Energy Justice Network

...helping communities protect themselves from polluting energy and waste technologies

ENERGYJUSTICE.net

Tire Pile Problems

- Tires cause health problems (mosquitoes)
- Can catch fire
- Expensive to get rid of

Tire Derived Fuel – US EPA

General Information

• In 2003: 130 million scrap tires used as fuel (45% of amount generated)

• Shredded or whole tires used

Claimed Advantages

• Tires produce the same amount of energy as oil and 25% more energy than coal

• The ash residues from TDF may contain a lower heavy metals content than some coals.

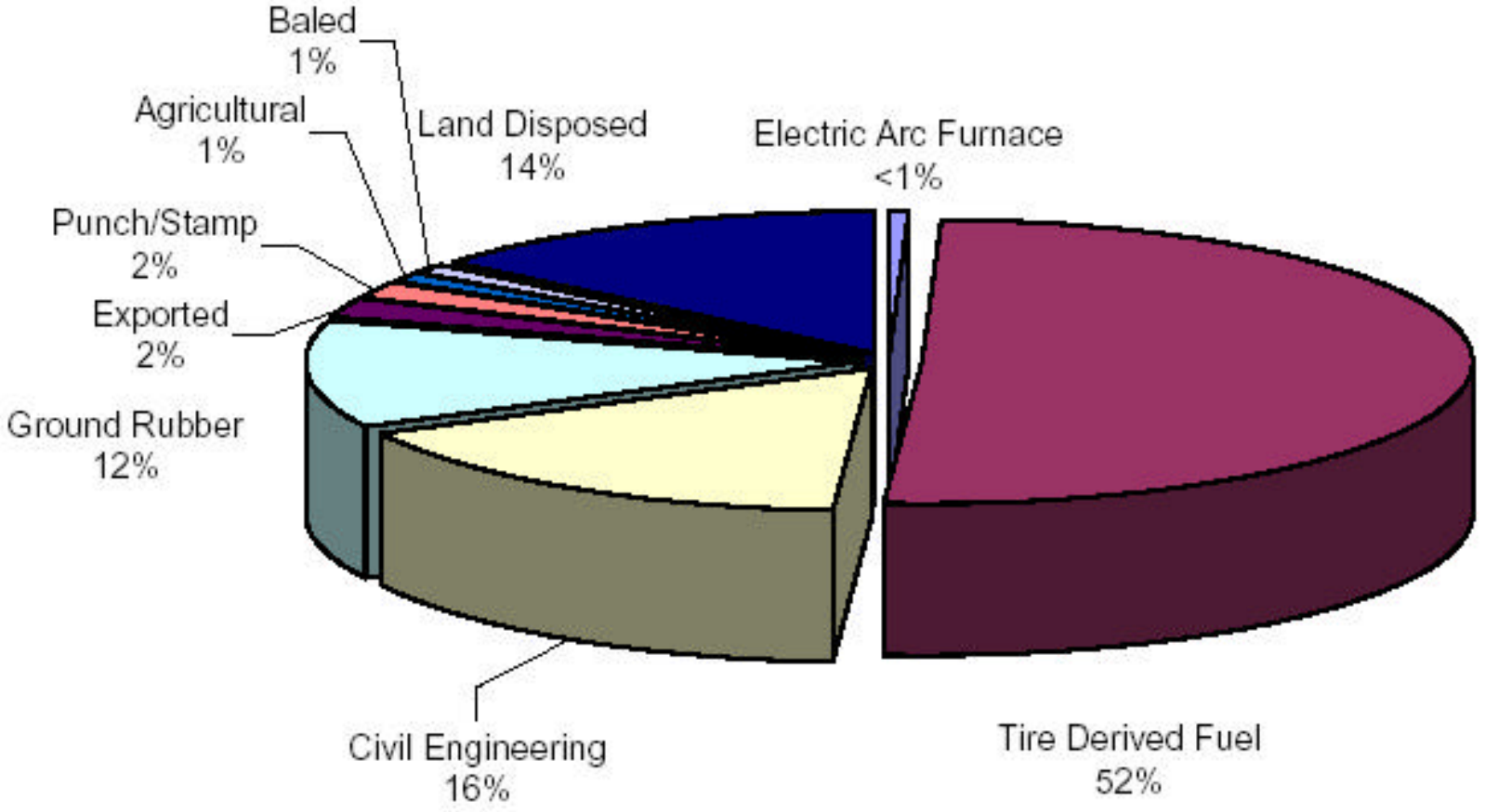
• Results in lower NOx emissions when compared to many U.S. coals, particularly the high-sulfur coals.

