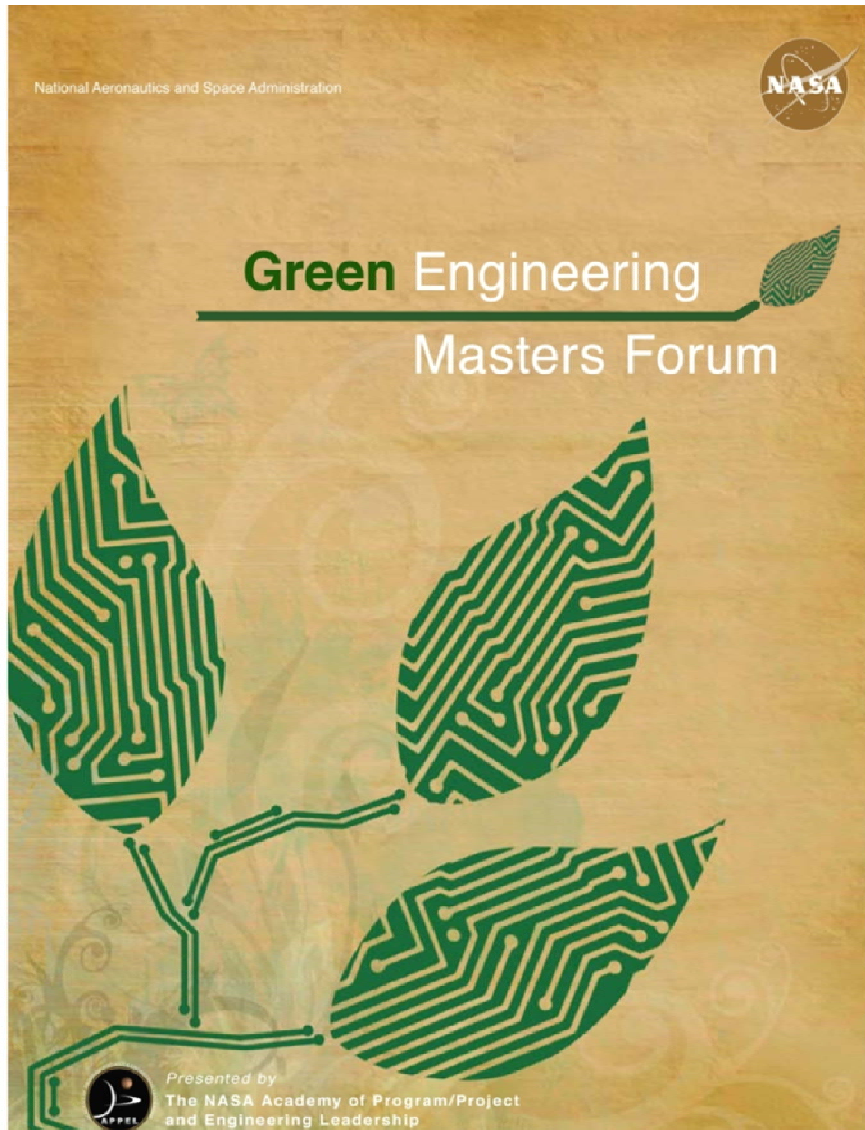
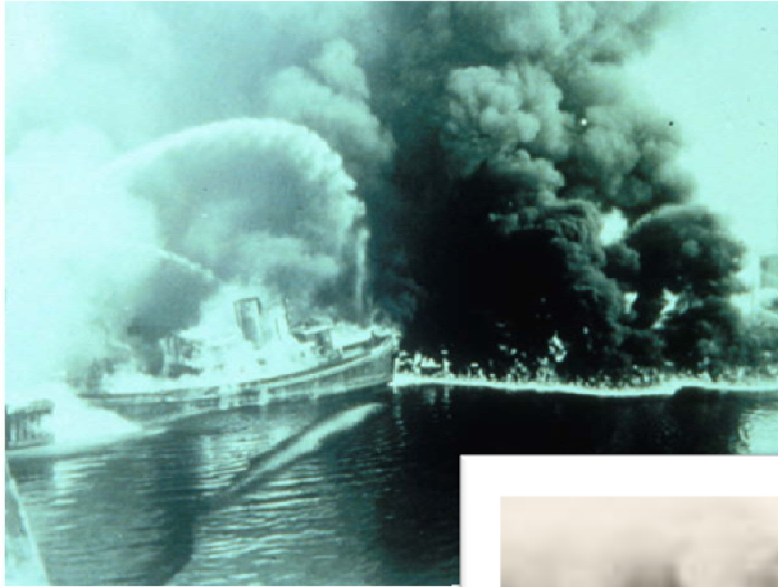


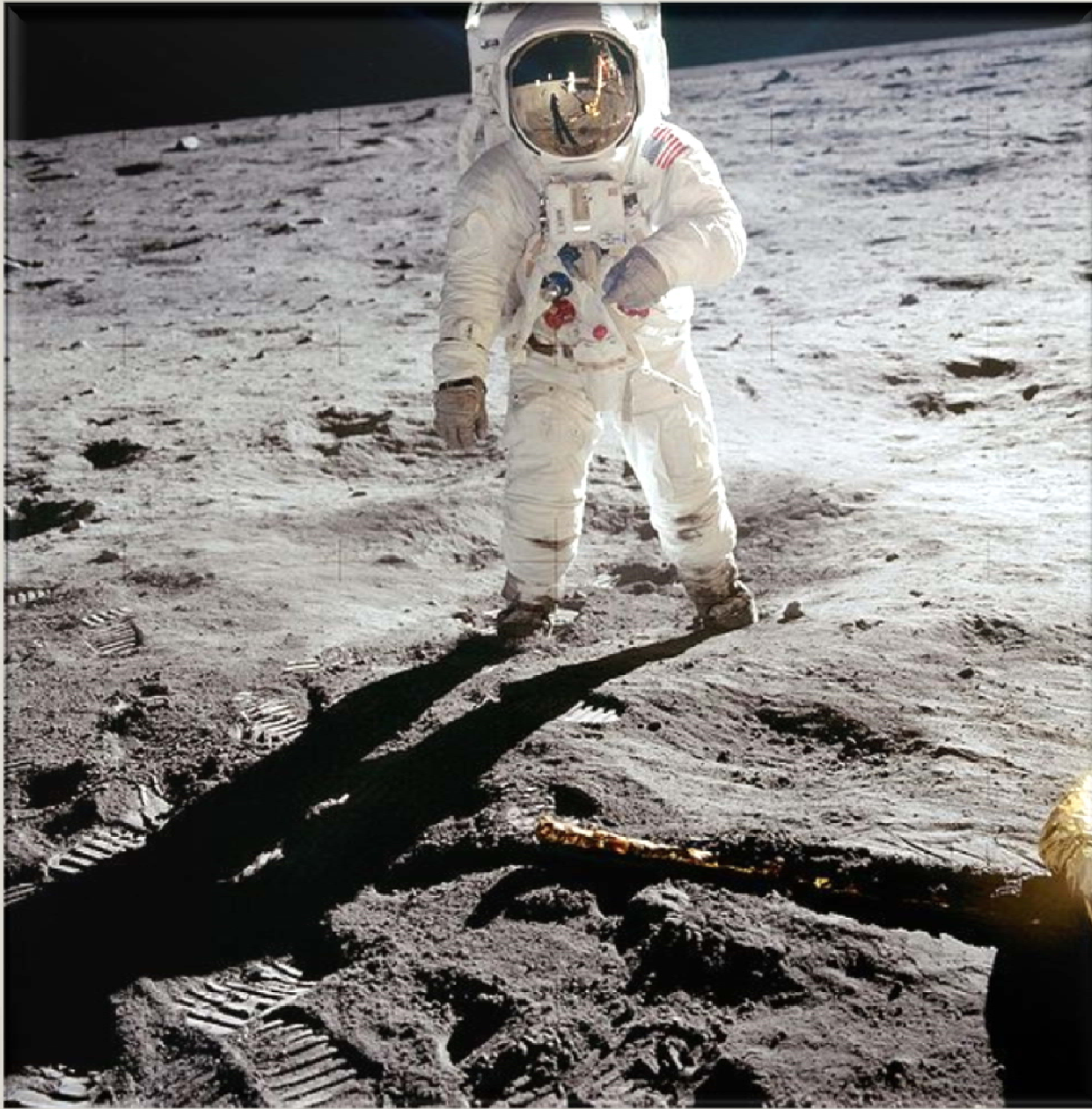
Green Engineering Masters Forum



James Leatherwood
Director Environmental Management
30 Sept 2009

Pollution & Ecological Disaster





Buzz Aldrin poses on the Moon allowing Neil Armstrong to photograph both of them using the visor's reflection.



