ENGR 202 – Review Sheet:

Introduction to sustainable development and the role of engineers:

What is "The Environment"?
The environment is the aggregate of surrounding things, conditions or influences, especially as affecting the existence or development of someone or something. This generally refers to the physical environment around us; the air we breathe, the water we drink and the lands, oceans, rivers and forests that cover the earth.

What are the two categories that categorize sources of anthropogenic environmental change?
- *Changes associated with land use.*
- *Changes induced by emissions* or from products and industrial processes.

What is the role of Engineering in regards to environmental issues?
Engineers are primarily involved in problems related to technology development and deployment. Engineers also design and build all the manufacturing processes, industrial technology, and transportation infrastructure needed to extract, transport and refine raw materials; fabricate products; and distribute the goods and services of modern societies worldwide

What are the three sources of environmental impacts?
- Materials Selection
- Manufacturing Processes
- Energy Use

What is Industrial Ecology?
Industrial ecology is the means by which humanity can deliberately and rationally approach and maintain a desirable carrying capacity, given continued economic, cultural, and technological evolution. The concept requires that an industrial system be viewed not in isolation from its surrounding systems, but in concert with them. It is a systems view in which one seeks to optimize the total materials cycle from virgin material, to finished material, to component, to product, to obsolete product, and to ultimate disposal. Factors to be optimized include resources, energy, and capital. (*Essentially the application of the Life Cycle Analysis*)

What is Sustainable development?
Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

What is environmental engineering?
Environmental engineering is the application of science and engineering principles to improve the environment hence allowing future generations to meet their own needs.

Overview of Environmental Issues:

Air Pollution:

What is the basis for all environmental concerns?

- *Human Health and;*
- *Human Welfare*

How is human health effects classified?

- *Acute* – Short term exposure results in immediate response in the human body
- *Chronic* – Long term exposure results in long-term response in the human body
- *Carcinogenic* – Exposure leads to cancer.

How is human welfare effects classified?

Aesthetic qualities such as good visibility free from air pollution.

Name things that affect the air:

General (specific):

- Particulate Matter (Diesel Combustion, Mills)
- Sulfur Dioxide (Combustion of coal and oil)
- Carbon Monoxide (Carbon Containing materials are not completely combusted)
- Nitrogen Oxides (Fuel Combustion and Industrial Chimneys)
- Tropospheric Ozone (Photochemical reactions between sunlight and nitrogen oxides)
- Lead (Combustion of Leaded Gasoline)

What is particulate matter?

Particulate matter refers to a mixture of small solid or liquid particles suspended in air.

- Cardio Vascular, Lung Disease, Carcinogenic

What is Sulfur Dioxide?

SO_2 is emitted primarily from the combustion of coal and oil, which contain sulfur as an impurity.

- Respiratory problems, Asthma, Acid Rain

What is Carbon Monoxide?

CO is a colorless, odorless gas that is produced when fossil fuels or other carbon carbon-containing materials are not completely combusted

- Dizziness, lack of breath, asphyxiation and death

What are Nitrogen oxides?

Nitrogen oxides oxidize in the atmosphere to for Nitrogen dioxide (NO_2) which is a reddish-brown gas that is toxic in very high concentrations. Nitrogen oxides are primarily produced through fuel combustion.

- Toxic in high concentrations, irritant in low concentrations, acid rain.

What is tropospheric ozone?

Tropospheric ozone or ground-level ozone is formed from complex chemical reactions in the atmosphere involving nitrogen oxides and hydrocarbon gases. These chemical reactions are triggered by summer sunlight, which provides the energy to initiate the

photochemical reactions.

- Oxidant, Extremely reactive and corrosive (in high levels)

What is lead?

Lead is a heavy metal that can cause neurological damage and adverse effects on organs such as the liver and kidneys. It is mainly produced through the combustion of unleaded gasoline.

- Immediate damage to liver and kidneys, especially to children and seniors.

