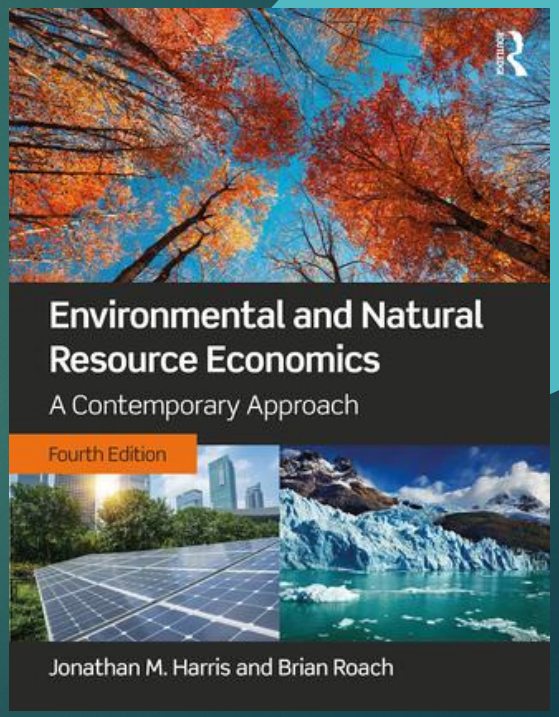
ECO2118A
Introduction to Environmental & Natural Resource Economics

G. Lenjosek, University of Ottawa

The Role of Economics & Alternative Approaches



Times have changed !!

- People have become increasingly aware of environmental problems at the local, national and global levels
- For example, in the case of fossil fuels (a depletable natural resource)
  - In the 1970s, the focus was on security of supply
  - In the 1980s, it moved towards energy efficiency and energy conservation
  - In the 1990s, it shifted to alternative forms of energy production (e.g., wind, solar)
  - More attention is now being paid to how the burning of fossil fuels contributes to greenhouse gas emissions and climate change, and affects the environment
- Despite international efforts, environmental problems in the areas of atmosphere, land, water, biodiversity, chemicals and wastes have continued or worsened
  - Except for ozone depletion – major reductions achieved through international agreement
- Global population growth underlies all these issues
  - 7.6 billion in December 2017
  - 11.8 billion by 2100 (U.N. estimate)

Some Major Environmental Issues

- Nitrogen pollution in freshwater and oceans
- Exposure to toxic chemicals and hazardous wastes
- Forest and freshwater ecosystem damage, including wetlands
- Water contamination and declining groundwater supplies
- Urban air pollution and wastes
- Overexploitation of major ocean species
- Climate change
- Species extinction
- The scale of economic activity has extended the scope of environmental problems across geographic (Great Lakes pollution) and generational boundaries (loss of biodiversity)

Why Economics?

- Can environmental issues be judged in terms of monetary values?
- Environmental policies are often evaluated in terms of their economic costs
  - Preservation of land with high commercial value
  - Hydraulic fracturing ("fracking")
  - Cost of reducing carbon dioxide emissions (1997 Kyoto Protocol and 2015 Paris Accord)
  - Oil production versus environmental protection (fragile ecosystems, pipelines)
  - Human needs versus environmental protection
  - Unilateral action may make a country/industry vulnerable to competition
- Conflicts often arise between economic development and the environment
  - Is environmentally friendly development possible?
  - There are trade-offs
  - Economics studies how people make decisions
    - All decisions involve trade-offs

The Role of Economics

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- Economics is the study of the allocation (via prices) of scarce resources (typical) among alternative uses (many) to satisfy human wants (willingness to pay)
- Economists study
  - How people make decisions
    - Consumers: How much to work, what to buy, how to invest their savings
    - Firms: What resources and technology to use to produce a good, what to produce
  - How people interact with each other
    - How prices and quantities of goods are determined
  - The forces and trends that affect the economy as a whole
- Economics provides tools for understanding/modifying human behaviour in the face of scarcity
  - Competitive market prices provide incentives for the wise use of current resources and for promoting innovations that can broaden the menu of future options
  - The circumstances in which competitive markets fail can be identified, and policy options to correct problems can be devised and tested

