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Global Challenges for a Sustainable Society

EURECA-PRO The European University
for Responsible Consumption and
Production

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Editors


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Responsible Consumption and Production


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Preface

The Second EURECA-PRO Conference on Responsible Consumption and Production provides an interdisciplinary forum for practitioners, academics, and scientific experts on the most recent advances to achieve UN Sustainable Development Goal 12 (SDG12), embracing the challenges posed by the European Green Deal. As such, the conference aims to represent a unique place to share experiences, scientific results, and visions for making the EU's economy sustainable by covering all sectors, especially transport, energy, agriculture, buildings, and industries. The conference also aims to constitute a benchmark for leading researchers in the SDG12 field to discuss current and future challenges, opportunities, and innovative solutions considering the technological, humanistic, economic, social, and environmental dimensions of responsible consumption and production.

Alliance consists of nine higher education institutions: Montanuniversität Leoben (Austria), Technische Universität Bergakademie Freiberg (Germany), Technical University of Crete (Greece), Universidad de León (Spain), Silesian University of Technology (Poland), University of Petrosani (Romania), University of Applied Sciences Mittweida (Germany), Hasselt University (Belgium), and University of Lorraine (France). EURECA-PRO integrates their joined forces to become the global educational core hub and interdisciplinary research and innovation leader in environmental and social framework development under the umbrella of SDG12, effectively contributing to the European Higher Education Transformation Agenda. Through the implementation of five Research Lighthouse Missions (LH) (LH1: 'Responsible Material Flows', LH2: 'Environment and Water', LH3: 'Sustainable Materials and Products', LH4: 'Clean Energy', and LH5: 'Process Automation and Industry 4.0'), EURECA-PRO is creating a research environment focused on actively developing solutions to SDG12 current global challenges.

In this book, readers will find excellence-based communications dealing with the following five topics: (i) Smart and Healthy Societies (LH2 and LH5), (ii) Recycling, Reuse, and Longer Lasting Products (LH1 and LH3), (iii) Clean Air, Freshwater, Healthy Soil, and Biodiversity (LH2), (iv) Cleaner Energy and Cutting-Edge Clean Technological Innovation (LH4) and (v) Industry 4.0. (LH5).

Thanks to the participants and the organising team for giving us this opportunity. The rest of us have no choice but to take advantage of it. On behalf of the organising committee, we hope you enjoy reading the content of the papers included in this book.

León, Spain

José Alberto Benítez-Andrades
Paula García-Llamas
Ángela Taboada
Laura Estévez-Mauriz
Roberto Baelo

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Consumption Behaviour in the Context of Sustainable Energy: Theoretical Approach

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Abstract. Increasing production and consumption have a growing environmental impact. The challenge for all countries is to decouple economic growth from the environmental impacts of consumption, resource use and waste generation. The economic sectors with the highest environmental impacts are electricity, gas and water supply, transport services and agriculture. It is therefore becoming important to improve energy efficiency and invest in innovative and resource-efficient technologies, recognising the need to change consumption patterns and behaviours. The Sustainable Development Strategy focuses on sustainable production and consumption. Although historically the focus has been on production and the associated environmental problems and solutions such as pollution control, cleaner production and recycling. Production and consumption as interdependent indicators have only recently come into focus as researchers have realised that production and consumption are highly interrelated. Sustainable Development Goals have stressed the importance of promoting consumption and production that have the least possible impact on the environment and are able to meet the basic needs of humanity.

Keywords: Sustainable consumption · Sustainable production · Sustainable energy · Consumer behaviour

1 Introduction

Consumption changes are continuously monitored by collecting and analysing data on consumer behaviour in individual countries or regions. During the quarantine of the COVID-19 pandemic, consumers started to realise how much influence they have on their decisions. For example, according to the European Environment Agency (EEA) (2020), one of the unintended consequences of such sudden socio-economic shocks has been a reduction in the concentration of air pollutants, mainly due to the restriction of traffic and other activities, especially in parts of China and Europe (e.g. during the period of isolation in the north of Italy) [1, 2]. The emergence of the COVID-19 pandemic has highlighted the relationship between people and nature, and has raised awareness that our health, our ecosystems, our supply chains, our patterns of consumption and production, and the planet's capacities are inextricably linked, and it has highlighted the basic principles of the trade-offs we are constantly faced with: that human beings have

infinite needs, but that the planet's capacities to meet those needs are limited. Therefore, it is necessary to protect and restore nature immediately. Before we can have a negative impact, we need to try to understand and assess the limits to human destruction of nature. These limits must be reflected in our consumption and production behaviour. There is a realisation that current patterns of consumption and production are unsustainable, and that new sustainable patterns of consumption and production are needed that stay within the planet's boundaries and move towards more sustainable practices. Of course, reducing consumption would improve the environment, but we are dealing with human habits, cultures and emerging customs. As consumption behaviour raises complex issues, it is necessary to study this topic in a coherent way. Insights from behavioural economics can help understand the direction of change.

