

# Ethics in Engineering and Research

## Lecture #12 Environmental Ethics (Part 1)

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## • Environmental Issues

- Increase levels of greenhouse gases
  - Global Warming, Sea level rise
  - Pollution
  - Extinction of species
  - Destruction of ecosystems
  - Depletion of natural resources
  - Waste
  - .....
- Ecological awareness as a part to engineer's responsibility

# Engineering , Ecology and Economics

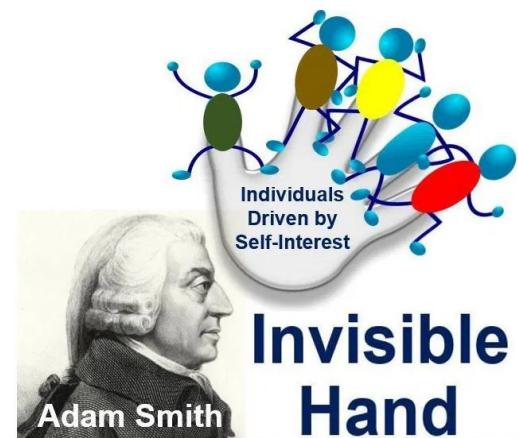
- If your technology messes up the environment, it can affect the health and safety of many humans!
- Environmental ethics = (1) the study of moral issues concerning the environment and (2) moral perspectives on those issues
- Two powerful metaphors have dominated thinking about the environment:
  - the invisible hand
  - the tragedy of the commons
- Both metaphors highlight unintentional impacts of the marketplace on the environment
- But one is optimistic and the other is cautionary

# The Invisible Hand

- The “invisible hand”: Adam Smith, 1776, “*The Wealth of Nations*”
- Businesspersons think of only their self-interest
- “It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest”
- Yet although “he intends only his own gain”, he is “led by an invisible hand to promote an end which has no part of his intention”
- By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it

- Professionals and many businesspersons do profess to “trade for the public good”, claiming a commitment to hold paramount the safety, health, and welfare of the public
- Predominantly motivated by self-interest, they also have genuine moral concern for others
- Companies benefit society in many ways through self-interest:
  - Create companies that produce goods and services for consumers
  - Competition drives quality improvements and cost reductions
  - New jobs for employees and suppliers
  - Wealth supports consumerism, taxes, and philanthropy

- Invisible hand metaphor does not adequately take into account damage to the environment
  - Pollution
  - Destruction of natural habitats
  - Depletion/damage of shared resources
- Self-interest of companies cannot be relied on to protect the environment



# Tragedy of the Commons

- Aristotle observed we tend to be thoughtless about things we do not own individually and which seem to be in unlimited supply
- W.F. Lloyd and G. Hardin: **Tragedy of the commons**: e.g., cattle in the common pasture of a village were more stunted than those kept on private land. Common fields were more worn than private land.

# The Tragedy of the Commons



Use of the commons is below the carrying capacity of the land. All users benefit.

If one or more users increase the use of the commons beyond its carrying capacity, the commons becomes degraded. The cost of the degradation is incurred by all users.

Unless environmental costs are accounted for and addressed in land use practices, eventually the land will be unable to support the activity.

- Individual farmers are motivated by self-interest to enlarge their common-pasture herd by one or two cows, given that each does negligible damage.
- Yet, when all the farmers behave that way, the result is the tragedy of overgrazing that harms everyone
- The same kind of competitive, unmalicious, but unthinking exploitation arises with all natural resources held in common
  - Air, land, forest
  - Lakes, oceans, endangered species
  - Entire biosphere



- Today, a wide consensus that we need concerted responses to ecological concerns that combine economic realism with ecological awareness
- Engineers play a key role in that consensus
  - Develop technical details on environmental impact, encourage corporations to be concerned about the environment
  - Help set policy, help follow laws
  - Help make it economically feasible

