
Actodemil® Technology

A Novel Approach for Recycling Energetics into Fertilizer

Technology Overview

March 2007

ARCTECH, Inc.
14100 Park Meadow Drive, Chantilly, Virginia 20151; (703) 222-0280



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ARCTECH PROFILE

- ❖ Established 1988 as spin-off company from Atlantic Research Corp.
- ❖ Headquarters and Laboratory Facilities – Chantilly, Virginia
- ❖ Manufacturing Facilities – South Boston, Virginia
- ❖ Market Profile: Development and Implementation of Innovative Solutions for Energy, Environment and Agriculture markets
- ❖ Selected as one of the six top bioprocessing firms in the United States (Arthur Young, 1989)
- ❖ Selected by DOD as a participant in the Pilot Mentor-Protégé Program with BDM Federal (1993-1996)



ARCTECH Proven Experience in Offering Economical Solutions for Safe Destruction of Military Munitions

- ❖ 1970- 80's Successfully developed and facilitated implementation of composting technology for bioremediation of explosive contaminated soils
- ❖ 1980-90's Successfully Developed and Commercialized humic acid product for use in addressing a variety of environmental problems
- ❖ 1990's Successfully validated Actodemil® for safe destruction of propellants and explosives for U.S Army
- ❖ Today Implementing Actodemil® System for safe destruction and decontamination of munitions for U.S. Army and other international clients



Actodemil® Technology

A Safe, Environmentally Protective, Easily Implementable And Cost Effective Approach For Recycling Of Propellants, Energetics, and Explosive Wastes Into Humic-rich Organic Fertilizer For Safe Application On Land.



Why Actodemil® Technology for Recycling of Energetics

- Patented and established technology for recycling Propellants and energetics
- No waste byproducts or toxic emissions
- Creates value-added fertilizer that meets requirements for land application and enhances soils and agricultural activity
- More cost effective than thermal treatment technologies
- ARCTECH has proven experience in marketing and selling fertilizer



Actodemil® Technology Multipurpose Applications

Actodemil® Technology can be Used for a variety of different applications.

- Recycling of Propellant and explosives wastes
- Handling of Propellants containing Lead
- Decontamination of Explosives-contaminated materials;
- Recycling of NC Fines
- Handling of Other Energetic Wastes



Actodemil® Technology System Deployment - US and Abroad

U.S. Army

- Actodemil® Technology Unit for the U.S. Army Defense Ammunition Center (DAC), McAlester Army Ammunition Plant (McAAP).
- Full-scale Actodemil® technology for U.S. Army Crane AAA.
- Actodemil® Technology for Recycling Propellants and High Explosives at Tooele AD, Tooele, Utah