Environmental & Natural Resource Economics

- Concerned with scarcity and accumulating pollutants
- Example 1: Greenhouse gases (water vapour, carbon dioxide, methane and other gases) heat the atmosphere and allow life as we know it to exist
  - Human activity has increased the stock of greenhouse gases beyond normal levels and enhanced the natural heat-trapping capacity of the atmosphere
  - Climate change concerns the damaging consequences to both humans and ecosystems of this anthropogenic increase
  - http://www.nytimes.com/2015/08/21/science/climate-change-intensifies-california-drought-scientists-say.html?_r=0
- Example 2: Water is vital to life, but about 40% of the world's population live in areas with moderate to severe water stress
  - In some cases, groundwater is being consumed faster than it is being replenished
  - https://www.nationalgeographic.com/magazine/2016/08/vanishing-midwest-ogallala-aquifer-drought/

Economic Approaches to the Environment

- There are two approaches
- Environmental economics
  - The application of mainstream economic principles to environmental and natural resource issues
- Ecological economics
  - The analysis of economic activity in the context of the ecological (biological and physical) systems that support life
  - Brings together viewpoints from different academic disciplines
- The boundary between the two is fuzzy, and there is considerable overlap

Environmental Economics

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- Four concepts underlie it
  - The theory of environmental externalities (chapter 3)
    - Market failure
    - Example: Fossil fuel burning versus air pollution
  - The optimal management of common property and public goods (chapter 4)
    - Market failure
    - Example: Ocean fishing versus species extinction
  - The optimal management of natural resources over time (chapter 5)
    - Objective: Maximize benefits across generations
    - How does one value future versus present benefits?
  - The economic valuation of environmental goods and services (chapters 6 and 7)
    - Premise: Environmental goods and services can be valued in monetary terms
    - Optimal environmental protection depends on benefits versus costs

