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ECONOMICS OF EXTRACTIVISM

ENERGY AND RESOURCES IN THE 21ST CENTURY

Rosa Mª Regueiro Ferreira, Pablo Alonso Fernández
and Aurèlia Mañé Estrada

ROUTLEDGE

Economics of Extractivism

Extractivism is an economic model based on the extraction of natural resources for export that is widespread in resource-rich countries. Historically, extractivism was typically used in reference to fossil fuels but in recent decades the drive to find new energy sources has given rise to new dynamics in extractivism. This book identifies and describes these new dynamics and trends in extractivism and explores their effects on the economic development and environmental impact of different countries, to show the potential benefits and limits of renewable energies.

To this end, an introduction and contextualisation of the concept of extractivism in recent decades is provided. This is followed by a detailed description of the various impacts around extractivism of different energy sources throughout the 21st century: fossil fuels, renewables and other sources. Subsequently, the implications of extractivism for economic development, the environment, the energy transition, and the problems and conflicts arising from the relations between extractivist countries and consumers in the field of energy are examined in depth.

This book will be of interest to readers in ecological economics, environmental economics, energy economics, political ecology, and anyone working on energy issues in the social and natural sciences.

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1 Energy Transition, Sustainability, and Ecological Transition

1.1 General Remarks

In the current context, the tension between the physical limits of natural resource disposal, the overreach of the hegemonic production and consumption model, the end of access to cheap energy (especially in the form of electricity), and the scarcity of energy resources is evident (Carpintero & Nieto, 2022). The application of energy alternatives is an urgent and important need for contemporary society. However, it is necessary to ask whether this process of renewable development is 'sustainable' in the current landscape of the green transition. In line with the 2030 Agenda and the Sustainable Development Goals (SDGs) (ONU, 2017), the European Commission has championed the European Green Pact or "Green Deal". The aim is to make the European Union, by 2050, the first climate-neutral continent, thanks to a clean, zero-emissions economy, advancing global well-being (Comisión Europea, 2021). To achieve this, greenhouse gas emissions must be reduced by 55%, affecting above all the productive sphere and, in particular, the transport, energy, and industrial sectors. In this paradigm, non-renewable energy plays an important role, as it accounts for the sum of energy production and use plus 75% of the European Union's greenhouse gas emissions.

An energy transition can be defined as a significant change in the energy system, affecting the structure of the system (centralised or decentralised supply), its energy sources, its cost structure, or even the political-economic regime that affects it. Throughout history, different energy transitions have taken place, with perhaps the most important being the use of fossil fuels on a large scale, in particular coal (Linares, 2018). For Casal (2024), energy transition is a process of change from an energy model based on one type of energy to another model based on another type of energy, the best known being the change from consuming fossil fuels to renewable energies.

An ecological transition would be a process of global changes in production and consumption systems, in social and political institutions, in ways of life, and in the values of the population in order to transform the current, highly environmentally costly situation into a future environmentally sustainable situation compatible with the planet's capacity to maintain human activities; and

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all this without altering the organisation of economic activities (García, 2018). For Casal (2024) it implies a change towards a new metabolism adapted to function with renewable energies while respecting the limits of the biosphere and physical limits in general. A derivative would be the ecosocial transition, which would prominently consider social change parallel to the ecological transition.

Energy decarbonisation is a fundamental axis of action, promoting renewable energies, energy efficiency, and energy saving, among others. Furthermore, we must remember that the hegemonic energy system, which is clearly non-renewable, focuses on the use of fossil resources linked to monopolistic and/or oligopolistic market situations, characterised by use in transport and a growth in world demand in emerging economies and oil-exporting countries, in the acknowledged scenario of peak oil. But it also implies witnessing an energy and climate crisis, with expensive energy, which means that the energy transition requires a change in the hegemonic production-consumption system, taking into account the limits set by renewable energies (Carpintero & Nieto, 2022).

