



E Source

Alternative Commercial Laundry Systems

Poised for Big Energy Savings

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A New Dawn for Commercial Laundry Efficiency



New Technologies on the Rise...

Liquid
carbon
dioxide
(CO₂)



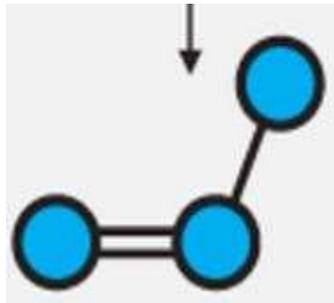
Courtesy: Scott A. Miller



Polymer beads

And an old technology is being revived

Ozone



Liquid CO₂



What's Liquid CO₂?

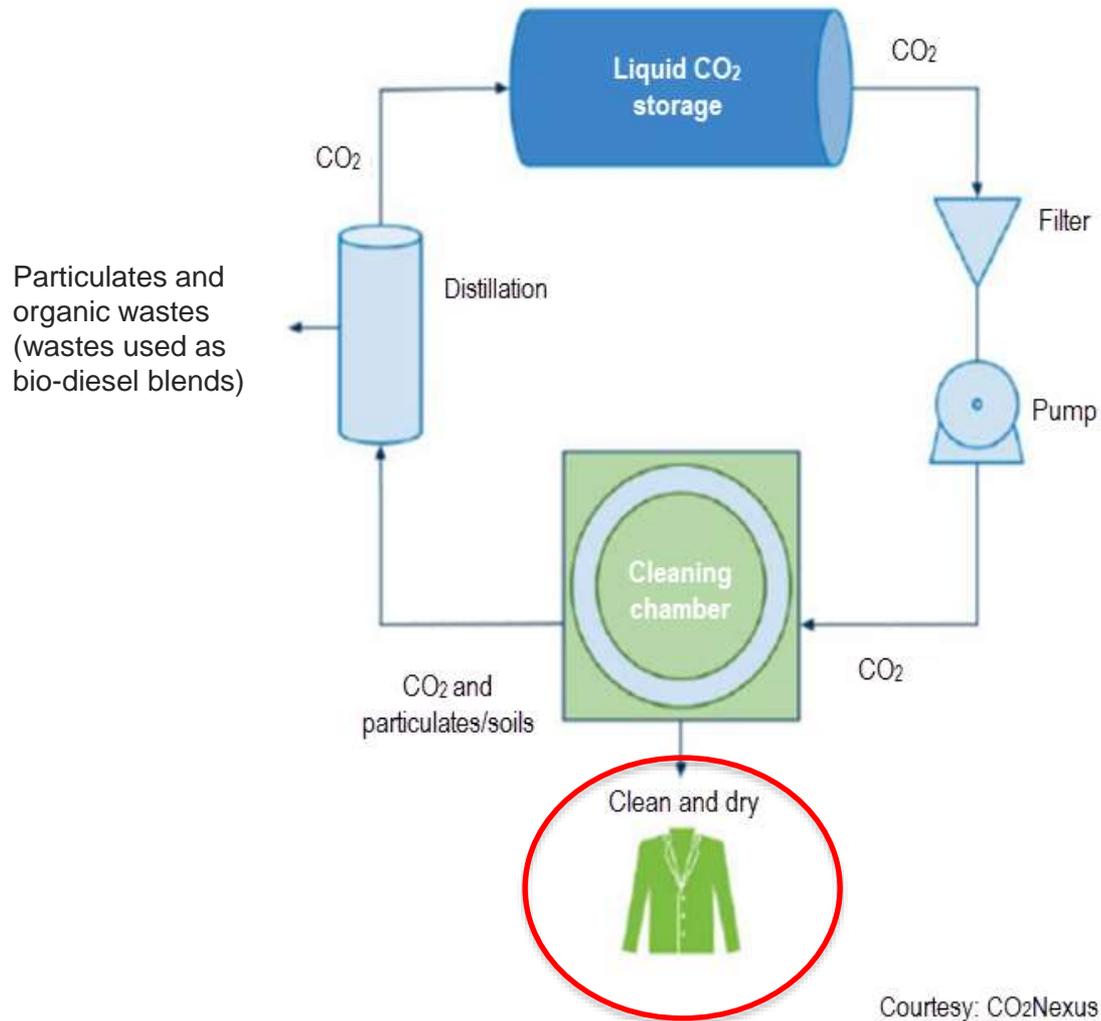
Gas at room temperature	Solid at low temperature	Liquid at higher pressures
		
