

**And then what happened,  
After I threw it away?**

*The Story of Waste Electronics & Recycling*

# The Story of Waste Electronics: The Weight of the Problem

A Working Definition of WEEE:  
Waste Electrical and Electronic  
Equipment

The total annual global volume  
of WEEE is soon expected to  
reach 40 million metric tons

That's equivalent to about 26  
million cars worth of waste  
electronics every year!

The Little Things:  
Cell Phones, iPods  
... and other consumer electronics

The Medium Things:  
Tablets, Personal Computers  
... and other home electronics

The Big Things:  
Refrigerators, TV sets,  
... and other appliances

Source: Sepulveda et al. 2010

# The Story of Waste Electronics: The Scope of the Problem

The Repair or Replace Dilemma:  
Many electronics, whether little,  
medium, or big, are less  
expensive to replace than repair.



Planned Obsolescence Culture:  
Falling prices and rapidly changing  
technology promotes the replacement of  
consumer electronics every 1-2 years.



Disproportionate Toxic Waste:  
Electronic waste tends to contain far  
more toxic waste than almost any other  
type of consumer-based waste.

70% of the heavy metals  
in U.S. landfills come  
from discarded  
electronics!

Source: Sepulveda et al. 2010

# The Story of Waste Electronics: The Scope of the Problem: the U.S.



In the United States alone (2007 numbers shown), Millions of units are disposed of every year, yet only a relatively small percentage is recycled and even a smaller portion is recycled at regulated facilities. Those WEEE that end up in landfills, whether in the U.S. or overseas, contribute disproportionately (more than other waste) to the toxicity of these waste sites.

# The Story of Waste Electronics: The Scope of the Problem around the World



Shown is Electronic Waste (WEEE) generated by Select Countries (units are thousands of metric tons)

The electronic waste generated in China is approaching that of the United States and will readily surpass it by 2015. India is generates about 50% of the electronic waste generated by the United States BUT India's electronic waste has increased 500% in the past seven years.

In addition to generating large amounts of electronic waste, developing countries, especially India and China, also import large quantities of waste, often for recycling and partial disposal in ways that are very harmful to human and ecosystem health.

# **The Story of Waste Electronics:**

## **The Impact**

### **And then what happened, After I threw it away?**

- Some WEEE goes to a qualified recycling site; many parts and materials are recycled; some are disposed of, but in an environmentally sound way. WEEE handled in this way makes up a small percentage of overall electronic waste.
- Significant WEEE goes to an ordinary landfill (the “Trash”). Ordinary landfills lack the type of lining which would prevent toxic materials from leaching into the soil below and into the groundwater, hence impacting public health across a wide radius via the drinking water supply.
- Significant WEEE goes to an improperly qualified recycling site. Many parts are burned – thereby producing toxic air pollution that impacts the local community and other communities miles downwind. Some parts are treated with acids like cyanide (to remove precious metals like gold) which results in acidified water supplies and mercury byproducts in waterways, drinking water, and recreational water supplies. Remaining, non-recycled components are disposed of in poorly or unlined waste sites where they ultimately impact soil and groundwater for generations to come.

The impact of WEEE disposal and electronics is far reaching both in time (this generation and next generations), in space (wide geographical areas are ultimately affected), and in consequence (a diverse range of disturbing ecosystem and health impacts).

# The Story of Waste Electronics: The Impact

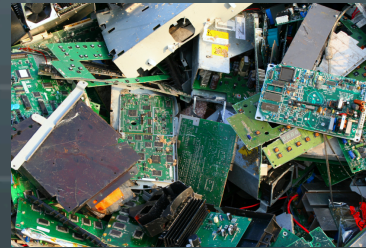
## Developed Countries

- Regulated Recycling
- Disposal in Landfills
- Illegal Dumping

Of all these approaches to disposing of waste electronics, the recycling of those electronics in an “Informal Economy” prevalent in developing countries is of primary concern.