EPA

• The Agency supports the responsible use of tires in Portland cement kilns and other industrial facilities

Tire Incineration in U.S.

- 52% of U.S. scrap tires are burned



2005 US Scrap Tire Market Summary

(millions of tires)

Tire-Derived Fuel (TDF)	
Cement Kilns	58.0
Pulp & Paper Mills	39.0
Electric Utilities	27.0
Dedicated Tire Incineration	10.0
Industrial Boilers	21.0
Total TDF	155.1
Products	
Ground Rubber	37.5
Cut/Punched/Stamped	6.1
Civil Engineering	49.2
Misc./Agriculture	3.1
Electric Arc Furnaces	1.3
Export	6.9
TOTAL USE	259.2
TOTAL GENERATION	299.2

- Most tire incineration is done in cement kilns and paper mills
- These are also very polluting and have been fought by community groups

Alternatives to Burning Tires

- Source Reduction
- Toxics Use Reduction
- Reuse (Retreading)
- Recycling
- Devulcanization
- Rubberized Asphalt Concrete
- Monofills

Dedicated Tire Incinerators

- Modesto Energy LP – Westley, CA
  - Giant tire pile fire in 1999, closing plant
- Exeter Energy LP – Sterling, CT
  - Opened in 1991
  - Its ash is considered hazardous waste due to high levels of toxic metals; ash was improperly sold as fertilizer in Washington state in the mid-1990s
- Geneva Energy, LLC – Ford Heights, IL
  - Opened in 1996
  - fire on the conveyor feeding the boiler shut it down; reopened in recent years
- Heartland Energy and Recycling, LLC – Preston, MN
  - Never built
  - Defeated by community opposition in 2005

Erie Renewable Energy, LLC

- Majority owned by Caletta Renewable Energy of Boston, MA
- Plans to burn 800 tons of shredded tires per day
- Would use a “fluidized bed” boiler
- Expects to produce 70 megawatts of electricity
- Company has NO experience with building, owning or operating tire incinerators or any power plant or waste facility

Tire Burning is NOT Renewable

- No state laws in Pennsylvania or neighboring states qualify energy produced from burning tires as renewable or “alternative” energy
- No environmental organizations consider tire incineration renewable
- Renewable energy certification programs do not, either
- The proposed federal renewable energy law also doesn’t.
- Tires are produced from fossil fuels and other non-renewable resources (like zinc and other metals)

Tire Pile Fires

- ERE says they won't have stockpiles of tires because they'll chip the tires as soon as they come in (mostly via rail)
- Some tires will have to be piled while waiting for the shredder
- Chipped/shredded tires will still be stockpiled on-site, in a building
- Shredded tires have a higher surface area with more air exposure and would catch fire more quickly.