Carbonation	Dry ice	Liquid

Courtesy (left to right): Scott A. Miller, Mr. Thomas, and Michael Melgar

- Solvent properties of CO₂:
 - Lower viscosity and surface tension
 - Improved small-pore penetration
 - Cleans better and more quickly



How the Process Works



Comparing Apples to Apples

Baseline Standard Commercial System

Washer

- Equipment
- Electricity (ongoing)

Water for wash (ongoing)

Water treatment

- Equipment
- Chemicals (ongoing)
- Pump energy (ongoing)

Water heating (natural gas)

Detergents (ongoing)

Water for rinse (ongoing)

Dryer

- Equipment
- Electricity (ongoing)
- Natural gas (ongoing)

CO₂ System

Washer, compressor, and pumps

- Equipment
- Electricity (ongoing)

CO₂ (one-time)



Liquid CO₂ Savings

Annual
process consumption

	Water-based system	CO ₂ -based system	Percentage reduction
Water (gallons)	4 million	0	100%
Electric energy (megawatt-hours)	444	200	33%
Natural gas energy (megawatt-hours)	667	300	22%
Chemicals (pounds)	30,000 (disposed of in municipal water system)	9,000	70%
Garment life	50+ cycles	2 to 3 times longer life	NA

Note: Based on 1.2 million pounds of garments throughput per year.

© E Source; data from CO₂Nexus



Economics and Applications

- Simple payback period target of 2 to 4 years
 - Laundry-as-a-service: \$/lb basis
 - Application- or market-specific
 - Water/energy costs vary geographically
- Applications
 - Hospitality
 - Upstream textile processing
 - Coated fabrics and garments
 - Oil and gas
 - Healthcare
 - Dry cleaning



Non-Energy Benefits

- CO₂ is recycled
- Clothes come out dry
- No secondary waste stream
- Short cycle times (approximately 20 minutes)
- High throughput
- Increased fabric/garment life
- No shrinkage or color bleeding
- Cleans a wide variety of fabrics
- Non-toxic, non-hazardous, non-flammable, and inexpensive

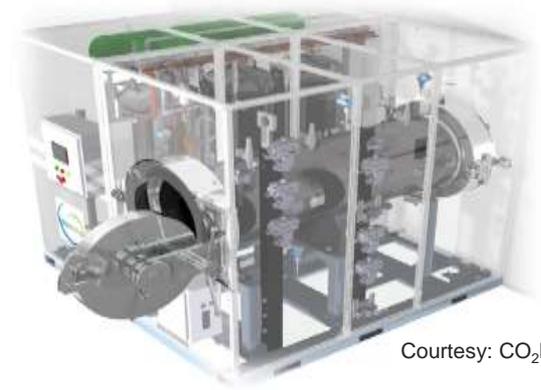


Source: MS Clipart



Demonstration Project

- Cleanroom garment field test
 - CEC PIER project
 - Aramark Cleaning Services, Los Angeles
 - Testing completed March 2014