## Developing Countries

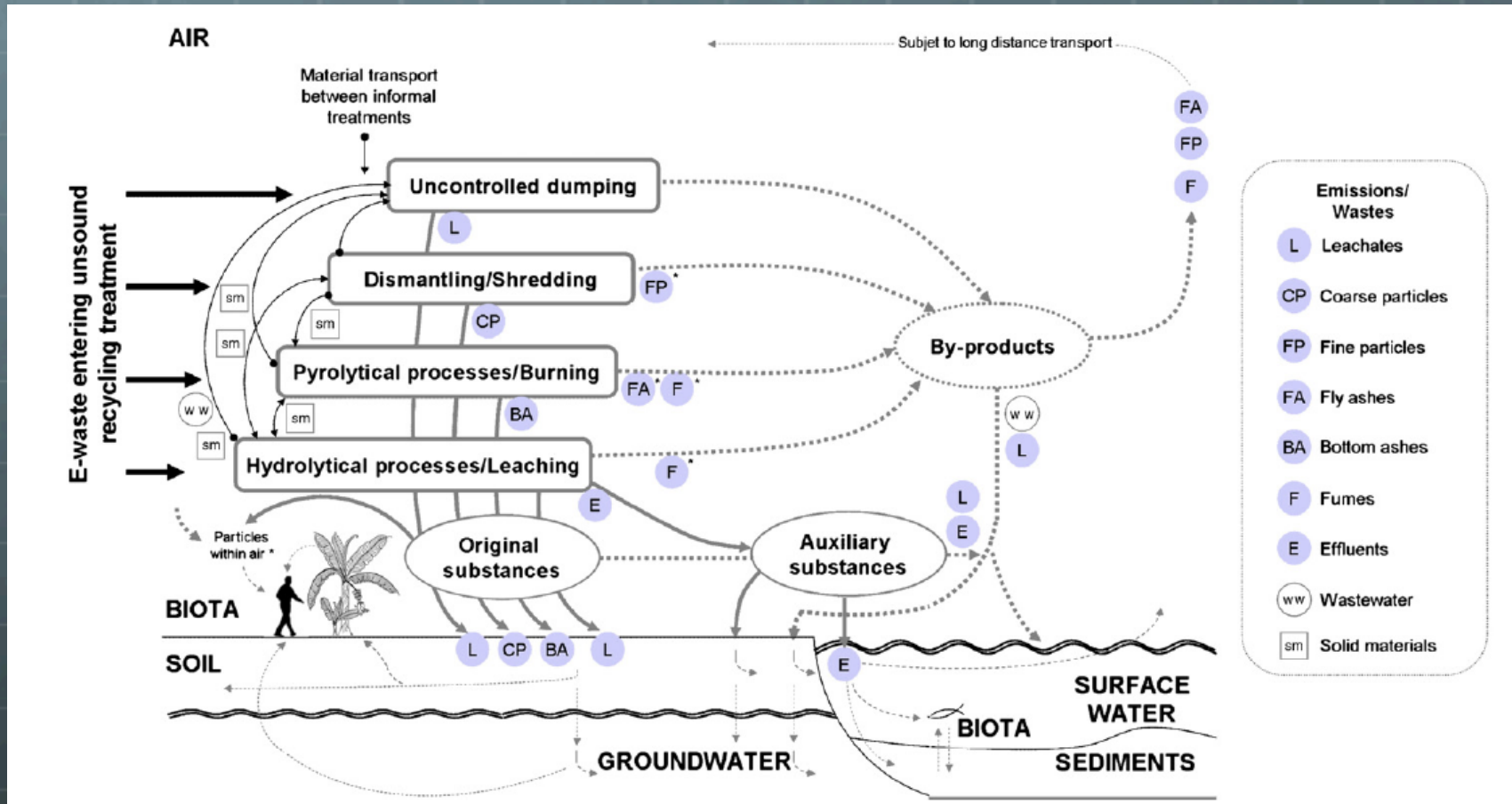
- Extensive Recycling in an “Informal Economy”
- Illegal Dumping



### What is an Informal Economy?

- A combination of legal, unregistered, and public accepted businesses who often carry out illegal and secretly executed processes whose impact on public and ecosystem health is often not fully understood or disregarded.
- In WEEE, this means that businesses collect, sort, and manually separate electronics and electronic equipment, often applying crude methods to separate materials of interest for re-use, recycling or disposal

# The Story of Waste Electronics: The Consequences in Developing Countries



Source: Sepulveda et al. 2010



Source: Sepulveda et al. 2010

# *The Story of Waste Electronics:* *The Consequences in Developing Countries* Shredding and Dismantling

## Consequences to Human Health:

Dismantling and Shredding releases contaminated dust into the air and can be ingested by workers and others in local communities containing these unregulated WEEE sites.



Chronic inhalation of dust can ultimately degrade and compromise the body's defense systems, making it more vulnerable to a wide range of diseases over the long haul.

# The Story of Waste Electronics: The Consequences in Developing Countries

## Burning

### Consequences to Human Health:

Unregulated burning of electronic waste can result in (a) large particles that are respiratory irritants to local communities, but are largely “stopped” by the upper respiratory tract; (b) small particles that can travel hundreds or thousands of miles away, cause respiratory irritation and nose, throat, lung, and fully body health impacts over short and long term.



Burning doesn't just impact those involved in improper WEEE recycling, but can also affect uninvolved people hundreds and thousands of miles away



### Consequences to Environment and Ecosystem:

In addition to this incredible range of impacts on human health across wide geographical areas, the types of particles that can contaminate soil on land and sediment in waterways which ultimately influence the food supplies, drinking water availability, biodiversity, and food chain integrity

# *The Story of Waste Electronics:* *The Consequences in Developing Countries* Leaching (and other Hydrolytical Processes)

## Consequences to Human Health:

Mercury amalgamation is often used to extract precious metals, in a similar process to leaching. Mercury poisoning through exposure to mercury during leaching and consumption of contaminated water and food (especially foods higher up on the food chain) causes peripheral neuropathy (loss of feeling in hands, feet, etc) and long term damage to brain, kidneys, and lungs.



