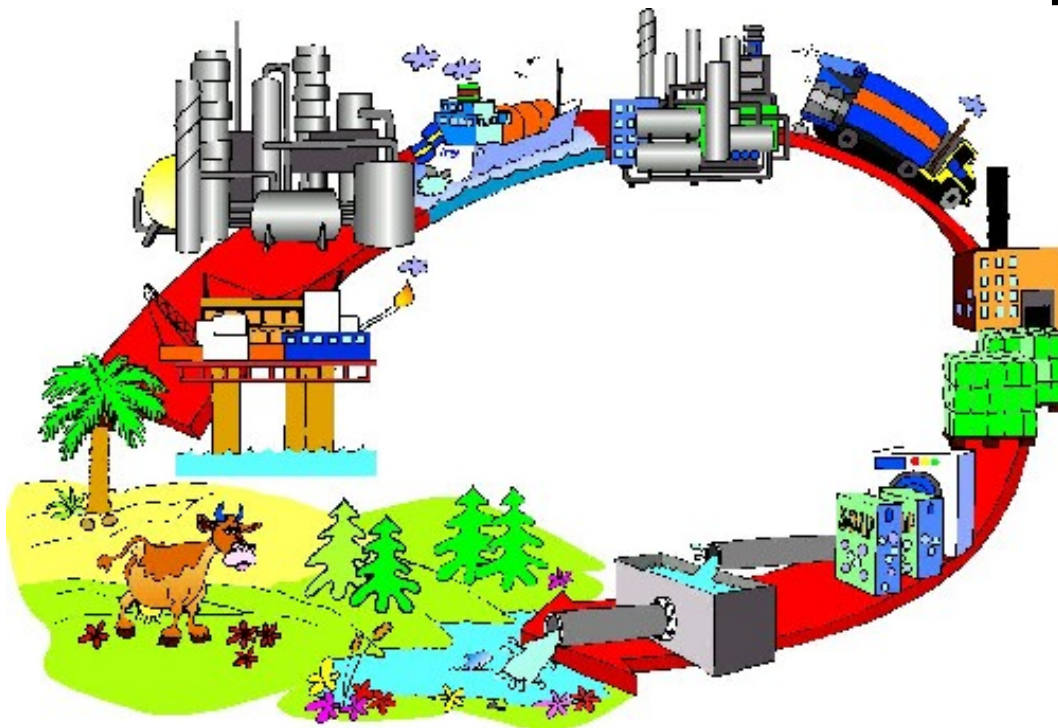


# Environmental Life Cycle Assessment

## PSE 476/FB 576

### Lecture 2: Philosophy of LCA



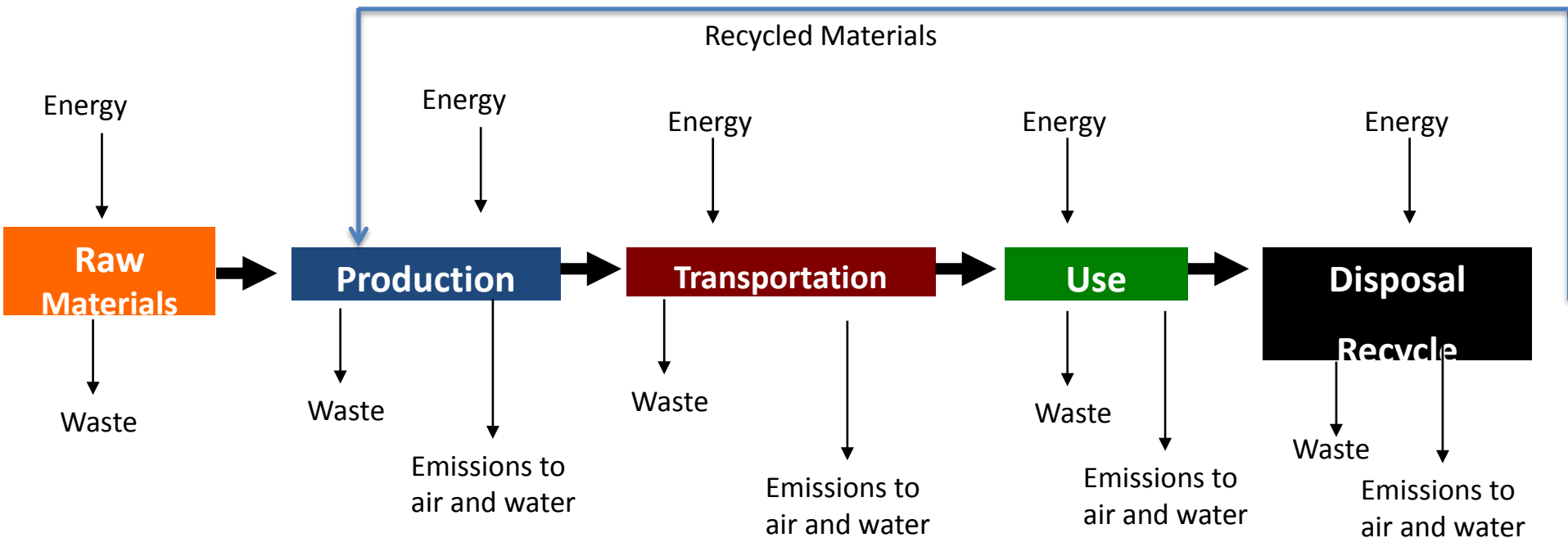
Fall 2016

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# What is a Life Cycle Assessment ?

**Life Cycle Assessment** (LCA) compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle [ISO 14044:2006E].



- Define technosphere
- Define environment
- Show globe

# The Environment and Ecosystems

**Environment:** all of the physical chemical, an biological factors and processes that determine the growth and survival of an organism or community of organisms

**Ecology:** study of the abundance and distribution of organisms in relation to their environment

- The earth has sustained living organisms for >3.8 million yr
- Humans have had the greatest effect on the environment

**Ecosystem:** is the combination of a community of organisms and its physical and chemical environment, functioning as an integrated ecological unit, taken in a specific area.

- Example: lakes, forest, earth
- include **biota**, living organisms
- include **abiotic**, nonliving things

# Ecosystem Services

- **Ecosystem services:** the resources and services provided to humans supplied by ecosystems
  - **Provisioning:** food, water, air
  - **Regulating:** climate, flow of water, absorption of pollution
  - **Cultural:** spiritual and recreational benefits
  - **Supporting:** nutrient cycles, soil formation, pollination...
- No doubt, humans are a special organism with high and fast changing demands of ecosystem services: *stress on ecosystems*

