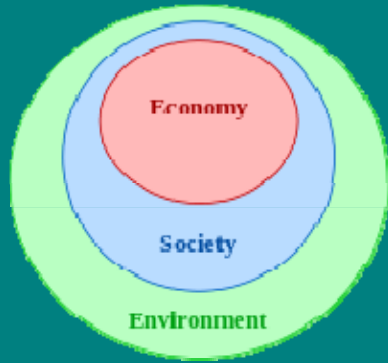
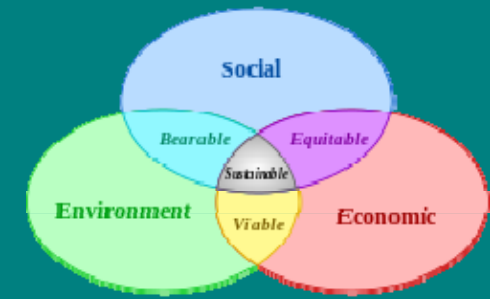


A satellite image of Earth showing the Americas, with a large white text overlay in the center. The text reads "Sustainability and Pollution Prevention". The image shows the Earth's surface with blue oceans, green and brown landmasses, and white clouds. A prominent hurricane is visible in the upper right quadrant.

Sustainability and Pollution Prevention

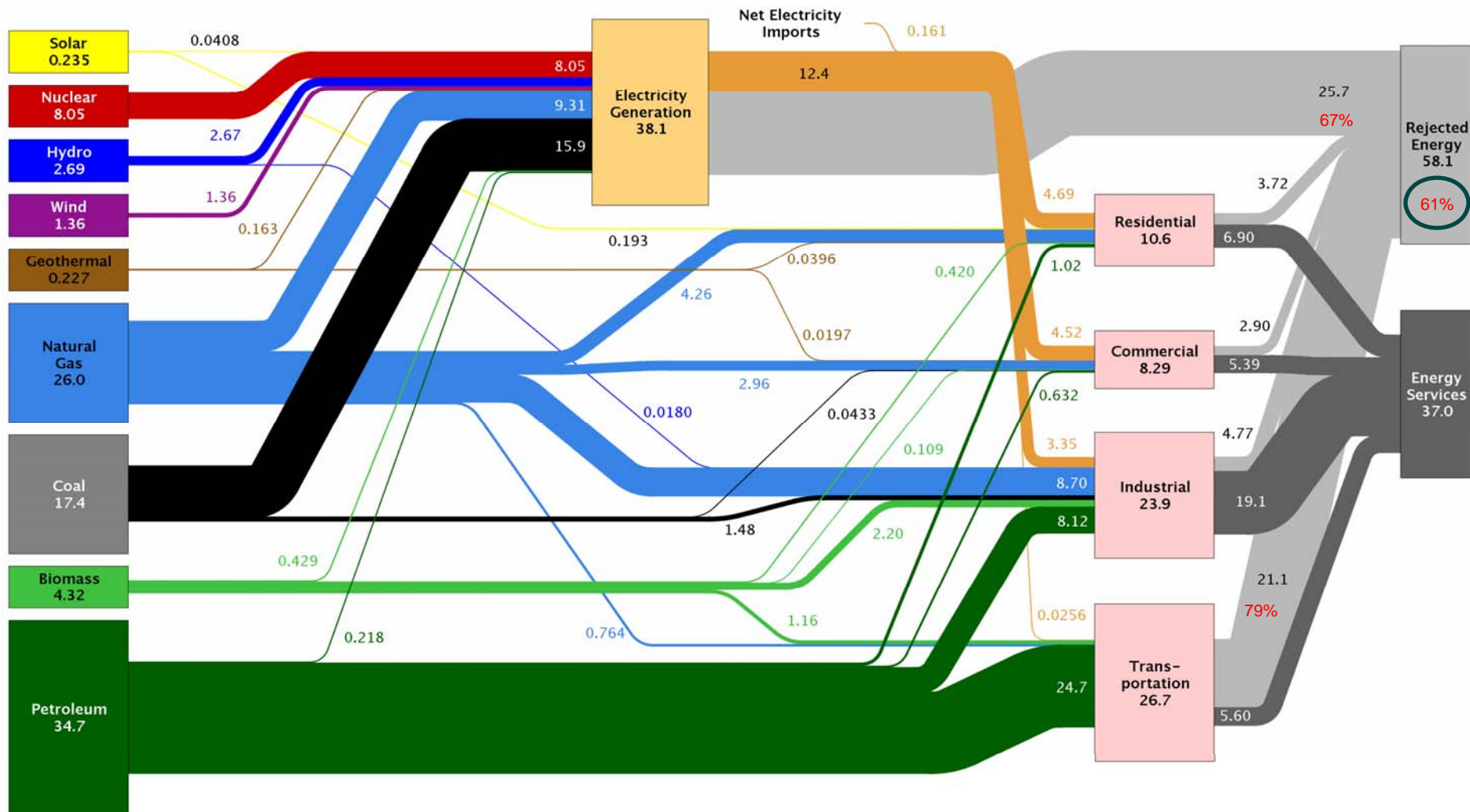


Sustainability



- Able to be used without being completely used up or destroyed; involving methods that do not completely use up or destroy natural resources; able to last or continue for a long time – Merriam-Webster
- Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs – Brundtland Commission of the United Nations

Estimated U.S. Energy Use in 2012: ~95.1 Quads



Source: LLNL 2013. Data is based on DOE/EIA-0035(2013-05), May, 2013. If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory and the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant "heat rate." The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 65% for the residential and commercial sectors 80% for the industrial sector, and 21% for the transportation sector. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527

What is Pollution Prevention?