## What is Leaching?

Leaching is the process of chemically processing circuit boards (or similar electronics) to separate desired materials (like gold and other precious metals) from the rest of the electronics.



## Consequences to Environment and Ecosystem:

Cyanide salt and hydrochloric acids are commonly used for these leaching processes, which can upset pH in water and soil, causing large disruptions in ecosystem health through loss of biodiversity and loss of population in certain species.

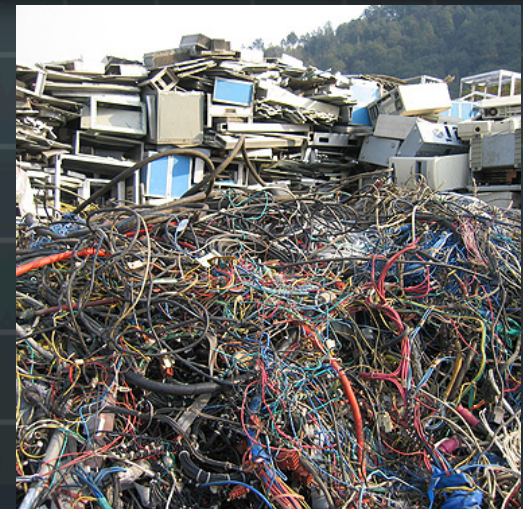
# WEEE Recycling & Disposal in Developing Countries

What can Engineers do?

Begin the Solution at Home

In our personal lives: practice and communicate habits that move away from increasing consumption rather than toward it. CONSUME less, talk to others about consumption, and set an example for family and friends. Beyond our local sphere of influence, letters/campaigns to NGOs, government agencies, and other organizations involved in regulating and handling WEEE can have an impact.

In our work lives: although the corporate profit engine and its reliance on planned obsolescence can seem bigger than we are, every small step made toward designing or using more sustainable products in the workplace makes a difference.



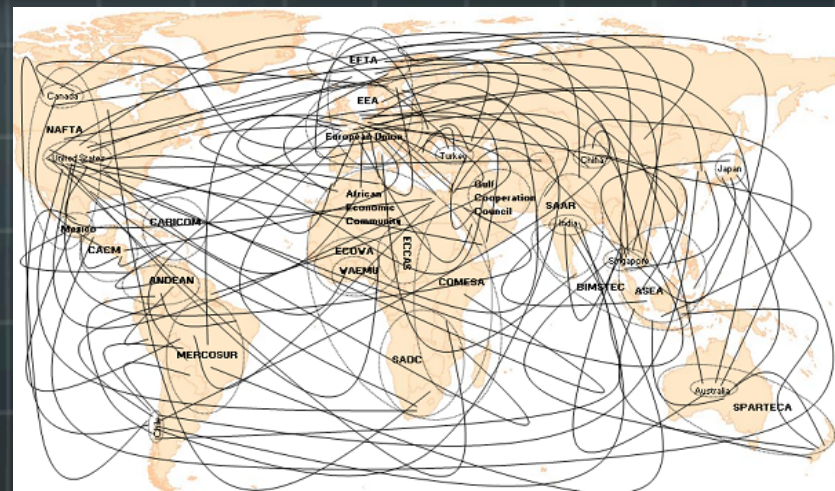
# WEEE Recycling & Disposal in Developing Countries

What can Engineers do?

Invest in a Solution overseas

SWOT (Strengths, Weaknesses, Opportunities, Threats) the problem ---  
Many techniques can be readily implemented at low cost to reduce the net impact of WEEE on those developing communities that deal with its recycling and disposal. Technical assessment of the strengths and weaknesses (SWOT) of each technique can assist in a more prioritized approach to resolving problems for target communities.

The problem of WEEE is so big and so complex that solutions are often not contextualized in the big picture. Technical know-how and engineering talent are an essential part of constructing the big picture, to know what actions can have the most impact.



# **The Story of Waste Electronics:**

## **Summary**

**Although waste electronics can have negative consequences to ecosystem and public health in developed countries through illegal dumping (non-landfill) and legal dumping (landfill), the consequences of these poor recycling practices pale in comparison to informal, high volume practices in developing countries.**

**The consequences of WEEE recycling & disposal are both far-reaching in time:**

- People: short term irritation to long term disease/intelligence decline to next generation defects
- Environment: short term contamination to long term compromises in biodiversity, community composition, and ability to support a food supply

**And far-reaching in space:**

- From short range impacts of large particles in dust and ash,
- To medium range impacts on downstream communities,
- To far range impacts of fine particles travelling 100's and 1000's of miles

**Engineers have unique insights into understanding how electronics can be made in a way that has less impact on the Waste Electronics Story, AND at the back end, are adept at understanding which corrective actions can have the most impact.**