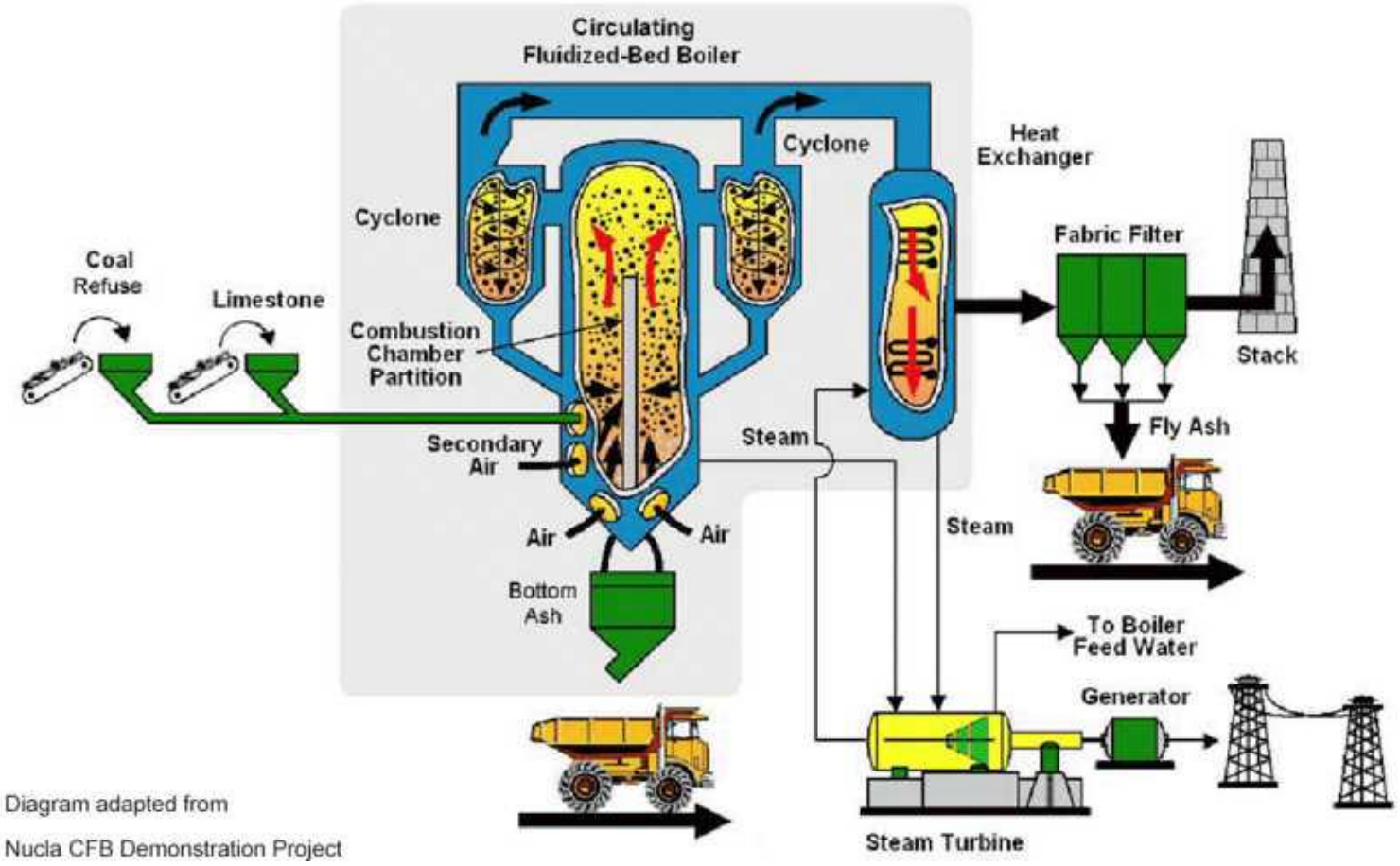
Westley, CA Tire Fire

- Tire incinerator is near land that had been used as a tire dump for years. The pile was struck by lightning Sept. 22, touching off a fire that burned for a month and consumed nearly 5 million of the 7 million tires that had been stored there.

Westley, CA Tire Fire

Fluidized Bed Combustors

- FBC boiler technology over 30 years old
- Can be used to burn a wide range of fuels, including very poor fuels like waste coal
- Started to be used to burn waste coal in late 1980s
- Some fluidized bed waste coal burners have also been used to burn tires



It *is* an Incinerator!

- Fluidized bed combustors are one of several types of incinerators
- Patent claims, environmental agencies, scientific journals and industry agree
- The industry avoids the term “incinerator” because people recognize it as the polluting technology that it is
- Burning = combustion = incineration
- It’s not appropriate to call this “tires-to-energy” or simply a “chemical process”

Incinerators are “Waste-to-Toxic Ash and Toxic Air Emissions Machines”

- Large volumes of limestone are added to fluidized bed burners to control sulfur emissions
- For waste coal burning fluidized bed burners, 85 tons of highly toxic ash are created for every 100 tons of waste coal burned
- The Exeter Energy tire incinerator in Sterling, CT has been considered a “Large Quantity Generator” of hazardous waste

Chemical Composition of Tires

Typical types of materials used to manufacture tires:

Synthetic Rubber
Natural Rubber
Sulfur and sulfur compounds
Silica
Phenolic resin
Oil: aromatic, naphthenic, paraffinic
Fabric: Polyester, Nylon, Etc.
Petroleum waxes
Pigments: zinc oxide, titanium dioxide, etc.
Carbon black
Fatty acids
Inert materials
Steel Wire