Definition

- The term "source reduction" (P2 Act) means any practice which -
 - reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal
 - Includes other practices that reduce or eliminate the creation of pollutants through
 - Increased efficiency in the use of raw materials, energy, water, or other resources
 - Protection of natural resources by conservation
- Prevention of pollution (ISO 14001)
 - Use of processes, practices, techniques, materials, products, services or energy to avoid, reduce or control (separately or in combination) the creation, emission or discharge of any type of pollutant or waste, in order to reduce adverse environmental impact
 - Note: prevention of pollution can include source reduction or elimination; process, product or service changes; efficient use of resources; material and energy substitution; reuse; recovery; recycling; reclamation, and treatment.

Pollution Prevention

- The reduction or elimination of wastes at the source (source reduction) instead of at the end of the pipe or stack.
- Occurs when:
 - Resources are used more efficiently
 - Less harmful substances are substituted for hazardous ones, or
 - Toxic substances are eliminated from production raw materials, water, energy, and other processes

P2 Mantra

- Change the material
- Change the process
- Change the technology

P2 Strategies – Input Substitution

- Changing a raw material to something less toxic (e.g., Toluene in spray painting)
- Low VOCs, metals
- MIT EHS Green Chemical Alternatives Purchasing Wizard - <http://ehs.mit.edu/site/content/green-chemical-alternatives-purchasing-wizard>
- Toxic Use Reduction Institute CleanerSolutions Database - <http://www.cleanersolutions.org/>

P2 Strategies – Process Modification

- Making a change to or replacing a process

A comparison of the “current” and “advanced” chemical systems is summarized below:

Chemical	Current	Advanced	Advantages
Cleaner	Gardoclean® S 5219: Alkaline cleaner containing non-biodegradable petroleum-based surfactants.	<i>Environmentally friendly</i> Crysoat® 2707: 1) Employs acidic system containing bio-degradeable non-petroleum-based surfactants, and	1) Eliminates one chemical, & uses less chemical overall, 2) reduces heat to Stage 1 and eliminates heat to Stage 3, reducing energy costs,
Conversion coat	Crysoat® 2147	2) Combines cleaning & conversion coating within same chemical package, eliminating 1 chemical.	3) has neutral-pH discharge, easing load to municipal water treatment facilities, 4) is more simple to operate & maintain and has less chance for operator error.
Seal	Gardolene® D 6871: Contains biocide for bacteria control.	Gardolene® D 6810: No biocide needed .	5) Has no bacteria and no need for biocide, eliminating operator exposure to dermatitis.

P2 Strategies – Equipment Modifications

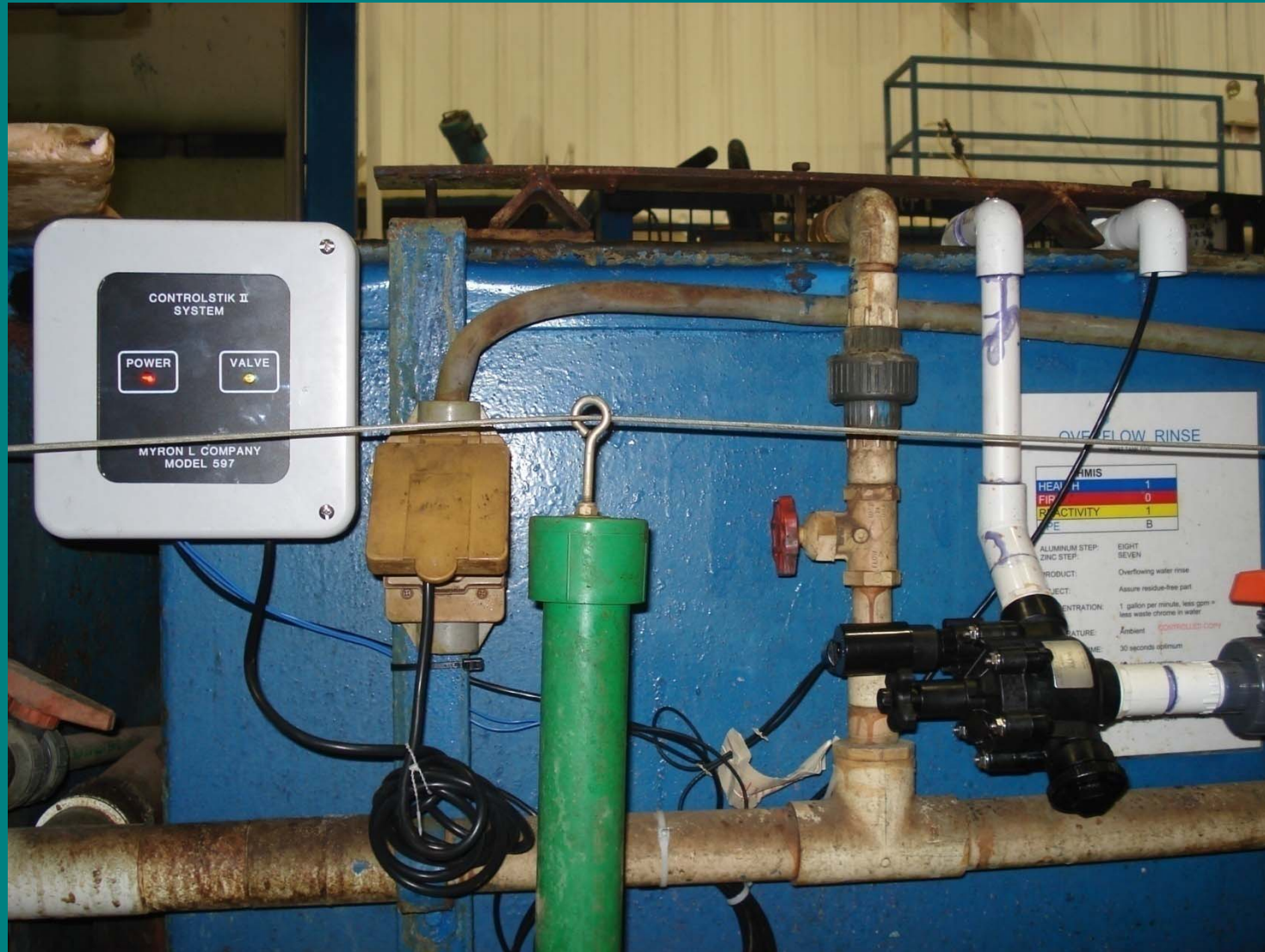
- An actual change or modification to equipment within a process
- Frito-Lay
http://www.nytimes.com/2007/11/15/business/15plant.html?_r=2&ref=science&oref=slogin&oref=slogin