What is acid rain and describe how acid rain is produced

Acid rain (also known as acid deposition) refers to the fallout of acidic particles through precipitation. Acid rain is produced when sulphur oxides (SO_x) and nitrogen oxides (NO_x) react with water in the atmosphere to form sulphuric acid and nitric acid. The sulphur and nitrogen oxides are primarily released through the burning of fossil fuels.

What are the effects of Acid Rain?

- Acidification of freshwater lakes and streams and result in the death of aquatic organisms.
- Contributes to the decline of some species of trees
- Soil acidification disrupts the complex soil chemistry that provides nutrients to vegetation and indirectly affects soil erosion, sedimentation of waterways, and changes in animal habitat.
- Deterioration of some building materials and monuments made of limestone or marble.

What is Stratospheric Ozone Depletion?

Stratospheric Ozone Depletion is the depletion of the ozone by human-made chemicals, most notably the family of compounds known as chlorofluorocarbons.

Water Pollution

Name things that affect the water

General (specific):

- Pathogens (Human and animal feces)
- Organic matter/waste (biodegradable organic wastes)
- Nutrients (Agriculture and Detergents)
- Toxic Organic Chemicals (Synthetic Organic Compounds)
- Toxic Metals (Mercury, Arsenic, Lead)
- Sediments (Land Erosion from human activities)
- Acidity (Sulphuric acid, when sulphur-bearing minerals react with water)
- Salts (industrial and municipal discharges)
- Heat (Electric Power Plants)

What are Pathogens?

Pathogens are disease-causing agents such as bacteria, viruses, protozoa, and parasitic worms called helminths. These microorganisms are commonly found in the intestines of

infected people or animals, and then are excreted in the feces that enter the sewer systems or fall onto the ground.

- Typhoid, diarrhoea, cholera, etc.

What are Organic Wastes?
Organic wastes are the main source of *oxygen-depleting substances* in surface water. (Biodegradable chemicals)

What are Nutrients?
Nitrogen and phosphorous are two essential nutrients needed to support vegetation and other forms of life. These chemicals are widely used in fertilizers and household detergents.

- Over-enrichment of nutrients in lakes, rivers, or streams that leads to a condition called *eutrophication*

What are Toxic Organic Chemicals?
Synthetic organic chemicals, which contain addition substances like chlorine, are potentially toxic to people, plants, and animals.

What are Toxic metals?
Mercury, lead, arsenic and; The health of humans and other living organisms requires trace levels of certain heavy metals such as: chromium, cobalt, copper, iron, manganese, molybdenum, vanadium, strontium, and zinc.

What are sediments and Suspended Solids?
Sediment consists of soil particles that enter a water body and eventually settle to the bottom.

What is Acidity?
Acidity is a key factor in water's ability to support aquatic life. Chemically, acidic water reflects a high concentration of hydrogen ions in solution. pH>7 Basic or Alkaline, pH<7 acidic

What are salts?
Salts refer to compounds of elements, including calcium, magnesium, sodium, and potassium, that produce positively charged ions in solution. Salts dissolve naturally into water bodies as water flows over rocks and soils. Human-made sources enter waterways via industrial and municipal discharges and urban runoff.

What is implied by heat?
Thermal pollution, primarily from waste heat generated at electric power plants, creates a plume of warmed water that can be detrimental to fish and plant life.

What is the percentage of leaking underground gasoline storage tanks?
12%

What are the standards for drinking water based on?

- Total Coliform bacteria
- Fecal Coliform and E. Coli

<u>Solid and Hazardous Wastes:</u>

Name three things that affect the soil

General (specific):

- Solid Waste (Paper and paperboard)
- Hazardous Waste (Wastewater treatment)
- Radioactive Waste (Uranium mining, milling, and refining)

What are Solid Wastes?

Solid wastes, also known as non-hazardous wastes, are wastes that have not been designated as Hazardous wastes.