Source: U.S. Rubber Manufacturers Association / Scrap Tire Management Council

Chemical Composition of Tires

Description	% By Weight, as Received
Moisture	0.62
Ash	4.78
Carbon	83.87
Hydrogen	7.09
Nitrogen	0.24
Sulfur	1.23
Oxygen (by difference)	2.17
Total	100
Elemental Mineral Analysis (Oxide Form)	
Zinc	1.52
Calcium	0.378
Iron	0.321
Chlorine	0.149
Chromium	0.0097
Fluoride	0.001
Cadmium	0.0006
Lead	0.0065

Representative Analysis of TDF Produced By WRI
(Source: TDF Produced From Scrap Tires with 96+% Wire Removed)
Source: U.S. Rubber Manufacturers Association / Scrap Tire Management Council

Chemical Composition of Tire Ash

COMPOUND	SAMPLE 1	SAMPLE 2	AVERAGE
Total Carbon -- %	0.071	0.258	0.164
Aluminum	0.128	0.283	0.206
Arsenic	0.002	----	0.001
Cadmium	0.001	0.001	0.001
Chromium	0.978	0.068	0.523
Copper	0.255	0.32	0.288
Iron	95.713	96.721	96.217
Lead	0.001	0.001	0.001
Magnesium	0.058	0.059	0.058
Manganese	0.058	0.307	0.416
Nickel	0.241	0.093	0.167
Potassium	0.01	0.015	0.012
Silicon	0.34	0.246	0.293
Sodium	0.851	0.701	0.776
Zinc	0.052	0.16	0.106
Tin	0.007	0.006	0.006
Sulfur	0.766	0.762	0.764

Preliminary Results Of Slag (Bottom Ash) Analysis

Source: U.S. Rubber Manufacturers Association / Scrap Tire Management Council

Chemical Composition of Tire Ash

Contents	Weight by Percentage	
Zinc		51.48%
Lead		0.22%
Iron		6.33%
Chromium		0.03%
Copper		0.55%
Nickel		0.03%
Arsenic		0.02%
Aluminum		0.76%
Magnesium		0.50%
Sodium		0.01%
Potassium		0.01%
Magesium Dioxide		0.36%
Tin		0.03%
Silicon		6.85%
Cadmium		0.05%
Carbon		32.20%
	Total	99.43%

Note: These results are from incineration of 100% tire fuel.

Sources: Radian Corporation, Results From Sampling and Analysis of Wastes From the Gummi Mayer Tire Incinerator, May 1985.

Source: U.S. Rubber Manufacturers Association / Scrap Tire Management Council

Tire Derived Fuel Emissions

- Data on emissions from tire burning varies
- Some studies compare a mixture of tires and coal to 100% coal; others compare to other mixtures of fuels
- Chemical composition of coal can vary by coal type and region
- Data is from cement kilns, paper mills or other industrial boilers
- Operating conditions may vary

Tire Derived Fuel Emissions

Common trends in comparing TDF/coal mixture to 100% coal

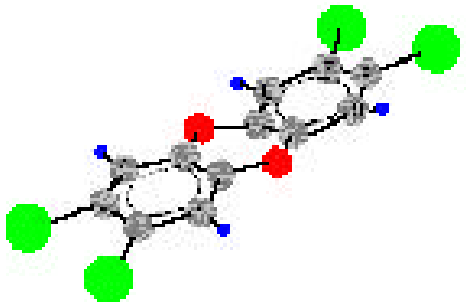
INCREASE	POSSIBLY INCREASES	DECREASE
Chromium	Arsenic	Fluoride
Copper	Barium	Nitrogen Oxides
Lead	Beryllium	
Nickel	Cadmium	
Zinc	Chlorine	
Dioxins/Furans	Hydrochloric Acid	
PCBs	Magnesium	
PAHs	Manganese	
Sulfur Dioxide	Mercury	
Carbon Monoxide		
Benzene		