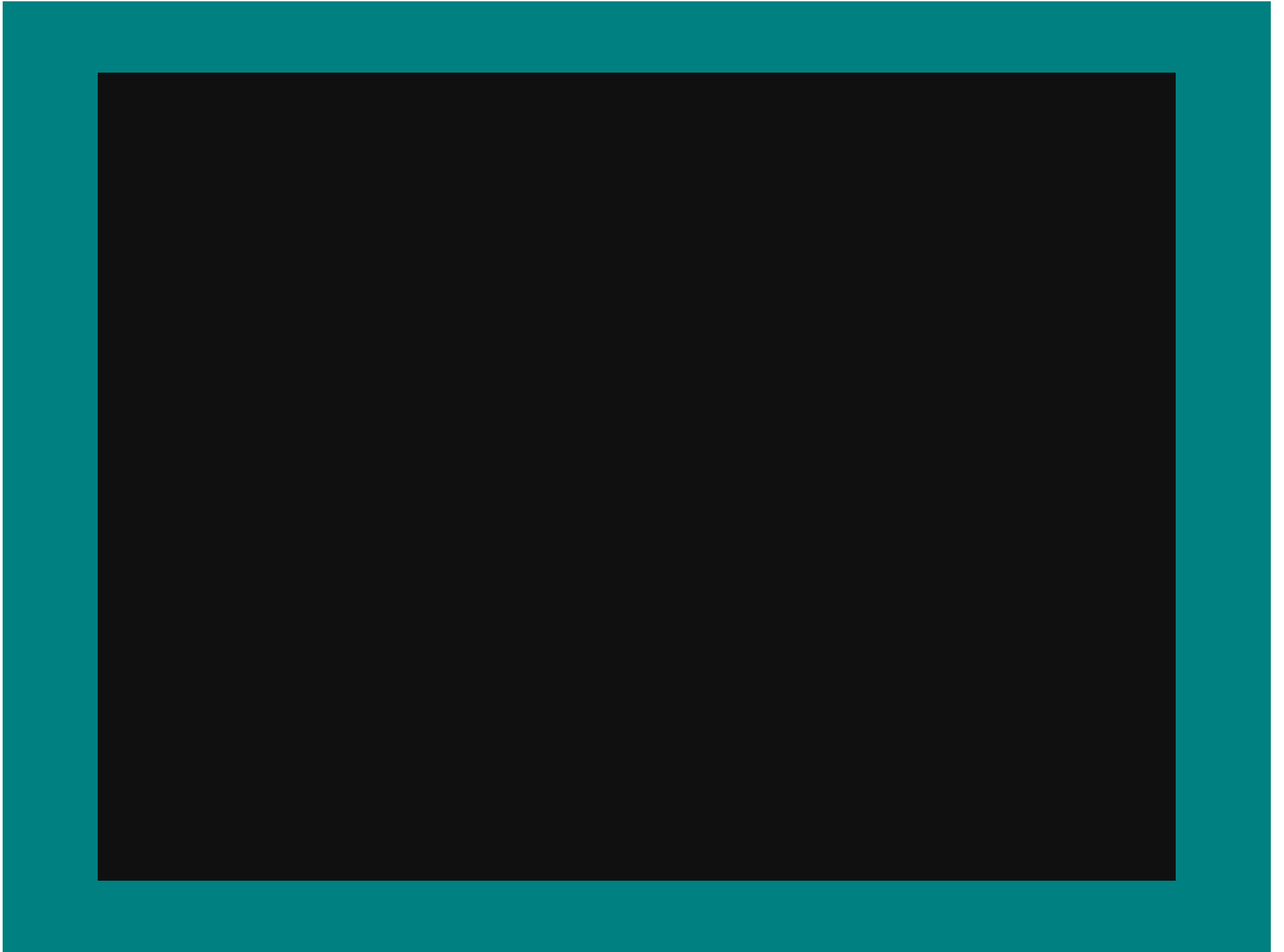


Company A

- Brake-manufacturing company
- Chemical finishing department – 730,000 gallons of water
- Continuous supply of fresh water for chrome rinse tank

Company A





Company A

- Added conductivity sensor, less than \$700
- Saved 600,000 gallons of water, \$14,600/year
- Total – 600,000 gallons of water; 24,500 kWh; \$45,800
- Company investment - \$3,000

Company B

- Third year of program
- Electric air dryer for industrial parts
 - Two 15 kW dryers
 - 9.5 hours/day
 - 70,000 kWh/year
 - \$5,400/year