Courtesy: CO₂Nexus

Results

Cleanroom Requirements

Classification based on air particulates

Static-charge control

Minimal biological contamination

CO₂ System Advantages

60% fewer particles

Reduced static buildup

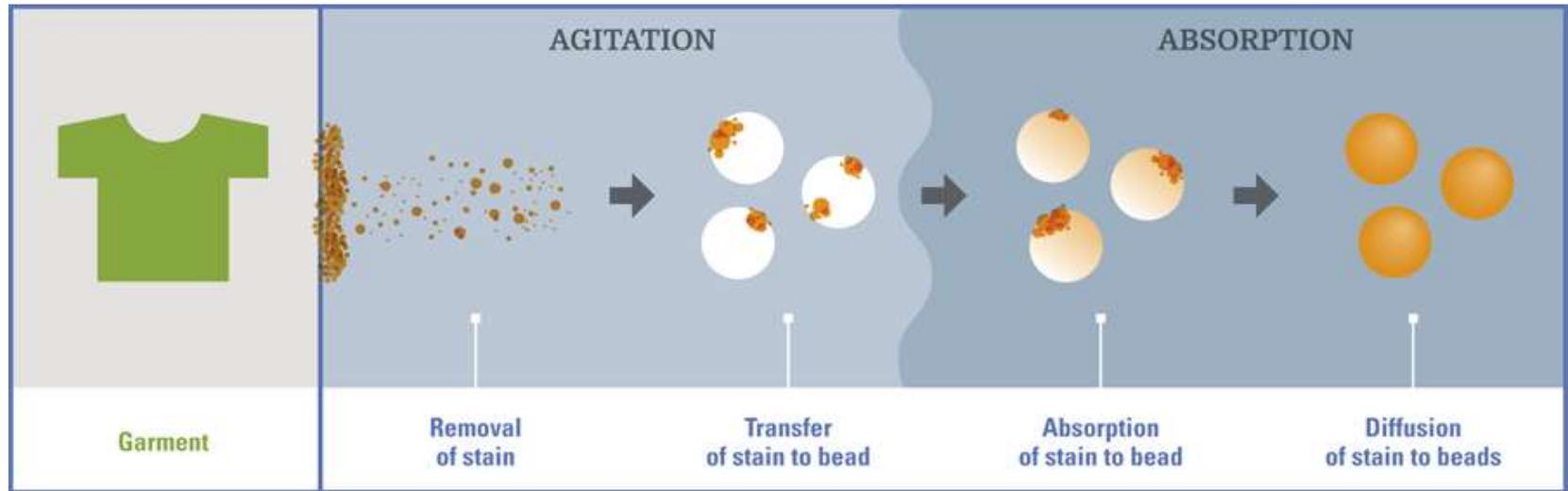
25% less bioburden



Polymer Beads



How Polymer Beads Clean and Work



© E Source

■ Polymer beads:

- Spheroidal
- The size of BBs
- 1:2 mass ratio of laundry to beads
- Expand with moisture
- Polarized with special additive

■ The Process:

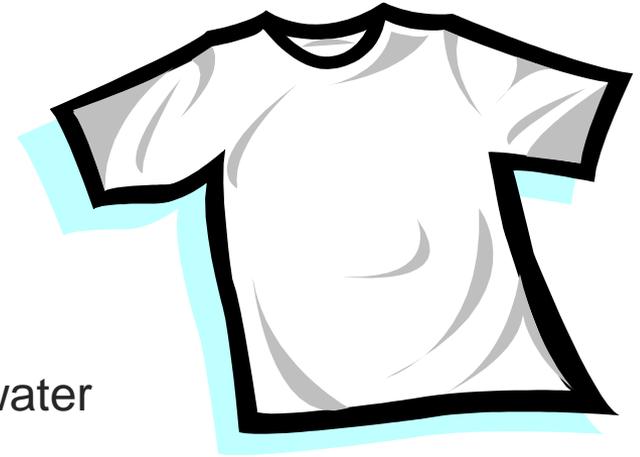
- Beads enter drum of specially made machine
- Polarizing additive added
- Agitate with fabrics
- Beads lift and absorb stains
- Beads exit drum for reuse
- No treatment of beads necessary



Why Polymer Bead Is Better



Courtesy: Liberty Utilities



Source: MS Clipart

- One-quarter of the water
- ~~Heat~~
- Half the detergent
- Less time
- Reduced drying*