Chlorine in Tires

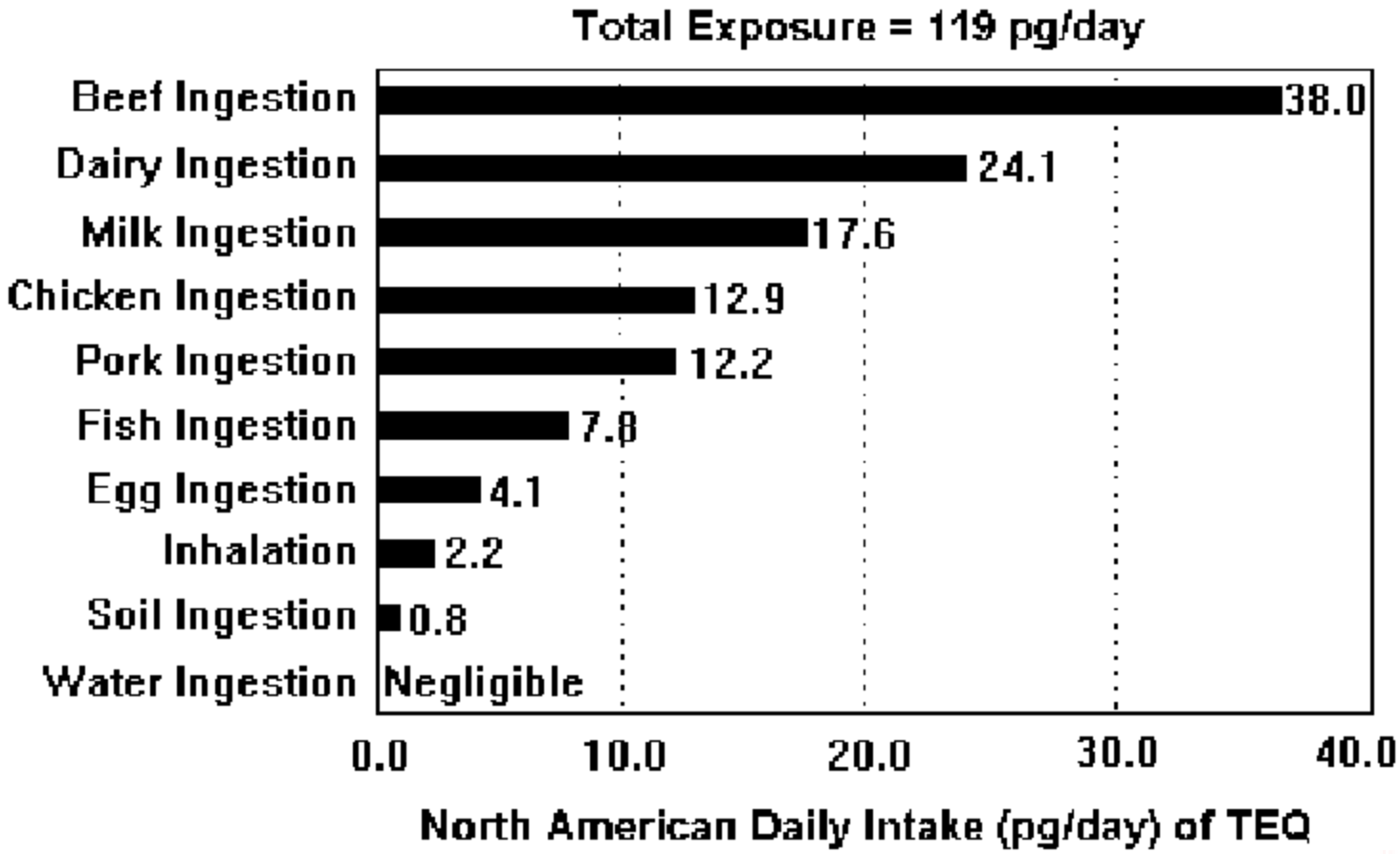
- Add Chlorine to tires
  - Aromatic extender oils
  - “Salt-bath" vulcanization process
  - Halogenated butyl rubber liners
- California study: Tires have 2-5 times the chlorine level of western coal
- EPA survey: chlorine levels in tires 2% higher than the national average for bituminous coal

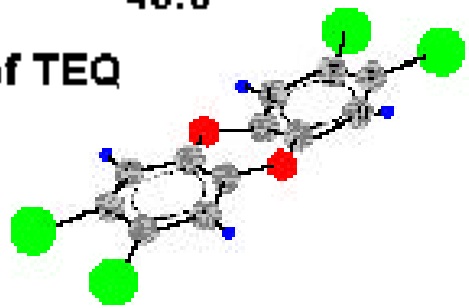
Dioxin Facts

- Dioxins and furans are the most toxic chemicals known to science. They are highly toxic even in miniscule amounts.
- Dioxins cause infertility, learning disabilities, endometriosis, birth defects, sexual reproductive disorders, damage to the immune system, cancer and more.
- 93% of dioxin exposure is from eating meat and dairy products.



