



ECOLOGISTICS - GOOD PRACTICES ON THE EXAMPLE OF POLAND

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1. **ABSTRACT:** This article presents information on ecologistics, with particular emphasis on presenting this concept in the context of Poland. Based on the literature analysis, the definitions of ecologistics and green logistics were presented and the difference between these terms was indicated. The following part of the article describes Poland, one of the member states of the European Union. The solutions that Poland has implemented in the context of green logistics have been presented. The article presents a case study of ecologistics solutions that have been applied in various areas of logistics.

2. INTRODUCTION

Environmental pollution is a consequence of industrial and social development, as well as rapid population growth. These are the main problems facing humanity in the 21st century. On the basis of reports presented by international organisations concerned with, among other things, controlling the state of the environment or the impact of man and the economy on the ecosystem (e.g. UN, WHO or WMO report), one gets the impression that mankind has lost control over the process of environmental degradation and related climate change. This process of change is progressing and its effects, if not now then certainly in the next few decades, will change the face of our planet forever. The environmental crisis is not only about the current state of environmental pollution, but also about the projections that assume its deterioration, the probability of which is relatively high.

Development towards the Sustainable Development Goals depends on governments and multiple bodies consisting of public society organisations, private sector organisations and millions of people (Scharlemann, and others, 2020). A significant cause of global warming is greenhouse gas emissions (Ahmed and others, 2021d). Over the years, CO₂ emissions have received much attention in the literature as a measure of pollution (Zhang and others, 2021). A report published by the World Meteorological Organisation (WMO, World Meteorological Organization) in March 2019 shows that the physical signs and socio-economic impacts of climate change are accelerating. Record concentrations of greenhouse gases are causing global temperatures to approach increasingly dangerous levels. The WMO also points to record sea level rise, as well as unusually high increases in



land and ocean temperatures. The organisation confirms that the described warming trend has continued since the beginning of the current century and is expected to continue (WMO, 2019).

The climate agreements that most of the world's countries are ratifying are a significant global manifestation of humanity's concern for the environment. The international community is now focusing on the pursuit of green growth. Scientists, too, are noticing the increasing impact of the environment on all decision-making areas in logistics and are advocating the need to adapt logistics processes to changing conditions, such as the climate crisis and restrictions on access to natural resources). In today's fast-paced and interconnected world, logistics plays a key role in the movement of goods and services, and the logistics sector plays a key role in the economic development of any country. However, given the growing emphasis on sustainability, the high levels of energy consumption and carbon emissions in the logistics sector do not support the sustainability of logistics. Companies are forced to increase productivity while using efficient and sustainable resources to eliminate environmental destruction. Green logistics, which is a holistic approach to logistics management that considers the environmental and economic implications of logistics operations, has emerged as a solution to these challenges. As such, green innovation, the supply chain loop, economic globalisation and the use of renewable energy are becoming increasingly popular.

The aim of the article is to present an in-depth analysis of green logistics practices in Poland, including the current state of these practices, the role of government and industry, and the impact of consumer behavior on their functioning. The article used both theoretical and practical research methods. The research involved a multifaceted approach that combines several methods to gather information and analyse the current state of ecological science in Poland.

The article provides a comprehensive review of existing literature and research on green logistics. The review was conducted to gather background information, identify knowledge gaps and understand the current state of green logistics practices and their impact. The literature review included academic journals, reports and industry publications.

Case studies have been used to provide a practical understanding of how green practices can be implemented. The case studies will provide a comprehensive understanding of the current state of green logistics practices, the challenges faced by the logistics industry in transitioning to sustainable practices and the role of government and industry in promoting green logistics initiatives.

