A Short Introduction to Ecological Economics

by

Tone Smith

Centre for Social-Ecological Economics

https://seecentre.org

Norway

July, 2025

Social Ecological Economics Discussion Paper SEE 25/3

SEEcentre Publications

SEEcentre discussion papers are written as independent pieces of research which are the sole work and opinion of the author(s). They have no association with any other staff or associates of SEEcentre nor any employer, political party, Government agency or any other organisation. Papers remain copyright of the author(s) but may be under consideration for publication in a journal or book.

A Short Introduction to Ecological Economics

by

Tone Smith

SEEcentre
Hurdal Økolandsby
Norway

Abstract

As the interest in heterodox economic theories increases so does the demand for overview articles presenting these theories. This discussion paper provides a short overview of the most important elements of the field of ecological economics. After a short historical introduction, it presents key concepts, a comparison with environmental economics, different directions within the field, examples of practical application, and finally a short reflection on the future direction.

Keywords: Ecological economics, social-ecological economics, limits to growth, degrowth, plural values.

Introduction

Ecological economics arose, in simplified terms, from a combination of a vision and a reaction. The reaction was against neoclassical theory, which was considered to be fundamentally problematic in a number of areas. The vision was the desire to develop an economic paradigm rooted in the knowledge of how natural systems work and with a focus on the interaction between the economy and the natural environment. That nature has its own independents laws and limits, and that there are therefore limits to growth, was the core of ecological economics from its very conception. With this starting point, ecological economics therefore take a biophysical perspective on the economy, i.e., the economy is first and foremost material and should be studied as such. Ecological economists are thus concerned with understanding the economy's (or economies') embedding in and dependence upon the biophysical world, and by extension, how the economy should or can be reshaped in order to function on nature's own terms.

Although ecological economics is a relatively young field of study, emerging in the late 1980s, its intellectual roots goes back at least to the 1880s. Many contributions that had disappeared from academic interest was given renewed attention by the field's founders. Important works included Sergei Podolinsky's energy accounts for agriculture, Frederic Soddy's criticism of Keynes' view of economic growth and not least Nicolau Georgescu-Roegen's work bringing thermodynamics into the study of economic processes. Economic historian Joan Martinez-Alier's book *Ecological Economics: Energy, Environment and Society* (1987) was central in bringing new life to these and others forgotten theorists.

In the 1960s and 1970s, much happened that prepared the ground for a better understanding of pollution problems and resource scarcity. Environmental problems received a lot of attention, the modern environmental movement was born and the environment was put on the political agenda. Ecological economics, however, was not established before the end of the 1980s, and it actually happened on the initiative of a group of ecologists. These ecologists wanted a holistic approach to studying society's environmental problems, by expanding ecology's object of study to include human society, rather than only studying the interactions inside natural systems. In addition, they had understood that economists experted important influence on politics, and therefore sought cooperation with this professional group (Røpke, 2004). In 1988, the International Society for Ecological Economics (ISEE) was established. The following year, the organisation got its own scientific journal (Journal of Ecological Economics) and the subsequent year the first international academic conference was held in Washington (USA).

Despite its short existence as an academic subject or field of study, ecological economics has developed substantially, from a theory that first focused on the technical aspect and ecological-

economic interactions, to increasingly incorporating social aspects. Economists such as K. William Kapp, Thorsten Veblen and Karl Polanyi, as well as feminist economics have been important for the understanding of how economic systems works socially. In general, ecological economics contains elements from many heterodox economics theories, in particular institutional economics, feminist economics, Marxist economics, evolutionary economics and also from happiness research. In addition, ecological economics is interdisciplinary, and has therefore borrowed heavily from other fields: from the natural sciences, in particular insights from thermodynamics and energy theory (theorized for economics by Georgescu-Roegen) and (biology's) systems theory and evolutionary theory (rather than mainstream economics' mechanistic world view). This has in turn led to a (re-)introduction of themes such as social dynamics, chaos, irreversible processes, radical uncertainty (cf. Keynes), etc.

The starting point for ecological economics thus differs strongly from mainstream models where the basic units of the economy are businesses (producers) and households (consumers), and the driving forces are profit and utility maximisation. Based on insights from amongst others institutional theory, ecological economists instead underline that the economy's driving forces depend on the design of society's economic institutions. There are no immutable economic laws, although there are immutable "laws of nature" with consequences for the economy.[1] Therefore, there is not just one natural economic system - even if the way the economy is organised often seems "natural" in his own era.

Another important difference is the theories' implicit or explicit goals for society. While neoclassical environmental economics focuses on efficiency, optimisation and utility, ecological economics is primarily concerned with how we can create good and sustainable societies. Thereby, ecological economics also challenges a basic premise within neoclassical theory: that we can never have enough. It has major consequences for theory building whether you start from a model based on the assumption that a human being can never be satisfied and will always want "more", or whether the assumption is that satisfaction and moderation is possible, and that it may even be an ingredient of "a good life". Furthermore, neoclassical theory is built on a foundation that understands values and utility as relative quantities only. Such a framework does not have the opportunity to deal with absolute values or limits, in contrast to the basic model in ecological economics.