- There are *municipal solid wastes* and they are generated by residences, commercial buildings, and institutional institutions; and
- There are *Industrial Wastes* and they are generated by industrial activities.

What is Hazardous Waste?

Hazardous waste is a solid waste or combination of solid wastes which because of quantity, concentration, or physical, chemical, or infectious characteristics may

- Cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or
- Pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

Name the four characteristics of hazardous waste

- *Ignitability* – An ability to burn easily or cause or enhance fires
- *Corrosivity* – Strong acids and bases, or substances able to corrode metal.
- *Reactivity* – An ability to react violently or cause explosions, including reactions with water.
- *Toxicity* – An ability to threaten water supplies and health, as determined by a *laboratory test of leach-ability.*

What is the Toxicity Characteristic Leaching Procedure?

If the metals and other chemical compounds specified in the TCLP are leached in amounts above specified thresholds, the material is considered toxic and hence hazardous.

What are Radioactive Wastes?

Two key attributes distinguish radioactive wastes:

- Its harmful effects on living organisms are induced by radiation rather than by chemical mechanisms; and
- Radioactive wastes remain dangerous up to hundreds of thousands of years

What is High-level Radioactive Waste?

High-level radioactive waste is the most dangerous. High level waste is characterized not only by the *intensity of its radioactivity* but also by its *very long half-life.*

What is Transuranic Waste?

Waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste with half-lives greater than 20 years, except for high-level waste... *All TRU elements are heavier than uranium, have several isotopes, and are typically man-*

made.

What is Low-level Radioactive Waste?
Any radioactive waste that is not officially classified as high-level waste, transuranic waste, or by-product waste from uranium mining and milling is called *low-level waste*.

What are the 3 purposes for humanity's use and consumption of the Earth's natural resources?
- As a source of food
- As a source of energy, and
- As a source of raw materials for structures, devices and other human endeavours.

What are the two general categories of natural resources?
- *Renewable resources* – Which have the capability to be replenished
- *Non-renewable resources* – Which exist only in finite amounts

What is Environmental Impact?
Environmental impact is a term used to describe some of the broader implications of human activities for the environment

What is an Ecosystem?
The term ecosystem is used to refer to any biological community that functions as a cohesive unit within its physical environment.

<u>Global Warming and Greenhouse Effect:</u>

Name some greenhouse gases, but not the important ones
- CO_2 Carbon Dioxide *(important)*
- CH_4 Methane *(important)*
- N_2O Nitrous Oxide *(Laughing gas)*
- CFC-11, CFC-12, CFC-113, Halocarbons
- O_3 Tropospheric Ozone

What is the definition or climate?
Climate is not synonymous to weather. It is more commonly defined as the "average" weather, patterns typically over a 30-year averaging period. Climate is determined by complex interactions of many factors that together constitute the *global climate system*.

What is the heat flux?
The heat flux is the expression of radiative energy in terms of the rate per unit surface area:

$$\text{Heat flux} = (\text{Total Rate of heat flow})/(\text{Total surface area}) \quad (W/m^2)$$
$$q=Q/A$$

How to find the Radiative heat transfer from a black body?

$$q=5.67(10^{-8})\ T^4$$

Where T is the temperature in Kelvins (Celsius + 273)

What would be the average temperature of earth if the greenhouse effect did not

exist?
-19 degrees Celsius, the average temperature of earth, however, is 15 degrees Celsius.

Explain the Greenhouse Effect:
The greenhouse effect is the trapping of radiation within the atmosphere, which warms the planet. Just as in a greenhouse, most of the incoming radiation (as ultraviolet) gets through to warm the earth's surface, and most of the outgoing radiation (as Infrared) is blocked or absorbed by the atmosphere. Gases that absorb infrared radiation are defined as *greenhouse gases*.

What is the Tropopause?
The Tropopause is the upper boundary of the troposphere approximately 10km above the Earth's surface.