3. THEORETICAL FRAMEWORK OF ECOLOGISTICS

Logistics can be defined as the management of an organisation's inventory, the transportation of goods, purchasing and the flow of information through its marketing channels to increase revenue (Christopher, 2016). Logistics has become the backbone of the global economy, driven by both consumption and production. Logistics occupies a significant position in a country's economic growth and development, but also increases air pollution, including greenhouse gases. Consequently, initiatives in the area of the so-called green economy are playing an increasingly important role in today's world. Green development means choosing a strategy for the operation and functioning of all structures in such a way as to combine environmental protection with all other functions of the economy. Ecology in logistics should prevent the negative effects of the functioning of logistics systems mainly in the production, transport and storage of physical goods (Korzeń 2001).



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In order to properly understand the issues of environmentalism, it is necessary to define the concept and define its area. In theoretical terms, environmentalism is a sub-area of ecology-oriented logistics. Initially, environmental science was mainly concerned with the collection, treatment and disposal of waste. In this view, environmental science is concerned with research and activities related to the implementation of optimal solutions for the collection, gathering, disposal and routing for utilisation or environmentally and socially unobtrusive disposal of various types of waste (Korzeniowski and Skrzypek 1999). Nowadays, the term describes a much broader meaning, understood primarily as the subordination of logistical strategy to environmental objectives.

The concept of ecologistics is becoming more and more popular in Poland, but it should be noted that it is understood differently and covers other topics than in the international arena. In the English-language literature, ecologistics is a rarely encountered concept. In the world, the most commonly used terms are green logistics, but also: reverse logistics and waste logistics. In Poland, these three terms coincide with the definition of ecologistics. Based on the foregoing, these terms will be used interchangeably.

Ecologistics, seen as a group of logistics activities, is aimed at reducing the negative impact of physical and information flows on the environment. It is a concept combined with green logistics. Green logistics is an idea that stimulates pro-environmental strategic, operational and organisational solutions, into which ecologistics also fits (Baraniecka, 2019). The definitions of ecologistics and green logistics developed over the years are presented in Table 1.

In the modern world, the concept of ecologistics can be considered in terms of two criteria - economic and ecological. The economic consideration stems from the actual essence of logistics and is aimed at reducing the costs of logistics processes in terms of waste flows by using them efficiently or preventing them from occurring. These activities are also concerned, through waste prevention, with increasing product profitability and increasing demand for the products of the company in question, which directly increases revenues.

The ecological aspect in the context of ecologistics, on the other hand, is concerned with protecting natural resources and reducing emissions generated during logistics processes. These activities should focus primarily on the adaptation of the operators' activities to existing legal regulations and social norms.

Green logistics is one of the elements that can lead to achieving the targets of sustainable development. By lowering the operating costs of companies and saving energy without harming the environment and society, while increasing the quality of life of society, green logistics fits into the tenets of sustainable development (Karia and Asaari, 2016).

Table 1. List of definitions of ecologistics

Ecologistics is an integrated system which: is based on the concept of managing recirculating flows of streams of waste materials in the economy and the flows of information coupled with them

Korzeń 2001



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Green logistics is the management of the flow of knowledge, materials and funds between institutions whose goal is growth with an emphasis on social and environmental sustainability, while paying attention to the requirements of all stakeholders

Seuring and Müller, 2008

It's green supply chain management that you can define as an organization's activity that takes into account environmental issues and integrates them with supply chain management

Lee and Klassen, 2008

Applying the concept of logistics to residues in order to reduce their formation, including (very importantly) preventing their formation and inducing their economically and ecologically effective flow, with simultaneous spatial-temporal transformation, including a change in quantity and species

Baraniecka, 2019

The term "green logistics" is defined as supply chain management practices and strategies that reduce the environmental and energy footprint of goods distribution, which focuses on material handling, waste management, packaging and transportation

Rodrigue, Slack and Comtois, 2012

The current state of green logistics practices is a rapidly growing field that has attracted increasing attention from both the public and private sectors in recent years. This growth is driven by a growing awareness of the negative environmental impact of traditional logistics practices, as well as a growing demand for environmentally friendly products and services.

Green logistics practices cover a wide range of activities, including the use of renewable energy sources, efficient transport methods and the reduction of waste and emissions. These practices have been shown to have a positive impact on the environment, including reducing greenhouse gas emissions, conserving natural resources and reducing waste.

