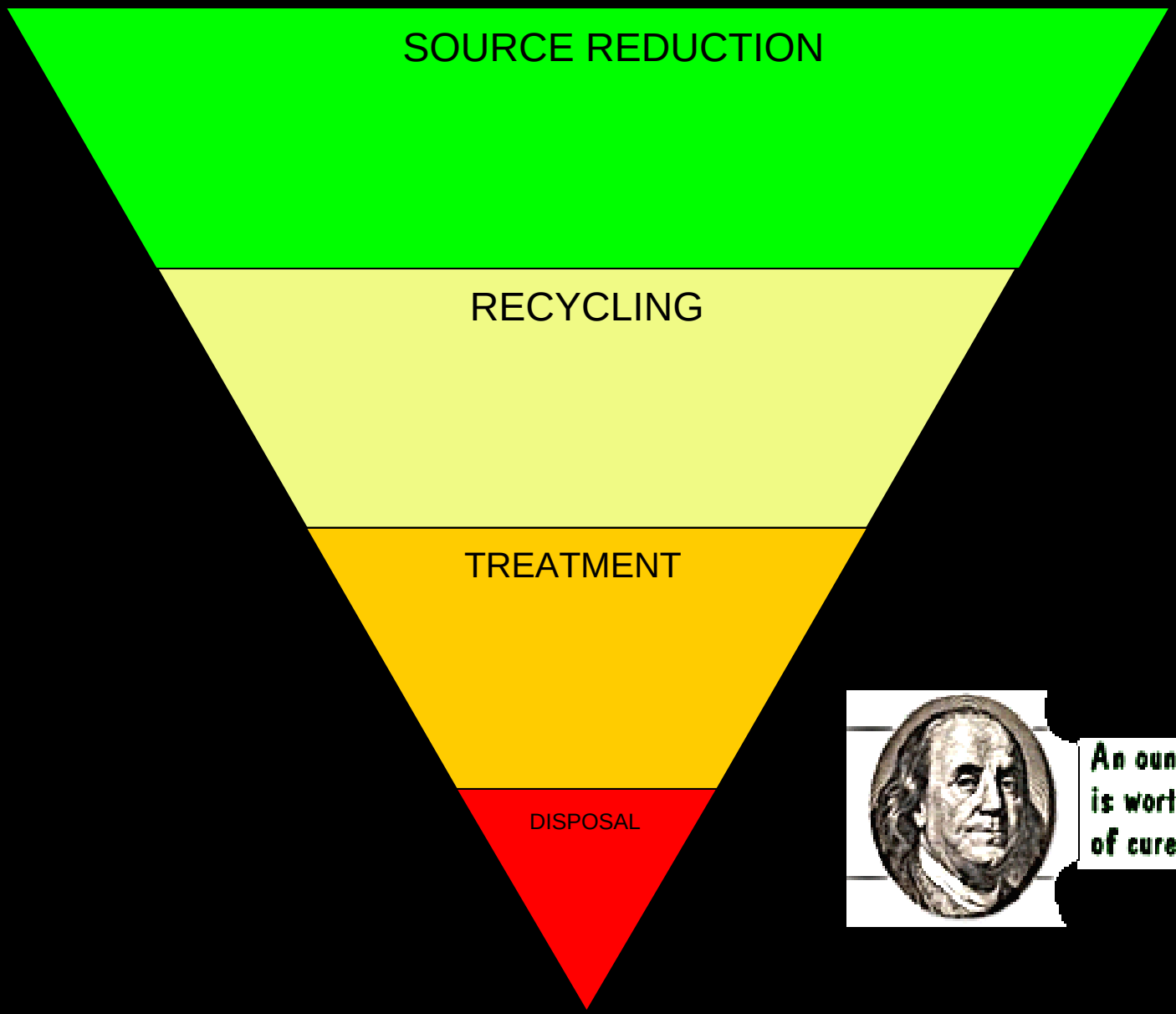
POSSIBLE FACILITIES SOLUTIONS

Before

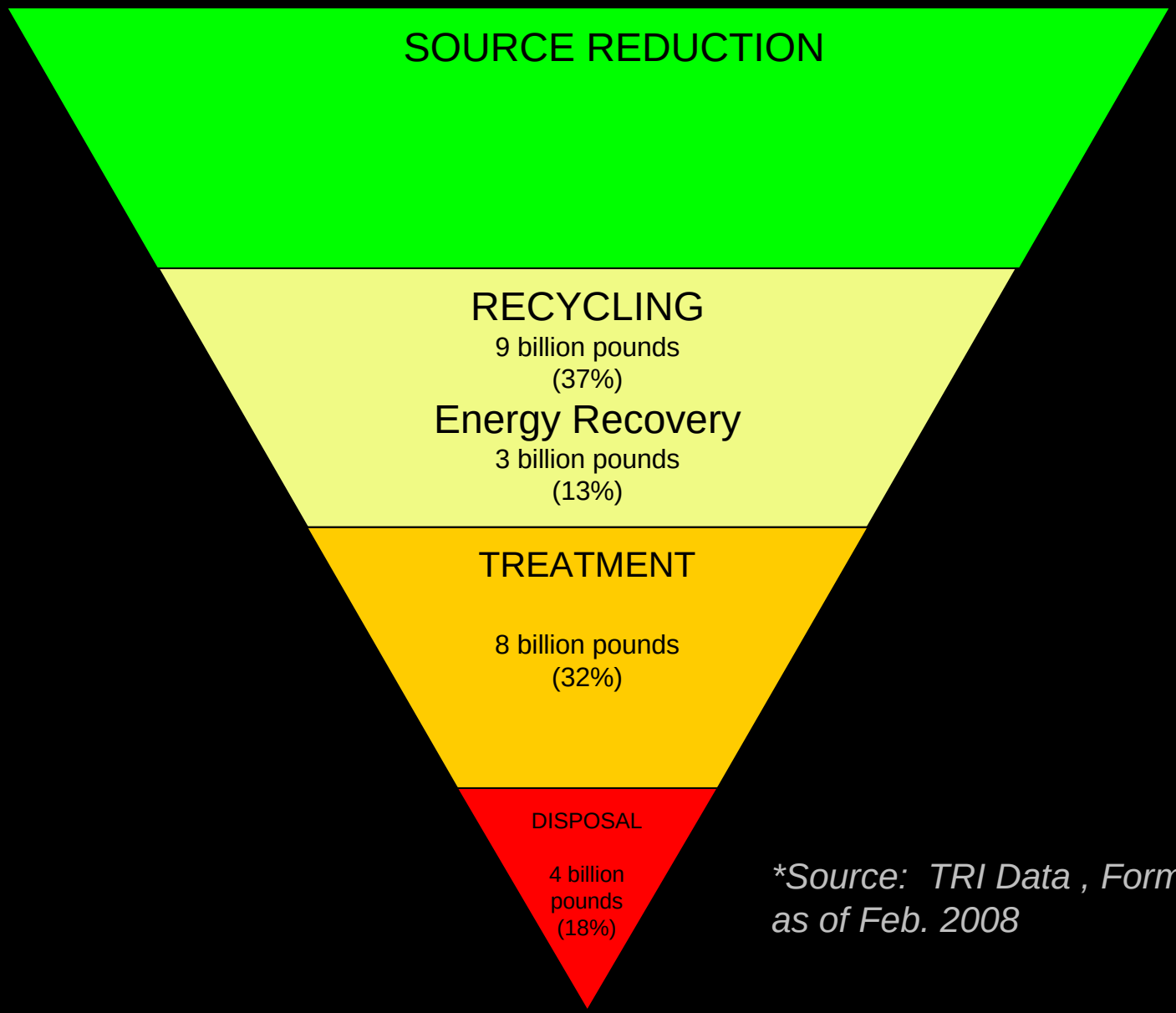


After

WASTE MANAGEMENT HIERARCHY



TOTALS: TOXIC RELEASE INVENTORY FACILITIES

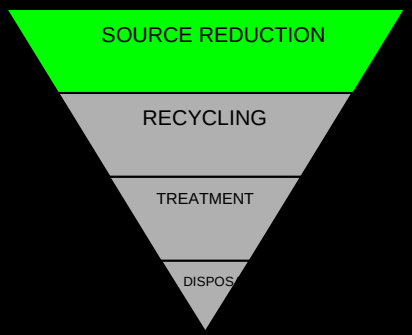


**Source: TRI Data , Form R as of Feb. 2008*

DRIVERS OF BEING GREEN

- **Regulatory Drivers**
  - SB14 , Source Reduction and Waste Minimization Planning
- **Corporate Incentives**
  - The right thing to do
  - Corporate image
  - Cost savings
  - Employee morale
  - ISO 14001-Environmental Management System
  - US EPA Climate Leaders