# Engineers: Sustainable Development

- Historically, engineers were not as responsible concerning the environment as they should have been. They simply reflected attitudes predominant in society.
- Individual engineers differ considerably in their views, including their broader holistic views about the environment (e.g., politics affect)
- All engineers should reflect seriously on environmental values and how they can best integrate them into understanding and solving problems

# What is “Sustainable Development”?

- United Nations World Commission on Environment and Development, *Our Common Future*, 1987:
  - Sustainable development = development that meets the needs of the present without compromising the ability of future generations to meet their own needs



# Other views on sustainability

- But should “needs” be the central focus of sustainability”?
- Solow defines “sustainability as the requirement that the next generation must be left with whatever it takes to achieve a standard of living at least as good as our own and to look after their next generation similarly.”
- Amartya Sen (in “The Idea of Justice”) says we need to sustain, and when possible expand, freedoms (including the freedoms to meet our needs and to live our life according to certain standards) and capabilities, and what humans value and have reason to think are important, without compromising these for future generations.

- ASCE:
  - Sustainable development is a process of change in which the direction of investment, the orientation of technology, the allocation of resources and the development and functioning of institutions [is directed] to meet present needs and aspirations without endangering the capacity of natural systems to absorb the effects of human activities, and without compromising the ability of future generations to meet their own needs and aspirations.





# Codes of Ethics and “Sustainable Development”

- ASCE, 1997:
  - Engineers shall hold paramount the safety, health, and welfare of the public and shall strive to comply with the principles of sustainable development in the performance of their professional duties.
  - Also have requirement to notify “proper authorities” when the principles of sustainable development are violated by employers, clients and other firms

# IEEE Code of Ethics

- 1. To accept responsibility in making engineering decisions consistent with the safety, health, and welfare of the public, and to disclose promptly factors that might endanger the public or the environment
  - Weak!
  - No hold “paramount”
  - No integration of the concept of sustainable development

# Corporations: Environmental Leadership

- In present climate, it is good business for a corporation to be perceived by the public as environmentally responsible
- Example: Compaq Computer Corp. (now merged with Hewlett-Packard), Life-cycle strategy, “Design for Environment”
  - Efficient use of resources
  - Energy-efficient products
  - Easy disassembly for recycling
  - Waste minimization

# Nespresso's Sustainability Program

The screenshot shows the Nespresso website with a dark header featuring the Nespresso logo and navigation links for Register, Login, and Your Basket (0). Below the header is a horizontal menu with categories: Selected Promotions, Coffee, Machines, Accessories, Become a Member, Sustainability, Our Service, Find us, and Professional. The main content area has a large background image of a person recycling coffee capsules. Overlaid on this image are several text elements and icons. On the left, there are three circular images: a person working in a field, a globe, and a close-up of colorful capsules. To the right of these images are sections for the Nespresso Recycling Program, B Corp certification, and recycling points. A central text block provides instructions for ordering capsules online or by phone. A white call-to-action button labeled 'FIND MORE' is located at the bottom right.

Sustainable coffee quality

Doing is everything.

Nespresso Recycling Program

FRESHLY CERTIFIED  
B CORP™

Nespresso is proud to join the global B Corp™ movement.

RECYCLING POINT

We are committed to delivering premium coffee, responsibly. Together we can minimize our impact, that's why we make it easy for you to recycle.

HOW CAN YOU RECYCLE YOUR CAPSULES?

By internet, on mobile or by phone, order your capsules from 6:00-24:00 with the solution that best suits your needs...

RECYCLING POINT

FIND MORE

- Other Examples

- Usage of Biodegradable Materials in products
- Reduce-Reuse-Recycle campaign
- Earth Day Celebration
- No plastic bag in supermarket or reuse



# Government: Technology Assessment

- Government laws and regulations are the lightning rod in environmental controversies.
- Need laws to protect degradation of the commons
- But how much law, and what sort, and to what ends, are matters of continual disagreement

- Incentive policy and tax rebate for renewable energy installation, electric vehicle, etc.
- Carbon credit
- Paris Agreement (limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C, compared to pre-industrial levels)
- Kyoto agreement (signed by 150 governments in 1997, to reduce carbon emissions to 5.2 percent below 1990 levels by 2012)
- And others .....