In terms of economic impact, green logistics practices have been shown to have both direct and indirect benefits. For example, the implementation of green logistics initiatives can lead to lower operating costs, improved efficiency and increased competitiveness of logistics companies. In addition, the growing demand for environmentally friendly products and services creates new business opportunities and drives economic growth in the green logistics sector.

4. GENERAL OVERVIEW OF POLAND

Although scientific research and reports prepared by governmental and non-governmental organisations emphasise clear progress, the practice of environmentalism in Poland cannot be



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considered advanced. On the basis of the research results, it should be pointed out that the main barrier to the implementation of ecological solutions in the field of logistics is the expected high costs, as well as the identified low competence in the implementation of pro-ecological investments. Barriers most often arise as a result of low ecological awareness among enterprises, as well as a low appreciation of the fact that one's actions can actually have an impact on the environment. These barriers, are relatively easy to eliminate, e.g. by introducing management solutions in the form of decision-making models and algorithms, organisational solutions and changes in human resource management.

Although climate change occurs and is considered on a global scale, it is important to remember that very often its origins can be traced to the local area. This is why most countries in the world, regardless of their membership of various international organisations, monitor their own environmental state.

Poland is situated in the centre of continental Europe. The capital city, Warsaw, is located in central-western Poland. Other large cities include: Krakow, Poznan, Lodz, Wroclaw, Gdansk and Rzeszow. Poland's extensive natural resources include particularly abundant deposits of hard coal, exploited in the mines of Upper Silesia, and brown coal extracted mainly through the open-cast method. Deposits of copper, sulphur and zinc-lead ores, and other minerals such as rock salt are of major economic significance. Poland also has substantial quantities of geothermal water and mineral waters (Eurostat). Poland, with a surface area of 312685 km², is the ninth largest country in Europe. Poland borders the Russian Federation (Kaliningrad District), Lithuania, Belarus, Ukraine, Slovakia, the Czech Republic and Germany. On date 22 June of 2022 total amount of population in Poland is: 37 840 001. Poland is ranked 5th among the European Union countries (Eurostat). GDP and main components (output, expenditure and income) on 09.01.2023 Poland have: 574 771.8 mln. EUR. Real GDP per capita on 09.01.2023 amount : 13 760 mln. EUR. Poland is the 8th biggest economy in the European Union, yet GDP per capita remains significantly below the EU average. The country's industrial base combines coal, textile, chemical, machinery, iron, and steel sectors and has expanded more recently to include fertilizers, petrochemicals, machine tools, electrical machinery, electronics, cars and shipbuilding. On the expenditure side, household consumption is the main component of GDP and accounts for 60 percent of its total use, followed by gross fixed capital formation (20 percent) and government expenditure (18 percent).

Socio-demographic changes and economic growth are causal factors influencing the state of the environment. Development without respect for the environment would result in the overexploitation of natural resources and increased emissions of pollutants. In view of this, the current concern for the environment and its resources, manifested within the framework of the idea of sustainable development and the concept of a green economy, is therefore most justified.

The resilience of the environment and its capacity to regenerate is limited. It is assumed that in order to ensure sustainable development in the long term, countries must be characterised simultaneously:

- an ecological footprint of less than 1.8 gha (so-called global hectares) per capita,
- Human Development Index higher than 0,8.



The HDI index can measure a country's level of social development in relation to other countries, both at a given point in time and over a longer period. Poland, with an index of 0.85, is among the highly developed countries.

The ecological footprint, on the other hand, shows how much space on Earth, including land and sea, each of us consumes. Our use of natural resources in the broadest sense is compared with the planet's capacity to regenerate them. When human needs exceed the capacity of the environment, there is an ecological deficit. Poland's ecological footprint was in 2018. 4.8 gha per person. Although this is clearly less than in the 1980s, and historically an upward trend alternates with a downward one, it is still 0.5 gha more than in 2000. Meanwhile, the biological potential remains at a similar level of around 2 gha per person. We consume 2.5 times more than our environment can reproduce. Poland, compared to other EU countries, is not isolated in this case. If everyone on Earth lived as Poles do, humanity would need 3 planets not to incur a so-called ecological debt (Stan Środowiska w Polsce, Raport 2022).