  - Green Chemistry Initiative / Green Certifications

SOURCE REDUCTION

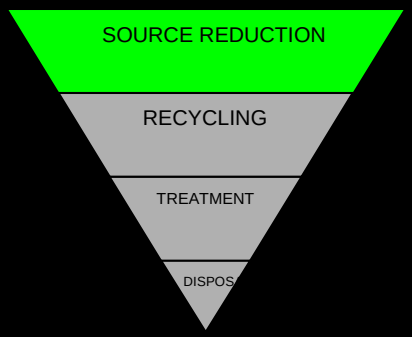


- **Segregation**
  - Non-hazardous debris from hazardous lab debris
  - Empty lab bottles (triple rinsed)
  - Corrosive waste pH <2 or >12.5
  - High BTU wastes

Stericycle Reusable Sharps Container

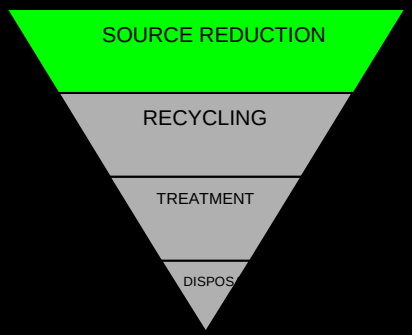
- **Packaging**
  - Reusable Containers (sharps)
  - Smarter packaging of lab packs
  - Larger waste transportation containers (e.g., cubic yard boxes)

SOURCE REDUCTION



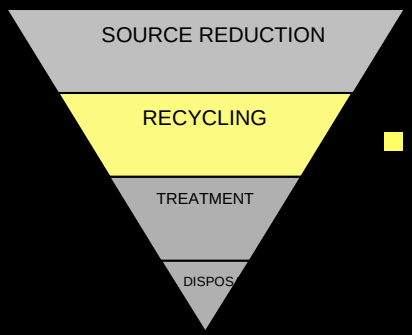
- **Donating Surplus**
  - Computers –universal waste