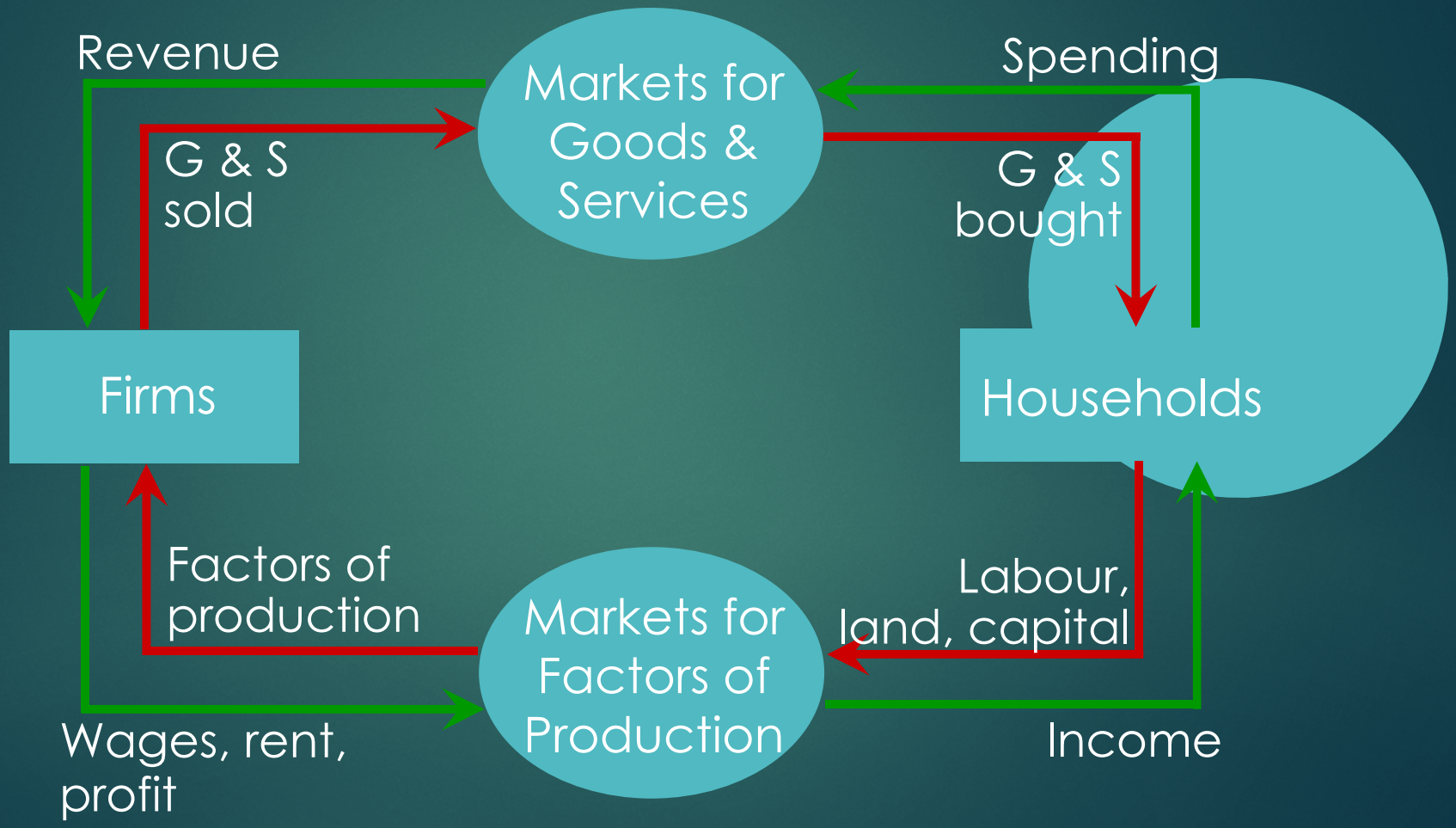
Ecological Economics

- Core concepts are harder to define
  - Broader field
    - Includes biology, ecology, engineering, systems modeling, history, philosophy
  - More variation in viewpoints and disciplinary approaches
- General agreement on three
  - The economic system is a subset of the broader ecological system
  - Sustainability should be defined according to ecological, rather than economic, criteria
  - Need to rely on a range of academic disciplines and perspectives to provide insights into environmental issues
- These concepts have implications for how economics is conducted and how policy is formulated

Models

- We will use a variety of models to investigate relationships between the economy and the environment
- We will start with a very broad conceptual economic framework
  - To place the economic system in an environmental context
  - To understand how specific environmental issues and policy responses fit into the bigger picture
- The circular flow diagram is a building block of mainstream economic theory
  - It needs to be modified to:
    - Include the environment
    - Situate economy activity within the context of the environment
    - Begin to understand the interactions between the two

The Circular Flow Diagram



The Circular Flow Diagram (cont'd)

- The inner loop represents the flow of inputs and outputs
  - Natural resources (renewable and non-renewable) are inputs
  - Renewable: Forests, fisheries
  - Non-renewable: Minerals, fossil fuels
- The outer loop represents the flow of currency
- Applied to a nation, this model forms the basic foundation for calculating GDP
- Economic actors that the diagram omits, but which can be added
  - The government
    - Collects taxes, buys goods and services
  - The financial system
    - Matches savers' supply of funds with borrowers' demand for loans
  - The foreign sector
    - Trades goods and services, financial assets, and currencies with the country's residents