Company B



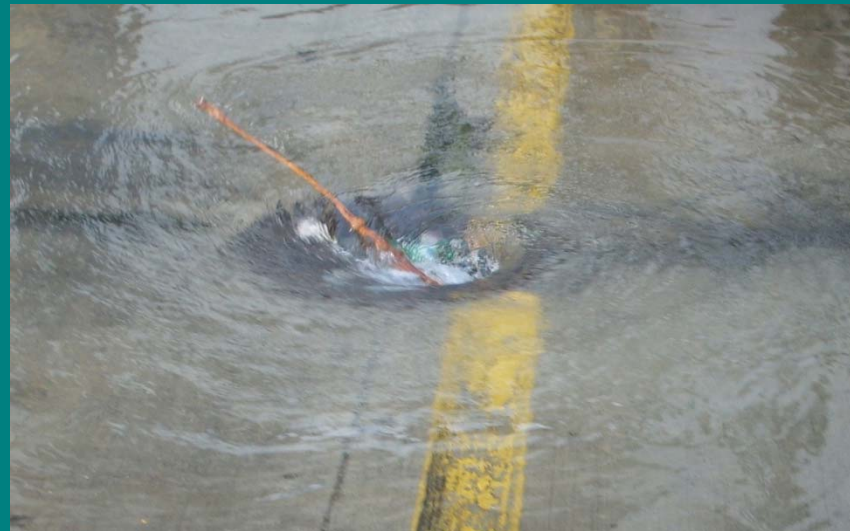
Company B

- Added simple timer, less than \$50
- Approximately one hour/day
- Saved 64,000 kWh/year, \$5,000/year
- Total – 342,715 kWh; 444,000 gallons of water; \$29,000/year
- Company investment - \$4,400