  - Chemicals
- **Inventory Control**
  - FIFO
  - Databases
- **Training**
- **Employee Award Programs**
- **In-house Policies**

SOURCE REDUCTION



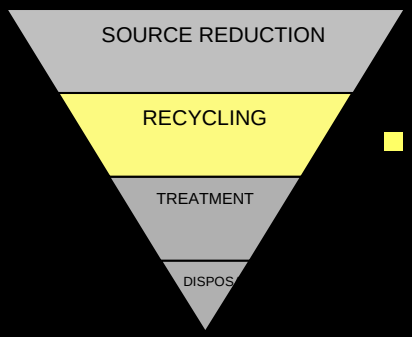
- **Process/Equipment Change**
  - Oil-less pumps
  - Non-mercury thermometers
  - Cleaning methods
    - ultrasonic tank cleaners, CIP, segregating last rinse
  - Digital imaging
  - Equipment selection
    - EHS considerations/evaluation

RECYCLING



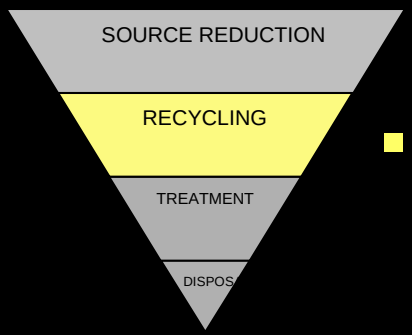
- **Solvents in Large Volumes**
  - Thousands of gallons/regularly generated
  - Regeneration onsite or offsite