Over a Billion Dollars in Environmental Liability



Location where an engine would be mounted

Flame Bucket

Plum Brook Reactor Facility

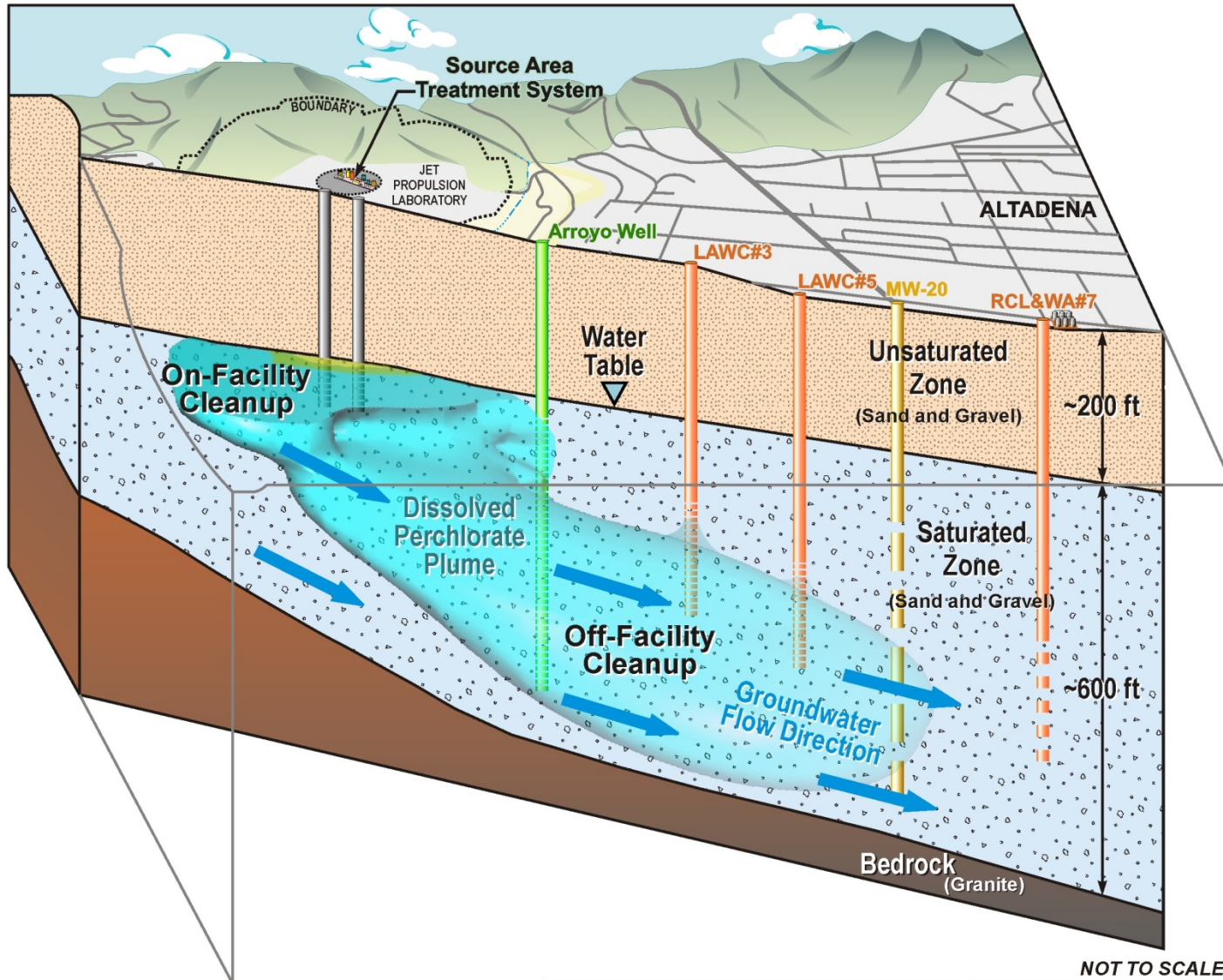
Operated 1961 - 1973

Plum Brook Reactor Facility
5/17/05





JPL Plume Impacts Water Supply Wells





Moon Rise from Apollo 8.