# Environmental Laws...

- National Environmental Policy Act, 1969
- Occupational Safety and Health Act, 1970
- Clean Air Act, 1970
- Clean Water Act, 1972
- Toxic Substances Control Act, 1976

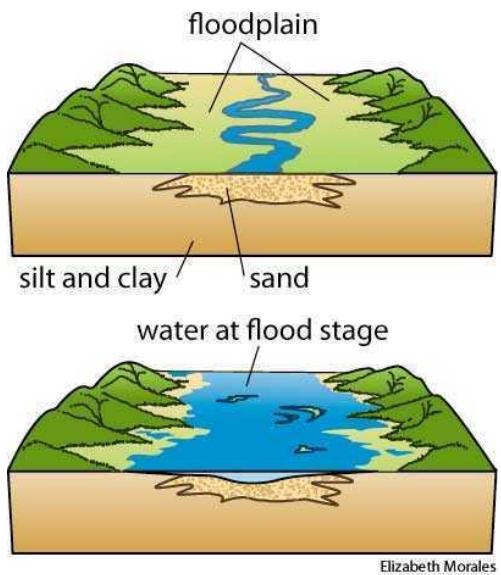
Find out the environmental laws in China.  
Do it as homework!

# Market Mechanisms: Internalizing Costs

- Typically, only include direct costs of labor, raw materials and use of facilities
- True cost would include
  - Effects of pollution
  - Depletion of energy and raw materials
  - Disposal
- Taxpayers are revolting against higher levies so the method of having the user of a particular product or service pay for all its costs is gaining favor

# Communities: Preventing Natural Disasters

- Communities at local and state levels have special responsibility to conserve natural resources and beauty for future generations.
- They also have responsibility to prevent hurricanes, floods, fires, and earthquakes from becoming disasters
  - Restrictions on human habitat (e.g., homes should not be built in floodplains, homes in prairie country should have tornado shelters, hillsides should be stabilized to avoid landslides, structures should be able to withstand earthquakes, roof coverings should be nonflammable, etc.)



Elizabeth Morales



Floodplain



Tornado shelter



Landslide protection

- Strengthening the lifelines for essential utilities such as water and electricity
- Put in defensive structures such as dams, dikes, breakwaters, avalanche barriers, etc.

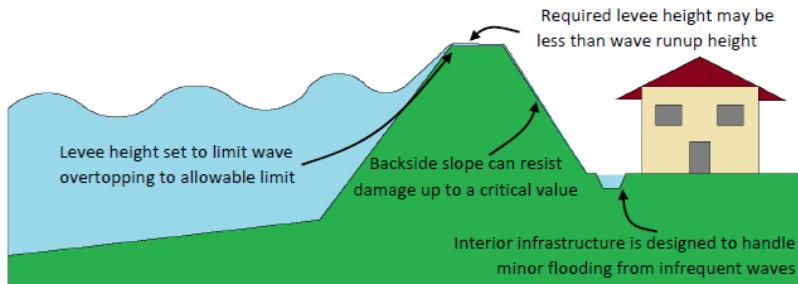
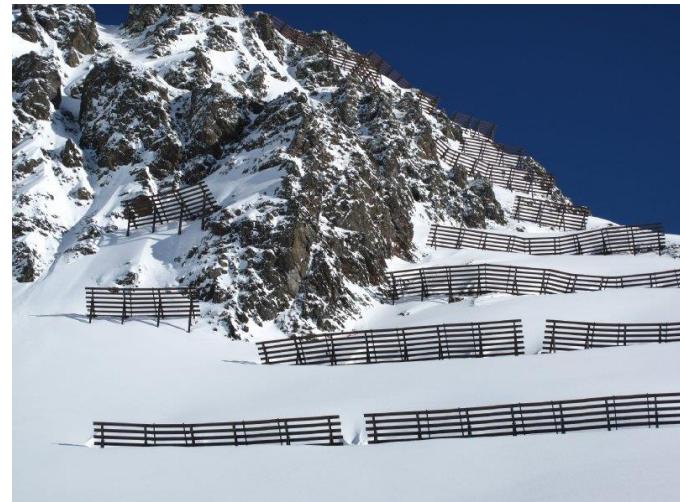


Figure 4 – Diagram of limited allowable wave overtopping.