What is Radiative Forcing?
The term *radiative forcing* is used when any change in the net radiative balance will *force* the climate system to readjust so as to ultimately restore equilibrium

$$\Delta F = \Delta q_{(\text{out or in})}$$

What does radiative forcing depend on?
- Wavelength
- Speed
- Frequency

How is the Net Forcing from Atmospheric Changes determined?

$$\Delta F = \Delta q_{out} - \Delta q_{in}$$

Where

Δq_{out} = (W/m^2 outgoing initially) – (W/m^2 outgoing after perturbation)
Δq_{in} = (W/m^2 incoming initially) – (W/m^2 incoming after perturbation)

How to find Equivalent CO_2 Concentration?

$$C_{equi}(ppmv\ CO_2) = C_0\ e^{(\Delta F total/6.3)}$$

What is the climate sensitivity factor γ?
The climate sensitivity factor is known as the ratio of the final temperature change, ΔT_e, to the change in radiative forcing, ΔF_{rad}:

$$\gamma = \Delta T_e / \Delta F_{rad}$$

Climate sensitivity is an important parameter in climate modeling. It relates the net change in radiative forcing caused by greenhouse gases and aerosols to the resulting change in the earth's average temperature.

How to calculate the time lag and Temperature Commitment?

- Equilibrium temperature = (percent change)(CO_2 change *(i.e.doubling)*)

$$\Delta T_e = (\Delta\%)(T_{eq})$$

- Time lag = (time final) – (time initial)

$$\Delta t_{lag} = t_{eq} - t$$

- Temperature commitment = (CO_2 change *(i.e.doubling)*) - (Equilibrium temperature)

$$\Delta T_{commit} = T_{eq} - T_e$$

Where were the tests performed to determine possible past effects of climate change?
Vostok, Antarctica.

How much of a reduction of emissions are required to stabilize atmospheric CO_2 levels?
The international goal of stabilizing atmospheric CO_2 levels will require anthropogenic emissions to roughly 60 to 80% below the 1990 emission rates.

What is the typical carbon and energy content of each fossil fuel?

Energy Source	Carbon Content (%)	Heating Value (kJ/g)	Carbon Intensity (g C/MJ)
Natural Gas	74	54.4	13.7
Crude Oil	85	44.3	19.2
Coal	59	24.2	24.4

How to measure carbon content and mass of carbon emitted:

- 1 mass unit of C = 44/12 = 3.667 mass units of CO_2
- Mass of Carbon emitted = (wt%C / 100) (Mass of fuel burned)
- Mass of carbon emitted = (Energy use) (Carbon intensity)

How to measure Carbon Intensity of Fuels:

- Carbon intensity = (Fuel carbon mass) / (Fuel Energy)
- Carbon intensity = (Fraction of C in fuel) / (Fuel heating value)

What are the factors affecting CO_2 Emissions Growth?

- *Population Growth per year* – This reflects the size of the population and effect of population growth. Increasing population generates greater demand for food, clothing, shelter, and other human needs.
- *GDP per Capita* **–** This measures average affluence. As this term grows, an individual's demand for goods and services also grows.
- *Energy Intensity (energy use / per GDP)* – This is most related to technology and technological change.
- *CO_2 emissions per unit energy* – This depends principally on how the energy is being generated.

Multiply all of these together to get the CO_2 Emissions Growth.

What is carbon Sequestration?
Carbon sequestration is the natural ability of biomass to absorb CO_2 from the atmosphere. This however cannot achieve the sizeable long-term reductions needed to stabilize atmospheric concentrations in the face of global energy demands.

What are the greatest failures of the International society to date?

- Kyoto Protocol
- Copenhagen

<u>Life Cycle Assessment</u>

Describe the Inventory analysis:

- Listing of all inputs (raw materials, energy) and outputs (products, wastes, energy).

- Qualification of each input and output.