It should not be forgotten that the Brundtland Report defined sustainable development as a development model that meets the needs of the present without compromising the ability of future generations to meet their own needs. This requires an economic system that is aware of the Earth's ecological limits (the depletion of materials and resources) (Meadows et al., 2006).

1.2 Economic Approaches to Resource Management

1.2.1 Ecological Economics

Ecological economics is an analytical approach that considers economic aspects to be independent of physical issues. Therefore, physical issues and those related to resources or energy are not treated separately but are analysed as a whole. Therefore, it is interesting to introduce some of the key aspects of this perspective.

If energy is considered from the perspective of its potential for human use, two states can be distinguished: available and unavailable. Available energy is that which allows mechanical work to be performed, and its use converts it into unavailable energy, from which work can no longer be extracted (Ehrlich & Ehrlich, 1980; Valero, 1999). This statement is derived from the interpretation of the first two principles of thermodynamics, which indicate:

1. First principle of thermodynamics or principle of conservation of energy: the amount of energy contained in the universe remains unchanged and constant. This energy can be transformed, passing from one state to another, but it is neither created nor destroyed.
2. Second principle of thermodynamics or law of entropy: the transformation of energy implies an irreversible degradation of that energy, so each change of state of the energy contained in a system implies an increase in the entropy of the system.

Therefore, based on the principles of thermodynamics, energy transformation occurs unidirectionally, moving from available to unavailable energy irreversibly. The law of entropy can be extended to the field of material (Georgescu-Roegen, 1971). As with energy, two qualitatively different forms of matter can be distinguished: available matter, which allows work to be obtained, and unavailable matter, from which work cannot be extracted. Considering that the Earth is a closed system for the input of material resources, the availability of resources on Earth is limited, and problems of scarcity are inevitable and must be managed.

In terms of energy, the Earth can also be considered a closed system, at least from the perspective of human needs. It does receive large amounts of energy from the sun, but most of this energy is dissipated, resulting in a zero-energy balance (Valero & Naredo, 1999). The small portion of solar energy that is retained is due to plant photosynthesis, which, over millions of years, has allowed large amounts of energy to accumulate in the form of fossil fuels. In recent centuries, human societies have used amounts of energy that far exceed the flow from the sun. Thus, the rate at which the energy stored in fossil resources is consumed far exceeds the rate at which they can be replenished. Therefore, at this scale of energy demand, the Earth is equivalent to a closed system for humans.

The energy imbalance generated by fossil fuels can be addressed through renewable energy sources. These sources present two important limitations that must be considered. First, their flow-based nature, rather than stock-based nature, limits energy capacity to the availability of the harnessed flow. Second, the technologies required to harness these energy sources require significant amounts of very scarce material resources, such as rare earths. Therefore, a direct transition without any adjustment from the fossil fuel system to a fully renewable system is not feasible.

1.2.2 Conventional Economics

In conventional economic analyses, resources are interpreted as infinite and free (Naredo, 1987), so their value is primarily related to extraction costs. This approach has led to little attention being paid to potential problems of resource scarcity, based on two main premises. On the one hand, principles such as Hotelling's rule indicate that there is an optimal level of exploitation for each resource, which is set at the level that guarantees supply for the current and next generations (Hotelling, 1931). Under this rate of exploitation, there is always room to address potential shortages with sufficient time to find alternative resources or technologies that significantly reduce consumption (Solow, 1974). Hotelling's rule has been adopted as a valid economic principle, crystallising in the idea that sustainable development can be achieved if the needs of the current generation are met without compromising future generations, as defined in the Brundtland Report (United Nations, 1987). The growing evidence of the effects of resource use has favored a more detailed analysis of this phenomenon. Many economic activities can cause undesirable effects on third parties not involved. These effects are called externalities, and can be of two types (Baumol & Oates, 1975):

- Positive externalities: These occur when economic activity generates a positive effect on an uninvolved third party, and the latter does not pay for it.
- Negative externalities: These occur when economic activity produces a negative effect on an unrelated third party, for which the activity is not compensated.