The Economic System and the Environment

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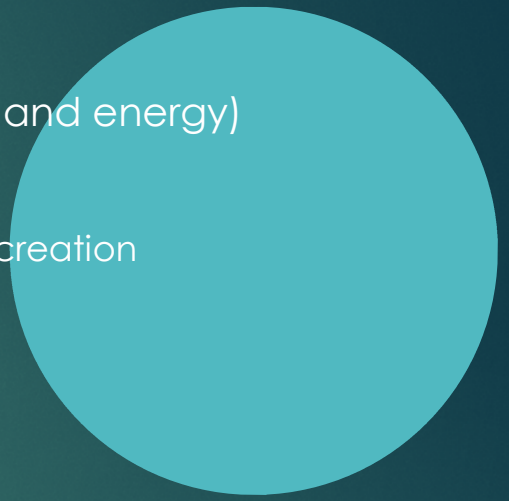
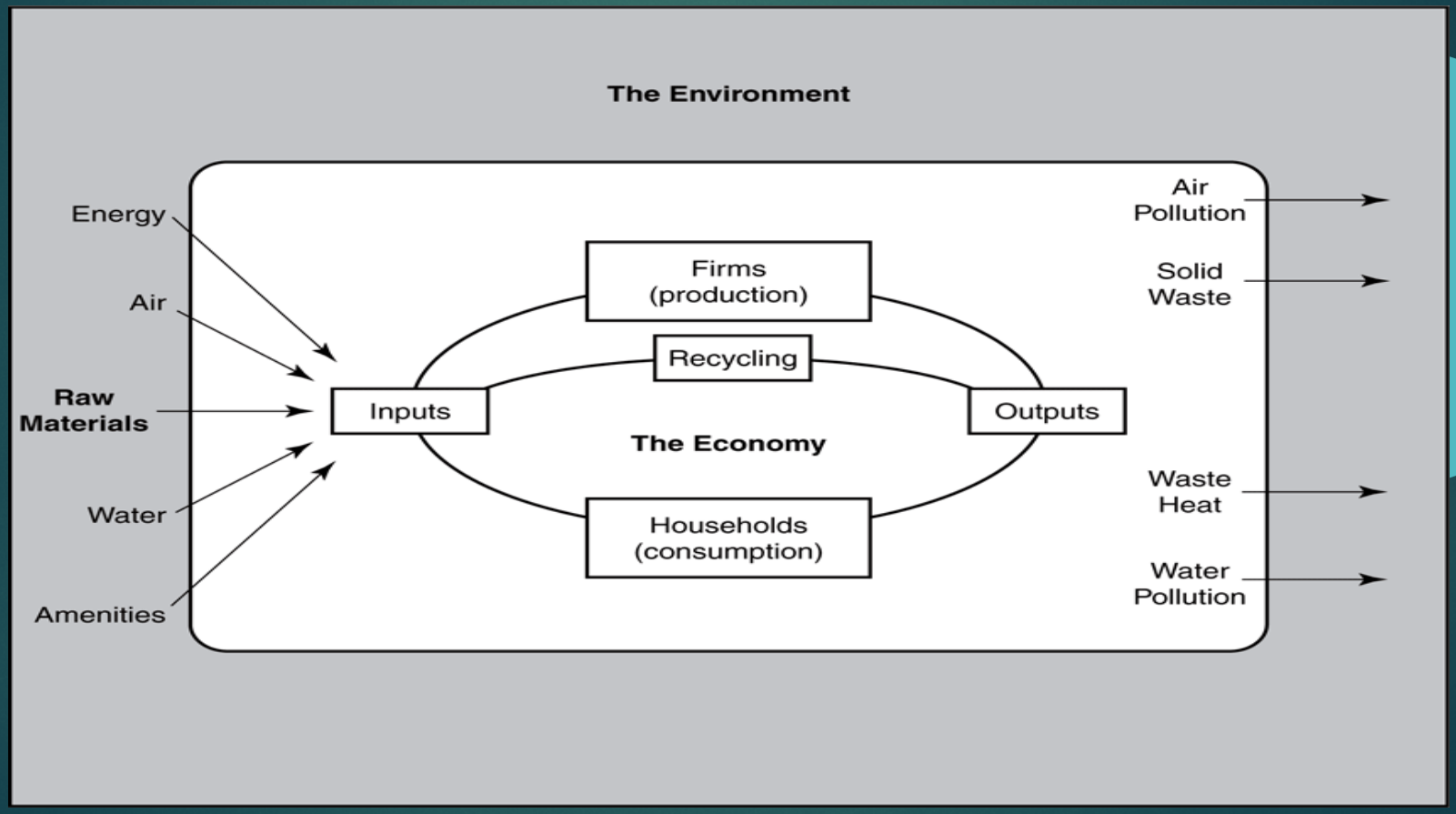
- The environment also needs to be added
- The environment
  - Is an input used in production (natural resources – raw materials and energy)
  - Provides goods and services directly to consumers
    - Examples: Air, water, biodiversity, carbon sequestration, scenery, recreation
- Its use returns waste products to the environment
- Economic activities also change the environment
  - Not shown in extended diagram