Given the global environmental situation, where, according to experts, we are approaching serious tipping points in several environmental domains, including greenhouse gas concentration in the atmosphere and losses of biological diversity, it is becoming increasingly clear that we need an

[1] "Laws of nature" is here used metaphorically, and refers to how the non-human world works in itself. Human understanding of and knowledge about these laws, however, is not static and can of course change over time.

economic theory able to relate to such factors as well as to the biophysical reality of the economy, if we are to be able to propose alternative paths out of this problematic situation.

Key Concepts and Building Blocks

The Biophysical Embeddedness of the Economy: A Hierarchical-Realist Understanding of Reality

Ecological economics differs not only from neoclassical environmental economics – it is also the only heterodox attempt to establish a holistic economic theory where the economic system is a subsystem of the biosphere. Since the beginning, therefore, ecological economists have used a concentric circle diagram to illustrate the economy's dependence on nature, as well as its embeddedness in society or the wider social structures (see Figure 1). Despite great variation within the works of ecological economists, this basic conception of reality is often understood as the field's defining feature.

With this starting point, ecological economics assumes a biophysical perspective on the economy. A biophysical perspective, means that the economy's most basic structures and mechanisms are biophysical. But in the same way that the economy is understood as rooted in nature's structures and thus subject to the laws that apply within that realm, any economy is also rooted in a set of social structures. The difference is that while social structures and associated mechanisms are changeable (although in practice it generally takes long to change them), this is not the case for the basic mechanisms in the biophysical the realm. For example, humans cannot change the force of gravity or cause it to cease, although we can learn to understand how we can utilise other natural mechanisms to compensate for gravity (temporary), for example to make a plane take off (Spash and Smith, 2019).

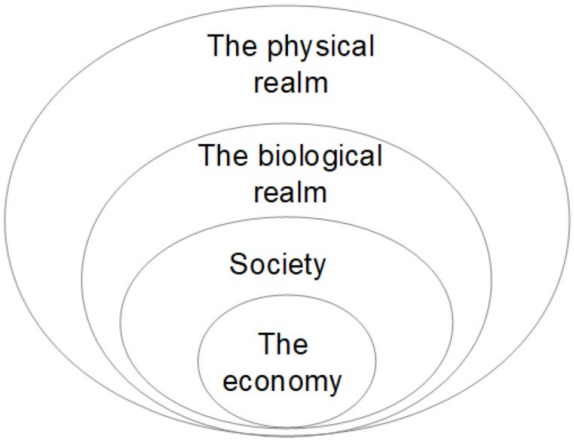

Figure 1. The concentric circle diagram, illustrating ecological economics' hierarchical-realist understanding of reality.

What does it mean that the economy is dependent on society, and that society depends on nature? This is an understanding of inequality in dependency relationships. Society can manage and exist without a market economy (or a given economic system), and nature will be able to exist without the species *homo sapiens* or human society. In the other direction however, the relationship is one of dependency – a society's economic system depends on its underlying life support systems. That is why we speak of a hierarchy of the spheres: the dependency increases the further into the circle we are located. From this understanding of reality follows that our economies are inextricably linked to the structures and modes of operation that characterise the outer spheres of the hierarchy.

The Biophysical Economy and Its Conditions

Thermodynamics and energy theory

Thermodynamics is the branch of physics that deals with qualitative transformation of energy. A central insight is that energy cannot arise from nothing, nor disappear. It can neither be created nor destroyed, only converted into other forms. This is the essence of the first law of thermodynamics, also called the law of conservation of energy. However, this applies not only to energy, but to all materials or matter: all extracted and processed matter will eventually be returned back to the environment, although in a different form – as a waste product or pollution.

All production depends on resources and energy on the input side, and generates waste substances in addition to the desired product. Production of waste is thus an inevitable consequence of any production process. This in turn means that pollution is an integral part of all economic activity, not just an unintended side effect (“externality”) which can be fixed with the right economic incentives.

Early on, Robert Ayers and Kenneth Boulding integration these insights into their models for explaining the economy, and developed concepts and metaphors to support this understanding. Boulding (1966) is known for his metaphor "Spaceship earth", where he demonstrate the importance of waste management on planet Earth by comparison with the situation in a spaceship. Kneese, Ayers and D'Arge (1970) developed a so-called material balance approach (also called material flow analysis) to study the economy (see Figure 2).

These perspectives from ecological economics have eventually influenced both EU statistical directives and international statistical standards such as the System of Environmental and Economic Accounting (United Nations et al., 2014). Figure 2 shows an illustration of that part of the economic process which is linked to material flows: A national economy consists of or contains raw materials either from domestic raw material extraction or from imports, goods produced through a production process and that remain in the economy as accumulated materials (until they finally come into being waste), and finally waste products generated directly from the production process itself.

Corresponding statistics are also created for the energy flows in the economy, so-called energy accounts, which also function as an important source of information for emissions statistics. This way of studying the economy – as a flow of energy and matter – is central to ecological economics. It has also been established as a separate subject area – industrial ecology – which concentrates on the physical part of the economy only.