Describe the Impact analysis:

- Listing of effects on the environment for each input and output identified in inventory analysis
- Qualitative and/or quantitative description of impacts: adverse effects on human health and welfare, ecosystems, and materials as well as resource depletion

Describe Improvement analysis:

- Listing of needs and opportunities to reduce adverse effects identified in impact analysis and inventory analysis.
- Qualitative and/or quantitative description of improvements.

Human Exposure to Toxic Metals:

What are the principal routes of human exposure to trace metals?

- Inhalation of air
- Ingestion of water
- Ingestion of food
- Ingestion of dust

How to find the mass of trace metal absorbed by the body/time?

Mass of trace metal absorbed by the body/time = $A_i = C_i U_i f_i$

Where
i = air, water, food, or soil/dust
C_i = concentration of the trace metal in medium *i*
U_i = uptake rate of air, water, food or soil/dust
f_i = fraction of trace metal absorbed by the bloodstream

What is the "dose" and how is it determined?

The total amount absorbed is known as the *dose* and it is defined as:

$$D_{total} = (A_{total})(t)$$

Where
A_{total} = the total absorption rate from all exposure routes
t = time of exposure

What can the response to a dose be represented by?

The response to a dose may be represented by a *dose-response curve*. Based on the available dose-response relationships we attempt to establish a maximum safe level below which there are no effects, known as the *threshold level*.

Automobiles and the Environment:

In the United-States, how many fatalities per year are caused by traffic accidents?
40,000

What was the increase in automobiles from 1900 to 2000?
Automobiles have increased from 8,000 to 135 million.

What is the number one environmental issue related to the automobile?
Air pollution is the number one environmental issue related to automobiles.

Although the design of cars has lowered emissions, what factors are off-setting this success?

- Increasing vehicle population
- Increasing travel per vehicle
- Departures from federal standards
- Greater use of light trucks

What is the reason for the immense challenge in regards to automobiles?
The engineering challenge is immense because nearly all cars now run on a single fuel source – petroleum. It is refined into gasoline, diesel oil, and jet fuel, *petroleum supplies about 97% of the energy used for all forms of transportation*.

How much of an automobile is recycled and how much is wasted at its end of life?
Around 75% of car's materials are recycled and 25% disposed.

What are other environmental impacts caused by automobiles?

- Lead Emissions
- CFC Emissions
- Waste Motor Oil
- Other Life Cycle Impacts

How is the Energy Efficiency?

$$\eta = (\text{Useful energy delivered for motion}) / (\text{Total fuel energy input})$$

$$\eta = E / E_{fuel}$$

How is Engine Efficiency calculated?

$$\eta_{engine} = (\text{Useful energy out}) / (\text{Total energy in})$$

$$\eta_{engine} = E_{shaft} / E_{fuel}$$

How is "*useful energy out*" calculated?

$$\eta_{train} = E / E_{shaft}$$

How is the final energy supplied to the drive wheels calculated?

$$\eta = (\eta_{engine})\ (\eta_{train})$$

How is fuel consumption calculated?

$$E_{fuel} = E / \eta$$

Or expressing in terms of the fuel needed to drive a given distance d

$$(E_{fuel}) / d = (1/ \eta) (E/d)$$

Risk Assessment and Decision Analysis:

What is Risk?

Risk = (probability of a *specific* undesired consequence) (Size of loss)

How does one assess risk?

- Subjective (as opposed to objective) personal opinion
- Understanding (we cannot assess what we do not understand)
- Exposure to the risk (over time, quantity)

What is a Hazard Assessment?

A hazard assessment is determining whether there is any potential problem from exposure to a given chemical

What is the Dose-Response assessment?

If the hazard assessment establishes that a chemical can cause some type of health effect, then quantify the relationship between the dose and the chemical – the mass of chemical ingested or received – and the resulting response or adverse effects. There are two types:

- *Carcinogenic Effects*
- *Non-Carcinogenic Effects*

What is the Exposure Assessment?