**This
photograph
illustrates the
Earth as an
isolated
ecosystem,
floating in
space.**



Air



Water

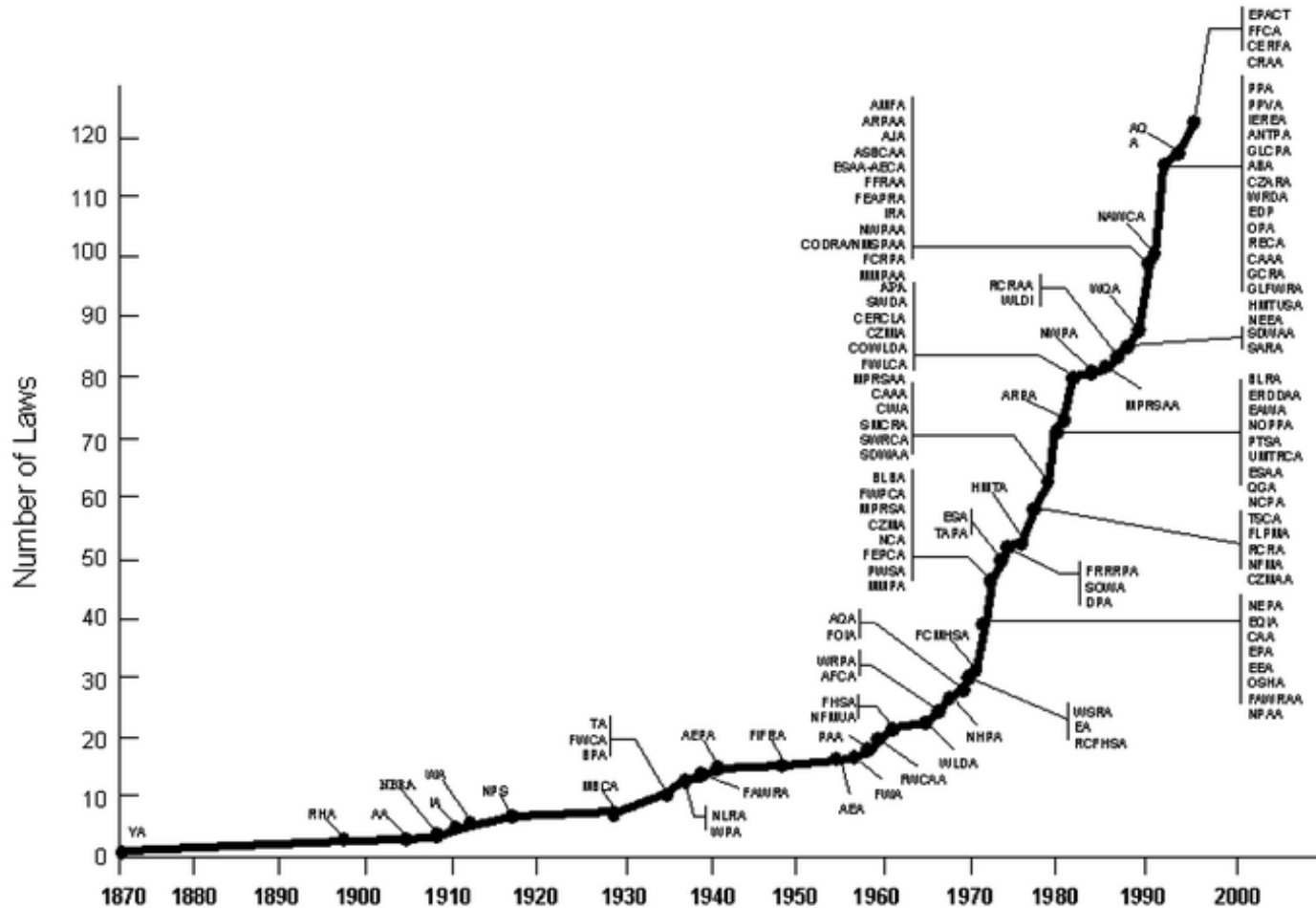


Land



Life

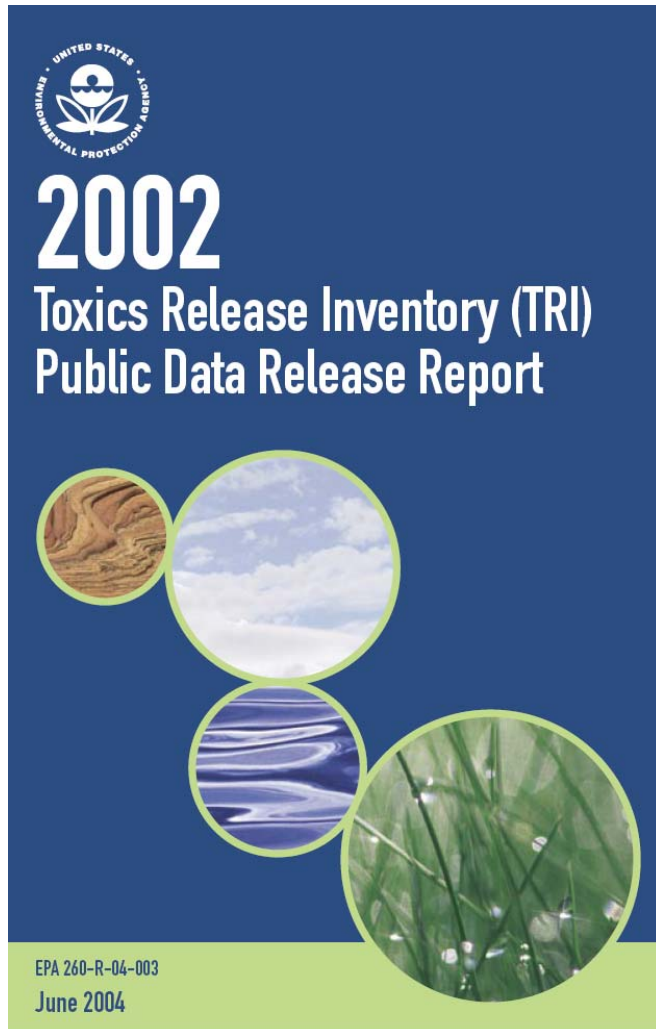
Environment - Regulation Growth



Source: J. A. Cusumano, *New Technology for the Environment*, Chemtech, 1992, 22(8), 482–489

P. T. Anastas, *Meeting the Challenges of Sustainability through Green Chemistry*, Journal of Green Chemistry, 2003, 5(2), G29-G34.

Environment - Toxics

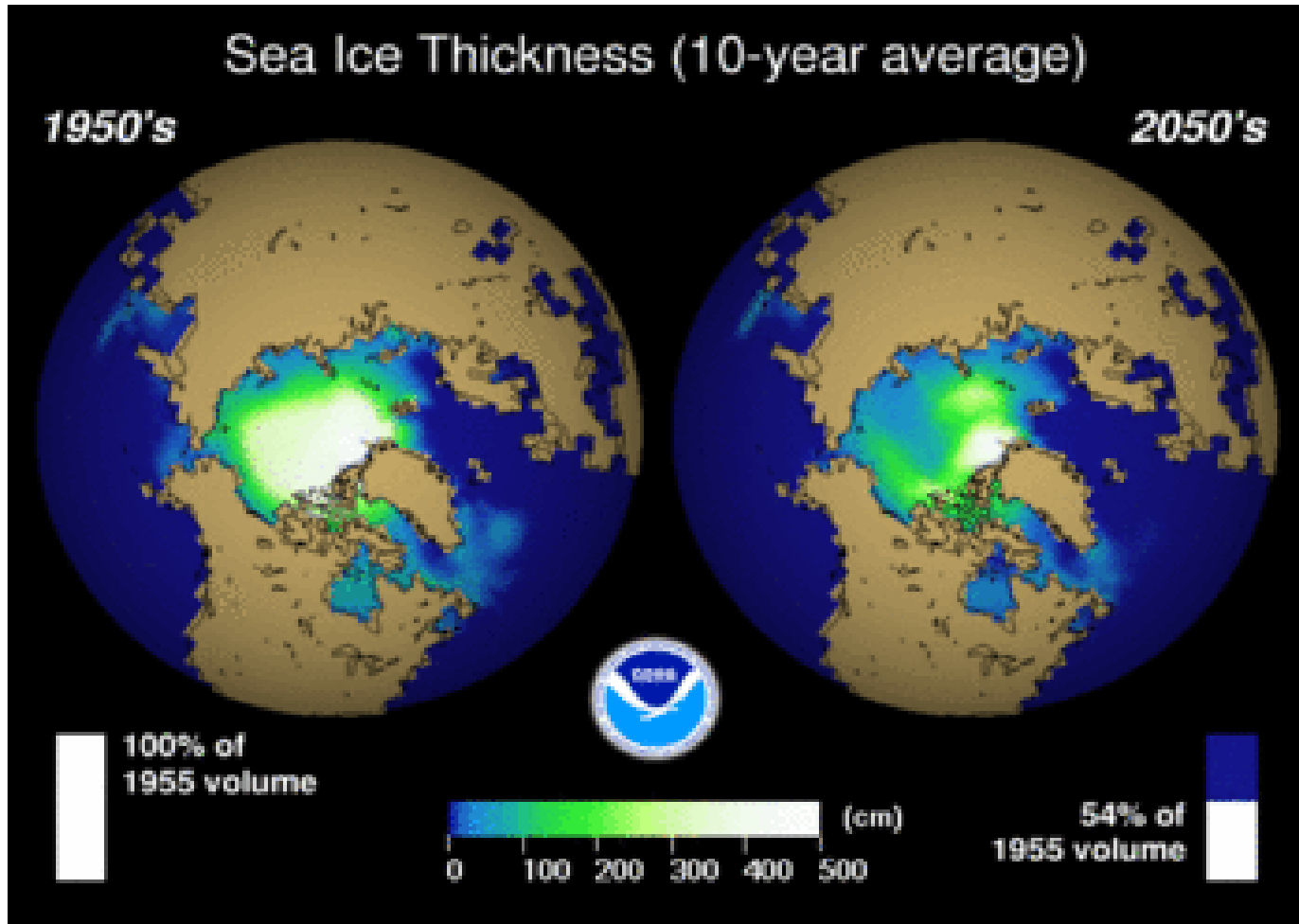


US facilities reported 4.79 billion pounds of toxic chemical releases to air, land, and water in 2002