RECYCLING



- **High BTU-value Organics**
  - 5,000 BTU/lb.
  - Incineration versus fuel blending
    - Recycling credit

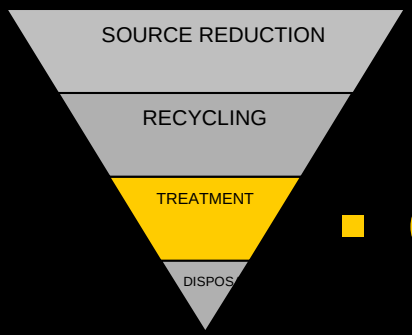
RECYCLING



- **Used Fixer** (silver containing)
  - Conversion to digital preferred
  - Recycle preferred over non-recycling treatment
    - Offsite recycling
    - For large producers (Onsite columns/return to vendor)

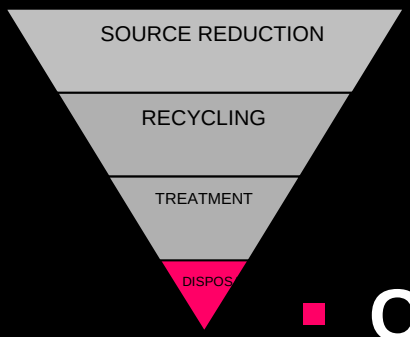
ECS Refining/Pureflow®

TREATMENT



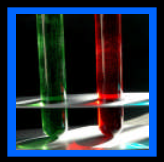
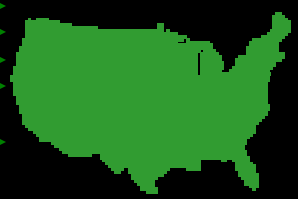
- **Onsite**
  - Benchtop treatment (H&SC 25200.3.1)
  - Conditionally Authorized
  - Conditionally Exempt

DISPOSAL



- **Consider energy recovery instead of land disposal**

WASTE DISPOSAL PROCESSES - Current

	Lab	Loading Dock	Transport	Storage	Disposal
Radioisotopes					
^{3}H	Long Half life Small Boxes	Drums	~30 Miles	Transported to Local Facility	~1,500 Miles → Thermal treatment
P^{33}	Short Half Life Small Boxes	Drums	~30 Miles	Stored in Local Facility	→ WA Sewer / Trash
Chemicals					
	Vessels	Drums	~30 Miles	Treatment	0 – 800 Miles → Treatment
				Local Facility	~800 Miles → Incinerator Utah
Biohazards					
	Red Bags Sharps	Drums	~30 Miles	Local Facility	~800 Miles → Incinerator Utah
Recyclables					
	Standard Recyclables Recycle Bins	Pallets/Gaylords	Local Collection Site ~20 Miles	Styrofoam, Plastics, Glass, Metal	
	Universal Waste Boxes	Pallets/Gaylords	~20 Miles	Batteries, Bulbs, e-waste	
	Heavy Metals Bottles	Bottles	~20 Miles	Silver, Mercury	Local Re-use

WASTE DISPOSAL PROCESSES - Future

	Lab	Loading Dock	Transport	Storage	Disposal
^{3}H	Long Half Life Small Boxes	Drums	~30 Miles	Transported to Local Facility	~1,500 Miles → Thermal treatment WA
P^{33}	Short Half Life Small Boxes	Drums	~30 Miles	Stored in Local Facility	→ Sewer

Radioisotopes

Lab	Loading Dock	Transport	Storage	Disposal
Red Bags Vessels Recycle Sharps Containers	Drums Pallets/Gaylords	~30 Miles	Local Facility	→ Local Treatment or Incinerator Waste to Energy

Non-radioactive Hazardous Waste

Lab	Loading Dock	Local Collection Site	Storage	Disposal
Standard Recyclables Recycle Bins	Pallets/Gaylords	~20 Miles	Glass, Metal	→ Local Re-use
Universal Waste Boxes	Pallets/Gaylords	~20 Miles	Batteries, Bulbs, e-waste	→ Local Re-use
Heavy Metals Bottles	Bottles	~20 Miles	Silver, Mercury	→ Local Re-use

Recyclables

Questions

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