# Paper or plastic?

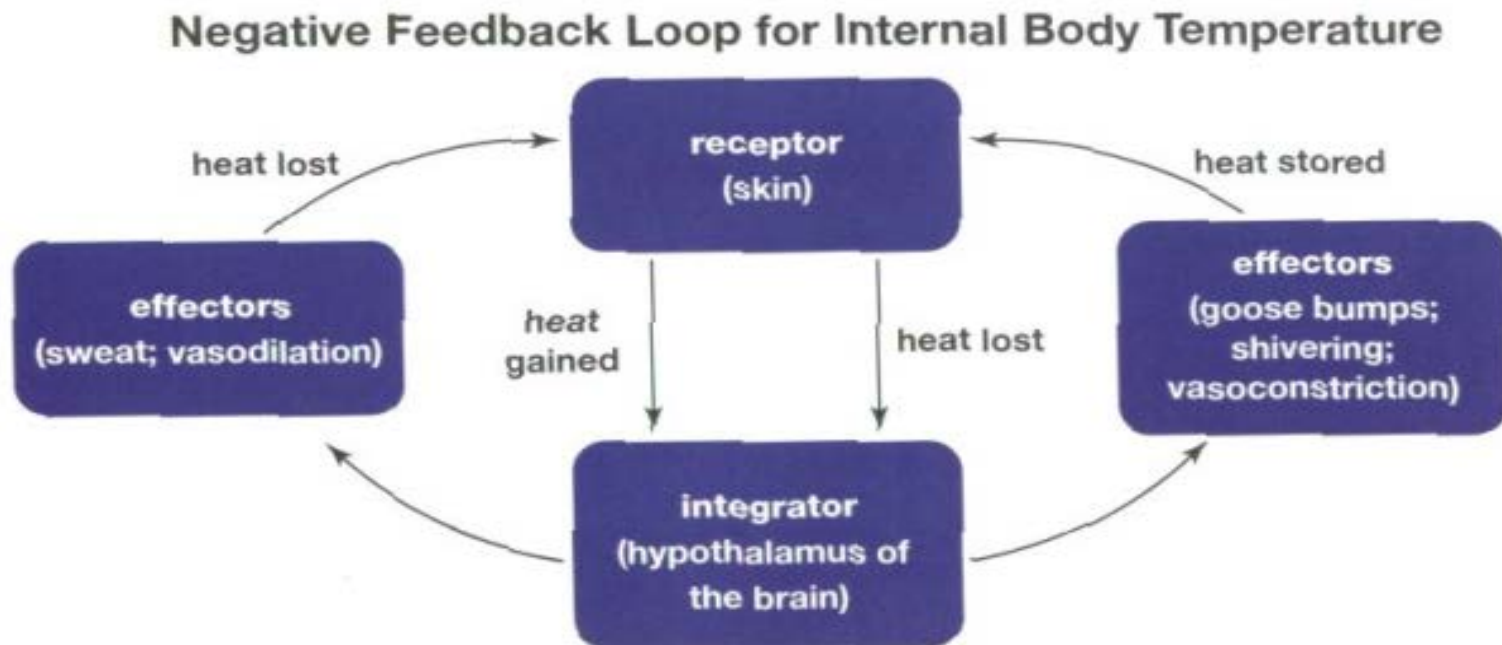


[www.simpleecology.com](http://www.simpleecology.com)

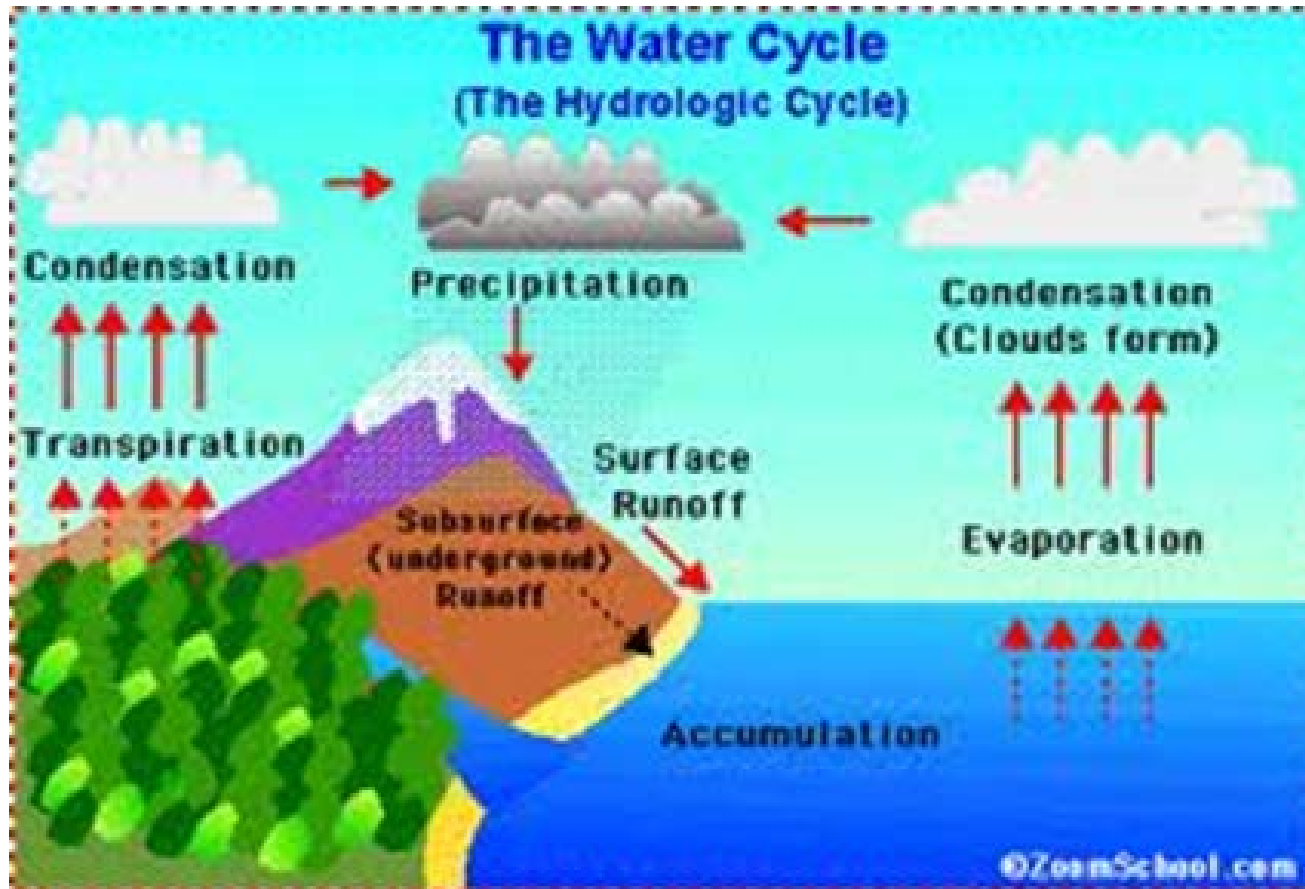
Simple Ecology™ Shopping Bag Analysis											
		Renewable Resource	Energy Required to Make	Water Pollution Created	Air Pollution Created	Chemicals Used	Recycle-ability	Landfill Space (Disposal)	Degrade-ability		
Paper	Yes	Very High	Very High	High	Very High	Med.	Very High	High	Free	Paper	
Plastic	No	Med.	Low	Med.	High	Low	Med.	Very Low	Free	Plastic	