The aim of the research is to identify the scientific assumptions that determine the need of change of consumer behaviour in the context of sustainable energy.

Research methods—scientific literature analysis and synthesis related to consumer behaviour, sustainable consumption, sustainable energy, innovative energy technologies, abstraction. The scientific literature analysis is the basis on which new knowledge related to the research being conducted is based [3]. The abstraction aims to focus on the main, essential features of the phenomenon under consideration, revealing their essence and creating generalized concepts, theories, classifications, categories, principles, etc. [4]. Information search for analysis was performed using Scopus, ScienceDirect, Google Scholar. Basic search parameters were defined as such: search by name, period from 1985 until 2022, using keywords: consumer behaviour, sustainable development, sustainable consumption, sustainable production, sustainable energy, innovative energy technologies, sustainable energy technologies. A chosen approach to investigate the issue at hand is widely used in many theoretical studies [5, 6].

2 The Origin of Sustainable Consumption and Production

In the context of sustainable development, most authors provide essentially the same definitions of sustainable development, emphasising the long-term development of a country in order to rationally reconcile the economic, social and environmental interests of a society in order to ensure the global well-being of present and future generations, while staying within the limits of acceptable environmental impacts [7–12]. For example, the use of inventions of new machines, equipment, and other mechanical instruments during the industrial revolution enabled humans to enhance economic growth and living standard; however, simultaneously threatened the environment and ecosystem [13]. Likewise, the use of energy in industry and services was driven by the quest for more effective forms of fuel to respond to the needs of a rapidly growing industrialization to fulfill the demands of large-scale accessible, reliable, and adaptable forms of energy [13].

In a document related to sustainable development, the European Union's Green Deal (2020) establishes a new strategy for sustainable and inclusive growth, which emphasizes the need to rethink the supply of clean energy for the entire economy and commits Member States to achieving full carbon neutrality by 2050 and to a full transition to

renewable energy sources. As part of the European Green Deal, the European Commission has developed European industrial strategy (2020) to better identify and overcome existing barriers to sustainable consumption and production, raise public awareness and change consumption behaviour. The transformation of consumption and production behaviour has become a key factor in the transition to a sustainable economy in order to achieve the green transformation.

Sustainable consumption is intrinsically linked to the principles of sustainable development [14], as it is the changes in consumption that have led to the emergence of sustainable development principles in the first place [15, 16], which is why more and more attention has been paid to sustainable consumption in particular in recent years [17–22]. Sustainable consumption broadly refers to efforts to promote more efficient consumption and the progressive conservation of energy and natural resources used. Sustainable consumption can be said to be an essential prerequisite for sustainable development and an integral part of green, sustainable economic growth. Scientific studies and analysis of EU and national documents show that incentives for sustainable consumption need to be focused on the areas where the impact of consumption is felt most strongly, i.e. private transport, the housing sector (including heating, hot water, electrical appliances, construction), and to pursue deeper systemic changes [17, 22–26]. In these areas, the environmental impact of consumption depends on consumer behaviour and the factors that influence it.

3 Relationship Between Sustainable Consumption and Sustainable Energy

The greatest sustainability challenge facing humanity today is the greenhouse gas emissions and the global climate change with fossil fuels led by coal, natural gas and oil [27]. Energy is currently recognized as one of the most important factors that influence the rate of progress as well as sustainable development of all nations [28], because the production and consumption of energy are posing serious environmental problems: concentrations of greenhouse gases and air pollutants are increasing in the atmosphere, leading to climate change. Therefore, sustainable energy is one of the EU's priority policy areas in implementing sustainable development goals. Sustainability is an important paradigm in the global energy transition where all dimensions of sustainability are addressed any policy formulation and implementation, planning, operation, and dispatch of the energy resources in both generation and consumption [29]. For a longtime, energy did not seriously factor in sustainable development [27]. However, sustainable development and sustainability issues now play a central role in energy and electricity by anchoring the evolution of the sustainable development paradigm [27].