Korean Army

- Actodemil® Technology for Transitioning to U.S. Forces in Korea

Egyptian Army

- Actodemil® technology for decontamination of demilled projos

Commercial Demonstrations

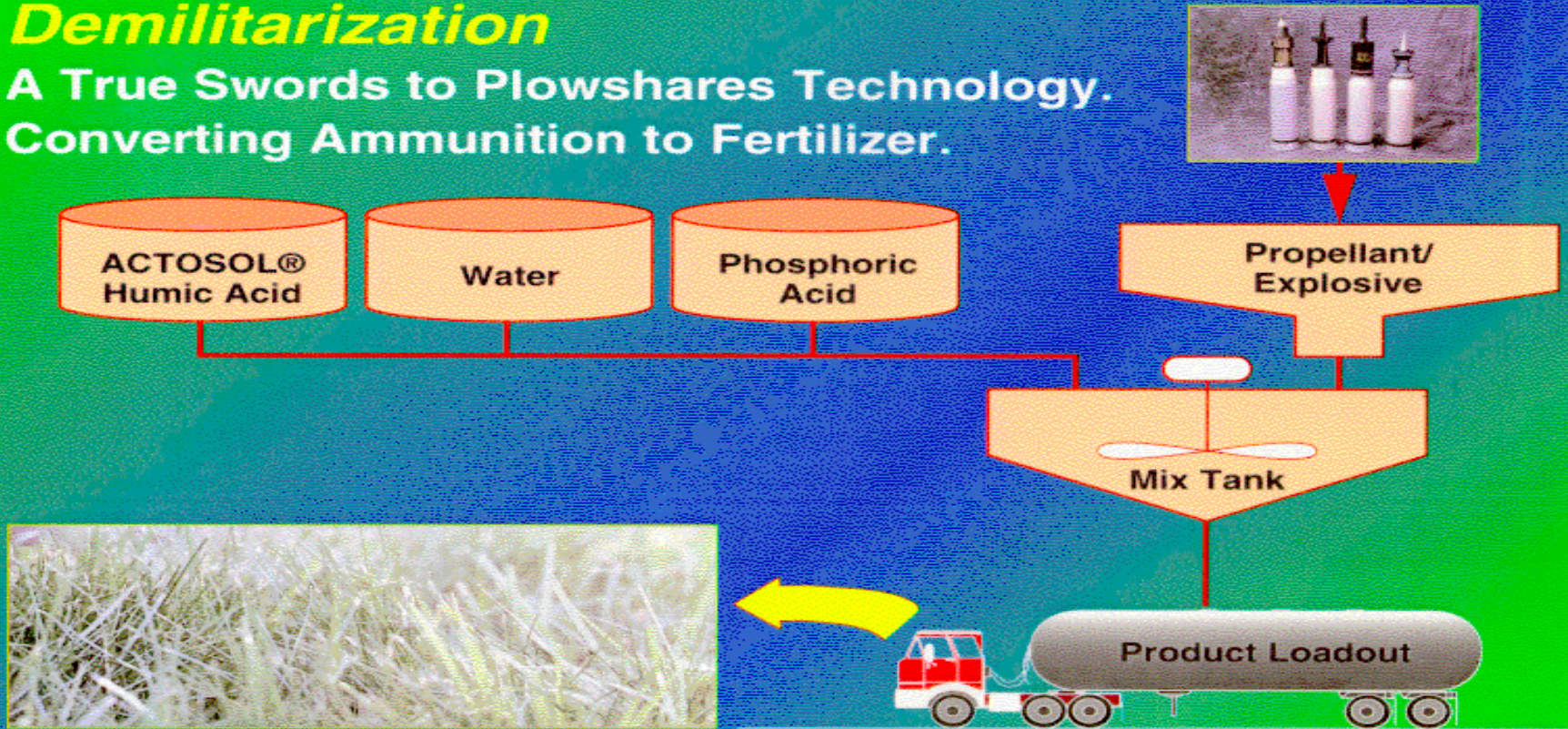
- Treatment of Solid Wastes – Dyno Nobel. Inc.
- Treatment of Energetic Wastes – Olin/Winchester Corp
- Recycling of NC Fines – Green Tree Inc.



Actodemil® Technology – General Schematic

Demilitarization

A True Swords to Plowshares Technology.
Converting Ammunition to Fertilizer.



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ACTODEMIL TECHNOLOGY

- Uses Naturally Occurring alkalized Humic Acid
 - Derived From Coal
 - Versatile Material
- Destroys Energetics and Chemical/ Biological Agents
 - Environmentally Sound
 - Safe
 - Irreversible Destruction



RELEVANT PROPERTIES OF HUMIC ACID IN THE ACTODEMIL TECHNOLOGY

- Enhances Reductive Hydrolysis
- Adsorbs and Retains Nitrogen, Organic Components, and Other compounds
- Results in Effective Fertilizer Containing Organic Humic Acid and Mineral Nutrients

DEVELOPMENT HISTORY

- 1995 - Laboratory-Scale Tests
- 1996 - 100-Pound Scale
Greenhouse Testing with Products
- 1997-98 One-Ton Scale Validation completed and
Products Field Applied
- Today - Mobile and Fixed Facilities being Deployed



Actodemil® Technology Tested on Variety of Materials

Actodemil™ TECHNOLOGY SUCCESSFULLY TESTED ON:

Energetics

Large-Bore Gun Propellants

- 3"/50, 6"/47, M6 (NC based)
- 105 MM (NC/NG based)
- 106 MM - M30, M30A1 (NC/NG/NQ)

Rocket Propellant

- 2.75" AA (NC/NG based)

Other Explosives - HMX, RDX, TNT,

DNT, Lead Azide, PETN, and AP

Chemical Agents

Nerve Agents

GB, VX

Blistering Agents

HD, HT, H

Biological Agents

E. coli



Regulatory Framework For Process

- MUNITIONS RULE

Munitions Rule Permits Recycling of Propellants to fertilizer provided that:

- End Product Meets TCLP requirements
- End Product Meets UTS requirements
- End Product is Not Reactive

- Exempt from RCRA (RCRA Operating Permit Not required)



Actodemil® Technology Production Unit at McAAP



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Rear View and Utilities Inputs



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Another View of Actodemil® Production Unit at McAAP