# Ecosystem Stability

- **Dynamic homeostasis:** how systems adjust to minimize variations from normal values
  - Example: body temperature
- **Feedback:** *ability to adjust based on changes in the system*
  - **Negative feedback:**
  - **Positive Feedback:**



# Ecosystem Stability



- How do paved areas impact this?
- How does global warming impact this?



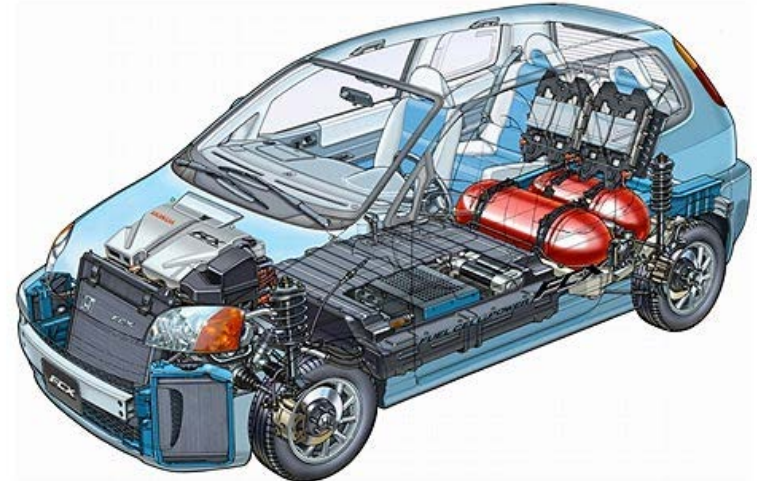
# Ecosystem Stability

- **Dynamic homeostasis:** how systems adjust to minimize variations from normal values
- *Change in ecosystems is inevitable and essential*
- *Will human stress cause change that is not sustainable?*
- *Will positive feedback events occur so that future generations will not be able to live like the current generation?*
- *How can we find thresholds of change?*

# Balance between ecosystem service consumption and Sustainability

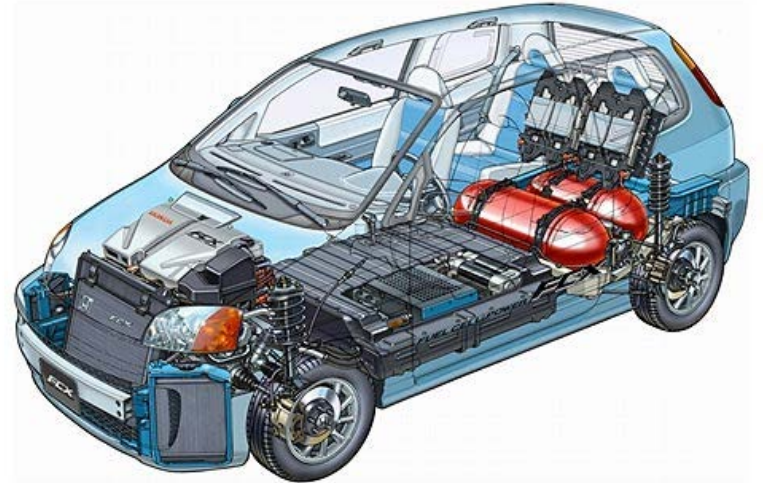
- *You are a college student that needs to sell parts of your car to live.*
- *Assume you had excellent knowledge about how a car works?*
- *What parts would you take off:*