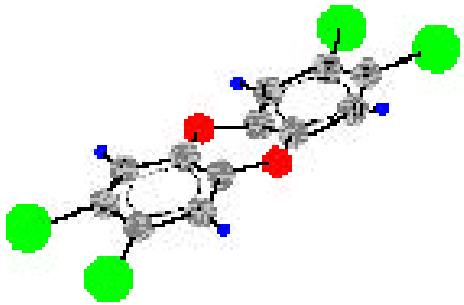
Exposure to Dioxins





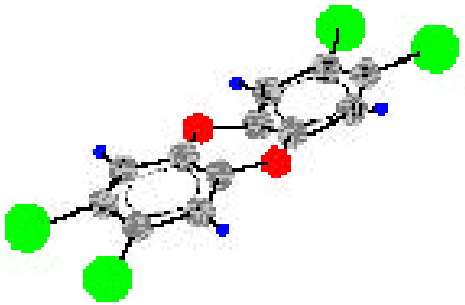
How to make dioxin

- Dioxins are created by burning hydrocarbons (fossil fuels, tires, hazardous wastes) with chlorine (present in coal, tires and some hazardous wastes) in the presence of oxygen.
- Dioxin emissions increase when:
  - More chlorine is in the fuel/waste stream (tires have more chlorine than coal)
  - Certain metal catalysts are present (tires have iron and zinc)
  - The gases stay in a low temperature range (200-450^{o} C)



Dioxin Emissions from Tire Burning

Data From	TDF Content (% TDF compared to 100% coal)	Dioxins/Furans
4 California Cement Kilns	<20%	Increased between 53% and 100%
5 Canadian Cement Kilns		Increased 37% and 247% in two tests Decreased 54% and 55% in two other tests
Victorville, CA Cement Kiln	24.60%	Dioxins increased 139-184% Furans increased 129%
Cupertino, CA Cement Kiln		Increased 30%
Davenport, CA Cement Kiln	30%	Dioxins increased 398% and 1,425% in two tests Furans increased 58% and 2,230% in two tests
Davenport, CA Cement Kiln	20%	Increased 25%
Lucerne Valley, CA Cement Kiln	20%	Dioxins and some dibenzofurans increased
Chester, PA Paper Mill	4-8%	Increased 4,140%
U Iowa, Iowa City, IA Industrial Boiler	4%	Decreased 44%
U Iowa, Iowa City, IA Industrial Boiler	8%	Decreased 83%



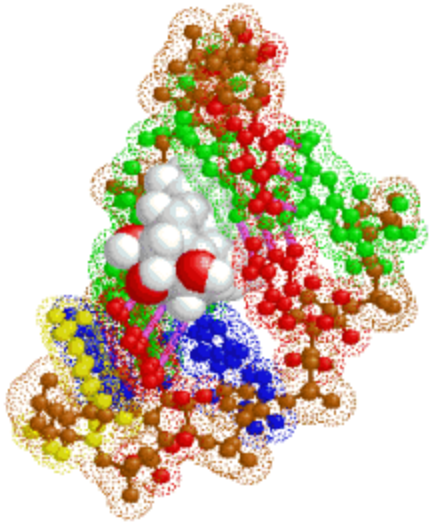
Creating Cancer

Polycyclic aromatic hydrocarbons (PAHs): group of over 100 different chemicals that are formed as byproducts of combustion

Most PAHs are known to cause cancer in animals and are suspected to cause cancer, birth defects and a wide variety of other health problems in humans.

Fluidized bed combustors form PAH more than normal coal burners due to:

- use of limestone injection
- low oxygen levels
- lower combustion temperature range
- low-rank coal
- higher sulfur levels in fuel
- higher chlorine levels in fuel



Benzo(a)pyrene

Mercury (Hg)

- Comes in three forms: methylmercury, elemental mercury, and other mercury compounds.
- The most common exposure is to methylmercury, which leads to impair neurological development and, in severe cases, peripheral vision impairment, sensation disturbances, lack of coordination, speech impairment, hearing impairment, and muscle weakness.
- Some studies show an increase in mercury emissions from adding tires to a fuel blend.