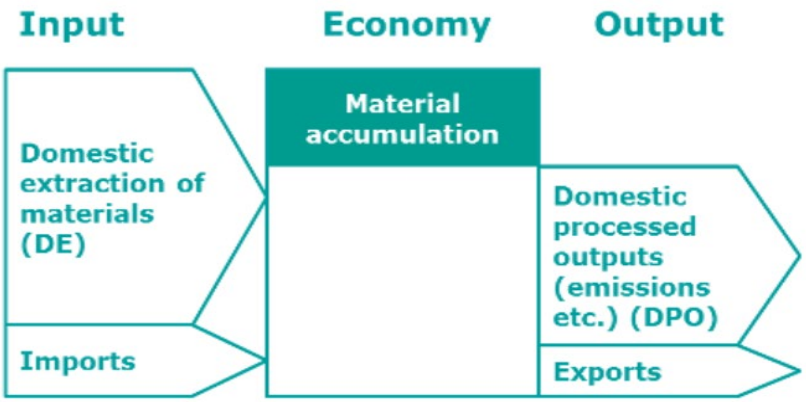

Figure 2. Material flow accounts. Illustration of statistical building blocs. Source: Eurostat.

A less intuitive part of thermodynamics is the so-called law of entropy,[2] which is of particular relevance for understanding energy-related challenges in society. Entropy is a measure of the "spread" of energy, or put another way, the quality or availability of the energy (for human use). "Energy" means the ability to perform mechanical work. Fossil energy, for example, is an energy source with a unique energy density and a high capacity to perform mechanical work. However, energy can only be used once to do such work, and, in contrast to matter/materials, cannot be recycled.

It was especially this part of thermodynamics Georgescu-Roegen (1971) theorised for economics. He focused on the irreversible nature of the production processes, and its far-reaching consequences regarding how we should think about consumption and conservation of energy and other resources. His key message was that we must care about both the quality and the quantity of what we consume. Despite being a highly regarded economist in his own time, Georgescu-Roegen's work on entropy received little attention until ecological economists picked up his ideas and started developing them further.

Social metabolism (the biophysical economy)

The fact that production processes are always also natural processes (biological, chemical, physical), means that they should be studied as such – that is, as flows of energy and matter. This dependency on resources and energy on the input side, and the generation of waste materials at the other end,

[2] This law states that the amount of available energy decreases in closed systems. The earth is in practice a closed system - if we disregard the sun.

has similarities with the human metabolism. This has led ecological economists to adopt the concept and metaphor of the "social metabolism" or "society's metabolism" to capture the biophysical aspects of the economy.

Environmental problems arise as effects of both the quality and the size of society's metabolism. Different energy systems enable different kinds of consumption and different emission problems. A qualitative difference between societies of former times (both hunter-gatherers and traditional agricultural cultures) and today's modern industrial economies, is that in traditional societies supply systems were largely locally based, and the energy systems were based on direct biological conversion of solar energy. Modern industrial economies on the other hand, are only made possible by access to large quantities of fossil energy. As mentioned above, this is a unique energy source, created through the accumulation of solar radiation to the Earth over millions of years – and then consumed in just about 200 years. When we now use up this non-renewable resource, it cannot be used again. At the same time, our current economies are structured in a way that depends on a large flow of energy to keep the wheels turning.

Estimated resource consumption for earlier kinds of societies puts today's economies into perspective. Estimates show that industrial economies use between 25 and 50 times as much material resources per person per year as hunter-gatherer societies did (Krausmann et al., 2016: 67). If we look at energy consumption, the picture becomes even more pronounced: we are then talking about several orders of magnitude (Simmons, 1989). When, in addition, we know that the population has multiplied, it becomes obvious that the economy is taking up an ever-increasing amount of "ecological space". The enormous increase in material wealth in many parts of the world over the last 200 years must therefore be explained primarily by the large availability of cheap fossil energy. This is in contrast to the common belief that our prosperity is due to us being much more productive. Labour productivity has not increased primarily because we are so efficient and work so much "smarter", but because we have replaced human (and animal) labour with fossil energy and machines. This has made it possible to produce enormous amounts of material goods and has created (material) prosperity for a large part of the world's population. The problem, however, is that the same process has also led to enormous resource use, depletion and destruction of ecosystems, the over-accumulation of greenhouse gases in the atmosphere, and other environmental problems.

The living and complex nature

So far we have mainly talked about energy and matter, and about physical transformation processes. But humans are also dependent on living nature. It supplies us with food and other materials we depend on and absorbs waste materials we release into the environment. But none of these ecosystem functions are unlimited, because nature's cleaning capacity can be exceeded and

ecosystems can be destroyed. The same applies to nature's ability to regulate, for example, the climate. Now, it should be mentioned that humans do not only live from nature in a material-instrumental sense – we also live *in* nature and *with* it (O'Neill et al., 2008).[3] This points to other kinds relationships with nature, linked to aesthetics, (place) identity and spirituality. We will return to these types of values in the section on social aspects, but will concentrating on the material aspects first.