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_



# Balance between ecosystem service consumption and Sustainability

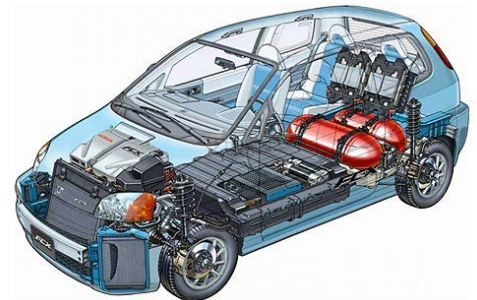
- *You are a college student that needs to sell parts of your car to live.*
- *Assume you had no knowledge about how a car works.*
- *What might be the parts you first start taking off?*



- Uncertainty: there are things that we don't know about ecosystems
  - Ignorance
  - Complexity
- Scientists try to reduce uncertainty using hypotheses and the scientific method
- ***The uncertainty is critical since we don't know which types of ecosystem service consumptions will result in positive or negative feedback***

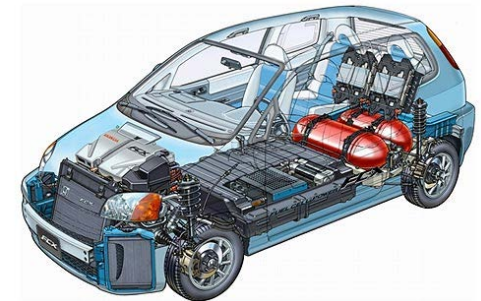
# Systems Thinking

- **Systems thinking** is the process of understanding how things influence one another within a whole.
  - In nature, examples include ecosystems in which various elements such as air, water, movement, plants, and animals work together to survive or perish.
  - In organizations, systems consist of people, structures, and processes that work together to make an organization healthy or unhealthy.
- an approach to problem solving
- viewing "problems" as parts of an overall system, rather than reacting to a specific part, outcomes or events and potentially contributing to further development of unintended consequences.
- Systems Thinking for a car: \_\_\_\_\_
- Parts Thinking for a car: \_\_\_\_\_



# Parts Thinking Examples

- Life cycle analysis is best approached as a systems thinking activity
- **Issue:** Over focus on global warming. Unintended consequences. Changing fuel sources (gasoline to corn ethanol).
- Parts thinking:
- System thinking:
- **Issue:** Motorcycles in developing countries.
- Parts thinking:
- System thinking:



# Parts Thinking Examples

- The introduction of rabbits to Australia by Europeans, which became economically and environmentally damaging, as the rabbits had no natural predators.
- The draining of American wetlands since colonial times, resulting in flash-flooding and seasonal droughts.
- The installation of smokestacks to decrease pollution in local areas, resulting in spread of pollution at a higher altitude, and acid rain on an international scale.
- Cane toads, introduced into Australia to control canefield pests, were unsuccessful and have become a major pest in their own right.
- Kudzu, introduced as an ornamental plant and to prevent erosion in earthworks, has become a major problem in the Southeastern United States. Kudzu has taken over lands and displaced native plants.



[http://en.wikipedia.org/wiki/Unintended\\_consequences](http://en.wikipedia.org/wiki/Unintended_consequences)

# Piece Thinking Examples

- **After about 1900, public demand led the federal government to fight forest fires in the American West, and set aside land as national forests and parks to protect them from fires. This policy led to fewer fires, but led to growth conditions that made what fires did occur much larger and more damaging. Modern research suggests that a certain level of wildfires is a natural and important part of forest ecology.**
- **In 1989 in Mexico City the mandatory Hoy No Circula ("one day without a car") program was launched to lower pollution levels in the city. Citizens began to purchase cheap old cars in order to be used in the off-day and soon the number of cars on the streets was the same as before. The old-new car mixture was different though, and pollution levels raised instead of lowering.**



# Ethical Dilemma:

- A pregnant woman leading a group of people out of a cave on a coast is stuck in the mouth of that cave. In a short time high tide will be upon them, and unless she is unstuck, they will all be drowned except the woman, whose head is out of the cave. Fortunately, (or unfortunately,) someone has with him a stick of dynamite. There seems no way to get the pregnant woman loose without using the dynamite which will inevitably kill her; but if they do not use it everyone will drown. What should they do?

<http://examples.yourdictionary.com/ethical-dilemma-examples.html>

# Ethical Dilemma:

- Your newspaper has published a report on a national study, which concluded that bottled water has virtually no health advantages over the tap water in more cities, including yours. The study included comments from local health storeowners and water distributors challenging the study. The AquaPure Bottled Water Company, advertising account worth over \$75,000 per year, has threatened to pull its account with your newspaper unless you run another story of equal prominence, focusing on the benefits of bottled water. What do you do?