Liberty Utilities Laundry Study



Courtesy: bartek3_14



Source: MS Clipart



Procedure

- Two machines
 - Milnor (baseline)
 - Xeros (polymer bead)
- Three types of fabrics
 - Bath towels
 - White linens
 - Colored linens
- Same loads
 - 60 pounds
- Measured
 - Water
 - Therms
 - Run time
 - Electricity



Big Savings

Per load	Milnor (baseline)	Xeros (polymer bead)	Savings
Time (minutes)	54 to 78	50 to 51	4 to 26
Water (gallons)	134 to 156	35 to 37	80%
Therms	1.02 to 1.59	0	100%
Electricity	2 kWh	3 kWh	-4,600 kWh ^a

Notes: kWh = kilowatt-hours.

a. total additional electricity use in a year (compared to baseline).

© E Source



Source: MS Clipart



Non-Energy Benefits



- Gentler on fabrics
- No sorting colors
- Improved cleaning
- No bleach



Economics

Total system cost: \$56,000

Incentives from Liberty Utilities, National Grid, Unitil, Public Service of New Hampshire, NSTAR, and New Hampshire

- **New construction**
 - 75% incremental cost (\$25,612)
- **Retrofit**
 - 50% cost (\$28,000)

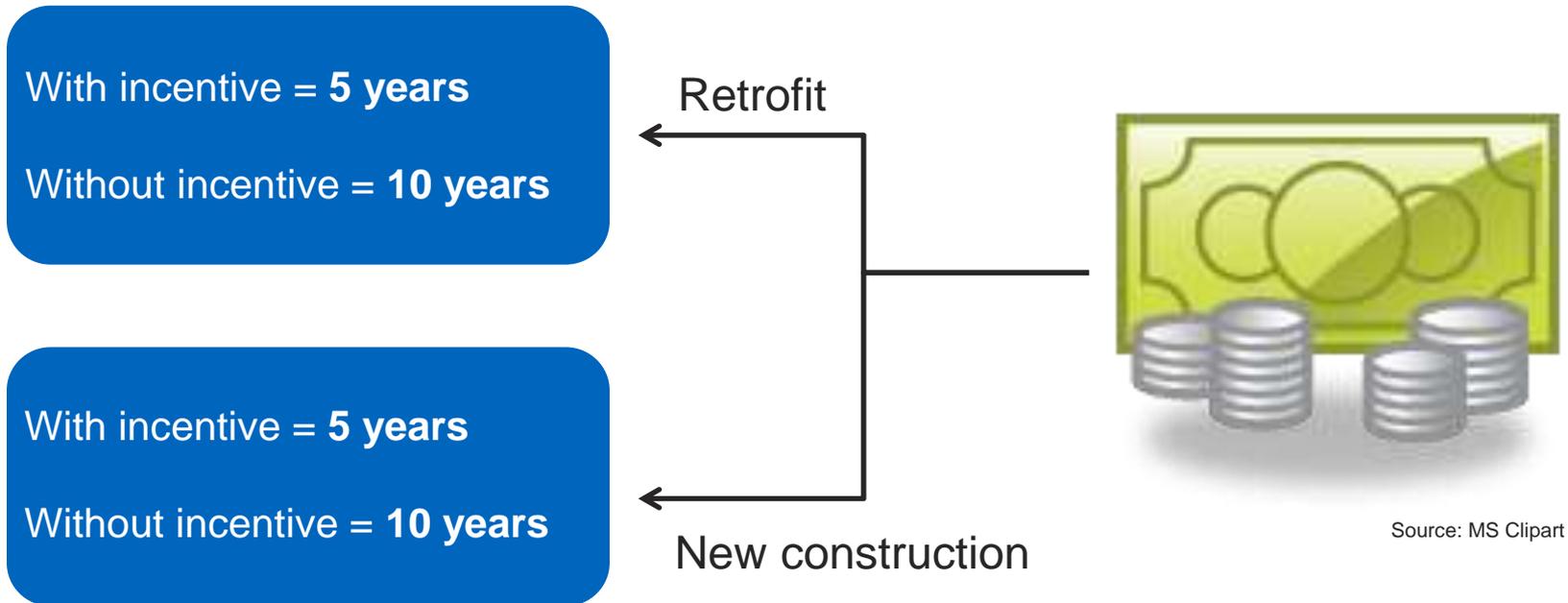


Source: MS Clipart



Economics (cont.)