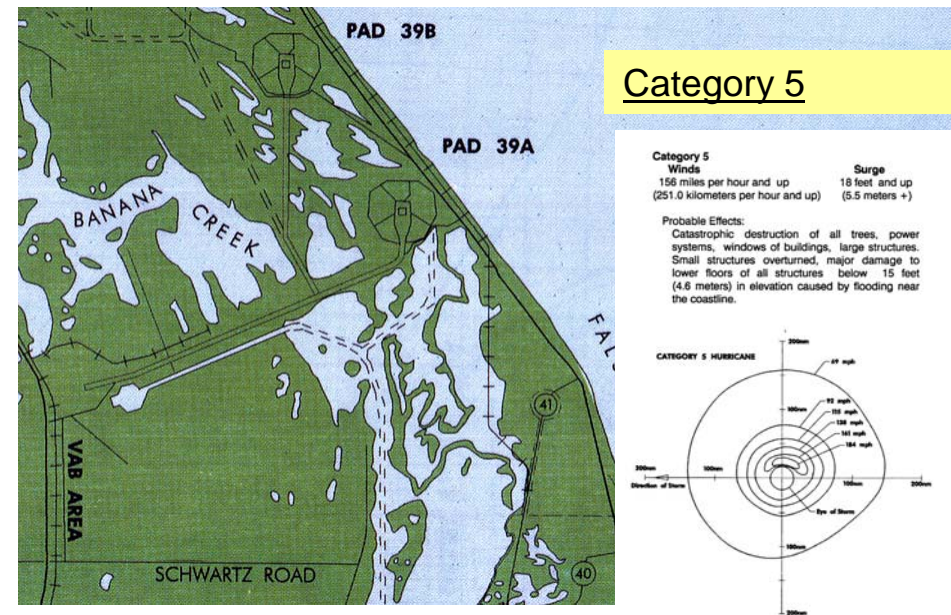
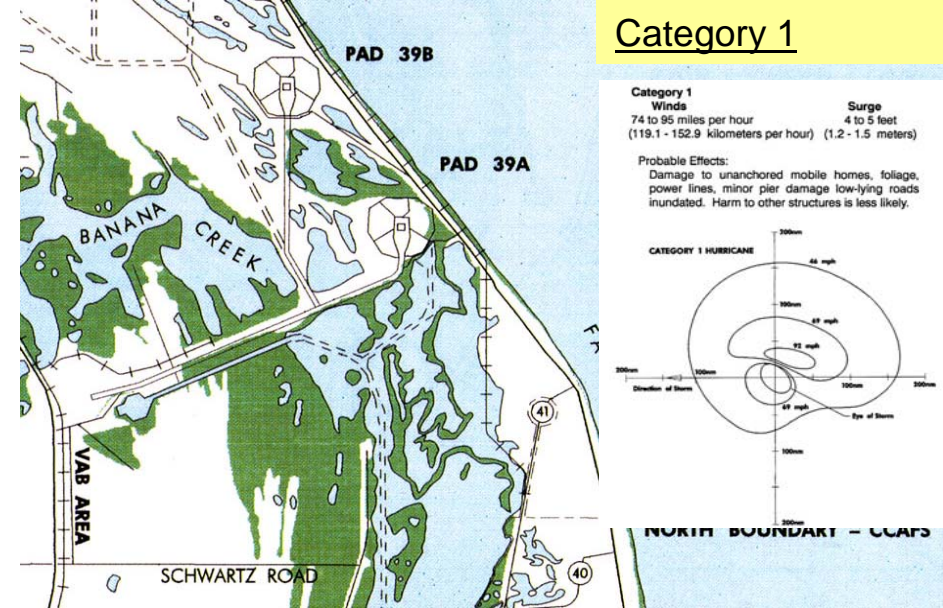
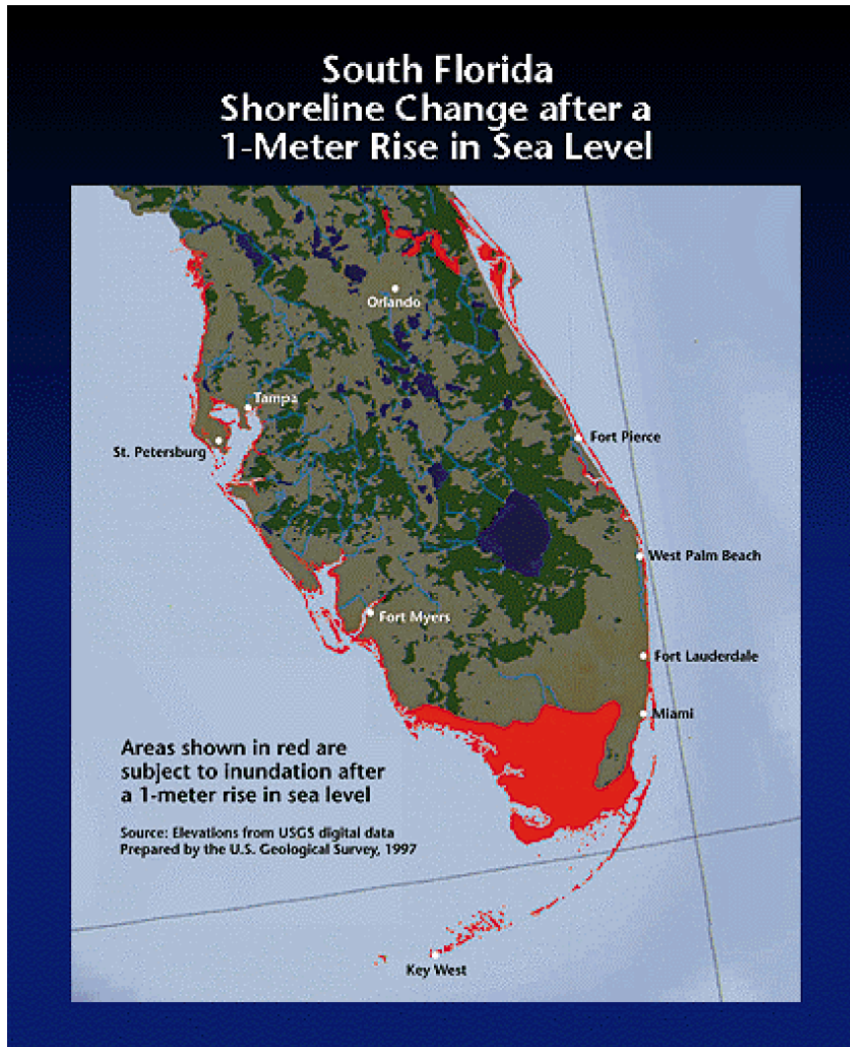
Persistent bioaccumulative toxic (PBT) chemicals accounted for almost half a billion pounds (e.g., lead, mercury, and dioxin)