So what is the solution?

The article goes on to present examples of the implementation of greening and the use of green solutions in various areas of Poland's functioning.

5. EXAMPLES OF GOOD PRACTICES IN POLAND

Adopting the right lines of intervention requires constant monitoring of progress. In the case of Poland, the actions taken related to clean energy and green logistics are mainly the result of legal regulations imposed by the European Union. In 2020. The EU adopted 'A new EU Circular Economy Action Plan For a cleaner and more competitive Europe'. It covers, among other things, the issues of extending so-called eco-design, extending the life of products and guaranteeing reparability, introducing digital product passports, increasing high-quality recycling. It points to the need to "close the loop" in 7 key areas: plastics (including an end to microplastics), textiles (highly material- and water-intensive with only 1% recycled in the EU), electronics and ICT (the fastest growing waste stream in the EU), food, water and nutrients. According to the EU's farm-to-table strategy by 2030. food waste per capita is to be halved by 2030 (European Commission), packaging (all to be reusable or recyclable by 2030), batteries and vehicles (e.g. reducing carbon footprint), buildings and construction (e.g. material and energy efficiency) (Stan Środowiska w Polsce, Raport 2022).

5.1 Waste management

It is undoubtedly necessary to reduce the negative human impact on the environment, including the consumption of the Earth's resources in the broadest sense. It is not only about reducing consumption, but also about greater efficiency in the use of resources and the so-called closing of the economy in circulation. In the simplest terms, this is the longest possible use of the value of raw materials, materials and finished products. In practice, this primarily involves using, repairing, renewing, reusing, as well as borrowing and sharing for as long as possible. On the other hand, in the case of waste generation, recycling and, in particular, recovery.



The mass of municipal waste generated in Poland is gradually increasing. In 2021, it was 360 kg per Polish inhabitant on average. However, this is one of the lowest values in the EU, where a statistical inhabitant generates 505 kg (data for 2020) of waste per year (Stan Środowiska w Polsce, Raport 2022).

The recycling rate of municipal waste in Poland has increased - from less than 18% in 2010 to approximately 27% in 2021. In order to monitor the treatment of municipal waste in the European Union, the rate of preparation for reuse and recycling of municipal waste is analysed. Its value has also increased, from 24% in 2013 to 41% in 2020. For all waste generated, of which mining and quarrying is the main source (57%), less than half (47.5%) was recovered and less than 44% was landfilled. New challenges are emerging in waste management. For example, the growth of e-commerce, especially used during pandemics, is causing an increase in packaging waste (Stan Środowiska w Polsce, Raport 2022).

As the Institute for Innovation and Responsible Development INNOWO points out, of all materials and raw materials used in the Polish economy - from metal ores and non-metallic minerals to biomass and fossil fuels - 10.2% are recirculated. This is above the global average (8.6%), but it also means that the so-called circularity gap in the Polish economy is close to 90%. It should be emphasised here that even Scandinavian countries such as Sweden and Norway, associated with many ecological solutions, fare much worse in the comparison (3.4% and 2.4% respectively) (Stan Środowiska w Polsce, Raport 2022).

5.2 Consumer behaviour

The attitudes and moods of consumers towards broadly understood ecology are constantly changing. Poles are more and more aware, and thus, more often pay attention to what they buy and whether what they buy is eco. In the research of the Ministry of Climate and Environment on the awareness and ecological behavior of the inhabitants of Poland, 86% of respondents indicated that they are willing to limit the purchase of material goods in order to preserve natural resources and reduce the amount of waste generated (Stan Środowiska w Polsce, Raport 2022).