When we talk about limits to growth, the implication is that energy and other resources are finite and will eventually be fully extracted or exhausted. However, it is often the ecological systems that reach "limits" or tipping points first, through reductions in their land areas or because the amount of waste (pollution) to be handled simply becomes too large. For example, climate scientists assume that the consequences of climate change for the natural environment will be dramatic long before we have exhausted the available fossil energy sources.[4]

Ecosystems and biodiversity are thus threatened not only by pollution and overexploitation, but also by a constant reduction in land and habitats. Areas are shrinking through conversion to monoculture agriculture, sealing of land by developing industry, infrastructure and housing, or fragmentation due to new transport routes. Ecosystems are complex systems, and it is not easy to know their limits or tipping points, or what they can "tolerate" in terms of intervention and reduction before they are destroyed or change dramatically. It is nevertheless estimated that we have already moved beyond the safe limits, and there is increasing agreement among scientists that we have entered the sixth period of mass extinction of species, and that this is the first time that such a mass extinction has been caused by human activity. International reports on the state of the Earth's biodiversity and ecosystems in recent years are therefore grim reading. In 2017, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) presented an assessment which showed that over 75% of the Earth's land areas are degraded by human activity. The following year, the Global Assessment Report (IPBES, 2018) was released, showing among other things, that two-thirds of the oceans are also under severe pressure. The conclusion was clear – and in a policy context quite controversial: Transformative change is needed, including steering away from the paradigm of economic growth.

To understand the environmental consequences of economic activities, it is therefore necessary to understand interdependencies and feedback mechanisms both within natural systems and between these and the economy. Identifying tipping points in complex systems is difficult. Rockström et al. (2010) have attempted to calculate the "Planetary Boundaries". However, even the best assessments of experts will always be characterised by uncertainty. Therefore, the

[3] While many ecological economists focus on the limits of nature and the economy, others focus on the need to establish an economic system that aligns with the basic principles of ecology. See, for example, Capra and Jakobsen (2017).
[4] Which in turn has given rise to the idea of carbon budgets (see e.g. Bows et al. 2006).

precautionary principle has always been important for ecological economists (Stirling, 2017; Seidl, 2017). As mentioned at the outset, ecologists and systems thinkers were central to the establishment of the field, and they brought in knowledge and awareness of the properties of complex systems, including that they are open, dynamic, non-linear, have feedback mechanisms and are characterised by uncertainty, ignorance and irreversibility.

Social Aspects

Economic growth, distribution and varieties of growth critique

The biophysical perspective on the economy that was explained in the previous section, implies that the real economy is biophysical or material. One aspect of this understanding is that if one person uses the resources, others cannot also use them (they are "rival goods"). The growth-critical approach of ecological economics means it has been concerned with and emphasised distribution issues since its very beginning. Some are concerned that if poverty and inequality cannot be remedied with *continued* economic growth, resources/goods must instead be redistributed. Others have problematized the growth economy *itself*, building on perspectives from the so-called "post-development" literature, which also includes degrowth perspectives. Herman Daly's concept of "uneconomic growth" belongs to the first category. Daly argues that above a certain level of economic prosperity, growth entails greater "costs" - in the form of pollution, etc. – than it provides benefits. Many have therefore been concerned with whether there are identifiable threshold values, measured as GDP per capita, for uneconomic growth. Whether a certain degree of economic growth is good and should be promoted or whether it is the growth economy as such that should be challenged, is, however, a topic subject to much discussion (Spash, 2020). The post-development literature emphasises that the growth economy has always happened at the expense of certain groups, whether we are talking about the British enclosure movement, the colonisation of countries in the global South in the past, or, more recently, by measuring development using GDP per capita (see e.g. Sachs, 2015 and Latouche, 1993).

In this way, the discussion about distribution shifts from a national to an international level. In contrast to mainstream economics' focus on comparative advantage in international trade, ecological economists are concerned with the social and environmental aspects of the theory of "unequal exchange". This has included topics such as the international division of labour and the work hours associated with commodity flows (Pérez-Sánchez et al., 2021), global waste flows, and – building on the energy and material balance accounts - also biophysical trade balances (Weisz et al., 2006). The fact that large parts of the population in countries in the global North benefit from trade with (and exploitation of) countries in the global South is an aspect that is often not much touched upon in current debates on (national) inequality. However, the topic is central to the

international environmental justice movement. Within the field of political ecology, Brand and Wissen (2017) have recently theorised the phenomenon using the concept of the “imperial mode of living.”

Welfare, needs satisfaction and a good life

Many ecological economists have researched alternative measures of well-being and needs satisfaction, a field of research closely linked to both happiness research and applied (moral) philosophy. Ecological economists dare to question consumers' preferences and their validity for a good life, and to problematise what has shaped them. In addition, the fundamental premise of neoclassical theory, that "more is always better" is challenged. The implications of the laws of thermodynamics are unambiguous: Modern Western societies must consume both differently and less. This also means that if everyone's need is to be satisfied, it is important to be able to distinguish - theoretically and conceptually - between needs and desires. Thus, economics must develop a theory of needs and needs fulfilment or satisfaction. Economist Amartya Sen is known both for his work on poverty, hunger and rights (Sen, 1986) and for the so-called “capability approach”, which he developed together with philosopher Martha Nussbaum. The approach is concerned with identifying and defining the space of possibilities, or the set of choices, that makes it possible for a person to live a life that he or she has reason to value (Sen, 1999). Nussbaum (2000) has over time developed a list of forms of freedom (“central capabilities”) that are necessary for people to be able to live dignified lives. This includes both internal, mental capacities and external, societal conditions (including minimum threshold values), where the latter can be used as a basis for policy measures. Within ecological economics, however, Max-Neef's (2009 [1992]) theory of needs and "satisfiers" holds a special position because it links needs satisfaction and the environmental perspective.