In general, most externalities generated by production are negative: destruction of the natural environment, damage to third-party property, pollution, and so on. Because these externalities affect economic agents not involved in the operation, they are not economically accounted for, so there are no incentives for the agent who generates them to manage them (Baumol & Oates, 1975; Pigou, 1920). The proposed solutions require the economic valuation of the externality, attempting to internalise it within production costs. To achieve this, regulations must ensure that property rights are adequately defined and that perfect competition exists (Coase, 1960; Hardin, 1968). In this way, the agent causing the externality and the injured party will have greater ease in negotiating, and an optimal level can be reached in which there is a balance between the damage caused and the compensation received.

In this area, the main problem arises from the great difficulty in valuing these externalities beyond monetary terms. Payment for the disutility generated by an externality can lead to economic equilibrium, but this does not necessarily coincide with ecological equilibrium. The ecological perspective considers it pointless to attempt to monetarily value environmental damage or the resources consumed (Costanza et al., 1997; Kapp, 1970). Their irreversible and finite nature means that the only appropriate management involves minimising the resources used and the impacts generated.

The conception of natural resources as inexhaustible or easily replaceable has led to a lack of concern for their management. In general, it has been considered sufficient that technical progress allows for progressively increasing efficiency in resource use. This reliance on the action of the market and technology implies the implicit assumption of substitutability between capital and resources extracted from nature (Solow, 1991). Considering this, and that optimal resource consumption can be achieved by assessing the needs of future generations (Solow, 1995), a sustainability approach can be defined, which is usually referred to as weak. At the opposite extreme, the ecological approach (strong sustainability) considers that this substitutability between capital and natural resources does not exist. Therefore, economic activity will be sustainable only when it does not negatively affect the recovery of ecosystems and its effect on the stock of natural capital is minimised (Arrow et al., 1995). Table 1.1 summarises the main differences between the two approaches to sustainability:

Table 1.1 Differences between strong sustainability and weak sustainability

Strong sustainability	*Weak sustainability*
Natural capital is necessary to produce other forms of capital and is not replaceable by them.	Natural capital is replaceable by other forms of capital.
Economic activity should not affect the conservation of natural capital.	Determining the discount rate to replace amortised capital.
Well-being is not related to economic growth, which is also unsustainable. Well-being must be achieved without negatively affecting ecosystems.	Economic growth is essential to improving well-being. Maintaining growth requires considering the use of natural capital.

Source: own elaboration.

1.3 The Ambiguity of Sustainability in Energy Transition

Considering the intense debate on the scope of the concept of sustainable development, the idea of sustainability/sustainability incorporated in the Brutland report is fully applicable and valid for the issue at hand, as it addresses the social, economic, and environmental dimensions:

a economic interactions: a new economic model is needed to recognise the limit set by the biosphere, that the availability of resources is not infinite, depending on the category of resources (renewable, non-renewable), as well as changes in the behaviour of all the actors involved (consumers, companies, institutions).
b the production process causes negative environmental impacts (emissions, waste, residues) that must be dealt with in order to reverse the current process. Policies must be articulated to enable this new 'sustainable' model, through measures such as the integral promotion of renewable energies, the creation of infrastructures that enable sustainability, tackling the problems of goods and passenger transport, energy efficiency models, and the design of a fiscal and institutional framework that encourages sustainable consumption, etc.
c society must be an active part of this new model.