The survey was carried out on March 2-9, 2020 by SW RESEARCH, the Market and Opinion Research Agency, using the online interview method. As part of the study, 847 surveys were conducted. Among the most popular forms of ecological promotion, the change of product packaging was most often indicated (76%) and the use of ecological icons/symbols (72%). In second place, the use of BIO / ECO names was mentioned - over 60% of the respondents encountered this form of promotion. surveyed. According to the respondents, agriculture, animal husbandry and plant cultivation most often use the communication of elements of ecology (40%). The high score can be explained by the growing trend for organic, non-modified food. The second position in the eco-ranking of industries was taken by beverages and water (37 percent of responses), and the third place was taken by the beauty industry (32 percent), related to the production and cosmetic services. Such high indications for the listed industries may be significantly influenced by consumer associations related to the increasingly common use of new, more ecological packaging, ecological symbols and icons, and the use of ECO and BIO labels, resulting partly from the need to meet standards and legal requirements, and partly from purely marketing and promotional activities (<https://www.horecanet.pl>)

5.3 Renewable energy sources

Renewable energy can help restore energy security and focus on the challenges of climate change. Using and supporting renewable energy sources can help reduce pollution and minimise dependence on fossil fuels (Rahman and Alam, 2022). Climate change experts believe that renewable energy sources have long been known for their ability to reduce CO₂ emissions as well as create more environmentally friendly circumstances.

In Poland, the sector with the largest direct energy consumption is industry (approx. 35% in 2020). This is followed by transport (c. 27%) and households (c. 23%) with a significant share (State of the Environment in Poland, Report 2022). Transport therefore accounts for a significant share of greenhouse gas emissions in the EU.

Based on data provided by Eurostat, it is possible to observe the share of renewable energy sources used in transport in EU member states since 2004. The common target set for all EU countries for 2020 is at least a 10% share of renewable energy in transport. Analysis results presented by Eurostat show that the average share of renewable energy in transport has increased from 1.6% in 2004 to 10.2% in 2020. This represents 0.2 percentage points above the target level. Figure 1 illustrates how the target has been achieved.