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Cooling System



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Scrubber System



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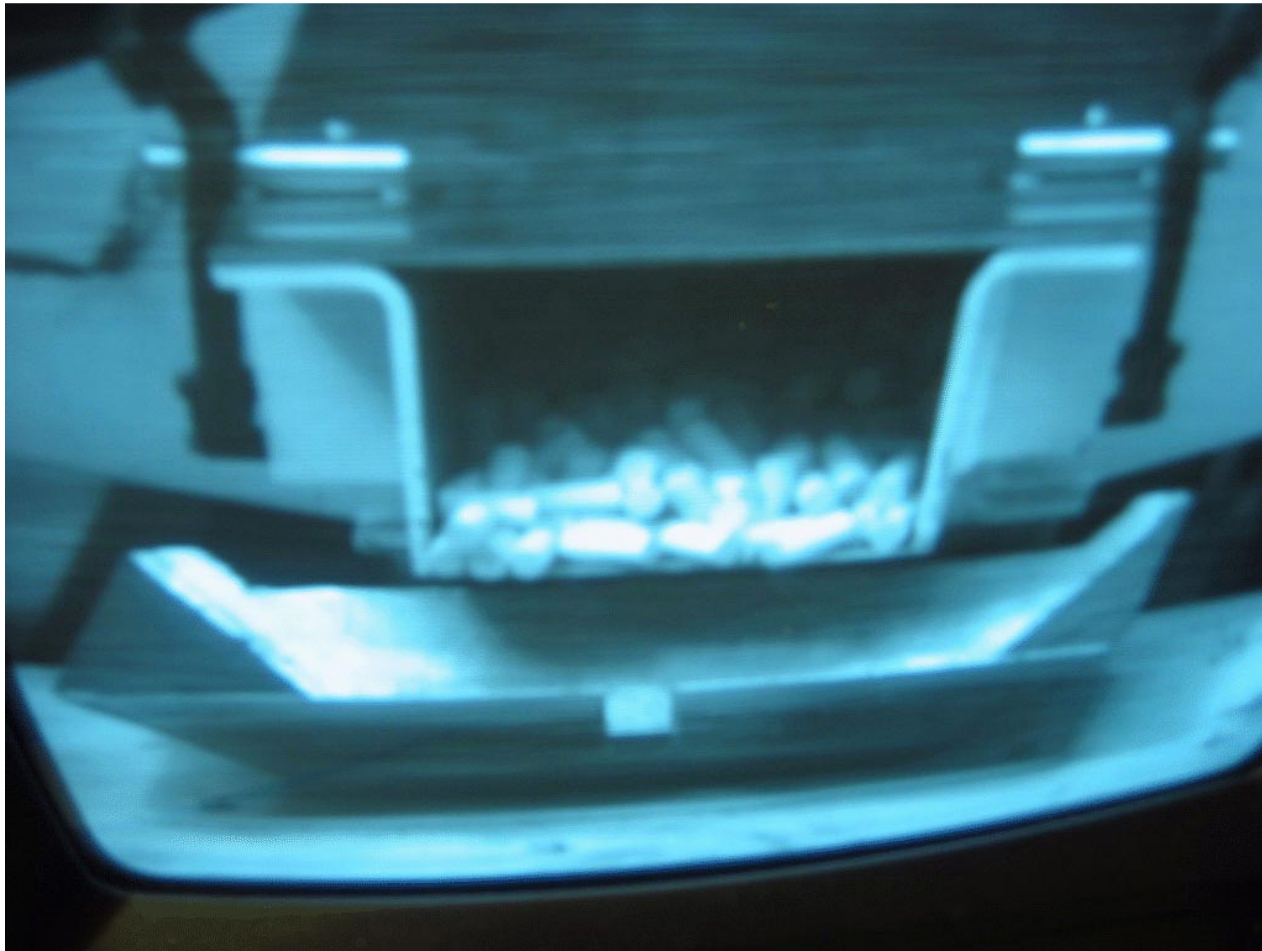


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ANOTHER VIEW OF HOPPER AND FEED SYSTEM



PICTURE OF PROPELLENT BEING FED INTO REACTOR



Major Conclusions from Actodemil® Technology Demonstration Tests

- All Tested Propellant/Energetic Chemicals (NC, NG, NO, DNT, etc) Completely and Irreversibly Destroyed
- Applicable to Single, Double, and Triple Base Propellants, High Explosives, Chemical Agents, Primary Explosives, Energetic manufacturing wastes
- Different Grain Sizes (up to 1-inch in length) Tested
- Process is Safe and Heat Release is Controllable
- Propellant Conversion Complete in 1-2 Hours at 180-190°F
- Final Fertilizer sold to various Users around McAlester, OK