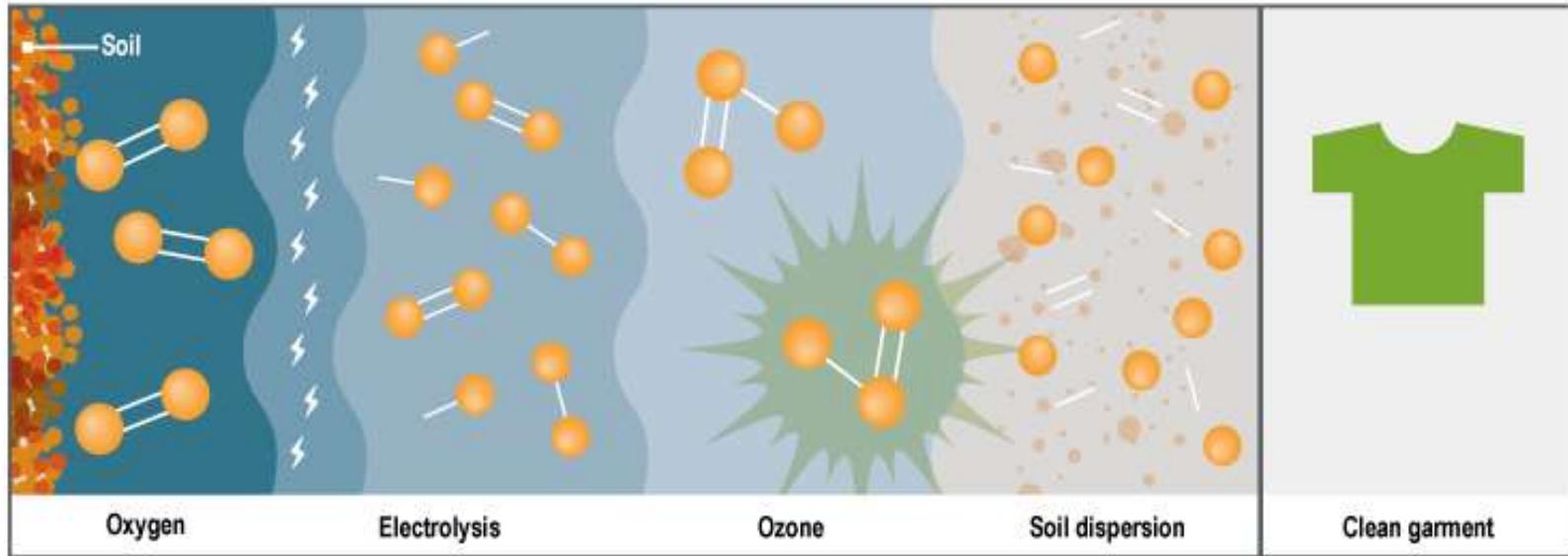
Approximate simple payback periods



OZONE



How Does Ozone Clean?