315 federal facilities reported 85.2 million pounds of toxic chemical releases

Green House Gas Emissions



Environment - Climate



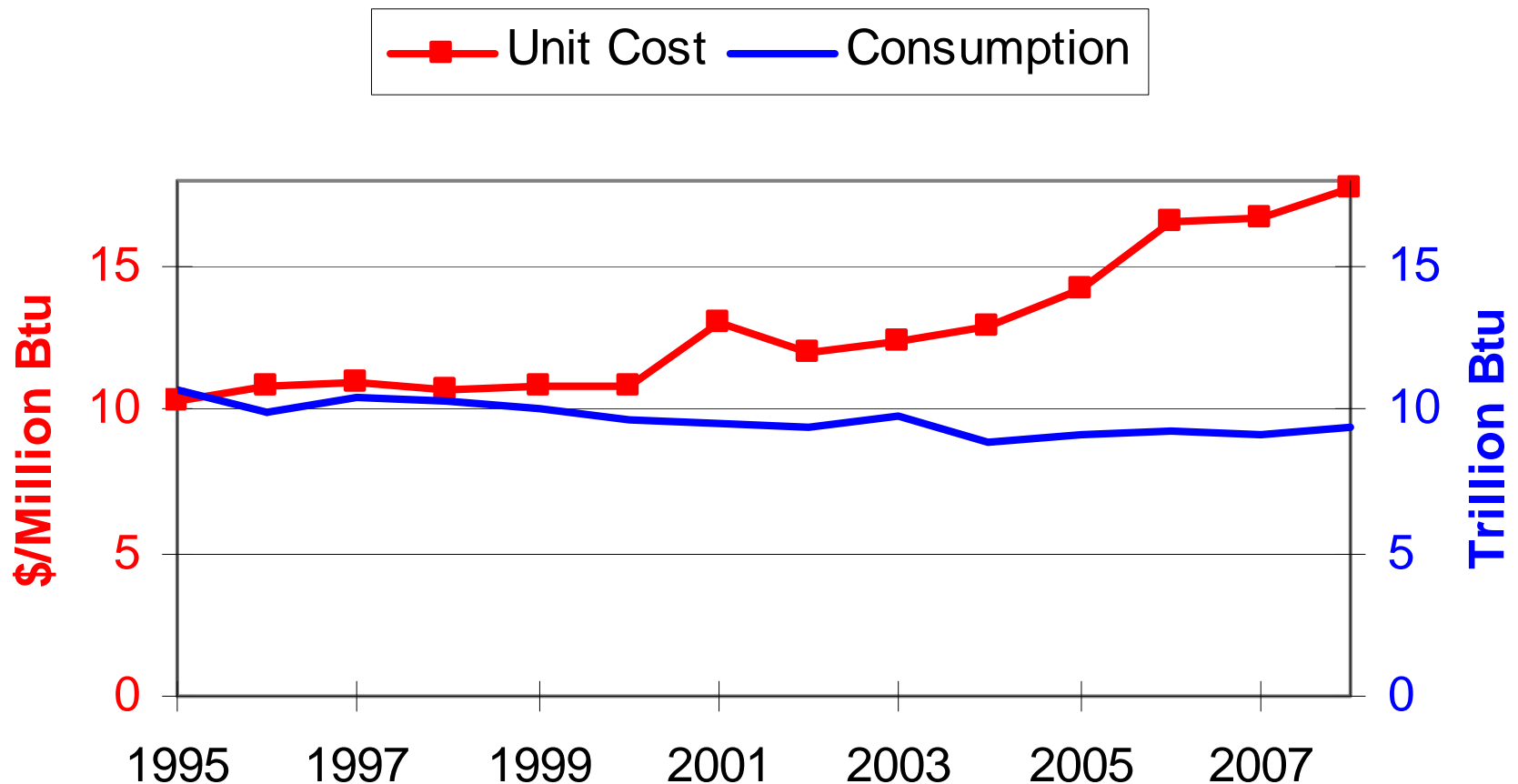
From : John P. Holdren (Harvard University) 2003 "Risks from Global Climate Change: What do we know? What should we know?" at Institutional Investors' Summit on Climate Risk United Nations.

NASA-KSC Challenges:



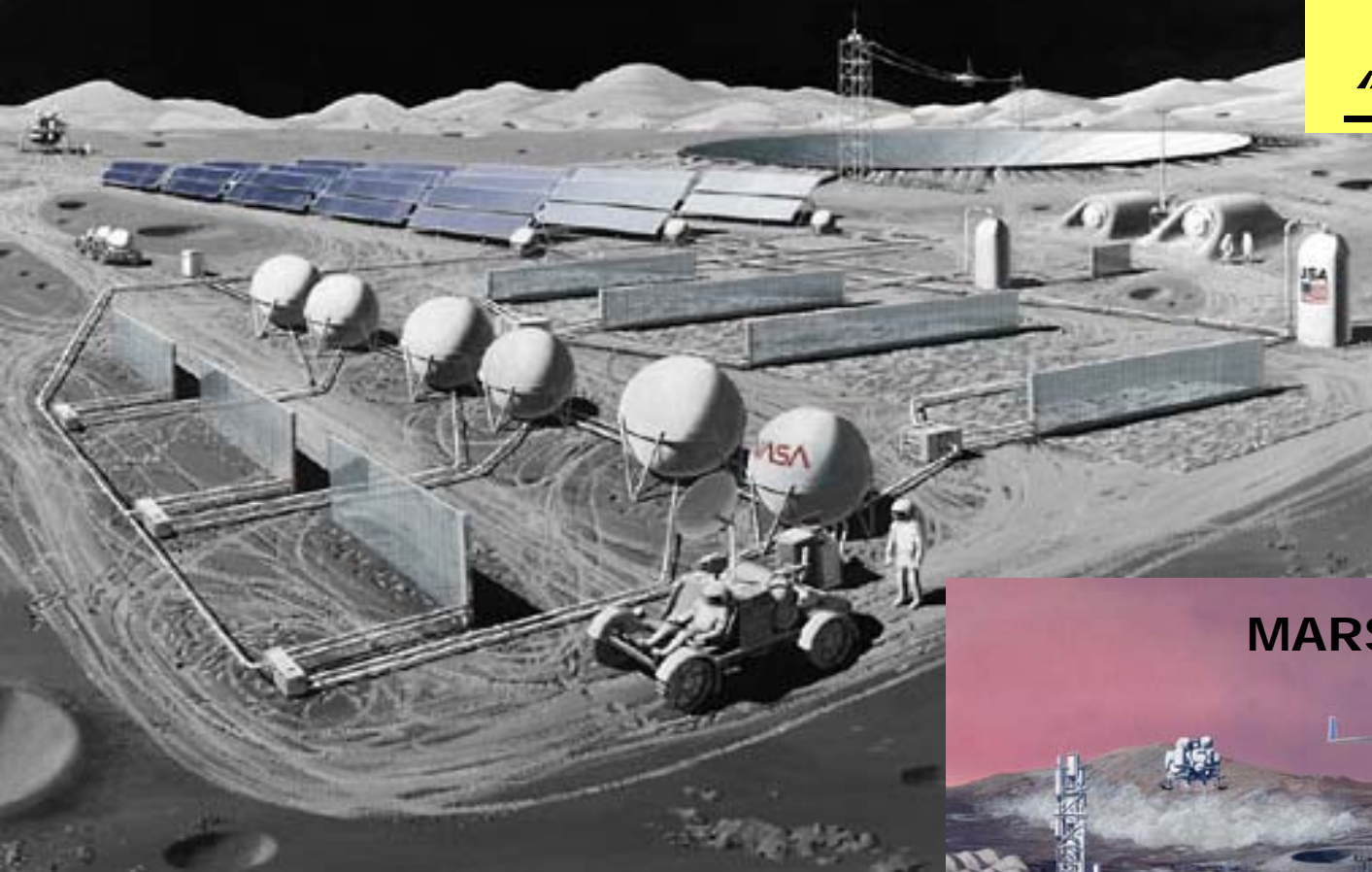
Energy Unit Cost and Consumption Trend

- Rising energy unit costs eroding mission funding
 - \$167M NASA facility energy cost in FY 2008
 - Trend: Buying less yet spending more
 - Since FY 1995, use down 12% and unit costs up 72%





MOON BASE



http://www.nasa.gov/centers/glenn/images/content/101885main_C91_08781_516x387.jpg

http://www.nasa.gov/centers/glenn/images/content/101903main_C88_11517_516x387.jpg

REMOTE SITE RESEARCH: "THE DREAM"

MARS BASE



ANTARCTIC BASE



MATERIALS MANAGEMENT

REMOTE SITE RESEARCH: "THE REALITY"

ARCTIC BASE



www.cep.aq/default.asp?casid=6896

[http://web.archive.org/web/20051125095443/
www.antarctica.ac.uk/About_BAS/Cambridge/
Divisions/EID/Environment/fb_before.jpg](http://web.archive.org/web/20051125095443/www.antarctica.ac.uk/About_BAS/Cambridge/Divisions/EID/Environment/fb_before.jpg)

<http://response.restoration.noaa.gov/pribilof/>

LOOK out K*

* TRENDS, CULTURE, DISCOVERIES, IDEAS, PEOPLE

Science

Astronauts waiting for shuttle to pick up trash at messy station

There's no space in the space station.

So, a few weeks ago, the two astronauts who live there tossed out some useless junk, letting it float away in space.

The throwing-away — during a recent spacewalk — was done cautiously so that the discarded antenna covers and expired pump panel didn't become deadly boomerangs.

Such is life in space, post-Columbia.

With no garbage pickup by shuttles for nearly two years, the international space station is looking more and more like a cluttered attic.

A barrage of hurricanes and their devastating blow to NASA's launch site have delayed the next shuttle flight, by Discovery.

So the stuff will keep piling up

and up.

"It's at the point where we have to figure out a way to handle it. You can't just wish it away," said astronaut Kenneth Bowersox.