Ground-Level Ozone, a.k.a. Smog

- By deflecting UV radiation, ozone is beneficial in the upper atmosphere, but at ground-level it is highly toxic. The EPA's Clean Air Scientific Advisory Committee has urged that the ozone standard be more protective of public health.
- Ozone ("O3") is not emitted directly as air pollution. It is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight.
- Numerous scientific studies have linked ground-level ozone exposure to a variety of problems, including:
  - lung irritation that can cause inflammation much like a sunburn;
  - wheezing, coughing, pain when taking a deep breathe, and breathing difficulties during exercise or outdoor activities;
  - permanent lung damage to those with repeated exposure to ozone pollution; and
  - aggravated asthma, reduced lung capacity, and increased susceptibility to respiratory illnesses like pneumonia and bronchitis.

Sulfur Dioxide (SO_2)

- SOx gases are formed when fuel containing sulfur, such as coal and oil, is burned, and when gasoline is extracted from oil, or metals are extracted from ore.
- Peak levels of SO_2 in the air can cause temporary breathing difficulty for people with asthma who are active outdoors. Longer-term exposures to high levels of SO_2 gas and particles cause respiratory illness and aggravate existing heart disease.
- Precursor to fine particulates, causes acid rain, reduces visibility, damages crops and ecosystems, and damages historic monuments.

Particulate Matter (PM), a.k.a. Soot

- Grouped by the EPA into two categories:
  - “Inhalable Course Particles”, basically dust
  - “Fine Particles”, smallest particles, found in smoke and haze
- Fine particles generate the most concern and have a range of health effects:
  - increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing, for example;
  - decreased lung function;
  - aggravated asthma;
  - development of chronic bronchitis;
  - irregular heartbeat;
  - nonfatal heart attacks; and
  - premature death in people with heart or lung disease.

Volatile Organic Compounds (VOCs)

- VOCs are a family of chemicals which have varying short- and long-term adverse health effects.
- Health effects of exposure to VOCs include eye, nose, and throat irritation; headaches, loss of coordination, nausea; damage to liver, kidney, and central nervous system.
- Some organics can cause cancer in animals; some are suspected or known to cause cancer in humans.

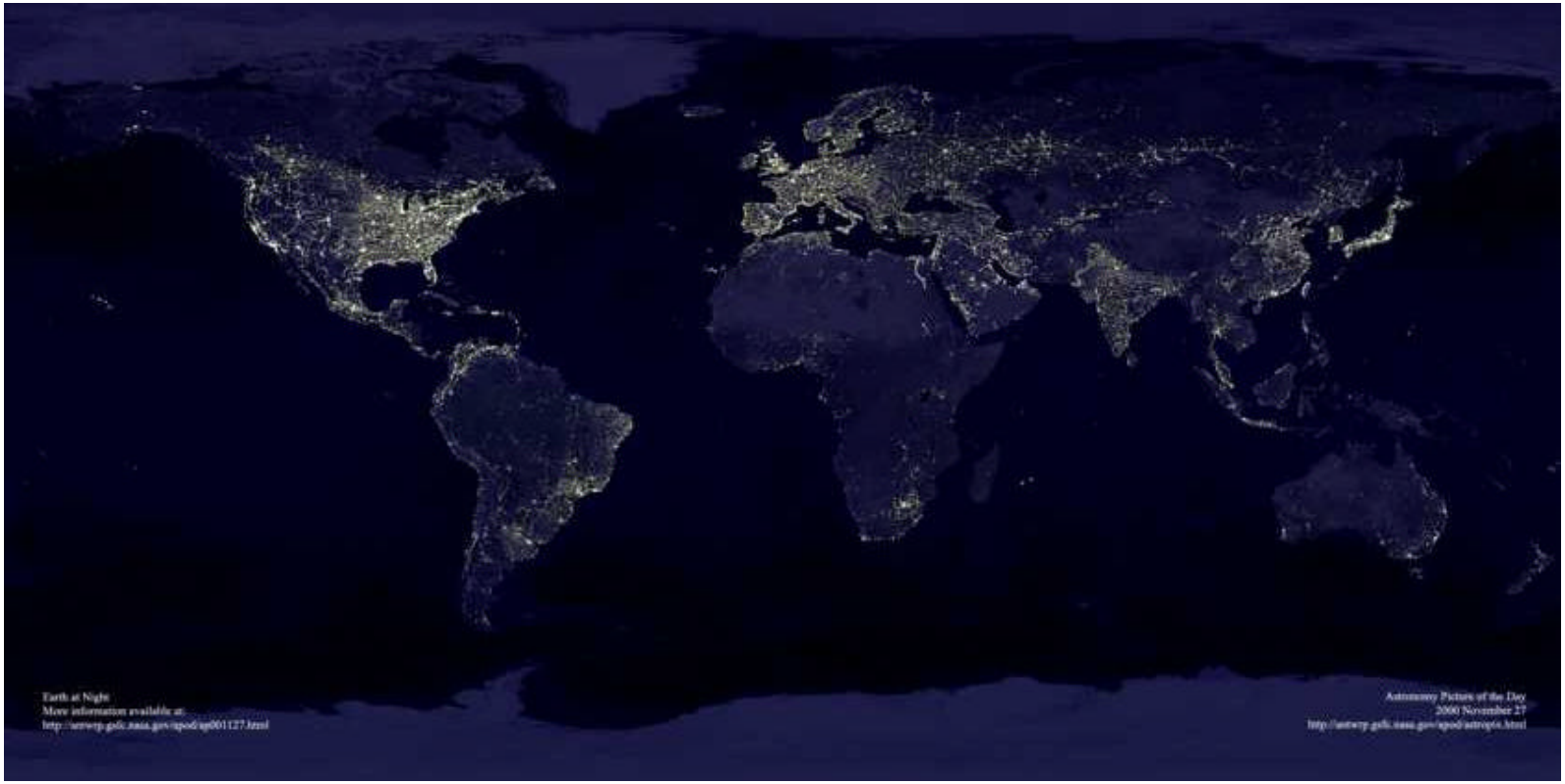
Nitrogen Oxides (NOx)