Based on empirical studies, particularly in Latin America, Max-Neef shows the large difference that exists with regard to what functions as "satisfiers" for certain needs in different cultures, and how different ways of fulfilling basic needs have striking differences in environmental impact. An example is the need for food, which can be satisfied either by a large amount of meat and long-distance transported fruit and vegetables, or by a meat-free diet mainly based on short-travelled food products.

Appeals to moderation and frugality, and discussions about less environmentally damaging lifestyles and what constitutes the “good life”, is often treated within a moral philosophy framework. Thus, the discussion of human behaviour tends to be individualised and abstracted from the specific contexts and structures within which people actually live their lives. It is therefore all the more important to bring context back into the discussion and evaluate how different types of social and economic frameworks promote or inhibit qualities or character traits in the individual (e.g. greed vs.

solidarity). These, in turn, are important both for the individual's own well-being or happiness and for development of society more broadly (Sayer, 2000). Such an approach provides us with an opportunity to evaluate and discuss the legitimacy of different economic institutions. The philosopher John O'Neill (1998), for example, has demonstrated and criticised the corrupting effects of market society on how we value things, relationships, and ways of living.

Value, value pluralism and valuation

Ecological economists have challenged the use of cost-benefit analysis for handling environmental problems and the strong focus on (economic) efficiency that has increasingly permeated politics since the 1980s. The spread of cost-benefit thinking and cost-benefit analyses is considered problematic for a number of reasons.

First, ecological economists have, through empirical studies, challenged the underlying assumptions of valuation studies carried out by neoclassical environmental economists (Soma, 2006; Vatn and Bromley, 1994). Two findings from these studies are of particular importance:

1. *Value pluralism* is widespread, both with single individuals and within society as a whole. Value pluralism means that several values often exist at the same time, and these may conflict with each other.
2. Values are often *incommensurable*. This means they cannot "be made equal", i.e. cannot be measured using proportional ratios or a cardinal scale.

Ecological economists have thus established a basis for a much broader concept of value than the narrow instrumental utility concept in mainstream economics. This allows us to include other value perspectives in discussions or conflicts about value issues and valuation, such as the "intrinsic value of nature", collective and relational values or rights-based thinking. One consequence of this insight is that there must be room for more than one type of value when societal projects are discussed and evaluated. In cost-benefit analyses, on the other hand, all values are ideally reduced to one dimension only – namely money, or, more precisely, relative marginal utility. When a value conflict is represented as a utility function, much information that could be relevant for a decision-making process is hidden. However, this is not only a criticism of neoclassical theory, but also of the widespread monistic and rationalist value position within governance more generally (cf. Max Weber). Appealing to monetary valuation of nature's values as a tool for making rational and "objective" decisions through cost-benefit analyses is therefore a dead end. Objective solutions to complex value questions are simply impossible. One cannot calculate a single number to resolve a value conflict. Instead, preferred choices or solutions must be argued for and explained, and evaluations accounted for.

What kinds of methods are available to help clarify the different interests and values at stake? How can one take into account a diversity of values in a decision-making process? When accepting

incommensurability and value pluralism, the recommendation is to use multi-criteria evaluation rather than monetary or monistic valuation. Another method that can provide a frame for expressing or articulating a larger diversity of values is various types of participatory processes.[5]

Summary

To conclude this general description of concepts and perspectives, it may be useful to clarify the significant differences between ecological economics and neoclassical environmental economics. Although the names may seem relatively similar, environmental economics is a specialisation within neoclassical economics with an emphasis on externalities, market failure, efficiency, cost-benefit analysis and economic valuation (pricing) of environmental goods. The two theories are summarised in Table 1.

Different Directions

Ecological economics is not a unified theoretical field, although most will agree that the elements presented in the previous section are important. Partly, there is an internal tug-of-war over which theoretical path ecological economics should take. On the other hand, there is disagreement about whether it is at all desirable to develop a unified theory or whether ecological economics should instead be a broad interdisciplinary field, open to different approaches, methods and theoretical bases.

Environmental economics	**Ecological economics**
• Equilibrium	• Dynamic, open systems
• *Homo economicus*, rational actors, utility maximising	• Plural values
• Unlimited wants/needs	• Needs vs. luxury, sufficiency
• Relative scarcity	• Absolute limits
• Environmental problems = «externalities»	• Pollution is an integral part of any production process
• Overarching focus: "efficiency"	• Overarching focus: sustainability and justice

Table 1. A summary and comparison of neoclassical environmental economics and ecological economics.