Allowable overtopping ( $q_{all}$ ) refers to the various levels of tolerable limits of wave overtopping based on the type of structure and the type of risk.



- Assure safe exits in the form of roads and passages designed as escape routes, emergency shelters, adequate clinical facilities, and agreements with neighboring communities for sharing resources in emergencies



# Social Activist

- **Rachel Carson**
  - ❖ Argued successfully against dichlorodiphenyltrichloroethane (DDT) as a toxic insecticide
  - ❖ Highly toxic insecticide that kills a variety of insects beyond the targeted insects
  - ❖ DDT persists in the environment by being soluble in fat, but not being soluble in water
  - ❖ Rachel was patronized, mocked, and reviled as a sinister force that threatened industry due to her scientific precision, poetic expression, and trenchant argument

# Social Activists

- Prof. Sherwood Rowland
  - Identified depletion of ozone layer via chlorofluorocarbons (CFCs)
  - Encountered criticism and protest from industry
  - Verified via NASA
  - Montreal Protocol, mandated CFC phase-out by 2000
  - Rowland and another two scientists were awarded the Nobel Prize in Chemistry in 1995, the first time the prize was given for applied environmental science

# HCFC (R-22) Gas Phase-out Plan Globally



MENU ▾

Search Canada.ca

Canada.ca > Environment and natural resources > Pollution and waste management > Canadian Environmental Protection Act Registry  
> Canadian Environmental Protection Act Registry: publications > Proposed revisions to the Ozone-Depleting Substances Regulations

## Proposed revisions to the Ozone-Depleting Substances Regulations: chapter 3

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### 3. Accelerating the Phase-Out of Hydrochlorofluorocarbons

As a Party to the Montreal Protocol, Canada had committed to the phase-out schedule for domestic consumption of HCFCs as well as to controls on the production of HCFCs for developed countries (known as non-Article 5 Parties).

The Montreal Protocol requires Parties to make the scheduled reductions at an aggregate (Canada-wide) level, and provides individual countries with the flexibility to achieve the reductions in ways that account for the special circumstances applicable in each country.



## R22 PHASE OUT

All 197 United Nations member countries are phasing out the production and import of ozone depleting substances, including R22, under the Montreal Protocol on Substances that Deplete the Ozone Layer.

### Australia's phase out of HCFCs including R22

In 1996 Australia started its phase-out of hydrochlorofluorocarbons (HCFCs), through import controls under the *Ozone Protection and Synthetic Greenhouse Gas Management Act 1989*.

Australia does not manufacture HCFCs and has gradually reduced imports of bulk HCFCs since 1996. Australia's annual import of HCFCs dropped from 250 ODPT (ozone depleting potential tonnes) in 1996 to 2.5 ODPT in 2016. The phase out is supported by bans on new equipment containing HCFCs.



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PCD/ODS/2.6

28 Aug 2012

To: All HCFC Licence Holders and Stakeholders

Dear Sir/Mdm

### HYDROCHLOROFLUOROCARBONS (HCFCs) PHASE-OUT MANAGEMENT PLAN IN SINGAPORE

This circular seeks to inform all local traders and importers of HCFCs about Singapore's implementation of HCFCs Phase-Out Management Plan.

2. Singapore becomes a Party to the Montreal Protocol on Substances that Deplete the Ozone Layer (hereby known as the Montreal Protocol) on 5 Jan 1989. The National Environment Agency (NEA) is the Designated National Authority administering the Montreal Protocol. At the 19<sup>th</sup> Meeting of the Parties (MOP-19) to the Montreal Protocol held in Sep 2007, Parties agreed to adjust their commitments relating to the phase out of HCFCs.