- Nitrogen oxides is the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts.
- Nitrogen oxides form when fuel is burned at high temperatures, as in a combustion process. The primary manmade sources of NOx are motor vehicles, electric utilities, and other industrial, commercial, and residential sources that burn fuels.
- Problems associated with NOx:
  - Precursor to ground-level ozone;
  - Causes acid rain;
  - Precursor to particulates;
  - Deteriorates water quality (eutrophication);
  - Impairs visibility; and
  - Leads to formation of toxic chemicals:
- In the air, NOx reacts readily with common organic chemicals and even ozone, to form a wide variety of toxic products.

Global Warming / Climate Change

Pennsylvania already emits 1% of the entire world's greenhouse gas emissions.

"N2O has a Global Warming Potential 296 times that of CO2."
"N2O is emitted from fluidized bed coal combustion… N2O emission from the FBC is equivalent to… **an increase of about 15% in CO2 emissions for an FBC boiler**"
-National Coal Council, May 2003



Test Burns are Unreliable

- Emissions estimates and regulatory enforcement usually based on infrequent testing under optimal conditions
- Tests don’t reflect startup, shutdown and upset conditions
- Tests are usually done with careful attention paid to temperature, air flow and other operating conditions
- May take multiple samples until one passes
- Tests are very infrequent

Continuous Emissions Monitors

- Only generally used for sulfur oxides (SOx), nitrogen oxides (NOx), oxygen (O2) and carbon monoxide (CO)
- Technology now exists to continuously monitor:

Ammonia (NH4)

Carbon Dioxide (CO2)

Hydrogen Sulfide (H2S)

Acid Gases:

- Sulfuric Acid (H2SO4)
- Hydrofluoric Acid (HF)
- Hydrochloric Acid (HCl)

Products of Incomplete Combustion (PICs):

- Dioxins & Furans
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Volatile Organic Compounds (VOCs)

Metals:

- Antimony (Sb)
- Arsenic (As)
- Barium (Ba)
- Cadmium (Cd)
- Chromium (Cr)
- Lead (Pb)
- Manganese (Mn)
- Mercury (Hg)
- Silver (Ag)
- Nickel (Ni)
- Zinc (Zn)
- …and more

FOR MORE INFO:

Keep Erie's Environment Protected
www.stopburningtires.com

Energy Justice Network's Tire Incineration Page
www.EnergyJustice.net/tires/

ActionPA
www.ActionPA.org

PA's "Alternative" Energy Law
www.ActionPA.org/cleanenergy/

Energy Justice Network

...helping communities protect themselves from polluting energy and waste technologies

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