In an empirical study, carried out by Spash and Ryan (2012), three main directions within the field was identified: 1) new resource economics, 2) new environmental pragmatism, and 3) social-ecological economics. The existence of the first category – new resource economics – shows that there are many ecological economists who still base their work in neoclassical theory, despite the

[5] The idea of participatory processes and deliberative democracy is often based on Jürgen Habermas' concept of communicative rationality. Arild Vatn's concept of "value-articulating institutions" also falls under this theme (see Vatn, 2021).

fact that the field's origins were largely linked to a critique of this theory. The biggest dispute, however, has been between those who have wanted to develop a consistent theory that has both explanatory power and can form a basis for effective environmental and economic policy (social-ecological economists), and those who have tried to operate within the existing logic of the system in order to be heard by politicians, bureaucrats and decision-makers (the new environmental pragmatists). An illustrative example of this disagreement was the discussion that unfolded following Robert Costanza et al.'s 1998-publication which included estimations of the value – in monetary terms - of all of the Earth's ecosystems. While Costanza himself believed that this could awaken the world to an understanding of the value of ecosystems and could lead society to take better care of nature, a large part of the ecological economics community (in fact also supported by more conventional environmental economists) believed that such an exercise was impossible and that the figures therefore made no sense. Moreover, a core element of ecological economics from the beginning was to highlight the intrinsic value of nature, while also making it clear that humans operate within a set of different (plural) values that they manoeuvrer between. Measuring nature in monetary terms therefore went against what had been a fundamental point of consent within the organisations from the beginning.

In practice, ecological economics has largely become a discipline that is about managing nature, natural resources and the environment, often by making use of microeconomic concepts such as "natural capital" and "ecosystem services", and which, based on a variety of arguments (including being "pragmatic"), often includes valuing nature in monetary terms. Then there are those who rather focus on macroeconomic issues related to growth and to the development of alternative economic institutions. Herman Daly's *Steady-state economics* (1992 [1977]) has long been a reference work within ecological economics. However, Daly's popular approach focusing on three main factors – the size of the economy, efficiency and distribution – is increasingly being challenged by the social-ecological camp, due to Daly's neoclassical assumptions about how markets function (Pirgmaier, 2017; Spash, 2024).

Ecological Economics in Practise: Challenging the Growth Paradigm

Economic growth is perhaps the policy area where ecological economists are unanimous in their criticism. Since the 1980s and the Brundtland Commission's call to solve the environmental problems associated with economic growth by "changing the content of growth", ecological economists have been relatively alone in their attempt to raise awareness of the systemic problems of the growth economy. Mainstream environmental policy has been concerned with efficiency and technological change, as well as structural change of the economy as a way to decouple environmental impact from economic growth. Ecological economists, for their part, have pointed

out that the potential for efficiency is limited given the laws of thermodynamics: No matter how much efficiency is improved, waste will be produced and a minimum of energy and materials will still be needed in production. This applies even to the circular economy, because recycling materials is energy-intensive. New technology can lead to a reduction in certain types of emissions, but a limitation in one waste product will always be replaced by other waste products. It is also being pointed out that renewable energy cannot simply replace all fossil energy, because renewable energy is produced on completely different premises, using different mechanisms. For example, trying to capture part of the annual solar radiation reaching the Earth is a completely different challenge than extracting fossil minerals that nature itself has spent millions of years producing (Giampietro, 2019). Ecological economists have also tiredlessly reminded us of the rebound effect, i.e., how efficiency gains tend to be "eaten up" by increased consumption, and that focusing on efficiency alone therefore does not produce any aggregated decrease in resource consumption in a given economy, quite the opposite.

Given these factors, ecological economists are concerned that we need to set and institutionalise upper limits to the economic process with regard to resource use. This does not mean that one must necessarily disregard the use of market mechanisms, price making markets or price adjustments, but that they alone cannot do the job: it is necessary to set upper limits on resource extraction and/or use. This can be done in different ways. Herman Daly, who has been a supporter of conventional economic instruments, has, for example, proposed extending (climate) emissions trading to other environmental areas.[6] Cap and trade involves setting an upper ceiling on emissions, resource extraction or something else, and letting the market allocate the rights to pollute.

Many ecological economists, however, are not in favour of this kind of economic instruments, partly because such instruments tend to have social and distributional consequences. In addition, it can have a greater environmental impact to regulate directly, i.e. by setting caps, but at the same time omitting the market element. And it is not only limiting resource consumption and emissions that are being discussed, but also other caps. Furthermore, such caps or limits do not need to be only for the country as a whole, but can be set, for example, per person per year or per company per year, and they can be introduced at different points in the economic system. A proposal that is increasingly being discussed is a system with both maximum and minimum limits for income (see e.g. Buch-Hansen and Koch, 2019).

A structural change in the economy is often about a change in the relative contribution of different economic sectors to GDP, for example a shift from industry to services. But in connection with the green transition and the necessity of phasing out fossil energy, there is also talk of other

[6] Daly has also proposed tradable quotas to regulate population size, a proposal that has been controversial both within and outside ecological economics.

types of structural change: because certain types of energy production must be phased out, the composition of producers within the energy sector can be changed by allowing more small producers to enter the market, and households themselves can become electricity producers (producing with the use of photovoltaic panels).