- What are HCFC Phase-out Plan and Schedule in China?
- Do it as homework!

## China: R22 Phaseout Enters New Stage as Gree Destroys Production Lines 09-30-2015

Gree Electric Appliances (Gree)'s destruction of its R22 air conditioner production equipment is a sign that China's transition from HCFCs is entering a new stage. But the government still has a lot of work to do if R290 is to become the dominant substitute for R22, according to analysts [CCM](#).



In late August, China's phaseout of HCFCs took a dramatic step forward as leading air conditioner manufacturer Gree destroyed over 600 pieces of its own R22 production equipment.



# Ethical Frameworks: Human-Centered Ethics

- Focuses exclusively on the benefits of the natural environment to humans and the threats to human beings presented by the destruction of nature
- Assumes that among creatures on earth only human beings have inherent moral worth and hence deserve to be taken into account in making moral decisions concerning the environment

- Utilitarianism says maximize good consequences for human beings
  - Concern many products made from natural resources
  - Aesthetic interests as in the beauty of plants, waterfalls, mountain ranges
  - Recreational interests as in hiking, backpacking
  - Scientific interests in study of ecological preserves like rain forests
  - Survival interests – conserve resources and preserve the natural environment



- Rights ethics: Argues that the basic rights to life and to liberty entail a right to a livable environment
  - W.T. Blackstone: “Each person has this right [to a livable environment] qua being human and because a livable environment is essential for one to fulfill his human capacities. And given the danger to our environment today and hence the danger to the very possibility of human existence, access to a livable environment must be conceived as a right which imposes upon everyone a correlative moral obligation to respect

- Duty ethics:
  - ✓ makes duties rather than rights fundamental
  - ✓ emphasize the need for **conserving the environment** because doing so is implied by respect for human beings who depend on it for their every existence.

- Virtue ethics: emphasizes...
  - Prudence, humility
  - Appreciation of beauty
  - Gratitude toward natural world that makes life possible
  - Stewardship over resources that are needed for future generations
- Not everything of importance within human-centered ethics fits neatly into cost-benefit analyses with limited time horizons
- Much must be accounted for by constraints or limits that cannot be assigned dollar signs

# Sentient-Centered Ethics

- Recognizes all sentient animals as having inherent worth
- Sentient animals: Those that feel pain and pleasure and have desires
- Some utilitarians extend their theory (that right action maximizes goodness for all affected) to sentient animals as well as humans
- P. Singer feels that ignoring sentient animals amounts to discrimination – “speciesism” (but he does allow animal interests to sometimes give way to human interests)

According to P. Singer's Sentient-Centered Ethics,

- Animals deserve equal consideration
- Their interest should be weighted fairly, but that doesn't mean equal treatment with humans
- **Example:** In building a dam that will cause flooding to grassland, engineers should take into account the impact on animals living there.

# Biocentric Ethics

- Life-centered ethics regards all living organisms as having inherent worth
- Schweitzer – “bioemphathy” – our capacity to experience a kinship with other life, to experience other life in its struggle to survive and grow
- He often spoke of reverence for life as the fundamental excellence of character

- Paul Taylor: Four duties:
  - Nonmaleficence which is the duty not to kill other living things
  - Noninterference which is the duty not to interfere with the freedom of living organisms
  - Fidelity which is the duty not to violate the trust of wild animals (as in trapping)
  - Restitution which is the duty to make amends for violating the previous duties

# Ecocentric Ethics

- Locates inherent value in ecological systems (rather than individual organisms)
- A. Leopold: “A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.”
- But, J. Baird Callicott: ecocentric ethic does not “replace or cancel previous socially generated human-oriented duties” (i.e., locating inherent worth in wider ecological systems does not cancel out or make less important what we owe to human beings)