"It's essential that when that first shuttle comes up, before they do anything, they start to clear out

"We're in a constrained situation right now. But it's still a safe situation."

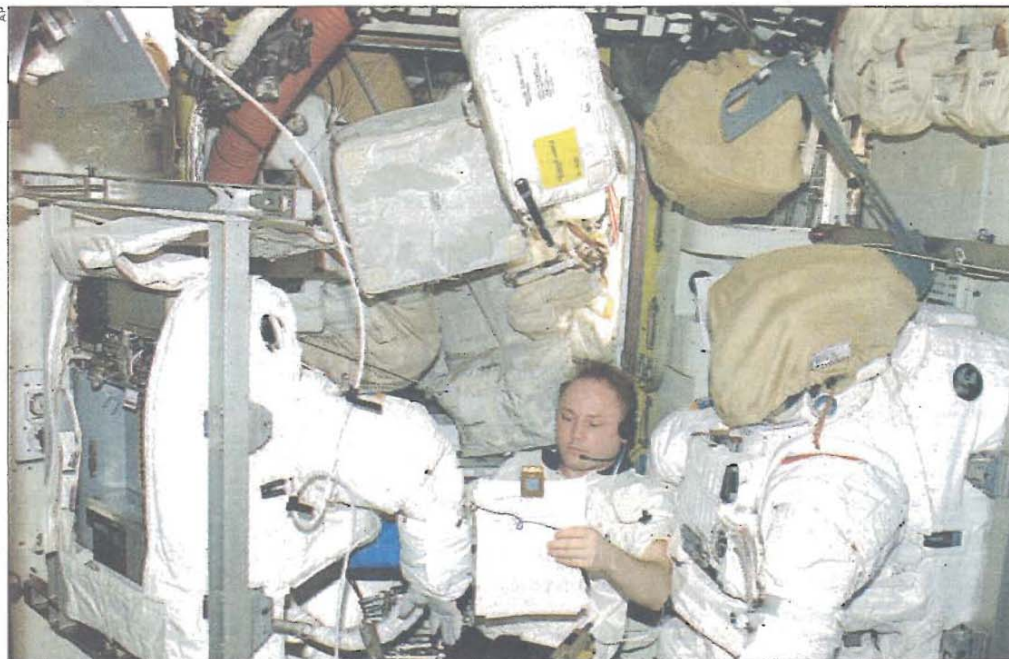
SUZAN VOSS
MANAGER OF NASA'S CARGO
INTEGRATION OFFICE, ON HOW
CLUTTER AFFECTS ASTRONAUTS

the items that we need to deliver back to Earth on the shuttle," astronaut Michael Foale said.

During Foale's six-month station stay, which ended in April, the overcrowding slowed him down and began to affect his work.

"We're in a constrained situation right now," observed Suzan Voss, manager of NASA's cargo integration office. "But it's still a

WASTE OF SPACE: Astronaut Mike Fincke tries to work around the gathering garbage.



Storage Space

safe situation."

Columbia's catastrophic plunge from the sky on Feb. 1, 2003, grounded the shuttle fleet

and halted all space station construction.

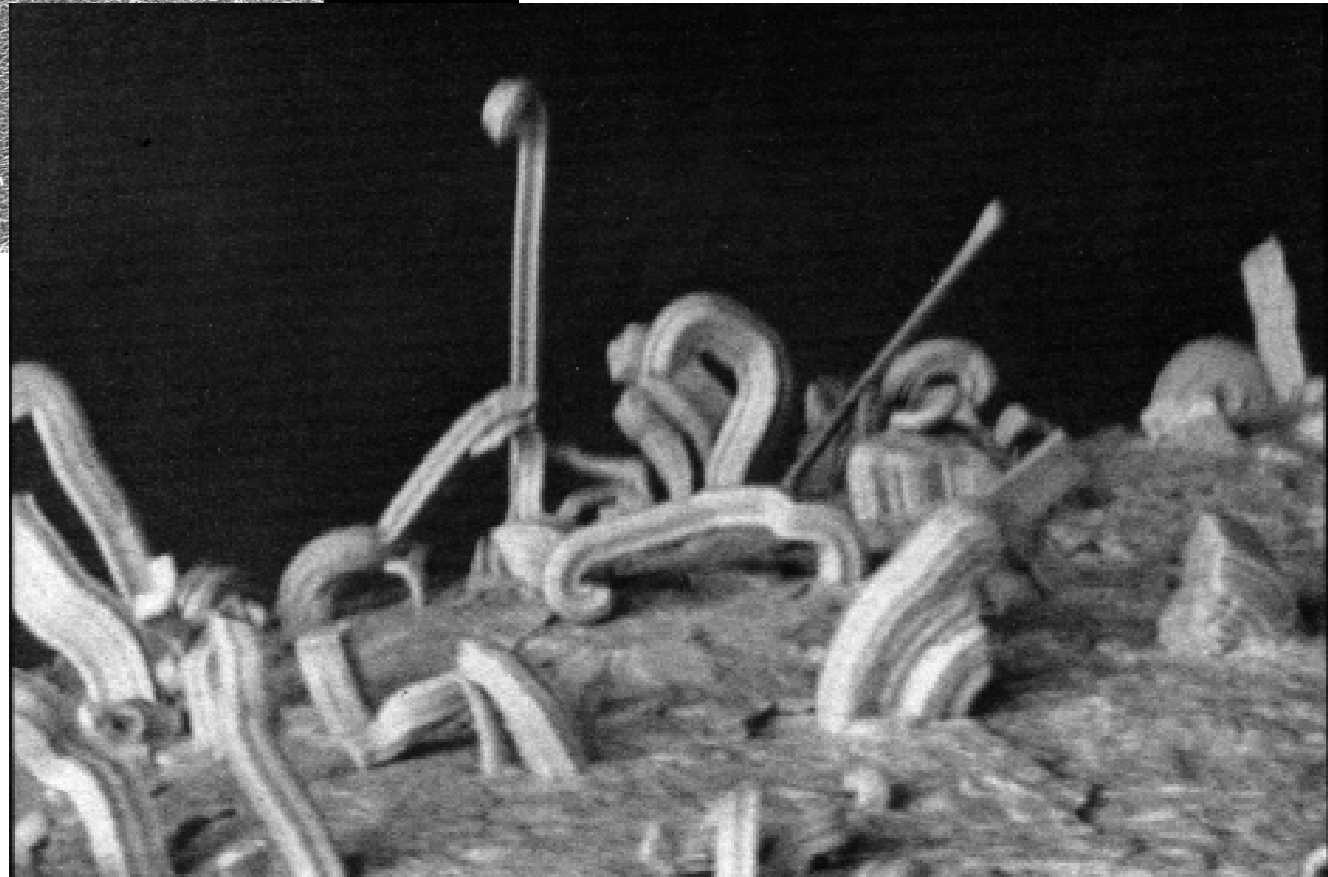
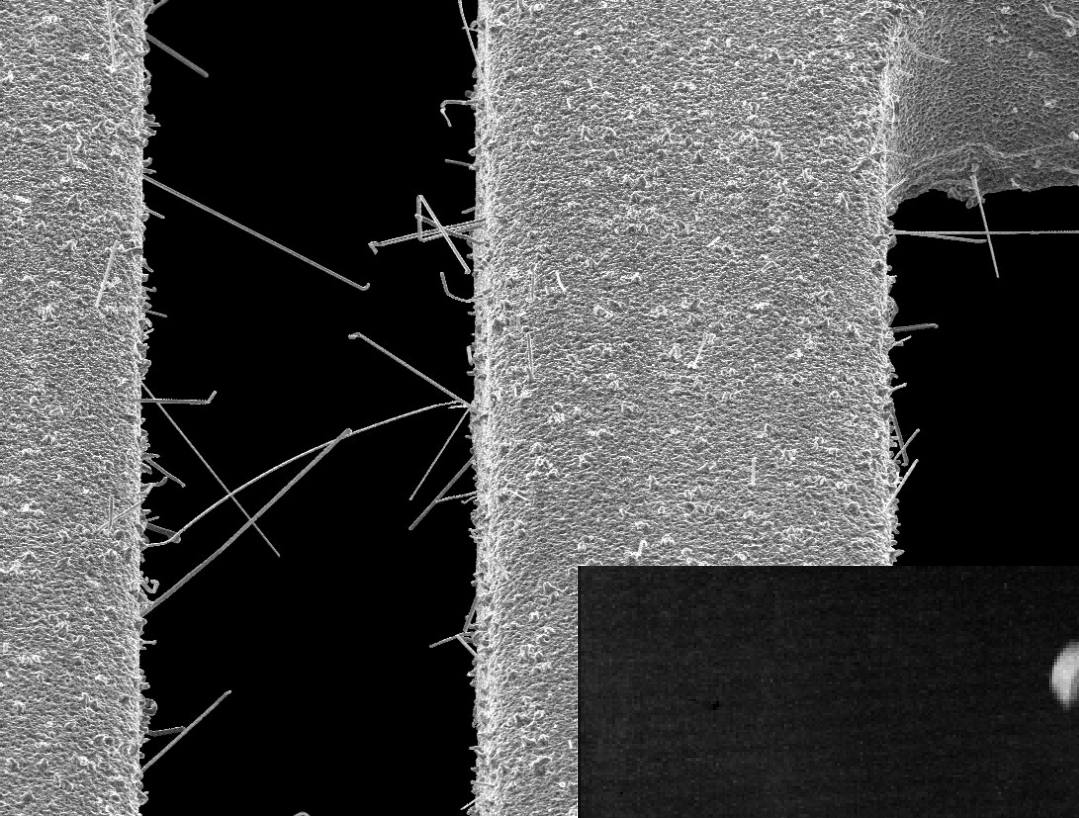
The Russian Space Agency has been sending manned capsules