Company C

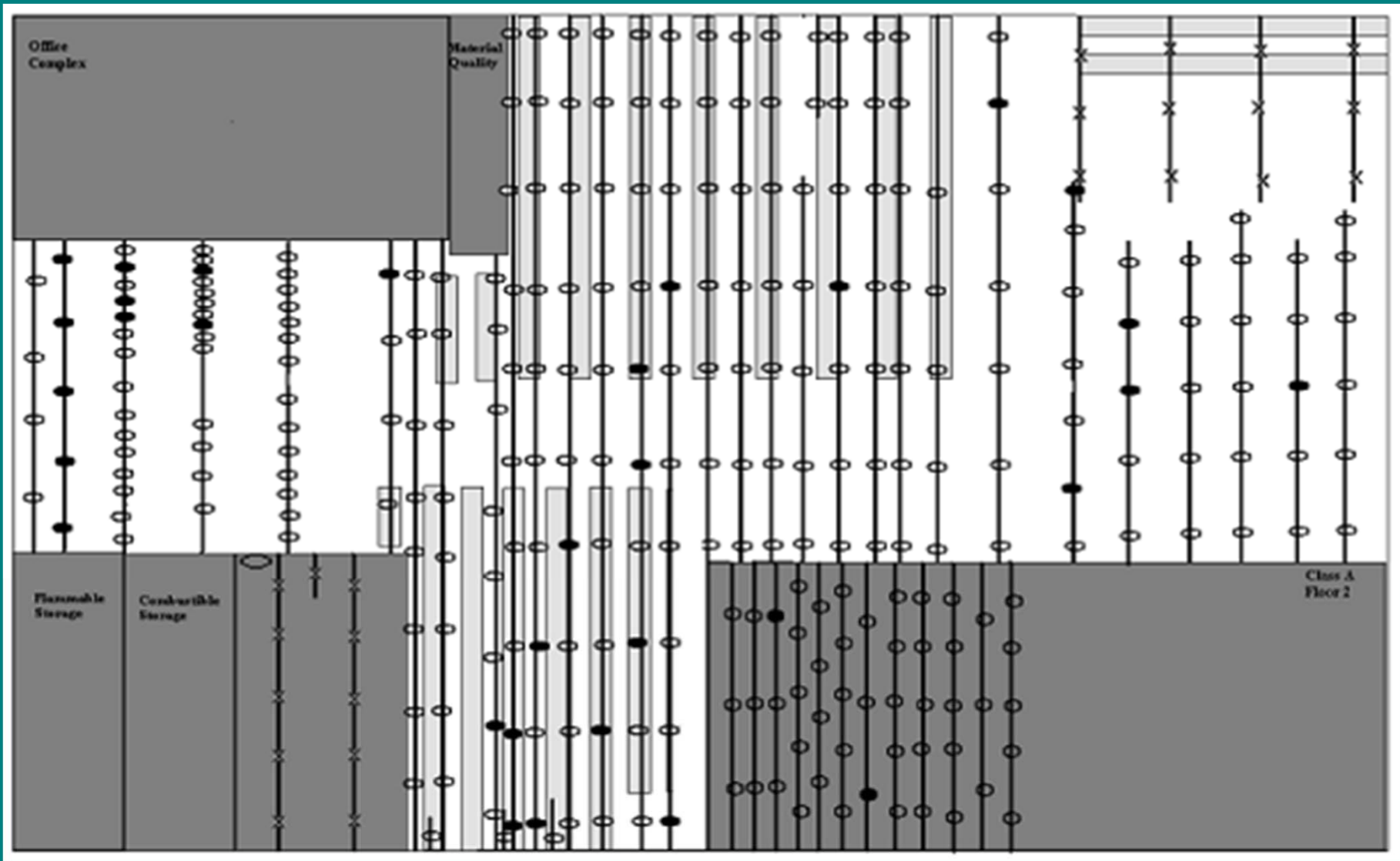


37 minutes;
750 gpm



2,440,649 gallons; \$16,928.01

Company D



Office Complex								Material Quality		8	1	2	9	1	7	2	2	10	8																			
								5	5	7	6	6	10	10	7	13	20	6	7	12	12	13	14															
								9	5	6	3	11	8	16	4	11	20	22	21	19	18																	
								8	3	2	8	7	6	10	4	12	19	22	19	16	23	20	19															
								6	6	3	4	11	4	12	6	11	18	15	14	18	18	20	18	12														
								6	6	1	5	10	7	10	3	12	15	19	18	12	17	17	15															
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5	5	8	15	15	20	20	22	8	8	4	4	4	8	9	6	7	11	11	11	12	14	17	14	9														
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								11	7	4	4	5	3	10	11	27	29	20	26	28	30	30	14	34	21	14	20	7	8	3	12	8						
								10	7	4	4	3	5	9	9	6	1	1	2	30	1	17	19	46	52	43	32	5	6	1	11	3						
								9	5	9	1	4	5	6	5	5	44	54	36	4	27	29	30	29	41	51	41	49	8	3	1	9	0					
								5	6	4	5	6	6	7	10	4	1	1	17	28	25	22	30	45	14	43	40	3	4	2	10	0						
								8	4	12	5	2	5	7	8	4	1	1	17	28	25	22	30	45	14	43	40	3	4	2	10	0						
								43	5	15	4	0	4	19	43	22	31	42	37	19	22	27	24	32	33	43	50	4	5	0	14	10						
								54	8	11	10	4	13	14	54	22	31	42	37	19	22	27	24	32	33	43	50	4	5	0	14	10						
Flammable Storage	Combustible Storage	11	14	8									8	7	4	4	5	3	10																			
		8	4									5	7	4	4	3	5	9	9	7	6	1	1	2	30	1	17	19	46	52	43	32	5	6	1	11	3	
		3									5	9	1	4	5	6	5	44	54	36	4	27	29	30	29	41	51	41	49	8	3	1	9	0				
		4	3									6	4	5	6	6	7	10	4	1	1	17	28	25	22	30	45	14	43	40	3	4	2	10	0			
		3	3									4	12	5	2	5	7	8	4	1	1	17	28	25	22	30	45	14	43	40	3	4	2	10	0			
		5	6	4									5	15	4	0	4	19	43	22	31	42	37	19	22	27	24	32	33	43	50	4	5	0	14	10		
		5	6	4									8	11	10	4	13	14	54	22	31	42	37	19	22	27	24	32	33	43	50	4	5	0	14	10		



Luminaire directly over racks

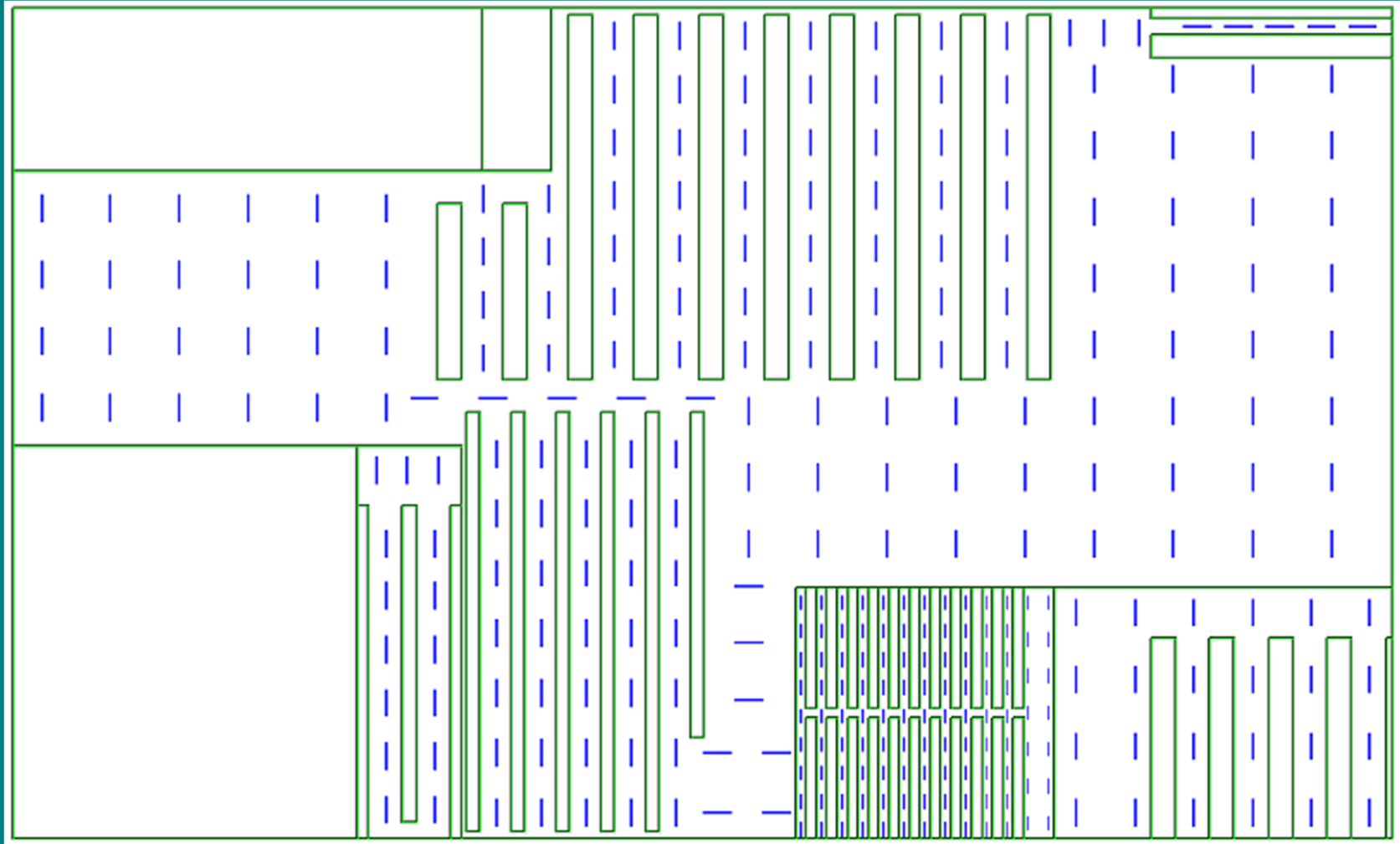


Uneven lighting and shadows

Company D

- Current: 95W and 60W T12s, 612,166 kWh/yr, \$47,871
- Recommendation: 32W T8s
- Cost : Approximately \$15,814
- Savings: 163,654 kWh; \$12,797; 1.2 year simple payback