The transition to sustainable energy is inseparable from consumers, which is why consumers have recently been encouraged to reduce their energy consumption and contribute to a sustainable environment. By using sustainable energy, we are promoting the very idea of sustainability to consume responsibly, to avoid wasting precious resources and to choose environmentally friendly ways of getting energy. The best examples of sustainable energy are solar and wind power, hydropower and geothermal energy. Modern

technologies that ensure energy efficiency have an important role to play in the transition to sustainable energy. These technologies help to reduce energy waste in Europe. For example, smart meter technologies digitally optimise processes such as lighting and temperature control, reducing energy bills in factories, homes, hospitals, offices and elsewhere. For example, the “Empower Demand” report on ‘The potential of smart meter enabled programs to increase energy and system benefits: a mass pilot comparison’, written and published by VaasaETT, shows that, depending on the user’s involvement, after installing smart meter technologies, savings on average are between 5 and 8.7% electricity.

Sustainable energy is in line with the concept of sustainable consumption and production—it’s more and better to use less. It also means decoupling economic growth from environmental degradation, increasing resource efficiency and promoting sustainable lifestyles.

4 Research of Topic

Consumer behaviour, which refers to the human activities directed towards the acquisition, consumption and use of products and services through pre- and post-purchase decisions, has been a topic of research interest for several decades [30–32]. Consumer behaviour science is at the heart of a wide range of research questions related to the acquisition or non-acquisition of goods and services, from the simple who, what, how, where, when, why to complex research questions [31–33]. Consumer behaviour science has as its content the study of the consumer decision-making process and the external and internal environmental factors that influence it [32–34]. Historically, successive theories of consumer behaviour have attempted to explain how and why individuals behave when making certain decisions. This has led to the development of several theories of consumer behaviour that emphasise different motivational aspects [32, 33]. Theories of consumer behaviour were actively constructed in the 1970s–10s [30, 33]. During this period, *theories of economic man* (Bernoulli, N., Von Neumann, J., Morgenstern, O.) based on the rational, self-concerned consumer, who makes decisions in a utility-maximising and effort-less manner; *psychodynamic theories* (Freud, S.), according to which consumers’ behaviour is determined by unconsciously and instinctively acting biological forces; *bioheuristic theories* (Pavlov, I, Watson, J., Skinner, B.) according to which a consumer can learn a certain behaviour under the influence of external factors; *cognitive theories* (Hebb, D. O., Neisser, U., Howard, J. A., Sheth, J. N., Blackwell, R. D., Miniard, P. W., Engel, J. F., Fishbein, M., Ajzen, I.), according to which the consumer is an information processor, active seeker, influenced by the environment and by social stimuli, and a decision-maker and response-maker, with a focus on perception, learning, memory, cognition, motivation, emotions, etc.; *humanistic theories* (Bagozzi, R, Warshaw, P. R., Perugini, M.) which consider the roles of consumers’ emotions, volition (lying between consumers’ purchase intentions and their actual purchase behaviour), desire, altruism-egoism motives, attempts and goals in decision making [33, 35]. This period saw the emergence of the major models of consumer behaviour [33, 36]. A consumer behaviour model is the form that consumer behaviour theory takes (an accurate representation of the phenomenon related to the consumption of goods and services that it attempts to

explain). There are a number of models that can be found in the scientific literature that describe consumer behaviour, but the more widely used are the classical ones, i.e. the Nicosia model; the Howard-Sheth model; the Engel-Blackwell-Miniard model [33, 35–39]. The basic concept of these models is to focus on conscious, sufficiently rational and detailed consumer decision-making, emphasising the infinite perceptual and learning capacities of consumers, the evolution of their attitudes and their possible actions towards a wide range of alternative choices.

While consumption has long been seen as a key driver of economic growth, today's consumption has negative environmental impacts [22, 40–43], for example, such as energy production from traditional sources, increased energy consumption and transport [44], a growing group of scholars and practitioners, with an increasingly diverse set of perspectives on the recent issues, are advocating for sustainable consumption [17–22], because “man-driven factors can overcome these issues” [44].