Major Conclusions from Actodemil® Technology Demonstration Tests

Final Product Regulatory Compliant

- Complies with TCLP requirements
- Is not Reactive (as Defined by RCRA regulations)
- Complies with UTS Requirements
- Friction, Impact Tests showed no Energetic Response
- Complies with U.S. EPA's Munitions Rule Requirements
- Is Not Mutagenic as Determined by Ames Assay Test

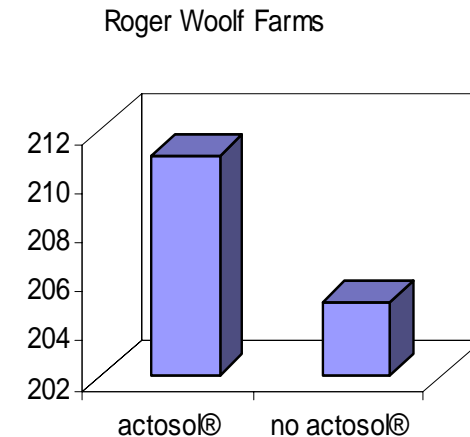
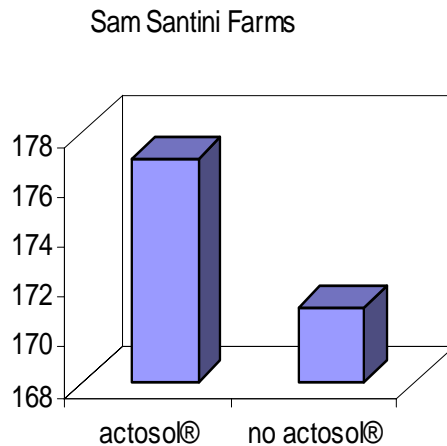
Final Product Useful for Plants