and supply ships to the station. The cargo carriers have provided backup stores of precious oxygen that have come in handy during the repeated breakdowns of the station's main oxygen generator. Little can be returned to Earth in the capsules besides the astronauts themselves, and the cargo ships are cut loose and incinerated in the atmosphere. So only trash goes into the carriers before undocking — empty food containers, dirty clothes, aluminum toilet cartridges full of solid waste.

International accords frown on dumping things overboard; the objects could become dangerous pieces of space junk.

MARCIA DUNN (AP)

Tin Whiskers



Space Debris: A “Failure” of Sustainable Materials Management



This image from the European Space Agency shows an artist's impression of the debris that orbits Earth. Scientists fear collisions of space junk may increase.

<http://www.expressnightout.com/printedition/reader.php?date=2009-02-20>. <accessed 20 Feb 2009>



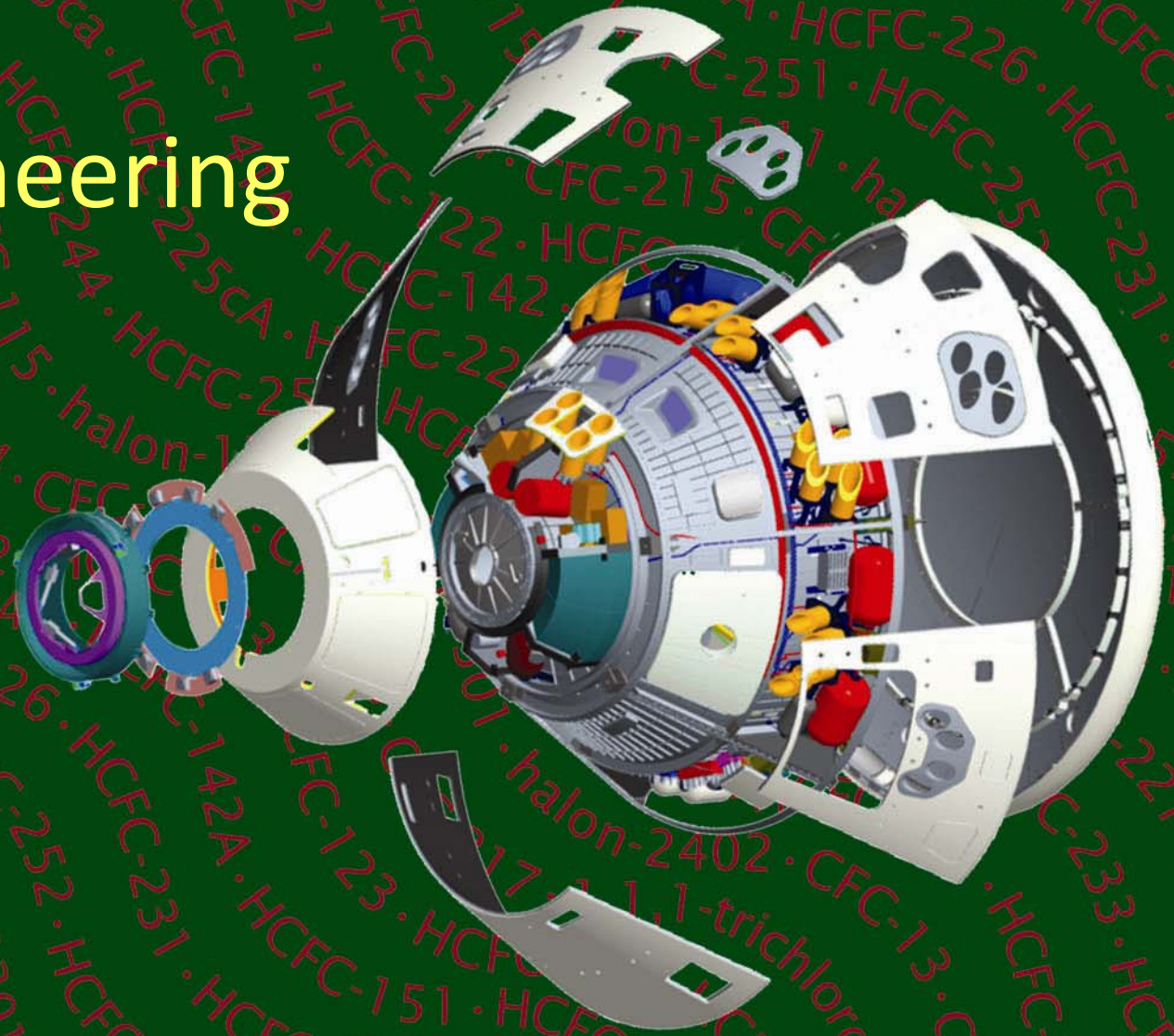
This is the main propellant tank of the second stage of a Delta 2 launch vehicle which landed near Georgetown, TX, on 22 January 1997. This approximately 250 kg tank is primarily a stainless steel structure and survived reentry relatively intact.