Another type of structural change concerns changes in the institutional foundations of the economy, a topic that is of concern to both ecological, feminist and institutional economists. Such changes, however, require challenging the established political framework itself. There is not enough space here to discuss these various proposals in detail, but we can at least list a number of areas and initiatives being currently discussed to take society's institutions in a more sustainable direction: democratisation of economic processes, reorganisation of business models, revitalisation of cooperative forms of ownership, changes to the legal basis of corporations, renewed attention to the commons, increased regulation of certain economic activities/sectors, shorter supply chains and routes for goods, institutions for fulfilling minimum needs (e.g., a basic wage/universal basic income and/or expanding universal basic services), (partial) decommodification of certain sectors, and national ownership of key provisioning sectors (e.g., energy supply).

The Road Ahead

Central to ecological economics is the unique understanding of how fossil fuels have enabled the enormous increase in material wealth in the West and the world over the last 200 years. In addition, the West's prosperity can be explained by the unequal terms of trade between industrialised and other countries, where not only money but also resources are in general channelled towards already wealthy countries. In today's political debate, the economic theories that prevailed in the 1950s and 1960s and that laid the foundation for building welfare states in many Western countries are often highlighted. An example of this is the various proposals for Green New Deals. Ecological economists, however, point out that welfare capitalism during this period was both environmentally harmful and based on unfair trade with poorer countries, which must be taken into account in the development of new models that take seriously the challenges facing the world today (Smith, 2021). That economies have biophysical limits, mean we need to develop both new visions and new institutions for sustainable economies. The growth-critical approach entails, among other things, an emphasis on distributional issues: If poverty and inequality cannot or should not be remedied through economic growth, resources/goods must instead be redistributed. It then also becomes important to look at how needs can be satisfied in ways that have a smaller ecological footprint, and to organise production and consumption accordingly. Two aspects then become central in discussions about social-ecological transformation: 1) visions and utopias for future societies, and 2) knowledge and ideas about how the necessary change can take place. Visions and utopias are about

how we want to live, what kind of society we want to live in, and how we should organize ourselves to safeguard both nature's limits and human needs (Jakobsen, 2019). Must economic growth and job creation be society's primary goals, or can broader societal goals be imagined, such as "a good life for all"? Must price-making markets be the sole institution, or are there other institutions to build on? The second aspect is about how the change to a sustainable society can happen. Or will happen. This is a large and open area of research, where understandings of how social change happens or can happen is of particular importance. It has therefore become important for ecological economics to draw on other social sciences with stronger traditions for researching social change, such as sociology.

Given that climate change and biodiversity loss are important topics on the international political agenda, while at the same time traditional economic instruments have fallen short of delivering the promised outcomes, it is likely that ecological economics, with alternative approaches to policymaking, will increase its influence in the time to come. We can already find ecological economics being promoted within, for example, the work of the IPBES (2019). At the same time, ecological economics is not only about the environment or topics related to environmental policy or environmental ministries. Ecological economics is a field of study that seeks to promote a different perspective on the entire economy, thereby also providing guidance for other policy areas such as business policy, health policy or even fiscal policy. As established truths are increasingly being challenged, like the need for never-ending economic growth or the possibility of green growth, or that efficiency improvements and new technology are sufficient answers to environmental challenges, opportunities are opening up for new debates, new instruments, and new (economic) policy and politics. In this process, ecological economics will have much to contribute.

References Cited

Boulding, K.E. (1966). «The economics of the coming Spaceship Earth.» In: *Environmental Quality in a Growing Economy: Essays from the Sixth RFF Forum* (3–14). H. Jarrett (red.). Baltimore: John Hopkins University Press.

Bows, A., Mander, S., Starkey, R., Bleda, M., & Anderson, K. (2006). *Living within a carbon budget.* Report for Friends of the Earth and The Co-operative Bank. Manchester: University of Manchester and Tyndall Centre.

Brand, U., and M. Wissen (2017). «The Imperial Mode of Living.» In: *Routledge Handbook of Ecological Economics. Nature and Society* (ss. 152–161). C.L. Spash (red.). London & NY: Routledge.

Buch-Hansen, H. og M. Koch (2019). «Degrowth through income and wealth caps?» In: *Ecological Economics, 160, 264–271.*

Capra, F., & Jakobsen, O. D. (2017). A conceptual framework for ecological economics based on systemic principles of life. In: *International Journal of Social Economics, 44(6), 831–844.*

Costanza, R., d'Arge, R., de Groot, Rs., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P., van den Belt, M., (1998). «The value of the world's ecosystem services and natural capital.» In: *Ecological Economics 25, 3–15.*

Daly, H. E. (1992 [1977]). *Steady-State Economics*. Second Edition with New Essays. London:

Earthscan.
Georgescu-Roegen, N. (1971). *The Entropy Law and the Economic Process.* Harvard University Press.
Giampietro, M. (2019). «On the Circular Bioeconomy and Decoupling: Implications for Sustainable Growth.» In: *Ecological Economics, 162(August), 143–156.*
IPBES (2017). *Summary for policymakers of the thematic assessment of land degradation and restoration.* IPBES/6/3.
Jakobsen, O. (2019). *Økologisk Økonomi. Et perspektiv fra fremtiden.* Oslo: Flux.
Kapp, K.W. (1978): *The Social Costs of Business Enterprise.* Nottingham: Spokesman.
Kneese, A.V., R.U. Ayres & R.C D'Arge (1970). *Economics and the Environment: A Materials Balance Approach.* Washington, D.C.: Resources for the Future.
Krausmann, F., H. Weisz & N. Eisenmenger (2016). «Transitions in sociometabolic regimes through human history.» In: *Social Ecology: Society-Nature Relations Across Rime and Space.* H. Haberl, M. Fischer-Kowalski, F. Krausmann & V. Winiwarter (red.). New York and Heidelberg: Springer.
Latouche, S. (1993). *In the Wake of the Affluent Society: An Exploration of Post- Development.* Translated from French by M. O'Connor & R. Arnoux. London: Zed Books.
Martinez-Alier, J. (1987): *Ecological Economics: Energy, Environment and Society.* Oxford, England: Basil Blackwell.
Max-Neef, M. (2009 [1992]). «Development and Human Needs.» In: *Ecological Economics*, 4 Volumes (Vol. 1, pp. 131–149). C.L. Spash (red.). London: Routledge.
Nussbaum, M. C. (2000). *Women and human development: The capabilities approach*. Cambridge: Cambridge University Press.
O'Neill, J. (1998). *The market. Ethics, Knowledge and Politics.* London and New York: Routledge.
O'Neill, J., A. Holland og A. Light (2008). *Environmental Values.* London: Routledge.
Pérez-Sánchez, L., R. Velasco-Fernández og M. Giampietro (2021). The international division of labor and embodied working time in trade for the US, the EU and China. In: *Ecological Economics, 180(February).* DOI: 10.1016/j.ecolecon.2020.106909.
Pirgmaier, E. (2017). The Neoclassical Trojan Horse of Steady-State Economics. In *Ecological Economics 133 (March 2017), 52–61.*
Polanyi, K. (1944). *The Great Transformation* (1st edition). New York/Toronto: Rinehart & Company Inc.
Røpke, I. (2004). The early history of modern ecological economics. In: *Ecological Economics 50(3–4), 293–314.*
Sachs, W. (2015). *Planetary Dialectics. Exploration in environment and development.* London: Zed Books.
Sayer, A. (2007). «Moral Economy as Critique.» In: *New Political Economy, 12(2). 261–270.*
Seidl, I. (2017). Safe minimum standards: addressing strong uncertainty. In: *Routledge Handbook of Ecological Economics. Nature and Society* (pp. 278–287). C.L. Spash (red.). London & NY: Routledge.
Sen, A. (1986). *Poverty and Famines: An Essay on Entitlement and Deprivation*. Oxford: Clarendon Press.
Simmons, I. G. (1989). *Changing the Face of the Earth.* Culture, Environment, History. Oxford: Blackwell.
Smith, T. (2021). «How Radical is the Green New Deal?» In: *Prokla, 202(1), 9–30.*
Soma, K. (2006). Natura economica in environmental valuation. In: *Environmental Values, 15(1), 31–50.*
Spash, C.L. (2013): The shallow or the deep ecological economics movement? In: *Ecological Economics, 93 (September), 351–362.*
Spash, C.L. (2021). «Apologists for growth: Passive revolutionaries in a passive revolution.» In: *Globalizations, Volume 18(7), 1123-1148.*
Spash, C.L. (2024). *Foundations of social ecological economics. The fight for revolutionary change*

in economic thought. Manchester University Press.
Spash, C.L., Ryan, A., 2012. Economic schools of thought on the environment: investigating unity and division. In: *Cambridge Journal of Economics, 36(5), 1091–1121.*
Spash, C.L. & T. Smith (2019). Of ecosystems and economies: re-connecting economics with reality. In: *Real-world economics review 87, 212–229.*
Stirling, A. (2017). Precautionary appraisal as a response to risk, uncertainty, ambiguity and ignorance. In: *Routledge Handbook of Ecological Economics. Nature and Society* (pp. 267–277). C.L. Spash (red.). London & NY: Routledge.
United Nations, European Union, FAO, IMF, OECD & World Bank. (2014). *System of Environmental-Economic Accounting 2012. Central Framework.* United Nations, New York.
Vatn, A. (2005). *Institutions and the Environment.* Cheltenham: Edward Elgar.
Vatn, A. (2021). *Bærekraftig økonomi. Innsikt fra økologisk og institusjonell økonomi.* Bergen: Fagbokforlaget.
Vatn, A. og D.W. Bromley (1994). «Choices without prices without apologies.» In: *Journal of Environmental Economics and Management, 26(2), 129–148.*
Weisz, H., F. Krausmann, C. Amann, N. Eisenmenger, K.-H. Erb, K. Hubacek, Klaus og M. Fischer-Kowalski (2006). «The Physical Economy of the European Union: Cross-country Comparison and Determinants of Material Consumption.» In: *Ecological Economics 58(4), 676–698.*