Is not Phytotoxic to Plants
Enhances Plant Growth and Yield

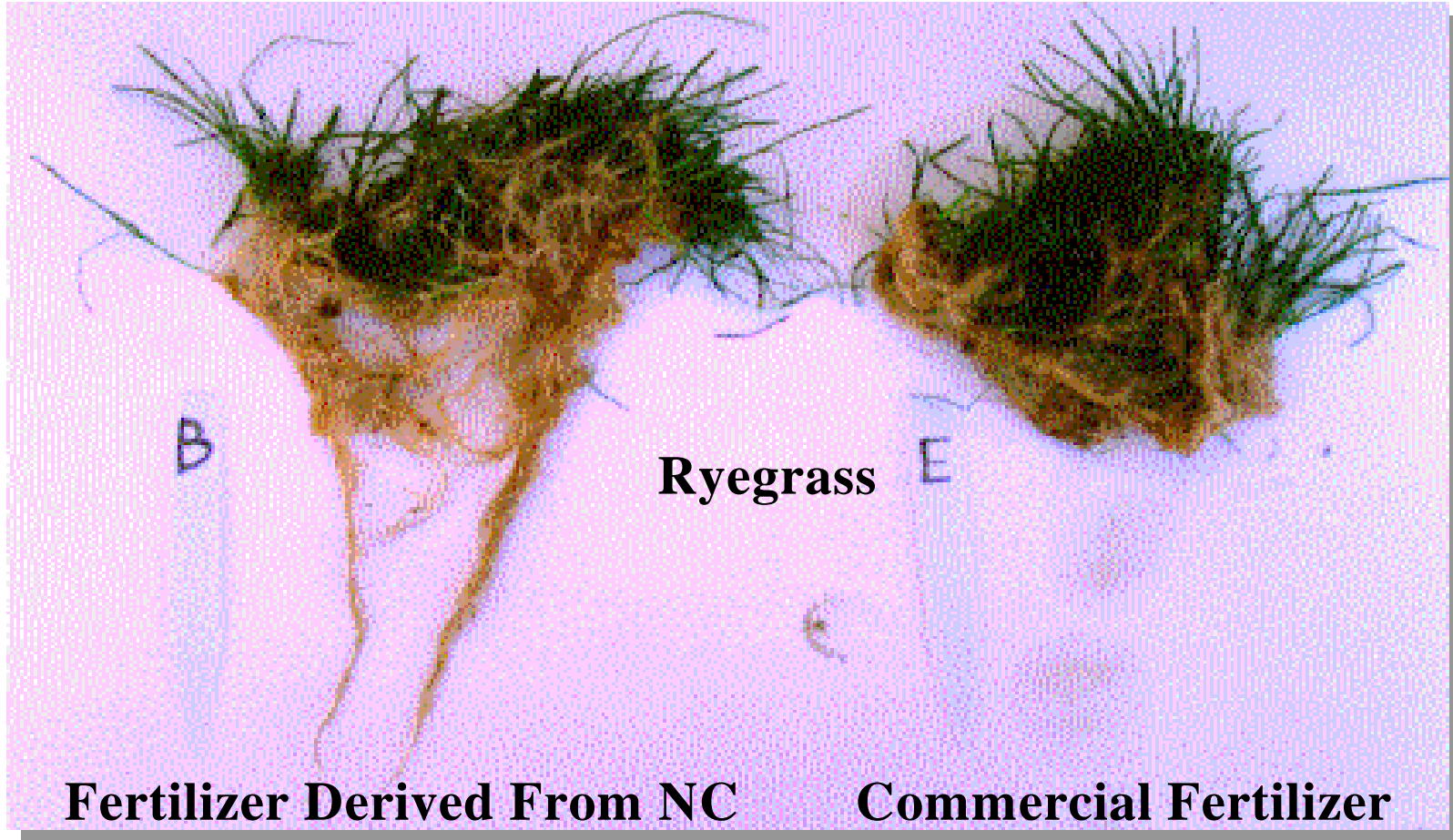


Actosol® Product from NC Fines Increases Corn Yield

- NC fines recycled to yield a 5-5-15 NPK actosol® product.
- Actosol® product tested on growth of corn at two farms in New Jersey.
- Actosol® product applied at 2 gal/acre.
- Increase in yield - 6 bushels an acre at each farm.



Actosol® Product Is Beneficial For Turf Grass Growth



Actodemil® Technology Supported by EPA regulators and the Public

.....the Agency has determined the recycling of propellants or explosives into fertilizer may be a permissible activity under RCRA.....the use of an unused explosive or propellant as an ingredient to produce commercial fertilizer would be exempt from regulation under RCRA.....

Excerpts from U.S. EPA Military Munitions Rule

40CFR Section 266.202.
April 1997

GOING GREEN AT THE DOD. Defense Department Scientists Agree Army Depot uses obsolete Demil Technology. Actodemil® Technology fulfills the biblical prophecy of tuning swords into plowshares

- Reno News
May 29, 2001

STATE OF NEVADA
KENNY C. GINN
Governor



DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
333 W. Nye Lane, Room 138
Carson City, Nevada 89706-0851

February 25, 1999

Dear Mr. Kaushik:

The Division first became aware of the ARCTECH study during an inspection at HWAD in March/April 1997. The Division later learned in July 1997 that fertilizer produced during the study was ultimately applied to the land as a fertilizer at the Ganes property in Fallon, Nevada. In response to concerns regarding the suitability of the product as fertilizer and adequate treatment of the waste munitions, the Division reviewed data provided by ARCTECH as well as soil samples taken by the Division, and determined that the "Actosol" product did not exhibit any of the characteristics of a "hazardous waste." However, because the waste munitions were being recycled in "a manner constituting disposal" (i.e., placed on the land), the Division was concerned that the laboratory data did not adequately demonstrate compliance with the applicable treatment standards of 40 CFR 268 Subpart D (see 40 CFR 266 Subpart C). ARCTECH later provided data indicating that the presence of the underlying constituent(s), specifically Barium, could be adequately addressed during the fertilizer manufacturing process.

Because waste munitions do share many of the same components of common fertilizers, the Division commends ARCTECH's efforts to develop fertilizers from this otherwise discarded material. Notwithstanding the potential merits of your process, the Division wishes to reiterate the importance of demonstrating compliance with 40 CFR 266 Subpart C and the applicable state requirements as conveyed in my letter to HWAD (dated November 18, 1998).



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Actosol® Humic Acid Being Applied Successfully in Various Applications

UNITED STATES

- Landscaping
- Erosion Control
- Landfill Closure
- Golf Courses
- Sod Farms
- Nurseries-Tomatoes
- Sand Dunes
- Floriculture
- Agriculture
- Horticulture

GULF COUNTRIES

- Rhodes Grass
- Water Melon
- Cucumber
- Alfa Alfa
- Orange Groves
- Grapes
- Onion
- Date Trees

MAURITIUS

- Sugar Cane
- Horticulture

S. KOREA

- Golf Courses
- Greenhouses



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SUMMARY

- Actodemil® is an established technology.
- The technology is effective for neutralization of a variety of propellants, explosives and other energetics
- The process can also be used for decontamination of explosives-contaminated scrap metal and other solid wastes
- The process produces a fertilizer that can be sold to produce revenues that can offset treatment costs.
- Actodemil® Technology Provides the Following Important Benefits:
 - More Safer (reaction at atmospheric pressure and temperature not exceeding 200° F)
 - More Easily Implementable (permitting issues minimal)
 - Higher Protection of Environment (no wastes generated, gas emissions insignificant)
 - More Cost Effective