Lighting Redesign



Using Visual lighting design software, <http://www.visuallightingsoftware.com/>

Company D

- Current: 95W and 60W T12s, 612,166 kWh/yr, \$47,871
- Recommendation: Redesign lighting layout, 32W T8s
- Cost: Approximately \$32,548
- Savings: 393,584 kWh; \$30,778; 1.0 year simple payback

Spray painting vs. Powder coating

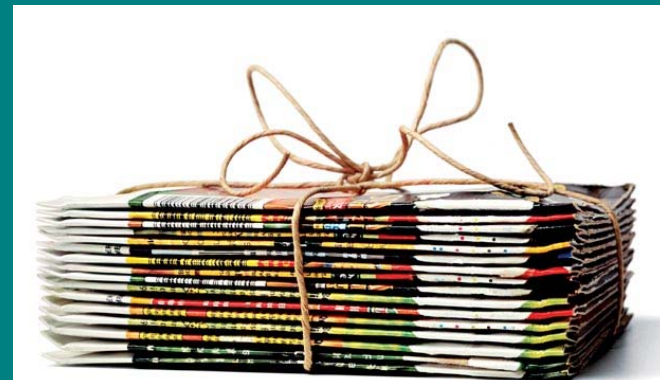


AEROSPACE GALLERY



P2 Strategies – Product Reformulation

- A change or modification to a product
- Yellow+Blue wines - <http://www.ybwines.com/content/templates/green.asp?articleid=15&zoneid=8>
- Lighter coke bottles - http://www.enn.com/top_stories/article/22686



P2 Strategies – Raw Material Use and Handling

- A change to a process to incorporate recovery and/or reuse of a raw material

P2 Strategies – Material Tracking and Inventory Control

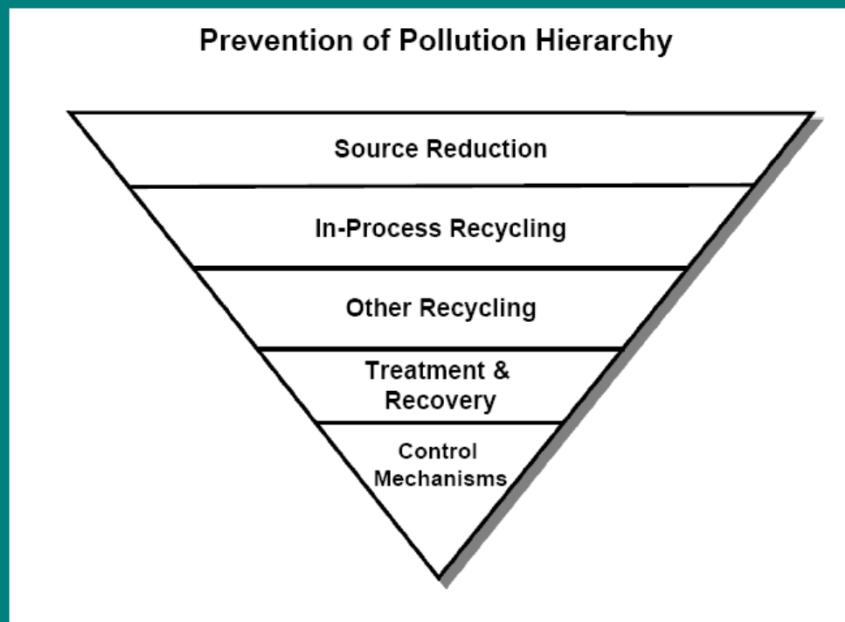
- A change allowing for tracking materials and inventory control (e.g., first-in, first-out; just-in-time manufacturing)

P2 Strategies – Improved Housekeeping and Maintenance

- Changes to improve housekeeping (e.g., dry cleaning instead of wet cleaning) and maintenance (e.g., air compressor audits and repair).