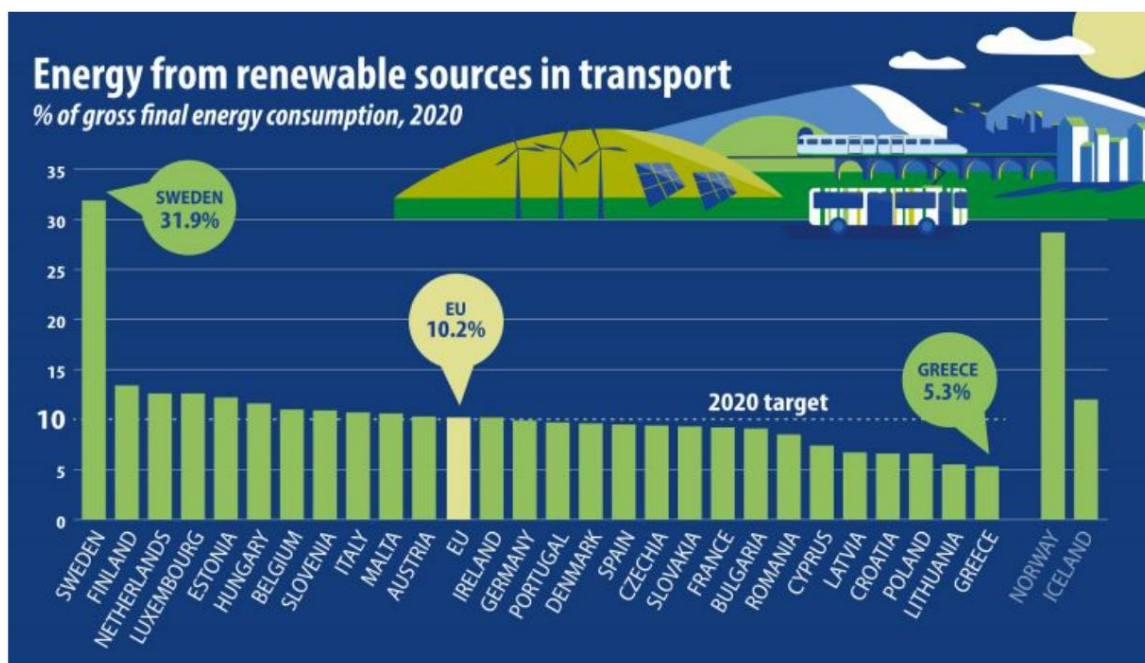


Figure 1 Energy from RES in transport

Source : <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20220202-2> accessed Nov. 24, 2022



However, it should be emphasised that each Member State set individual national targets for the use of energy from RES. Poland set its target at 6%, and therefore joined the group of EU countries that successfully achieved their targets in 2020.

The share of renewable energy in energy consumed in transport is calculated by dividing the value of renewable energy consumption in transport by the total value of energy consumption in transport. The share of renewable energy in fuel consumed in transport is one of the indicators monitoring progress towards the target of increasing the share of energy from renewable sources in the EU.

The main source of RES for transport is biofuels including liquid biofuels, which are produced from feedstocks of organic origin (from biomass or biodegradable waste fractions). Natural vegetable oils can also be used as liquid biofuels. These products are used as bio-components added to motor fuels made from crude oil. The most commonly used additives are bioethanol (an additive for petrol) and biodiesel (an additive for diesel).

The European Union's climate neutrality plans up to 2050 include the need to reduce emissions in transport not only through the use of RES. Cars and vans currently produce 15% of the EU's CO2 emissions. Road vehicles are the most emitting. They are responsible for more than 70 per cent of greenhouse gas emissions from transport in the EU. In 2018, emissions from road transport amounted to 786 million metric tonnes of carbon dioxide equivalent - a 27 per cent increase since 1990. CO2 reduction targets for 2030 are 37.5 per cent for new cars and 31 per cent for delivery vans.

Between 2010 and 2018, the amount of carbon dioxide produced on average by new passenger cars registered in Poland decreased by 12%. In order to both reduce greenhouse gas emissions and improve air quality and reduce noise exposure, electromobility is being promoted in Europe. Part of the EU's "Fit for 55" programme (europa.eu), published in 2021, is a ban on the registration of new cars with internal combustion engines from 2035. In Poland, by mid-2022, newly registered low-emission cars accounted for almost 40% of the market. The number of electric cars is growing rapidly. By mid-2022, there were more than 50,000 such cars (the share of all-electric cars and plug-in hybrids is almost equally distributed). Their number increased by 45% in one year. At the same time, the rapid transition to electrically-powered cars may lead to the need for a surge in electricity production. Providing appropriate charging infrastructure also remains a challenge. The transition to electric cars also requires a major change in consumer behaviour, due to the time needed to charge the battery, the availability of stations and heated garages.

6. CONCLUSIONS

Globally, in the last 50 years, the production of goods has doubled, the extraction of raw materials has tripled and the level of economic development, as expressed in gross domestic product, has quadrupled. We are therefore witnessing an ever-increasing demand for materials. As the European Environment Agency points out, this increase in human activity is a dominant cause of biodiversity loss and increased water stress, a significant source of greenhouse gas emissions and a source of pollution.

The complexity of the relationship between human activities and the state of the environment, global trade links and the planet's limited capacity and "resilience", challenges the country's economy



to reconcile the needs with the supply of environmental goods and services, and to reconcile its protection with an increase in the quality of life. Limiting consumption is not easy. Its growth is strongly linked to economic development and changes in society.

The energy transition, associated with the development of RES and electromobility, poses a number of challenges and requires consideration of the interrelationship between elements of the environment and human activities, related, inter alia, to energy sources, energy storage and transmission, materials used and waste generated. The initiatives implemented in Poland to develop RES and increase energy efficiency are in line with the idea of a closed loop economy. The growing problems of energy supply in Poland and across Europe will have their impact on environmental policy.

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