Quantifying the dose actually received in a particular situation. The purpose is to measure or estimate the frequency, intensity, and duration of human exposure to a chemical agent in the environment.

What is Risk Characterization?

Risk characterization is the act of combining the results of the exposure assessment with the dose-response function for each chemical in concern.

How is Chronic Daily Intake calculated?

CDI (*mg/kg-day*) = (Average daily dose (*mg/day*)) / (Body weight (*kg*))

What is the potency factor?

PF $(mg/kg\text{-}day)^{-1}$ = Incremental Cancer Risk for a Chronic Daily Intake of 1 mg/kg-day

How is the incremental risk of lifetime cancer risk calculated?

Incremental lifetime cancer risk = (CDI) (PF)

What level of risk is acceptable for a known or suspected carcinogen?

The EPA has concluded that a *lifetime* risk level of 10^{-6} (one chance in a million) or less

can generally be regarded as acceptable or inconsequential, whereas a lifetime risk of 10^{-3} (one chance in a thousand) or greater is considered serious and is a high priority for attention.

What is the reference dose and how is it measured?
The reference dose is a key parameter used in risk assessments to characterize the safe dose of a non-carcinogenic chemical.

$$RfD\ (mg/kg\text{-}day) = (NOAEL) / (UF)\ (MF)$$

Where, UF is the *uncertainty factor* and MF is the *modifying factor*.

What is the hazard quotient and how is it measured?
The Hazard quotient is the metric used in risk assessments to compare an actual dose of a chemical to the reference dose.

$$HQ = ADD / RfD$$

What is the hazard index?
The hazard index is the sum of all hazard quotients.

What are the options to dealing with unacceptable risks?

- *The source of the risk can be reduced or eliminated*, such as by removing contaminated soil, closing a facility, or installing environmental control technology to reduce emissions
- *The exposure pathway can be modified or avoided*, such as by installing an engineered barrier that prevents contaminant migration through the soil, or a tall chimney that disperses pollutants beyond the local community
- *Human exposure to the contaminants can be reduced or eliminated*, such as by relocating the affected population or prohibiting access to contaminated areas.
- *Effects can be treated or compensated for after they occur*, such as by medical treatment or monetary payments from parties responsible for the contamination

What are the different methods of decision analysis?

- An *influence diagram* is a way of visualizing the important connections among different elements of a problem. (symbolic shapes may be used)
- A *decision tree* is designed to highlight the ramifications of alternative decisions and uncertain events. The process of solving the tree is known as *folding back the tree*.

<u>Environmental Forecasting</u>

Define the term "Forecast":
The term *forecast* is generally used when one purports to know what will actually happen in the future. The terms *projection* and *prediction* often have the same connotation.

Define the term "Scenario":
In contrast to forecasts, a *scenario* attempts to describe what *would* happen *given some specified set of circumstances.* Rather than trying to predict what *will* happen in the

future, scenarios typically describe a *range* of possible outcomes that logically follow from different *assumptions* about key factors or events that can affect the outcome.

What is the time period of concern?
The time period of concern is an important characteristic of any environmental forecast or scenario. It can be defined as *near-term*, *midterm* or *long-term*.
What is the Spatial Scale of Concern?
The spatial scale is the different geographic scales that may be of interest for different types of environmental problems. It can be defined as *local*, *regional*, *national* or *global*.