The relationships between the energy system and society, in order to contribute to the formation of a sustainable environment, have been studied through different approaches, methodologies, and analyses. Undoubtedly, one of the most recognised is the contribution of ecological economics (Georgescu-Roegen, 1996; Naredo, 1987), which studies sustainability by considering the relations between economic subsystems within a system of higher rank: The set of social relations which, in turn, is part of another system, which is nature or the biosphere (Passet, 1996). Society uses materials or energy from nature and expels waste and dissipated energy through a metabolic/social process (Carpintero, 2005, pp. 113–194). The study of these relationships includes the study of the conflict between economic growth and the physical and biological limits of ecosystems. This analysis is transdisciplinary and holistic in nature, due to the complexity of the problems to be addressed, and it is necessary to have a long-term perspective in order to guarantee the distribution of resources for future generations, without preventing an equitable distribution to present generations.

Two key variables must be underlined in order to understand the practical role of renewable energies in the energy-ecological transition and in guaranteeing a minimum level of well-being: Climate change and energy sustainability. The link between renewable energies and the realistic and effective fight against climate change is based on energy consumption, its quantification, and the energy dependence of human and economic activities, transport systems, mobility, and so on. It is necessary to define 'dispensable' consumption, related to a new model of economic-social and inclusive development. The Stiglitz Report (Stiglitz et al., 2009) highlights a difference between the evaluation of well-being in the present and the evaluation of sustainability, understood as the capacity to maintain well-being over time. Present well-being depends on economic and non-economic resources that characterise people's lives, such as the natural environment. Sustainability depends on ensuring the availability of stocks of goods that guarantee our well-being for future generations.

Finally, the "energy trap" (Carpintero & Nieto, 2022) should not be overlooked: The deployment of renewable energy sources and infrastructures requires a massive use of fossil fuels (the faster the transition process is planned, the more rapidly it is implemented), and the massive deployment of renewables has significant consequences in terms of extraction and use of non-renewable minerals that need to be assessed and taken into account (Valero, Valero & Calvo, 2021). As the International Energy Agency has pointed out, in a scenario in which the Paris Agreement targets are met, the demand for minerals for renewable technologies would increase global mineral consumption over two decades by 40% for copper and rare earths, 60%–70% for nickel and cobalt, and almost 90% for lithium, leaving hardly any room for the use of these minerals for other current uses (IEA, 2021).

In global terms, an energy transition can be defined as a significant change in the energy system of a territory, affecting the structure of the system, the energy sources that compose it, the costs, or even the political-economic regime that affects it. But this change has to be global, affect the whole system, and be built on new premises, not just on the energy source. Without a doubt, this is an essential detail to be able to determine the potential effectiveness of this process in terms of achieving the objectives set for it.

However, energy transition does not mean ecological transition. The evident tension is between the physical limits of natural resource availability and the overreach of the hegemonic energy system, which is clearly non-renewable, and its own model of production and consumption. It raises its voice to demand an economic system alienated from the dynamics of destructive competition and aware of the ecological limits of the Earth, given that the depletion of materials and resources also affects renewable development.

The efficient use of energy is an unavoidable condition for all actors involved in the energy system, producers, consumers, and regulators. Considering the evolution of the energy sector in recent decades and the environmental and climatic changes, the role of energy efficiency, rational energy use and savings in the consumption of materials and resources should not be underestimated. As part of a more sustainable paradigm shift, it is presented as a concrete solution to contribute to greater intergenerational equity, improve the competitiveness of the economy, and reduce the environmental impacts of lower energy production and consumption, as well as to try to reduce emissions linked to the overall functioning of the energy system.

Recognising the physical limits of planet Earth is an urgent obligation, which justifies classifying the current situation as a necessary ecological transition rather than an energy transition. The reasons are based on the need to create an environment that should be sustainable, to improve society and the economy, to overcome the greed for technological advances, and because existing resources will continue to be indispensable and irreplaceable, but with a series of considerations:

- Fossil resources will continue to lead the way in maintaining energy demand, possibly with a clear increase in coal, especially in the face of demand peaks.
- Renewable energies will increase their contribution, although they will be controversial due to the combination of impacts on the local environment.
- Nuclear energy will reconcile its 'questioned' public acceptance with its contribution to meeting energy demand.

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