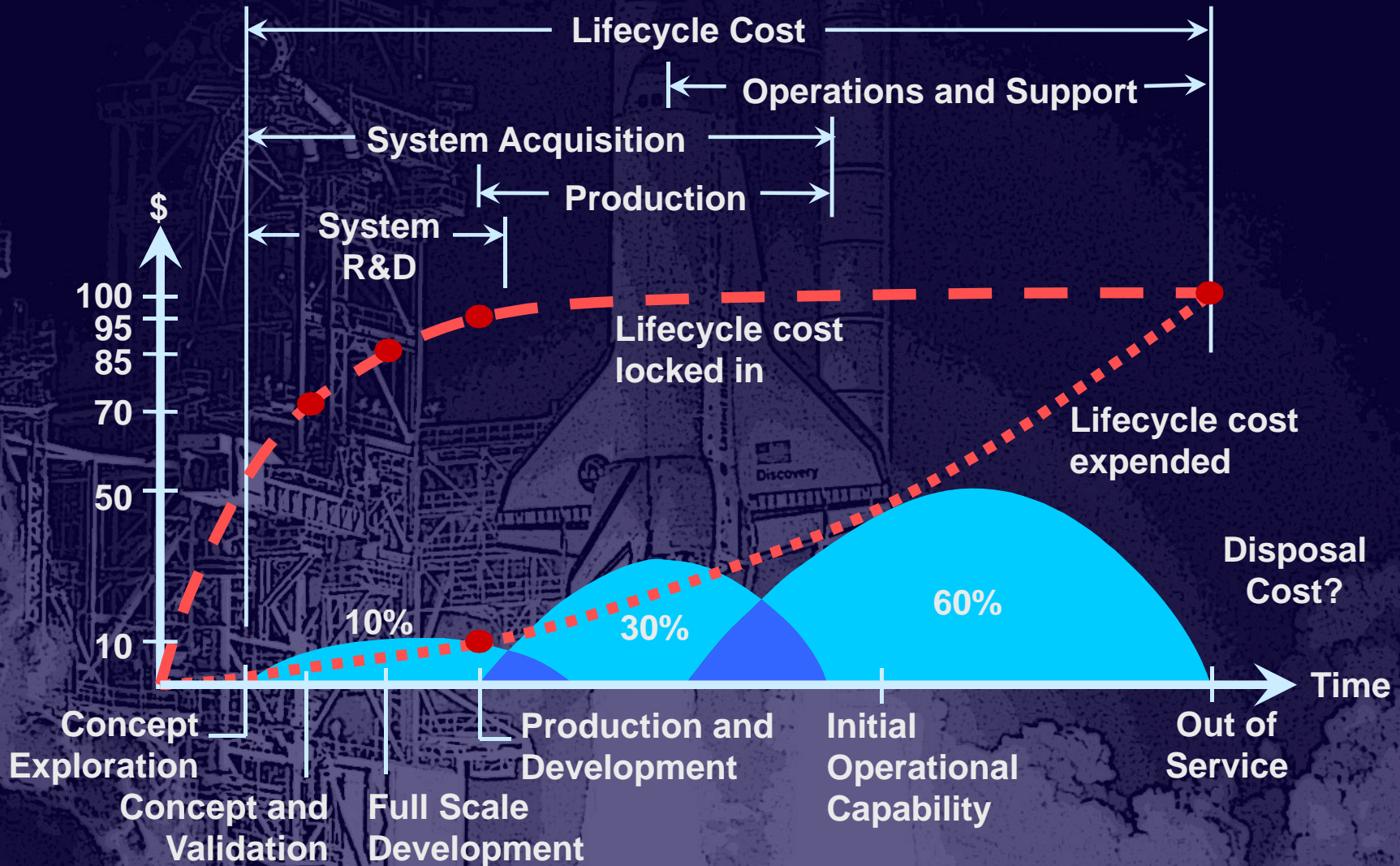
Blood mining in the Congo

- Humanitarian Crisis
- 1500 people die a day
- Over 5.4 million deaths
- 1.3 million people displaced from their homes

Green Engineering

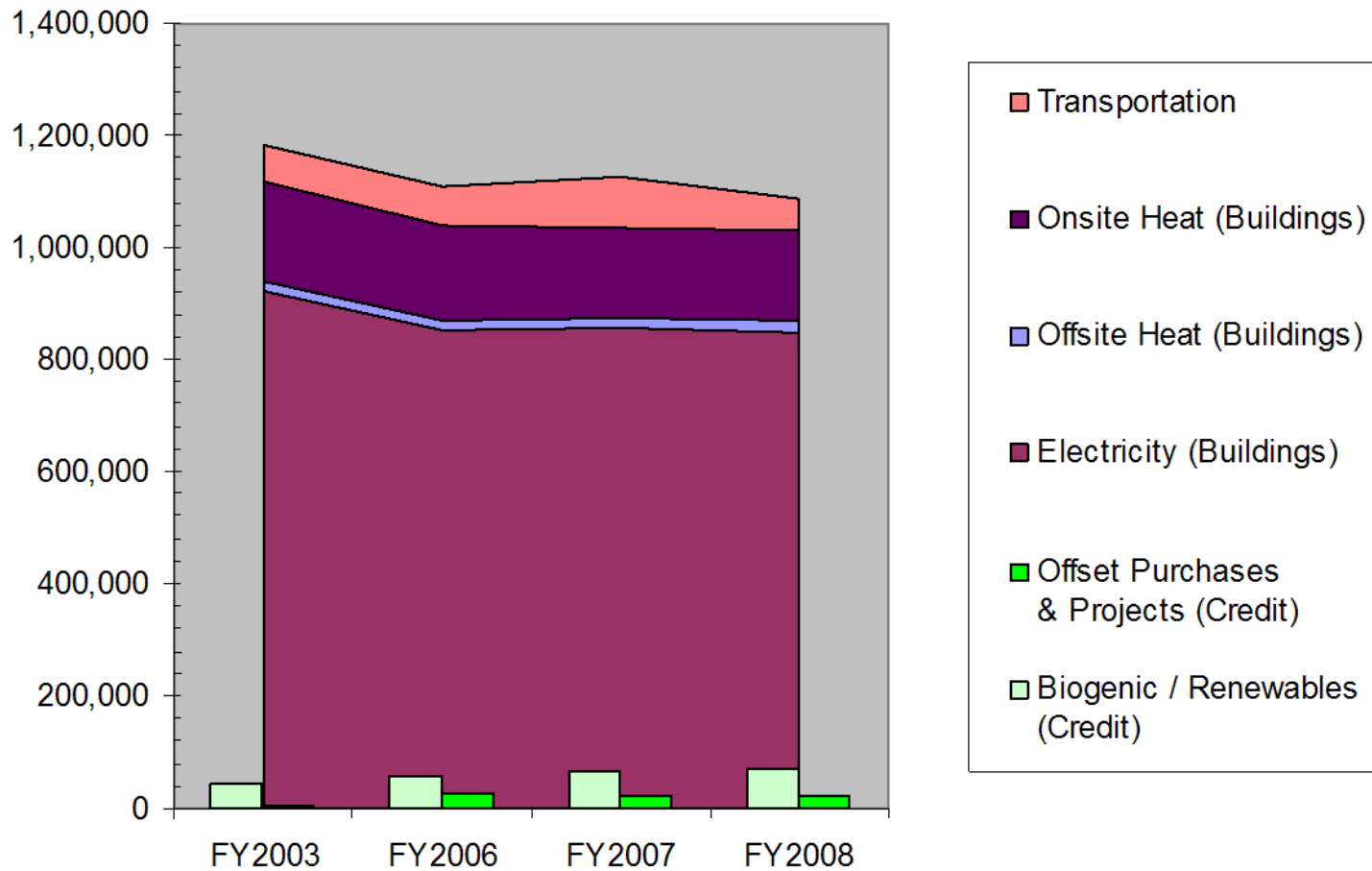


Impacts of Design Decisions



Green House Gas Analysis Agency Wide

NASA GHG Emissions (MTCO₂e) Trends By Source Type



Solar Photovoltaic System, Enhanced Use Lease, KSC

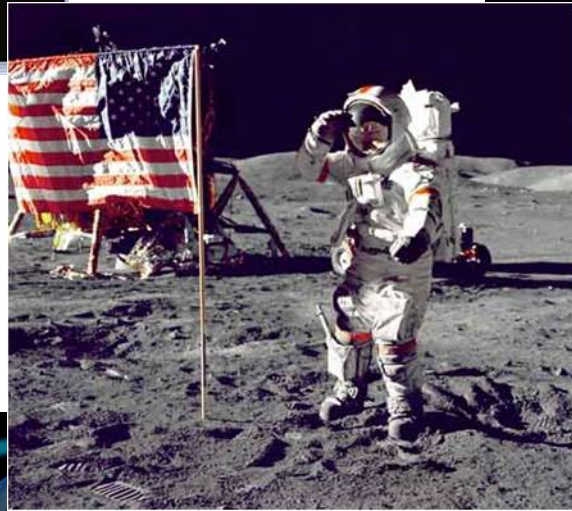




White Sands Test Facility

- Solar Voltaics
- Shade parking lot
- Provide energy to fitness center
- Reinforcement of positive action





“You have to skate to where the puck is going to be,
not where it's been.” – Wayne Gretzky



Questions?