## Coronavirus

# Venice canals run clear, dolphins appear in Italy's waterways amid coronavirus lockdown

20 March 2020, 17:30 | Updated: 3 April 2020, 08:42



## The animals taking back human spaces while the world is in lockdown

While the humans are away the goats, deer, ducks and bears have come out to play



Photograph: Shutterstock

By Ellie Walker-Arnott | Posted: Wednesday April 29 2020

## CRYSTAL CLEAR Himalayas are visible 125 miles away in India for 1st time in 30 years after coronavirus lockdown saw pollution plummet

[Henry Holloway](#)

8 Apr 2020, 16:58 | Updated: 8 Apr 2020, 19:05

# Religious Perspectives

- Judeo-Christian:
  - Genesis: “Be fruitful and multiply, and fill the earth and subdue it; and have dominion over the fish of the sea and over birds of the air, and over every living thing that moves upon the earth”
  - Genesis: Second chapter commands “stewardship over all the earth”, suggesting the role of a caretaker
- Old view is one of “dominion”

- Islam: Koran contains passages that alternate between themes of exploitation of nature for human pleasure and themes of responsible stewardship over what ultimately remains the property of God, not humans
- Judeo-Christian and Islamic Social Justice perspectives – rethinking their traditions in light of what we have learned about the environment (focus now, stewardship)

- Zen Buddhism: stresses unity of self with nature
- Taoism: accents themes of unity with nature and the universe
- Hinduism: promulgates an idea of oneness with nature and the doctrine of “ahimsa”, non-violence and non-killing. It also portrays the sacred and natural as fused symbolized in the idea of divinities being reincarnated in living creatures
- American Indian: Nonhuman animals have spirits. They are to be killed only out of necessity, and then atoned for and apologies made to the animal’s spirit
- Clearly, engineering decision-making on the environment could be influenced by a range of views... and affect differently a range of humans (i.e., how they view technology)

## Case studies...

Student: “I was working for a company that adjusted the level of waste dumped into a river according to the level of the river. In other words, they would dump excess (well over EPA regulations) amounts of waste into the river after periods of excess rain, or would wait until the river rose so that they could dump more waste again.” **What should the engineer do?**

Student: “I used to work for a civil engineer modeling a sewer system. We collected observations from survey crews. One day a photo came in of a company actively dumping industrial waste chemicals (paint) into a sewer. A note was attached, reporting that this is illegal. No one did anything about it.” **What should the engineer do?**

## Students taking action...

Student: "I have worked in industry for a while. Employees were dumping trichloroethane down the sanitary drain (it is a hazardous material). After discussing this with other employees we decided to put a stop to this nonsense." **Should this be reported to the EPA?**

Student: "I was employed for one day at Company X, a place where fuels and other chemicals are tested and created. I was hired as a utility person cleaning glassware, etc. When faced with disposal of heavy metals I inquired as to their procedure. They told me to dump it down the drain and don't ask questions. Clearly this was wrong, but I agreed to do it. Again, when two quarts of diesel fuel was to be disposed, I asked and got the same response. The next day I was fired for being an "environmentalist." I contacted a relative who has ties with the EPA. Recently, I saw that Company X was fined by the EPA for infractions." **Did the student do the right thing?**

## NSPE BER Case No. 07-6

- Engineer A is a principal in an environmental engineering firm and is requested by a developer client to prepare an analysis of a piece of property adjacent to a wetlands area for potential development as a residential condominium. During the firm's analysis, one of the engineering firm's biologists reports to Engineer A that in his opinion, the condominium project could threaten a bird species that inhabits the adjacent wetlands area. The bird species is not an "endangered species" but it is considered a "threatened species" by federal and state environmental regulators. In subsequent discussions with the developer client, Engineer A verbally mentions the concern, but Engineer A does...

- not include the information in a written report that will be submitted to a public authority that is considering the developer's proposal.
- Question: Was it ethical for Engineer A not to include the information about the threat to the bird species in a written report that will be submitted to a public authority that is considering the developer's proposal?