Waste Reduction Hierarchy



Source Reduction or P2 is the most preferred strategy for reducing waste

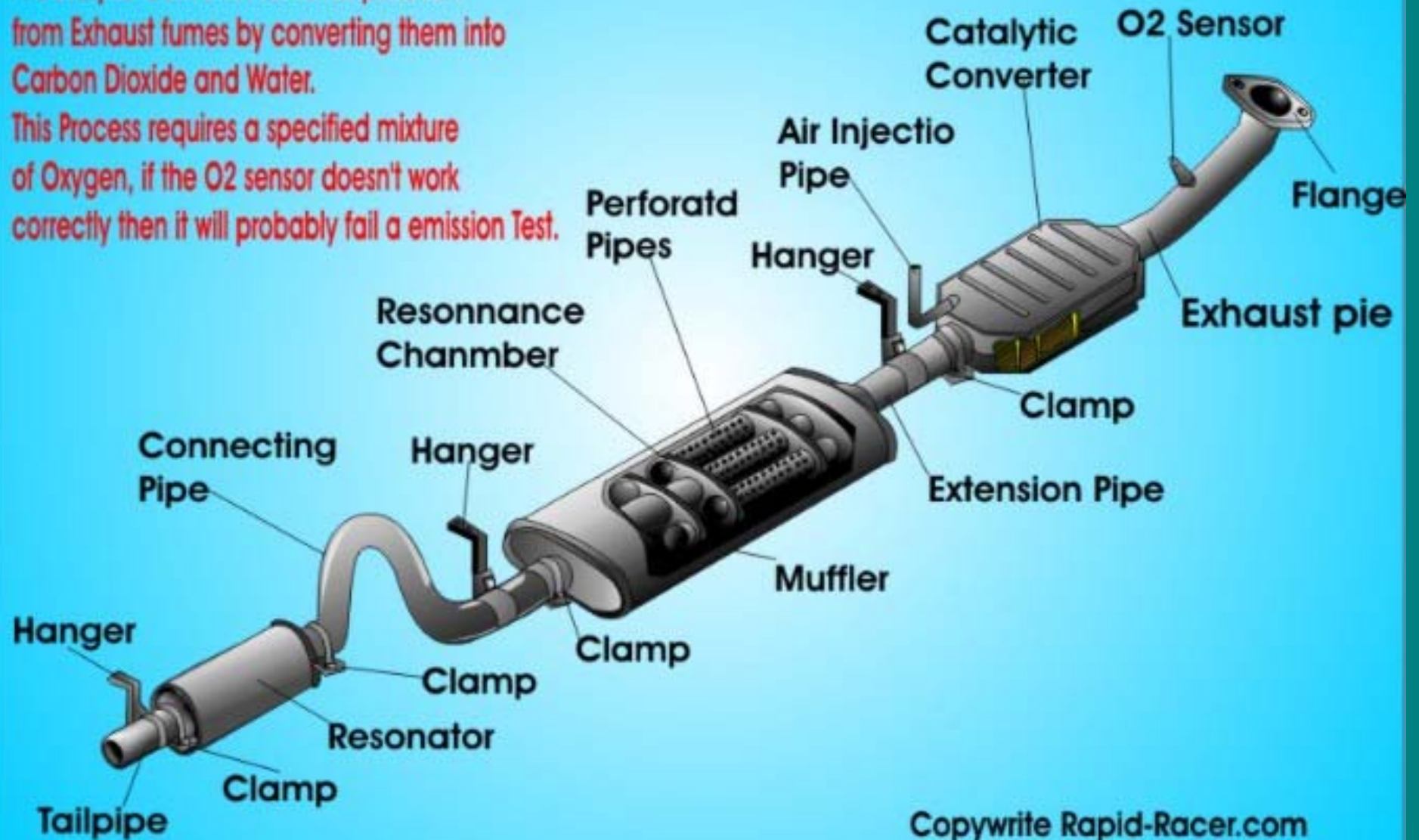
Benefits of Pollution Prevention

- Reduces liabilities and risks – disposal and workforce
- Reduces costs
- Assists in meeting environmental regulatory requirements
- Environmental improvement also means financial savings
- Improved image

Catalytic Converter

A Catalytic Converter removes pollution from Exhaust fumes by converting them into Carbon Dioxide and Water.

This Process requires a specified mixture of Oxygen, if the O2 sensor doesn't work correctly then it will probably fail a emission Test.



Thermal Oxidizers are typically used to destroy Hazardous Air Pollutants (HAPs) and Volatile Organic Compounds (VOCs) from industrial air streams. These pollutants are generally hydrocarbon based and when destroyed via thermal combustion they are chemically changed to form CO₂ and H₂O. Wikipedia