# Ethical Dilemma:

- Tony, a data analyst for a major casino, is working after normal business hours to finish an important project. He realizes that he is missing data that had been sent to his coworker Robert. Tony had inadvertently observed Robert typing his password several days ago and decides to log into Robert's computer and resend the data to himself. Upon doing so, Tony sees an open email regarding gambling bets Robert placed over the last several days with a local sports book. All employees of the casino are forbidden to engage in gambling activities to avoid any hint of conflict of interest. Tony knows he should report this but would have to admit to violating the company's information technology regulations by logging into Robert's computer. If he warns Robert to stop his betting, he would also have to reveal the source of his information. What does Tony do in this situation?

# Ethical Dilemma:

- You are doing an LCA consulting job for a major client, a \$350,000 project, the largest your company has ever obtained. You are doing a carbon footprint of the factory of the client. They have given you emissions data from their stacks for the last week. You calculate their carbon footprint and it looks good. The client is ecstatic and says they probably have other projects for you to do. You ask for some other information about the process and they send you a complete summary report on the entire factory for a year period. You notice there is emissions data from the stacks for the whole year. On 98% of the days the stacks have low emissions and the carbon footprint calculated based on this data looks really good. However, on 2% of the days the emissions are reported as high. You have one major contact in the company that you interface with, the contact is an accountant. When you enquire, your client contact says the gas tester sometimes gets stuck and gives inaccurate test results. What do you do?

# Ethics



- Ethics refers to **well-founded standards of right and wrong that prescribe what humans ought to do**, usually in terms of rights, obligations, benefits to society, fairness, or specific virtues.
- Ethics, for example, refers to those standards that impose the reasonable obligations to refrain from rape, stealing, murder, assault, slander, and fraud.
- Ethical standards also include those that enjoin virtues of honesty, compassion, and loyalty.
- Ethical standards include standards relating to rights, such as the right to life, the right to freedom from injury, and the right to privacy. Such standards are adequate standards of ethics because they are supported by consistent and well-founded reasons.
- Do unto others as you would have done unto you.....

<http://www.scu.edu/ethics/practicing/decision/whatisethics.html>

# Ethics in LCA

- The American Center for Life Cycle Assessment supports adherence to this code of ethics regarding LCAs. All members of the American Center for Life Cycle Assessment therefore make the following commitments:
- To make maximum use of national and international standards, particularly the ISO 14040 series standards, and U.S. federal FTC guidelines for claims when conducting an LCA;
- To avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;
- To be honest and realistic in stating claims or estimates based on available data;
- To the greatest extent consistent with retaining confidential business information, to disclose data and estimates in a full and transparent manner;
- To clearly distinguish between professional extrapolations and value judgments when developing, performing and using life cycle assessments;

# Ethics in LCA

- The American Center for Life Cycle Assessment supports adherence to this code of ethics regarding LCAs. All members of the American Center for Life Cycle Assessment therefore make the following commitments:
- To improve the understanding among LCA professionals, the general public and decision-makers of Life Cycle Assessment, its appropriate application, and potential consequences;
- To maintain and improve one's technical competence and to undertake tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations;
- To seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, and to credit properly the contributions of others;
- To treat fairly all persons regardless of such factors as race, religion, gender and sexual orientation, disability, age, or national origin; and
- To assist colleagues and co-workers in their professional development and to support them in following this code of ethics.

# Ethics: Uses of LCA's:

Application	Requirement on Methodology
Decision making, choices between alternative actions	Reflections of consequences of actions, fairness to all alternatives, inclusion of reasonable alternatives
Market communication	Fairness, possibility to compare results to other options, clarity
Purchasing decisions	Results presented on a high level of aggregation, simplicity, fairness to all options
Decisions on national, state, or local level, government policies	Data representing all regions of the national, state, or local area
Internal use to improve a product	Site specific data, to a detail such that individual changes can be understood



# Ethics: Choices in LCA

- Quality of data
- Boundaries
- Allocation
- Best case / worst case





# Summary

- Ecology
- Ecosystems
- Ecosystem services
- Dynamic homeostasis
- Negative feedback
- Positive feedback
- Ecosystem stability
- Ecosystem consumption
- Systems thinking
- Piece thinking
- Sources of Uncertainty
- Ethics in LCA