P. C. Stern (1997) observes, as quoted by J. N. Sheth, N. K. Sethia and S. Srinivas (2011), environmental damage caused by consumption threatens human health, welfare, and other things we value. Humanity's resource use and pollution already far exceed Earth's carrying capacity [43]. In 2007, the total global ecological footprint of humanity, with a population of 6.7 billion, was estimated at 18 billion global hectares (gha), or 2.7 gha per capita. However, the Earth's biocapacity—the total amount of renewable resources provided by the planet—was only 11.9 billion gha that year, or 1.78 gha per person. This nearly 50% overshoot meant that in 2007, human consumption was equivalent to 1.5 times the Earth's resources, and natural resources were being depleted faster than they could regenerate [43, 45]. High consumption footprint shows humanity's debt to nature. To date, developed countries have of course been responsible for most of the environmental impacts from consumption and production [22]. For example, US households represent 4% of the global population, however, they account for 20% of global emissions of greenhouse gases, with per capita emissions four times the Chinese level [22]. However, these problems are not only found in industrialised countries, where mass consumption is one of the main causes of global and local environmental problems, but also in rapidly developing countries, where wealth is created in resource-intensive ways [43]. A similar trend can be observed in Europe, where the old EU Member States still have the highest consumption costs, but the new Member States are catching up fast. For example, the results of a study conducted by researchers [46], disclosure that income is the main driver of global emissions between 1980 and 2015, while energy intensity is the most important factor holding back global emissions [46]. The research shows that energy intensity was the primary mitigating factor of global CO₂ emissions, followed by energy consumption structure; in contrast, income was the primary driving force of increasing global CO₂ emissions, followed by population over the four periods (i.e. between 1980 and 1990 global CO₂ emissions increase by 13.6%; between 1990 and 2000 global CO₂ emissions increase by 23.9%; between 2000 and 2010 global CO₂ increase by 34.5%; between 2010 and 2015 global CO₂ emissions increase by 7.3%).

Future sustainability squarely on the shoulders of decoupling economic growth from environmental impacts through technological innovations that support efficiency improvements (particularly in energy systems) [22]. Authors O'Rourke and Lollo [22] underline, that there are some encouraging signs of decoupling in developed countries.

For example, there have been noticed energy use reductions in homes and increases in ride-sharing services in US. However, as scientists Štreimikienė et al. [47] note, that the residential sector was responsible for almost 30% of final energy consumption in the EU in 2020 and has a huge GHG emission reduction potential which is not yet realized. Energy use efficiency improvements and the use of renewable energy sources in households are one of the main climate change mitigation measures linked to sustainable energy consumption [48].

Currently, the emissions from the energy sector contribute for over 80% of the total emissions [49], thus, there is a need to divert to other energy production resources that are environmentally friendly, like renewable energy technologies [44]. Sustainable energy topics are widely analysed in scientific papers [47, 50, 51]. Scientists argue that we need to modernise our economies to introduce sustainable consumption and production patterns, produce, consume energy and design buildings sustainably for our well-being [8, 23, 52–54].

McDonald et al. [55] points out that it is consumers who determine the laws and regulations, as well as the measures taken to achieve a more sustainable way of life. Researchers have found that all consumers can be divided into three groups when it comes to sustainable consumption: *translators* (in some aspects of their lifestyle, they consume sustainably, but not in others); *exclusive-confident consumers* (sustainable living is a priority for these consumers); *choosers* (consumers are distinguished by the fact that they mostly consume goods and services as a regular consumer, but also consume a few eco-friendly products or goods, for example; they may always sort rubbish, advocate recycling, but in all other aspects of their life, they do not pursue any sustainable consumption) [55].

5 Conclusion

To overcome the sustainability challenges we face, interventions and policies must include not only technological improvements, but also strategies to change the behavior of individual consumers, broader initiatives that aim to change systems of production and consumption. Structural interventions and measures to promote sustainability must be integrated into sustainable innovation through universal education and sustainable consumption efforts. Consumer behavior is determined by the interaction of many socio-cultural, economic, and technological factors, therefore, in order to make consumer choices more environmentally friendly, it is necessary to change their attitude in forming the need for environmentally friendly products and services. It should be noted that the support of the central and local authorities to achieve fundamental changes in the entire production and consumption system is very important. Advances in sustainable consumption and sustainable production can be achieved by ensuring the participation of stakeholders in the consumption and production system. Such cooperation would encourage consumers and producers to change their behavior patterns.

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