Extended Circular Flow Diagram



Implications of the expanded model

- Natural resources and energy are essential inputs
  - Human well-being is dependent on them
  - GDP understates their importance
  - Alternative indicators of well-being are needed (chapter 10)
- The relationship between our planet and the economy is:
  - A closed system (no imports or exports) for material inputs
  - An open system for solar energy
- The ecological system has its own circular flow
  - First law of thermodynamics: Energy and matter can neither be created nor destroyed (although Einstein proved that matter can be converted into energy)
  - Materials flowing into the economic system must either accumulate there or return to the environment as waste

Implications (cont'd)

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- Economic activity is limited by the availability of natural resources and the ability of the environment to assimilate wastes
  - Second law of thermodynamics (or entropy law): Entropy increases
    - Entropy is essentially a measure of the loss of energy and materials available for work
    - Some energy and materials are lost when transforming them from one form to another
  - Excessive wastes can depreciate the environment when they exceed its absorptive capacity
    - Examples: Air pollution can adversely affect health, obscure visibility, kill flora and fauna, and cause flooding
  - A closed system must eventually use up its available energy and materials
    - Once our stocks of stored energy (fossil fuels and nuclear energy) are gone, the amount of energy available for useful work will depend solely on solar energy

Sustainable Development (Chapter 9)

- Development that meets the needs of the present without compromising the ability of future generations to meet their own needs
  - 1987 U.N. Brundtland Commission report, "Our Common Future"
- Goal is to improve, maintain or prevent undue depreciation of the environment so that it can continue to provide aesthetic, life-improving and life-sustaining services
- Natural resources
  - Renewable resources can be sustained if extraction rates ≤ natural regeneration rates
  - Non-renewable resources are fixed in supply, but the known supply can be expanded through new discoveries
- The environment
  - Environmental economics: Some degradation of the environment can be acceptable if it does not interfere with meeting human needs (anthropogenic worldview)
  - Ecological economics: Ecological factors are more important than human factors (ecocentric worldview)

Environmental versus Ecological Economics

- Ecological economists promote pluralism (consistent with an ecocentric worldview)
  - Full understanding of an economic issue can only come from a variety of viewpoints, disciplines and approaches
  - Some ecological economists are not trained primarily in economics
- With respect to the circular flow diagram:
  - Environmental economists start from the inner circle and try to understand broader ecological issues in economic terms
  - Ecological economists recognize the importance of the inner circle, but place greater emphasis on the outer circle circular flow diagram
    - Some go so far as to put sole emphasis on the outer circle
- With respect to the value of the environment
  - Environmental economists place monetary value (WTP) on it
  - Ecological economists feel it has inherent value
    - Based on ethics, rights and justice

Environmental vs Ecological Economics (cont'd)

- Perfect competition provides a benchmark for the allocation of resources in an economy against which market failures related to environmental quality and inefficient resource management can be, and are, assessed
  - When externalities occur:
    - Environmental economists advocate market-based solutions
    - Ecological economists, while not necessarily opposed to market-based solutions, worry about the scale of market activity
- With respect to economic growth:
  - Environmental economists view continued growth as feasible and desirable
  - Ecological economists are more likely to advocate that it should level off or fall
- With respect to future generations:
  - Environmental economists would use weights inferred from market activity
  - Ecological economists would give more weight to future generations

Positive and Normative Economics

- Positive economics tries to describe/explain the world as it was, is or will be
  - Positive statements can be confirmed or refuted
  - Example: An increase in the demand for steel will enhance economic activity and increase pollution in Canada
- Normative economics tries to prescribe how the world should be; to improve it
  - Normative statements can be neither confirmed nor refuted
  - Example: An increase in the demand for steel is desirable
  - Alternatively (and more usefully): If pollution from steel production increases, how much pollution should we allow and what means might we use to control it?
- We will apply both
  - We will use positive economics to help determine cause and effect
  - We will use normative economics to compare policy options to achieve some objective and to help determine which options are optimal
- Environmental economists aim to be value neutral, while values are acceptable in an ecological economist's pluralistic framework