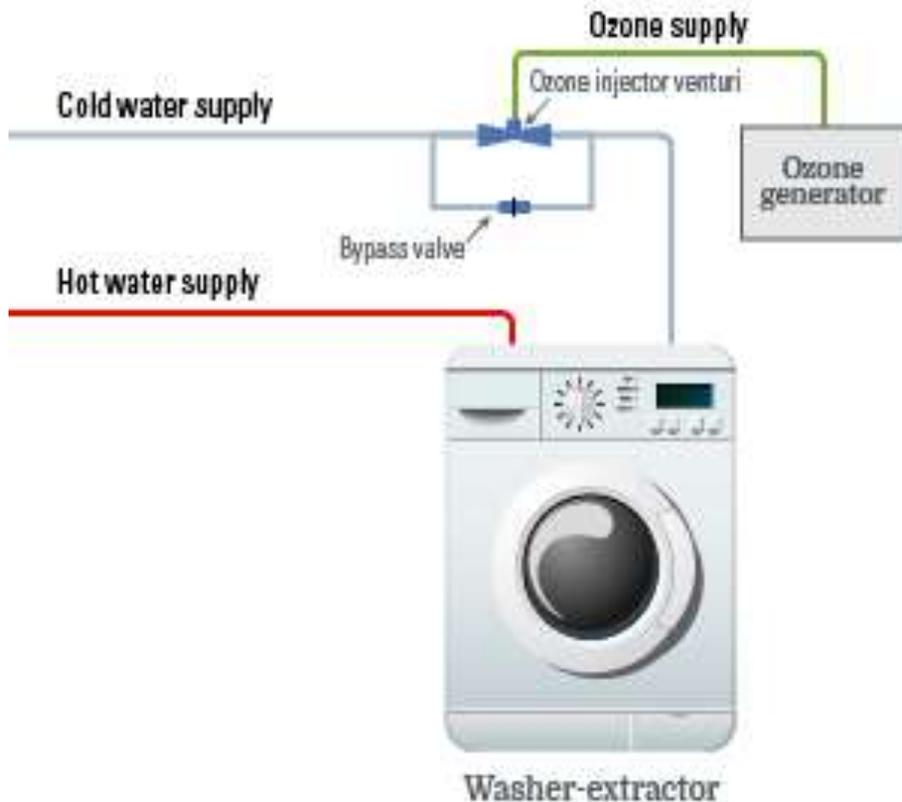


© E Source

- Chemically reacts with soil molecules
- Breaks soils into smaller molecules
- Water-soluble soils released and removed via agitation



How the Process Works



© E Source

- New or existing washer
- Ozone produced in generator
- Injected into cold water supply
- Ozone is reduced to oxygen (O_2) during wash process



Field Test Results: % Savings

	PNNL/Navigant	PNNL/Navigant	PG&E	Santa Barbara County
	Charleston Place Hotel	Rogerson House Asstd Living	Hilton Garden Inn	Santa Barbara County Jail
Natural Gas	65%	63%	66%	88%
Electricity	+ 1.5 kWh/load	+ 38 kWh/month	3.5%	n/a
Water	15%	+19%	31%	19%



Economics

Ozone System Costs

Simple Payback Period

**Charleston
House**

\$42,200

2.8 years

**Hilton
Garden Inn**

\$14,000

7.5 months



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Applications



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Hospitality
Food Service
Healthcare
Laboratories
Cleanrooms



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Non-Energy Benefits and Concerns

■ Benefits

- Increased garment life
- Improved effluent quality
- Reduced:
 - Water use
 - Chemical use
 - Cycle time
 - Drying time

■ Concerns

- Toxic gas code requirements
- British Columbia requires:
 - Special piping
 - Eye-wash station



Source: MS Clipart



Resources

Liquid CO₂

[Demonstration of a Carbon Dioxide–Based Industrial Laundry Machine](#) (PDF), California Energy Commission (2012)

Polymer Bead

[Xeros Laundry Technical Assessment Study](#) (PDF), Liberty Utilities (2014)

Ozone

[The Benefits of Ozone in Hospitality On-Premise Laundry Operations](#) (PDF), Pacific Gas and Electric Co. (2009)

[Project Test Report: Santa Barbara County Jail Ozone Laundry Detergent](#) (PDF), Southern California Gas Co. (2011)



Resources

Ozone

[Demonstration of Advanced Technologies for Multi-Load Washers in Hospitality and Healthcare – Ozone Based Laundry Systems](#) (PDF), US DOE (Navigant Consulting, PNNL, Efficiency Solutions), (2014)



For More Information



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Questions ?