How do engineers attempt to predict or assess future conditions?
They use Mathematical Modeling

What are the primary drivers of environmental change?
- *Population*
- *Standard of Living*
- *Technology*

What are some of the Population Growth Models?
- *Annual Growth Rate Model* – Quantifies the growth of a population assuming a constant annual growth rate.
- *Exponential Growth Rate Model* – Quantifies the growth of a population assuming that at any given point in time the rate of change in population is proportional to the total population at that moment.
- *Logistic Growth Model* - Quantifies the growth of a population assuming the same thing as an exponential growth rate model, but it also depends on the size of the current population relative to the carrying capacity P_{max}.
- *Demographic Model* – Growth Rate = (Birth Rate) – (Death Rate) + (Immigration Rate)
    - Age structure of a population
    - Fertility Rates
    - Projecting Future Population

What are some of the Economic Growth Models?
- *Activity Coefficients* – Total cars = (Cars / Person) (Population)
- *Economic Growth and Energy Use* – Attempting to correlate changes in GDP with other changes in the economy that have a bearing on environmental impacts.
- *Input-Output Models* – This type of model quantifies the value of goods and services that each sector requires from other sectors (the inputs) in order to make its own product (the output).
- *Macroeconomic Models* – This model concerns itself with the structure and performance of national economies and the effect of government policies on aggregate economic activity.

What are the different types of technological change?

- *Improvements to a current technology design*
- *Substitution of an alternative technology*
- *New classes of technology*
- *Change in technology utilization*

What are some models to measure the rates of technology adoption?

- *Specified Rate of change* – The most direct method of introducing a new technology is to specify its rate of adoption or diffusion into the economy.
- *Specified Market Share* – Specifying the market share at different points in time
- *Consumer Choice Models* – Introduce new technologies based on consumer preferences

Acronyms:

Processes:

- BOD – Biological Oxygen Demand
- COD – Chemical Oxygen Demand
- MACT – Maximum Available Control Technology
- TRI – Toxic Release Inventory
- MCL – Maximum Contaminant levels
- NPDES – National Pollutant Discharge Elimination System
- TCLP – Toxicity Characteristic Leaching Procedure
- EIS – Environmental Impact Statement
- GCM – General Circulation Model
- GWP – Global Warming Potential
- VMT – Vehicles-Miles of Travel
- CDI – Chronic Daily Intake
- NOAEL – No Observable Adverse Effects Level
- LOAEL – Lowest dose with Observed Adverse Effects Level
- UF – Uncertainty Factor
- MF – Modifying Factor
- ADD – Average Daily Dose
- RfD – Reference Dose
- HQ – Hazard Quotient
- HI – Hazard Index

Acts/Standards:

- SWDA – Safe Water Drinking Act
- FWPCA – Federal Water Pollution Control Act
- RCRA – Resource Conservation and Recovery Act
- AEC – Atomic Energy Act
- NWPA – Nuclear Waste Policy Act
- NEPA – National Environmental Protection Act
- CAA – Clean Air Act
- NAAQS – National Ambient Air Quality Standard
- NSPS – New Source Performance Standards

Things:

- LUST – Leaking Underground Storage Tanks

- MSW – Municipal Solid Waste
- TRU – TRansUrenic
- WIPP – Waste Isolation Pilot Plant
- LLW – Low-Level Waste
- HAP – Hazardous Air Pollutants
- CFC – Chlorofluorocarbons
- VOC – Volatile Organic Compound
- ROG – Reactive Organic Gases
- TSP – Total Suspended Particulates
- TSS – Total Suspended Solids
- TDS – Total Dissolved Solids
- HHV – Higher Heating Value
- LHV – Lower Heating Value
- LEV – Low Emission Vehicle
- ESP – ElectroStatic Precipitator
- FGD – Flue Gas Desulfurization
- SCR – Selective Catalytic Reduction
- SNCR – Selective Non-Catalytic Reduction
- CHP – Combined Heat and Power
- IGCC – Integrated Gasification Combined Cycle
- PWR – Pressurized Water Reactor
- BWR – Boiling Water Reactor
- PF – Potency Factor
- GDP – Gross Domestic Product

Agencies/Governmental panels:

- EPA – Environmental Protection Agency
- IPCC – Intergovernmental Panel on Climate Change
- WCED – World Commission on Environment and Development
- DOE – Department Of Energy
- NRC – National Research Council
- WMO – World Meteorological Organization
- UNEP – United Nations Environmental Program