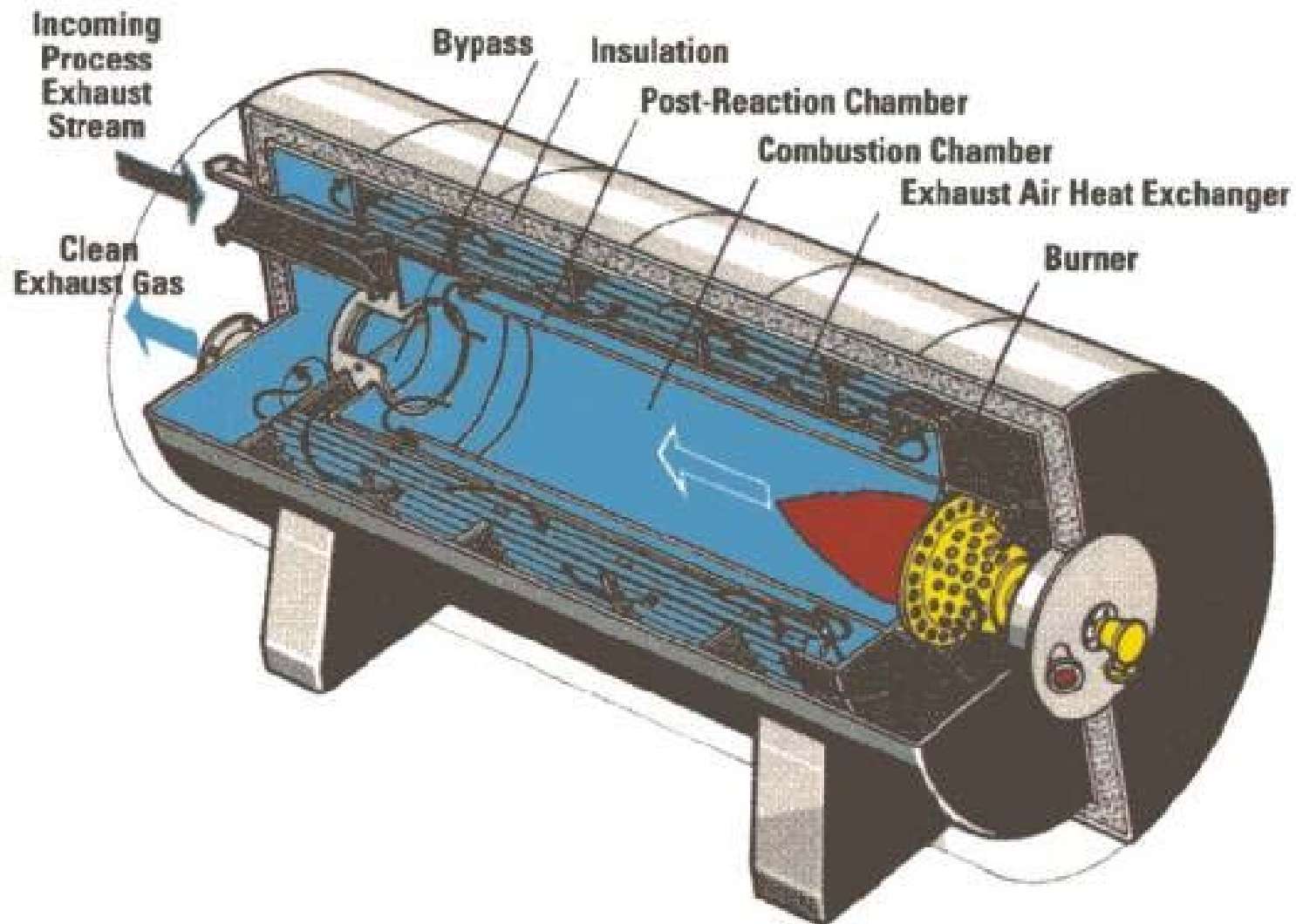
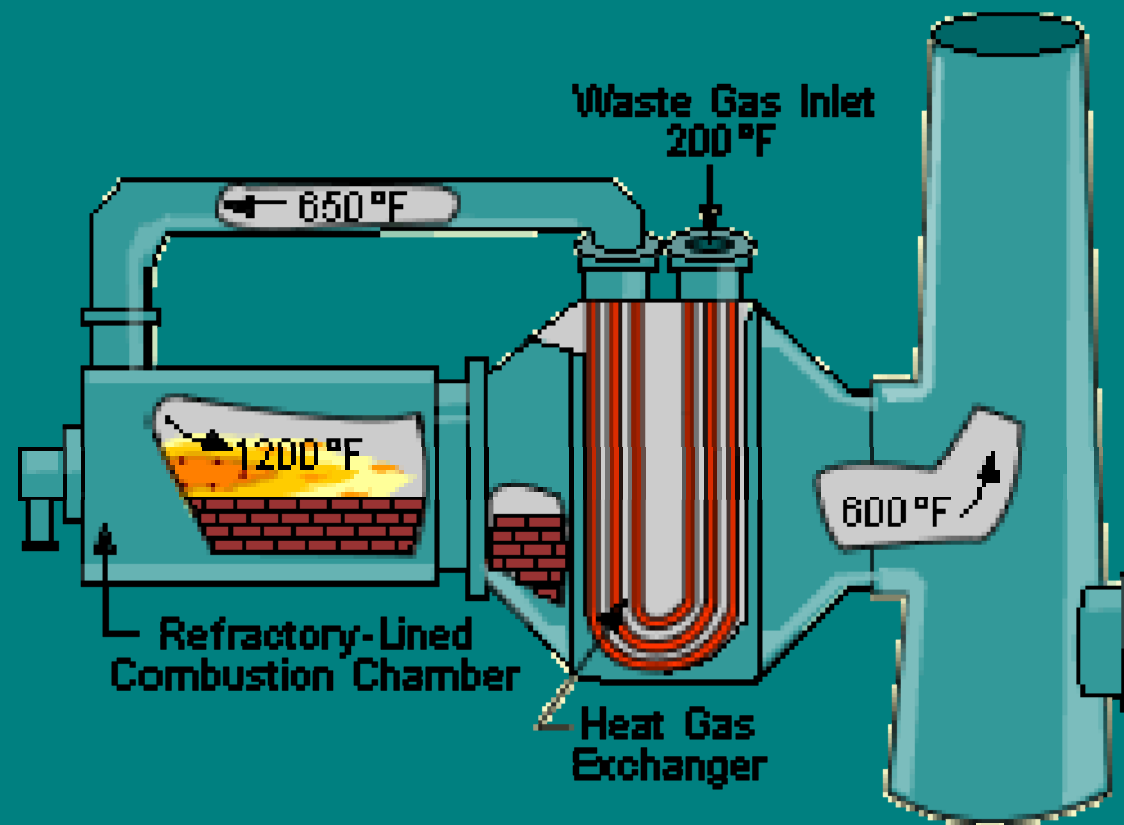


Figure 1. Thermal Oxidizer with Recuperative Heat Exchanger





Environmental Results

P2 Impacts	2006-2013			
	H2E	P2	SRA	Total*
Energy Conservation (kWh)	34,581,534	24,885,377	3,619,192	66,076,103
Natural Gas (therms)	0	512,102	26,218	538,320
Water Conservation (million gallons)	11,647,104	240,836,310	17,776,078	270,259,492
Waste Reduction (tons)	2,095	14,371	40	16,506
Chemical Replacement	0	86	0	86
Diesel	0	9,261	0	9,261
Cost Savings	\$2,038,553	\$7,914,184	\$424,091	\$10,571,828
MTCO ₂ e	24,591	19,600	2,751	46,949

- Implementation rate – 66% (soon to be 75%)
- Combined company investment – \$102,000

*includes one project from EPAP